TOKENIZATION OF OFF-CHAIN ASSETS

STATE OF THE MARKET

OVERVIEW

The relevance of digitally-native assets (like BTC and ETH) in the 'real-world' has long been a lively topic of discussion amongst both crypto-enthusiasts, and their critics. More recently, this same discussion has flipped inside out - what are the benefits of tokenizing the vast market of 'real-world' valuables (or off-chain assets, 'OCAs')?

In this report we offer an overview on the dynamic space of tokenizing OCAs, exploring advantages and obstacles, while delving into innovative projects and protocols in this field. Among other findings, we report the significant benefits that tokenizing OCAs may offer across key economic sectors. The most important of these benefits are improvements in asset management and administration, market efficiency and liquidity, as well as risk diversification. Despite these potential advantages, there are hurdles to overcome for OCA tokenization to reach its full potential. The most important of these include legal and regulatory uncertainties.

Given our report findings and OCA tokenization's massive growth potential, we see three likely key developments when looking ahead: First, tokenizing a diverse array of OCAs requires interdisciplinary and industry-specific expertise. As such, we expect increasing cross-industry collaboration between traditional finance, niche experts (e.g., insurance, trade financing, etc.) and blockchain technologists/ entrepreneurs. Second, overcoming key blockers, such as regulatory uncertainty and fully realizing the growth potential of OCA tokenization will likely affect sectoral growth dynamics within the OCA tokenization space. While stablecoins are today's champion in terms of market capitalization, tomorrow's challenger may be the massive (illiquid) OCA debt markets that comprise a significant proportion of global wealth. Third, unlocking the space for institutional players (via appropriate legal and regulatory frameworks) may affect demand for the underlying blockchain infrastructure, where we expect to see significant experimentation with various strategies for tokenizing OCAs, including more tailored designs, such as app-specific chains.

We discuss the above and more in this report that is organized into four parts:

1. The first part introduces the concept of tokenizing OCAs, gives examples for types of assets that can be tokenized, and provides an overview of the general steps in the tokenization process.
2. The second dives deeper into the potential benefits of tokenized OCAs for stakeholders in what we define later as the i) financial economy, ii) real economy, and iii) crypto economy. It also discusses the general hurdles that remain towards the widespread adoption of tokenized OCAs.
3. Part 3 maps out the landscape of OCA tokenization by discussing prominent and promising players in key OCA tokenization sub-sectors.
4. We end with our main findings in Part 4 and provide an outlook for the space.

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ACKNOWLEDGMENTS

While this report aims to provide an overview of the OCA / real-world asset (RWA) space, it is not intended as an exhaustive compilation of all firms operating in the OCA space. If you believe that your company or project was miscategorized or would like your project to be considered for follow-up reports, please contact research@theblock.co.

AUTHORS

Marcel Bluhm
Director, Research Reports

Twitter Linkedin

Dipankar Dutta
Research Analyst

Twitter

PART 1
INTRODUCTION
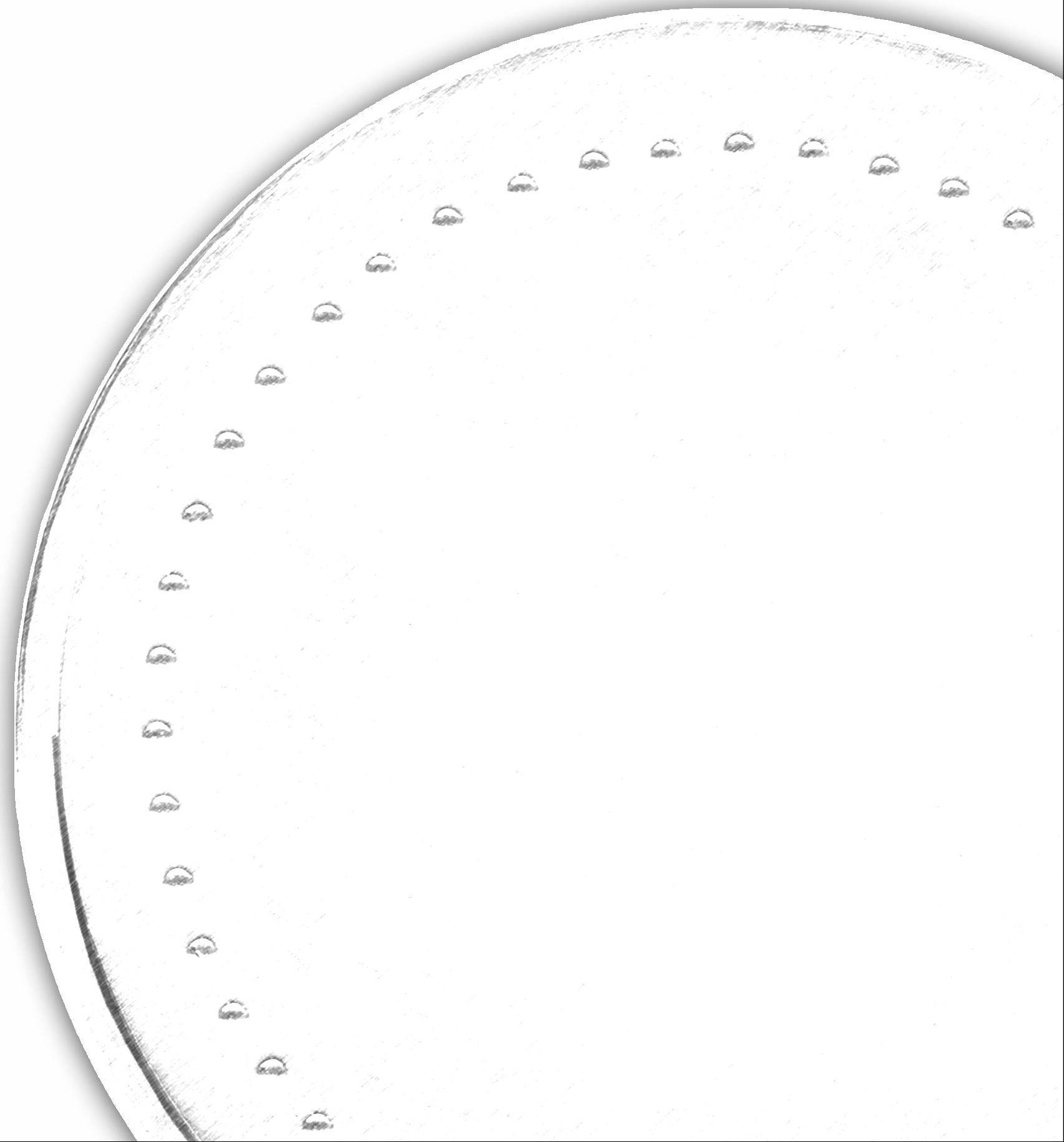
The digital asset class has experienced significant growth over the past few years, with an increasing number of financial products and services that incorporate blockchain technology becoming available. The S&P Cryptocurrency Broad Digital Market Index had an average annualized growth of 18.8% over the past 5 years, which is more than twice that of the S&P500 index over the same period. As such, a majority of institutions surveyed indicates interest in participating in the digital asset class, and plans to diversify their investment activities over the medium term. Despite challenges such as regulatory ambiguity and the (perceived) lack of trustworthy industry partners, institutions recognize the unique potential of digital assets and blockchain technologies to enable new products/services, and provide asymmetric returns while improving portfolio diversification.

Within the digital asset space, a recent survey indicates that institutions have strong interest in the potential of tokenized off-chain assets (OCAs), also commonly referred to as real-world assets (RWAs). Investing in tokenized OCAs and their infrastructure is therefore expected to rank high on their agenda in the coming two years. This research report provides an overview of the rapidly evolving space for tokenizing OCAs, examining the benefits and challenges associated with bringing OCAs on-chain, and exploring selected projects and protocols that are at the cutting-edge of innovation.

> *"You can now use a tokenized piece of art and reference it in a smart contract. This asset can be used as a collateral and has a market value. This can be done with all other sorts of assets, receivables, IP, shares, etc. This way, one can unlock so many new sources of liquidity which currently are not accessible. Using private, tokenized assets for on-chain borrowing is basically supercharging and making widely available the idea of the Lombard loan. This is the next step in the evolution of DeFi and will transform capital markets."*

Benedikt Schuppli, Co-Founder and Co-CEO at Obligate

As opposed to native cryptoassets (e.g., BTC and ETH), the terms OCA and RWA are broadly used to describe any asset that originates from or has its primary existence/use outside of blockchain ecosystems. Tokenizing OCAs is the process by which they are represented, traded, or otherwise interact with blockchains. Table 1.1 provides an overview on different types of OCAs, with financial instruments taking on the key role as the driver of innovation.

Throughout this report, we introduce the 'OCA' terminology instead of the term 'RWA', which is more commonly used in the cryptospace, for two main reasons:

1. **'OCA' is more generalized**: RWA suggests physicality, but many 'real-world' assets (like bank balances or stocks) are in fact digital. The OCA terminology is more generalized and is better suited to describe the wide diversity of assets that exist off-chain. Moreover, as digital and physical realities continue to merge (through developments in augmented reality, virtual reality, and the 'internet of things' etc.), OCA can accommodate these changes with more flexibility than the term 'RWA'.
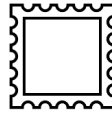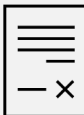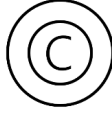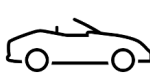
2. **'RWA' conflicts with established terminology**: For institutional investors, the acronym RWA already has an established meaning ('risk weighted assets') originating from regulatory concepts.

Table 1.1: Examples for the Types of OCAs that May Be Tokenized

Type		Examples
Business Assets		Physical infrastructure, inventory, equipment, and machinery used in the operation of a business
Commodities		Physical goods such as gold, silver, oil, agricultural products, and other natural resources.
Collectibles		Art, antiques, stamps, coins, and other items with historical, cultural, or aesthetic value
Financial Instruments		Bonds, stocks, and other securities that represent an ownership interest or a claim on an OCA or business
Intellectual Property		Patents, trademarks, copyrights, and other forms of protected ideas or creations
Real Estate		Land, residential properties, commercial properties, and other real estate investments
Vehicles		Cars, trucks, boats, airplanes, and other modes of transportation

Source: The Block Research.

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Methods for Tokenizing OCAs

OCAs are 'brought on-chain' through a process referred to as tokenization. Tokenizing OCAs allows for the tracking, trading, programmability and management of these assets - enabling the full range of the advantages afforded by blockchains (as described in Part 2). Table 1.2 details an overview of five general steps required to tokenize OCAs.

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Table 1.2: General Steps for Tokenizing OCAs

Steps for Tokenizing OCAs		Description
1. Identification		Choose the OCA you want to bring on-chain. This can be anything from real estate, art, and precious metals to intellectual property, stocks, or commodities.
2. Verification		Establish the ownership and value of the asset through legal documents or appraisals. A trusted third party, such as a lawyer or an auditor, can verify the asset's authenticity, ownership, and valuation.
3. Tokenization		Create a digital token or a set of tokens to represent the asset on the blockchain. Each token typically represents a fractional ownership or a specific claim on the asset. The token's properties and functionalities can be defined using smart contracts, which encode the rules and restrictions associated with the asset.
4. Issuance		The verified asset information and the created token(s) are recorded on the blockchain. The token issuance can be done through a variety of mechanisms, such as an initial coin offering (ICO), a security token offering (STO), or a direct listing.
5. Custody and Management		Ensure the safekeeping of the physical asset and the management of its on-chain representation. This may involve a combination of traditional asset custodians, and blockchain-based custody solutions.

Source: The Block Research.

THE BLOCK | Research

OCA's Growth Potential and Catalysts

> *"While the short-term outlook is not very bright, not least due to a challenging macro environment, I am very bullish medium-term. During a recent [discussion] panel that included [a bulge bracket bank], everybody was extremely excited about tokenization. It is also reflected in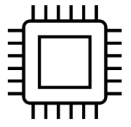 the public pronouncements from the likes of BlackRock and BNY Mellon. This is not DeFi vs TradFi, tokenized securities are simply continued digitization of finance."*

Siddhartha Siddhartha, Founder and CEO at Intain

Tokenization of OCAs has the potential to significantly reshape the digital asset landscape, as well as the global financial system at large. Despite significant price volatility and several spectacular bankruptcies in the crypto ecosystem in 2022, price recovery and market sentiment indicate that 'crypto is here to stay' relative to previous market crashes, notably also among some TradFi stalwarts. A more quantitative example of this may also be seen in developer activity, which remains strong (~6000 weekly active developers in the crypto space, at the time of writing), suggesting that the current environment continues to channel capital and talent into viable blockchain applications. Furthermore, with growing interest from corporate incumbents, entrepreneurs, and regulators, the global market for (illiquid) OCA tokenization is estimated to grow and reach $16 trillion by 2030.

However, scaling of OCAs within the digital asset space hinges on establishing a robust legal and regulatory framework. As OCAs encompass a wide range of assets, it is essential for a clear and well-defined legal structure to be in place to govern their tokenization, trading, and management. Such a framework must address the complex legal and regulatory challenges associated with integrating OCAs into blockchain ecosystems, while balancing the need for transparency, investor protection, and market integrity. In most countries, tokenizing off-chain assets is governed by securities law, which has not always kept pace with the rapid technological development in the blockchain space. Regulatory frameworks are outside the scope of this report. However, to provide an example, Case Study 1 in Appendix 1 gives a high-level overview of US securities law in the digital asset space. The full potential of the OCA tokenization space may likely only be unlocked by fostering a conducive legal environment and regulatory clarity. This in turn could attract institutional investors to enable widespread adoption, ultimately driving the growth of decentralized finance (DeFi) –i.e., on-chain finance– and revolutionizing the global financial landscape.

As the integration of OCAs into the on-chain ecosystem gathers momentum, it is crucial for stakeholders to stay informed about the latest developments in this space. By exploring the key benefits and obstacles for scaling OCA tokenization (Part 2), the current state of the OCA tokenization landscape (Part 3), as well as an outlook on the space (Part 4) this report provides valuable insights for investors, regulators, and industry participants alike.

PART 2
BENEFITS OF TOKENIZING OCAS & IMPLEMENTATION HURDLES
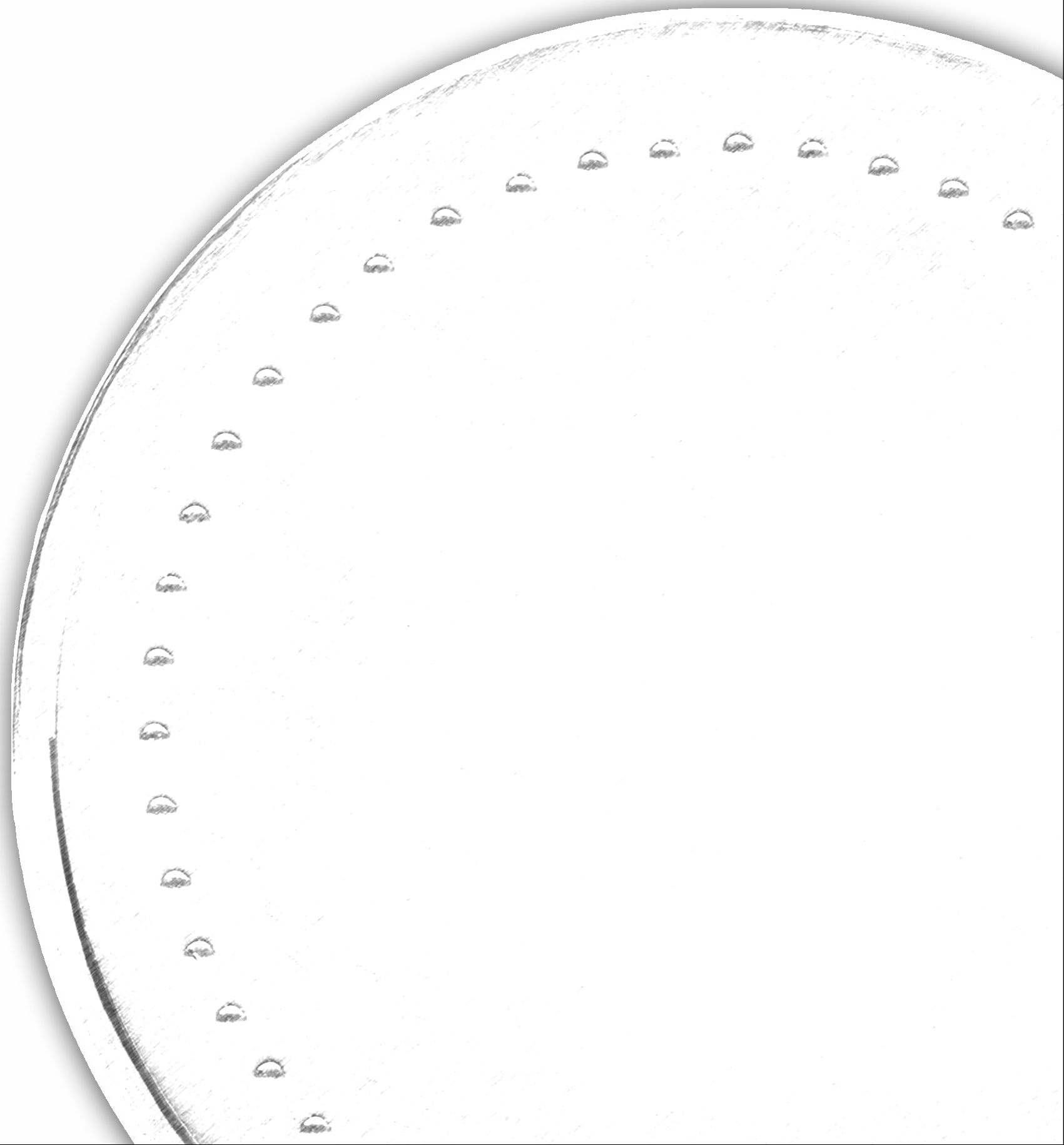
In Part 2 we explore the potential benefits and challenges of OCA tokenization from several economic perspectives. We discuss the unique advantages and transformative potential of tokenized OCAs using blockchains that include frictionless cross-border transactions, improved risk management and financial inclusion. Finally, we describe the major hurdles, such as legal uncertainties and regulatory challenges, that must be overcome for tokenized OCAs to reach their full potential.

> *"Tokenizing off-chain assets connects real-world economic activity with the efficiencies of a global 24/7 market powered by blockchain. While scaling may take some time, the possibilities are infinite."*
>
> Cliff White, Co-Founder and Vice President of Engineering at Re

2.1 Potential Benefits Of OCA Tokenization

To better illustrate the multifaceted benefits of tokenized OCAs, we analyze them from three different economic perspectives:

Figure 2.1: Benefits of Tokenizing OCAs for the Financial, Real and Crypto Economies

Source: The Block Research.
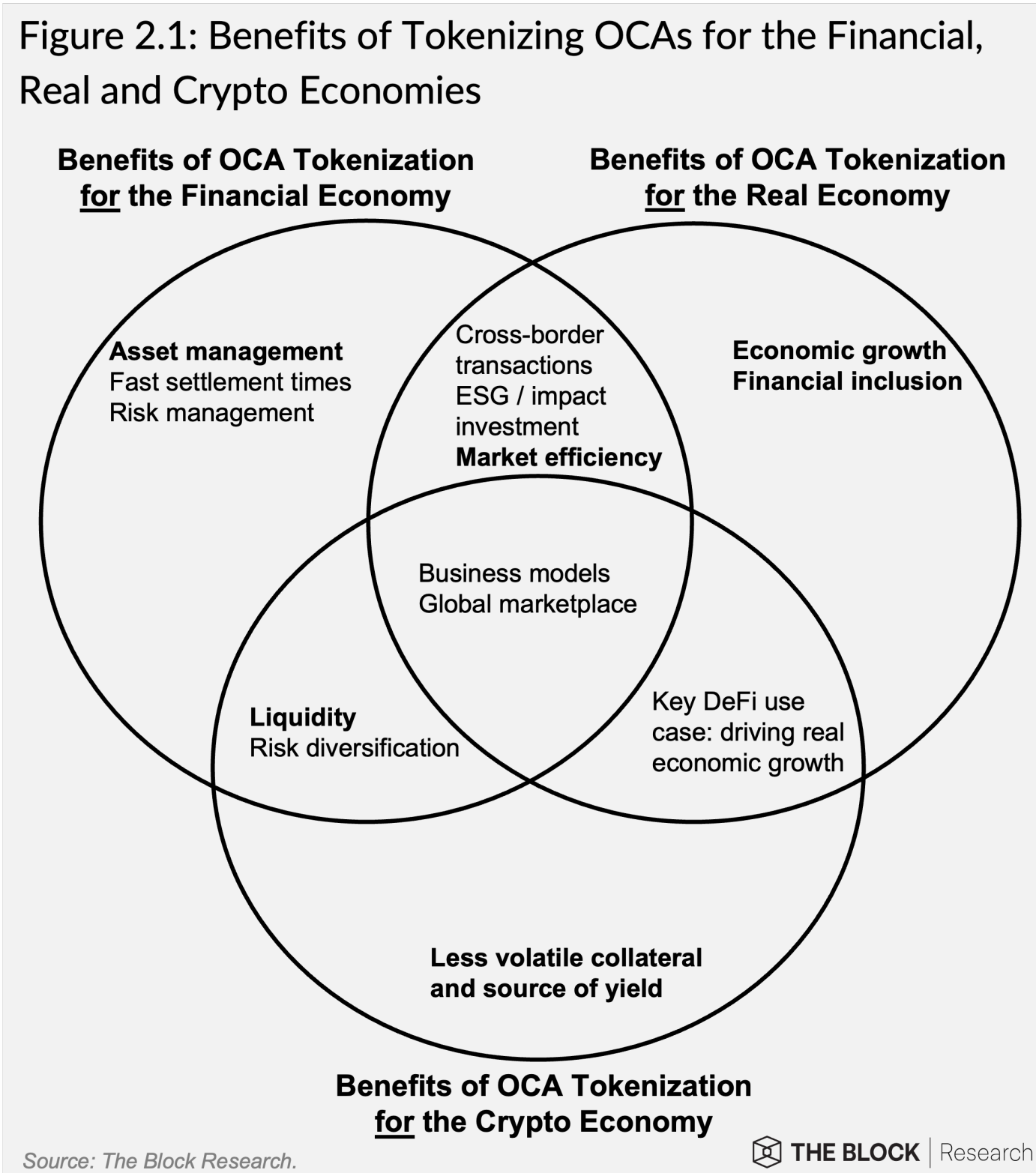
1. The first focuses on the financial economy, which covers aspects, such as financial transactions and financial assets involving regulated financial entities (e.g., banks, brokers, and the myriad of other institutional players).

2. The second focuses on the real economy, which covers aspects, such as the production of goods and services as well as employment. Under this perspective, we describe benefits of OCA tokenization for real economic growth.[1]

3. The third focuses on the crypto economy, which covers how tokenized OCAs might benefit the crypto native DeFi space.

Figure 2.1 illustrates the potential benefits of tokenized OCAs from the above three perspectives. While we examine the benefits distinctly from the various perspectives, note the areas of overlap that emerge. For example, all three types of stakeholders stand to benefit if tokenization truly enables a global marketplace for OCAs.

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1   Economists usually distinguish between 'real' and 'financial' economy to separate physical economic activity and financial market activity in modeling. The distinction taken here follows that approach. It is not meant to imply that physical activity is 'real' while financial market and crypto activity are 'fake.'

Benefits of OCA Tokenization for the Financial Economy

From a financial economy perspective (top-left circle in Figure 2.1), two potential key benefits stand out: improvements in i) asset management and administration, as well as in ii) market efficiency and liquidity.

> *"Tokenizing off-chain assets connects real-world economic activity with the efficiencies of a global 24/7 market powered by blockchain. While scaling may take some time, the possibilities are infinite."*
>
> Pat Hourigan, Co-Founder at DEFYCA

With respect to asset management, tokenization offers the potential to streamline operations across the management lifecycle. For example, embedding components of digital identity and investor accreditation in smart contracts can substantially reduce administrative burdens arising from manual paperwork and disparate record-keeping. The removal of unnecessary intermediaries has the potential to simplify fund administration, lowering both financial and logistical complexity. Furthermore, the inherent transparency of blockchains can improve risk management by enabling more precise tracking and asset analysis. This can also simplify and reduce the cost of regulatory compliance. A report from Finoa and Cashlink shows that tokenization introduces 35-65% cost savings compared to traditional securitization.

Efficiencies realized within the asset management lifecycle make smaller investment minimums economically viable for asset issuers, enabling a greater and more diverse investor base to access these assets. As such, tokenizing OCAs also offers the potential to significantly enhance market efficiency and liquidity. Underpinning these benefits are greater standardization, reduced settlement times, and reduced reliance on intermediaries. These factors contribute to more efficient price discovery and easy entry/exit points for market participants, which, in turn, may further enhance liquidity and potentially boost overall market trading volumes.

In addition to the key benefits outlined above, tokenization of OCAs offers several further potential benefits worth mentioning. The ability to track OCAs (in real-time) allows for ESG/impact investing by equipping investors to make more conscious and informed decisions. Furthermore, tokenized OCAs extend the digital asset class, offering investors opportunities for portfolio diversification, new business models (such as fractional ownership in real estate, lowering the entry barriers and enhancing liquidity in such markets) and exposure to DeFi products as well as the broader crypto market.

The outlined benefits are likely most pronounced in areas that have so far been difficult to access for most investors (e.g., private market investments). By facilitating a fully digital process and enabling smaller investment minimums, tokenization allows, for example, private capital funds to tap into a broader base of investors and borrowers. To give a more concrete idea about some of the benefits for the financial economy, Table 2.1 outlines insights that were provided by a sample of companies for this report.
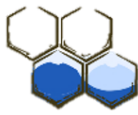
Table 2.1: Self-reported Benefits for Tokenized OCAs[2]

Company/Platform	OCA Product[1]	Benefits Self-reported by Company/Platform vs. BAU
Defyca	Private Credit	1) **Reduced administration costs** for funds to as low as <5 basis points (bps) compared to ~20-30bps on scales of 100mm to 500mm for BAU 2) **Lower limited partner aggregator setup costs** to ~30k USD from ~200k for BAU 3) **Lower investment minimums** of 1k USD that may open broader access and enable new subscription models as opposed to the capital-call model 4) **Trade and settle credit portfolios** for as low as 10bps per digital security within the permissioned secondary market
Intain	Structured Debt	1) **Reduced cost of issuance** from about ~150bps to ~50bps (on same scales) 2) **Lower feasible deal size** from ~100mm to ~10mm USD 3) **Reduced time** for validation and post-closing administration 4) **Near real-time reporting** on underlying assets and collateral vs. 5-7 weeks
Obligate	Debt Securities	1) **Smaller SME bond issuances** - secured bonds from 0.5-100mm USD are economically feasible 2) **Lower cost of issuance** of 50bps (annualized) for unsecured bond issuances vs. 100-500+ bps (on same scales) 3) **Reduced time** for contract to issuance from months to days
Re	Insurance Premiums	1) **Reduce overhead** to 1-2% of overall expenses for expanding entities vs. >5% for traditional reinsurers 2) **Data processing efficiency** gains using DLTs enable the automatic distribution of data to underwriters and auditors 3) **Automated binding contracts** using trustless on-chain protocols, which reduces the need for support resources for treaty evaluation and implementation 4) **Streamlined process of connecting capital** to reinsurance treaties by relying on smart contracts - eliminates the need for extensive human intervention

Notes: BAU refers to business-as-usual and/or traditional processes that do not incorporate blockchain technology.

[1]Part 3 of this report dives into more detail about the various sectors and sub-sectors of OCA products.
[2]This table provides information that was obtained from a sample of companies/platforms in response to a questionnaire provided by The Block.

Source: Company/platform responses.
Data as of June 26, 2023.

THE BLOCK · Research

Benefits of OCA Tokenization for The Real Economy

Regarding the real economy (top-right circle on Figure 2.1), the two biggest potential benefits lie in enhanced i) financial inclusion, and ii) economic growth. As mentioned above, the tokenization process facilitates the transfer of capital by simplifying transactions and reducing costs. This not only increases the efficiency of financial markets but also lowers barriers to entry, and thereby fosters financial inclusion. This may allow a wider array of individuals and businesses, including those from underserved communities (both in the developed and developing world), to participate in financial activities and to

access capital. Lower barriers to entry allow more businesses (e.g., small and medium sized enterprises) to raise capital. Better access to capital and financing may stimulate business innovation, drive job creation, and, by extension, spur economic growth.

One specific example (mostly applying to developing economies), where OCA tokenization could be beneficial for financial inclusion and output growth, lies in lowering the substantial trade finance gap, which is currently estimated to exceed $2 trillion. There are a number of blockchain-enabled platforms (as discussed more in Part 3) that aim to provide SMEs worldwide with access to capital for supply chain and trade financing. For example, companies like Centrifuge provide a tokenization platform to finance trade receivables, inventory or other tangible assets for companies in developing economies. At the same time, this opens the door for a wider range of investors, including both institutional and individual investors, to participate in this asset class.

In addition to the key benefits outlined above, a few other potential benefits arise, with most of them indirectly supporting economic growth. These include the aforementioned higher market efficiency on a global marketplace, streamlined cross-border transactions, potential new business models, and improved ESG/impact investment. For example, since OCA tokenization allows for more people to tap financing, it also provides more investible local opportunities, such as financing the green energy projects in developing economies.

Benefits of OCA Tokenization for the Crypto Economy

> *"The awareness of the need for uncorrelated yields in crypto will push the industry forward. As the maturation of multichain infrastructure and tooling continues, this will be a key unlock on the path to growth, as OCAs will require the use of alternative L1 and L2 networks to scale effectively."*

Asad Khan, Head of DeFi at Centrifuge

Two key benefits of tokenizing OCAs for the crypto economy (bottom circle in Figure 2.1) include new sources of i) less volatile collateral, and ii) less volatile yield for DeFi protocols - reducing exposure to highly volatile, often correlated, cryptocurrencies. For example, both DeFi protocols Aave and MakerDAO have tapped into tokenized OCAs to diversify their risk exposure to (volatile) on-chain collateral and may provide the protocol/investors/liquidity providers with a relatively more stable yield than that derived from other cryptocurrencies. Therefore, tokenizing OCAs can introduce a wider diversity of collateral and sources of yield, which are inherently less volatile and uncorrelated with cryptoassets.

Further potential advantages for the DeFi space include increased utility and attractiveness of DeFi platforms through compliant integration of tokenized OCAs. This has the potential to attract a larger set of participants and increase their growth potential from a global marketplace. Benefits may also include the potential for new business models interfacing with real economic activity. It is worth mentioning that tokenized OCAs provide DeFi with an important use-case, which is financing economic activity. This goes beyond the often self-referential speculation it has been criticized for.

2.2 Why Have Tokenized OCAs Not (Yet) Reached Scale?

While the potential benefits of tokenizing OCAs are clear, it has not yet been adopted on a large scale. Below are several hurdles (roughly in decreasing order of importance) that must be overcome for tokenized OCAs to reach their full potential scale on-chain.

1. **Uncertain legal claims**: Blockchains are ideal for enforcing on-chain asset transfers and contracts of blockchain-native assets (e.g., BTC, ETH transfers; AMM swaps, etc.). However, tokenized OCAs will also require off-chain enforcement that ultimately relates to social norms, legal systems, and courts. Therefore, tokenized OCAs have to still inherently rely on off-chain institutions to enforce property rights.

   For example, projects like Goldfinch rely on off-chain agreements to establish legal recourse in case of default —but such steps reintroduce points of centralization and administrative burden that hamper scale and efficiency that DeFi is supposed to address. One can imagine many aspects of tokenized OCAs eventually being fully blockchain-native and smart contract-mediated (e.g., bond coupon payments, stock dividends, etc.) but all of these will likely require off-chain enforcement components (e.g., legal recourse in case of default) to underpin their value.

2. **Regulation:** An important property of blockchains is their borderless and permissionless nature. In the context of OCAs, this promises for example to unlock global liquidity sources that can more easily be directed to traditionally underserved corners of the globe with weak financial infrastructure/institutional quality. However, OCA protocols that aim to fulfill this promise face a significant challenge as they need to navigate a complex web of diverse regulations. These rules cover areas, such as lending, securities, investor protections, and KYC/KYB/CTF procedures. This heterogeneity further complicates off-chain enforcement (e.g., complexity of enforcing recourse against default for an investor in Europe and a borrower in Latin America).

3. **Asset/Platform Standardization**: A key part of the value proposition that blockchains bring to OCAs is the potential composability of these assets with a variety of other on-chain services and primitives. However, the current OCA space lacks standardization across most dimensions, including how assets are represented, how ownership is determined, and how user identity is handled. For example, there is uncertainty whether OCA tokens that are issued by compliant entities, such as Ondo's US Treasuries product, can be used as collateral without legal risks for market participants on un-regulated DeFi platforms, such as Aave.

   Furthermore, there is a lack of native interoperability across different blockchain applications and ecosystems, which leads to fragmentation of users and liquidity. In addition to appropriate regulatory

frameworks, standardized OCA representations and interfaces are also needed for OCAs to interoperate smoothly across applications.

4. **Identity, Reputation and KYC/KYB**: On-chain identity is a key primitive for OCA protocols that allows projects to comply with regulations (e.g., KYC/KYB), incentivize honest behavior from participants, and establish measures of reputation that can help determine creditworthiness and trust. However, the decentralized on-chain identity space is currently highly fragmented, requiring users to frequently undergo onerous and repetitive identity verification checks. Establishing a single standard for identity is a key unmet need in the industry that could go a long way in improving UX and simplifying compliance.

5. **Trusted Off-chain Data/Audits**: Given that tokenized OCAs rely on off-chain data (e.g., NAV calculation, insurance payouts, etc.), one challenge relates to acquiring trustworthy and reliable data feeds. Further, OCAs are custodied off-chain, while the tokenized representation that is a claim on the custodied asset is minted on-chain. As such, token holders are required to trust the custodian to be honest and competent. To address these concerns, potential solutions could be implemented. These might include using trustless data oracles for data provision and requiring custodians to provide proofs of reserves.

6. **Adverse Selection**: As new entrants to the market look for underserved niches, where they can establish a foothold, some OCA projects may be more likely to onboard low-quality assets that cannot secure financing elsewhere. OCA projects may also have weaker underwriting capabilities than experienced players, which could hamper their ability to filter out low-quality assets. This could lead to higher rates of default, all else equal.

7. **Broader ambivalence for the crypto ecosystem in TradFi**: Many traditional investors have limited knowledge and understanding of OCA tokenization and the broader crypto ecosystem. This lack of education and awareness, coupled with inherent trust issues associated with this nascent technology, may hinder the adoption of tokenized OCAs. For example, institutional investors, many of which are required to use custodians, may be unfamiliar with the concept of self-custody. Furthermore they may face access challenges such as on- and off-ramping funds to/from the crypto space.

The path towards widespread adoption of OCA tokenization will require concerted efforts from all stakeholders, including industry participants, regulators, and policymakers, to overcome many of the above hurdles. Here, legal and regulatory uncertainty remains front and center.

To summarize Part 2, tokenizing OCAs presents a promising use case for bridging the gap between traditional finance (TradFi) and the emerging cryptoasset landscape. It may bring a host of benefits to various stakeholders, including in the financial, real, and crypto economies. These benefits range from increased efficiency and reduced costs to enhanced transparency, improved risk management, and greater financial inclusion. However, several hurdles hinder the widespread adoption of OCAs on-chain. These include regulatory and legal uncertainties, technical challenges, and a general lack of market understanding. Addressing these issues would be key in realizing the potential of tokenized OCAs, eventually contributing to a wider and more efficient financial landscape.
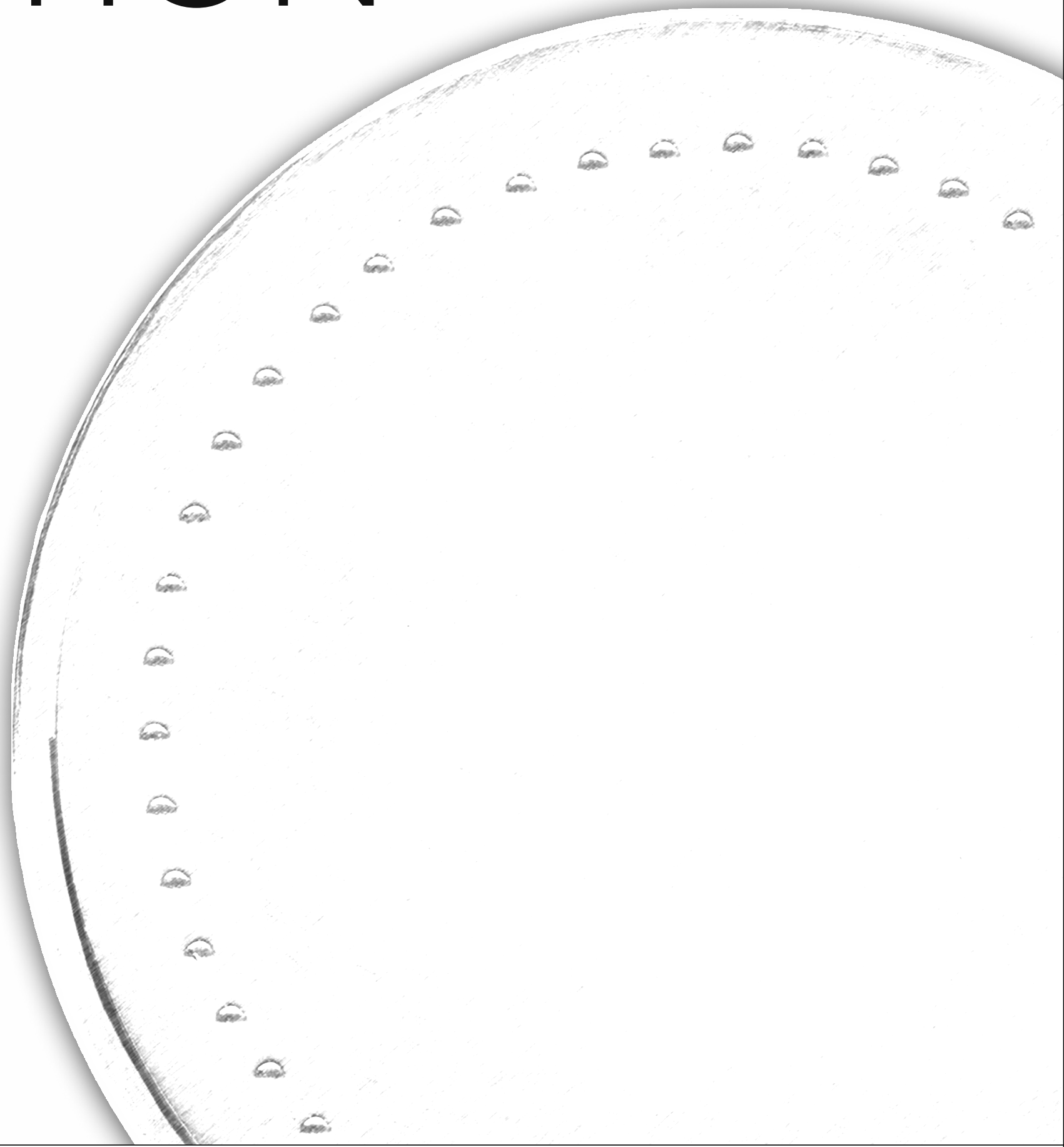
PART 3
THE LANDSCAPE OF COMPANIES AND PROTOCOLS FOR OCA TOKENIZATION

The landscape for OCAs tokenization companies and protocols is nascent, but already diverse and multifaceted, covering a wide variety of distinct OCA types (e.g., private equity, debt offerings, real-estate, collectibles, etc.). This section maps out notable tokenized OCA players and product offerings. One important note is that the landscape outlined here is not an exhaustive overview. Instead, we highlight a set of key players in a number of important sub-sectors based on i) quantitative metrics (e.g., funding, market cap, total value locked, etc.), ii) qualitative/subjective opinions (e.g., innovative potential, novel OCA type being tokenized), and iii) feedback from industry players and interviewees. Our goal is to delineate the breadth of diverse activities in the tokenized OCA space.[2] In addition to individual company insights provided in this part, Appendix 2 provides details on the specific OCA tokenization approach, including legal structures and choices for blockchain implementations of two companies, Centrifuge and Intain.

As a burgeoning industry with novel use-cases and developing regulatory frameworks, there are no widely accepted industry standards for categorizing the protocols, platforms and companies that tokenize OCAs. At a high level, we distinguish tokenized OCA offerings by categorizing them as either i) non-securities/commodities (Table 3.1) or ii) securities (Table 3.2) based on the OCA each tokenized product represents a claim on (listed in column titled 'Tokenized OCA Product(s)' in Tables 3.1 and 3.2). For example, we classify USDC (stablecoin tracking the value of USD) as a non-security/commodity in this report, as it is an on-chain representation of USD (a claim on USD). Note that in most cases we only highlight an issuer's key tokenized OCA products in order to not overload the tables.[3]

Tables 3.1 and 3.2 also display an issuer's backing for its tokenized OCA product (column labeled 'Backing For Tokenized OCA Product(s)'). Note that an issuer's backing for a tokenized OCA product may be different from the OCA it represents a claim on. Distinguishing between the two is important. For example, while the USDT is an on-chain claim on USD, attestation reports for USDT show that Tether backs the claim with holdings of cash, securities and commodities.[4]

Beyond classification as a security or a commodity, we introduce sub-categories (e.g., stablecoins, commodities, equities, debt, etc.) for the tokenized OCA products (leftmost column on Tables 3.1 and 3.2). Furthermore, we identify whether a protocol/company offers services for issuing tokenized OCA products to third-parties (column labeled 'Platform' on Tables 3.1 and 3.2). For example, Obligate allows other entities to issue debt on-chain. Finally, we also cover i) whether a protocol issues a native token

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2   Inclusion of a protocol/company in this report is not an endorsement of the same. We highlight selected OCA tokenization sub-sectors using representative examples of offerings and entities operating in each. Please note that highlighted protocols/companies may fit into multiple OCA sub-sectors. We have added protocols and companies in the sub-sectors where we saw them fit primarily. If you feel your organization was miscategorized or think it should be included in future reports, please contact us at research@theblock.co.

3   For example, in Table 3.1, regarding TrustToken, we only focus on its tokenized product for the USD (TUSD), which is its key product by market capitalization. TrustToken also has stablecoins pegged to other currencies, however, those are minor in terms of market capitalization compared to TUSD.

4   Note that discrepancies in USD value for: i) the on-chain market capitalization of a tokenized OCA product and, ii) the issuer's backing, may be due to real time availability of market data for the former, while attestations/audits for the latter are reported periodically.

(column labeled 'On-Chain Mcap of Protocol Token'), for funding or governance purposes, and ii) the blockchain ecosystem(s) used by issuers/platforms to deploy their tokenized OCA product ('Blockchain Ecosystem').

3.1 Non-security and Commodity Based Tokenized OCA Issuers

Non-securities and commodities encompass an array of assets including tangible goods like gold, oil, and agricultural products, along with other assets, such as real estate and collectibles. We separate non-security and commodity based tokenized OCA issuers into two subcategories: i) stablecoins and, ii) commodities.

Stablecoins

Principal among the covered entities are stablecoin issuers. Stablecoins are tokens that are pegged to the value of fiat currencies. They are arguably one example of a 'killer app' for decentralized public blockchains and so far, have been primarily used for trading/speculation in DeFi, and as a means of payment. They also act as an easily accessible proxy to USD exposure worldwide. Demand for stablecoins can fluctuate significantly not only due to prevailing market conditions, but also because it is a function of the stablecoin issuer's corporate structure, jurisdiction, makeup of holdings backing each token and their reporting practices.

Table 3.1 lists five major stablecoin issuers (by market capitalization) and their respective tokens. Among them are two US-based entities (Circle and Paxos) that carry a range of US licenses and post regular attestations breaking down the backing for their tokenized OCA products. Tether's USDT is notable both i) as the largest stablecoin issuer with a market capitalization for USDT of $83bn at the time of writing and ii) the number of alleged concerns around Tether's corporate structure and transparency of USDT reserve holdings. The confluence of market/macro/regulatory factors[5] as of June 2023 puts USDT's on-chain stablecoin market dominance at >65%, compared to ~50% in early-February 2023. Overall, OCA backing for stablecoins generally consists of highly liquid assets, such as cash, money market funds (MMFs) and short-term US treasury bonds. However, in some cases OCA backing can also include less-liquid instruments such as, corporate bonds, precious metals, secured loans, and Bitcoin. Portions of the OCA backing may also remain undisclosed by the issuer. TrustToken is a smaller stablecoin issuer. Its main token is the TUSD. Finally, MakerDAO's DAI is notable not only due to its

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5   Inclusion of a protocol/company in this report is not an endorsement of the same. We highlight selected OCA tokenization sub-sectors using representative examples of offerings and entities operating in each. Please note that highlighted protocols/companies may fit into multiple OCA sub-sectors. We have added protocols and companies in the sub-sectors where we saw them fit primarily. If you feel your organization was miscategorized or think it should be included in future reports, please contact us at research@theblock.co.

Table 3.1: Non-security and Commodity-based Tokenized OCA Issuers

	Organization	Plat-form (Y/N)	Foun-ding Year	Head-quarters	Funding Raised ($mm)	Head-count	Blockchain Ecosystem	Tokenized OCA Product(s)	On-chain Mcap of Tokenized OCA Product(s) ($mm)[1]	Backing for Tokenized OCA Product(s)[2]	USD Value of Backing For Tokenized OCA Product(s) ($mm)[3]	On-chain Mcap of Protocol Token ($mm)[1]
Stablecoins	Circle	N	2018	USA	$975	>900	Algorand, Avalanche, Ethereum, and others	Stablecoins Pegged to Fiat Currencies (USD & EUR)	$28,381 (USDC) $47 (EUROC)	Cash, Gov't Bonds & MMFs	$28,571 (USDC) $48 (EUROC)	N/A
	MakerDAO	N	2014	USA	$27	100-200	Avalanche, BNB Chain, Ethereum, Fantom, Polygon & others	Stablecoin Pegged to USD (DAI)	$4,711 (DAI)	USDC, USDP, GUSD, Cryptoassets & OCAs (MMFs, Bonds, etc.)	$8,426	$672 (MKR)
	Paxos	Y	2012	USA	$507	101-250	Ethereum	Stablecoins Pegged to Fiat Currencies (BUSD & USDP)	$4,226 (BUSD) $993 (USDP)	Cash, Gov't Bonds & MMFs	$4228 (BUSD) $1031 (USDP)	N/A
	Tether	N	2014	British Virgin Islands, Hong Kong	N/A	11-50	Algorand, Avalanche, Eos, Ethereum & others	Stablecoins Pegged to Fiat Currencies (USD EUR and others)	$83,193 (USDT) $36 (EURT)	Cash, MMFs, Gov't & Corporate Bonds, Precious Metals, Bitcoin, Secured Loans & Other Investments	$85,677 (USDT) $36 (EURT)	N/A
	TrustToken /Archblock/ Techteryx	N	2017	USA, Singapore	$36	51-100	Avalanche, BNB Chain, Ethereum & Tron	Stablecoins Pegged to Fiat Currencies (TUSD and others)	$3,137 (TUSD)	Cash, Short-term Debt & Other Yield Instruments	$3,147	N/A
Commodities	Kinesis	N	2018	Cayman Islands	N/A	95-250	Kinesis Network (Open-source Stellar Fork)	Stablecoins Pegged to the Value of Gold (KAU) & Silver (KAG)	$78 (KAU) $77 (KAG)	39,448 Troy Ounces of Gold & 3,116,067 Troy Ounces of Silver in Custody	$77 (KAU) $71 (KAG)	N/A (KVG)
	LandX	N	2019	Lithuania	N/A	N/A	Ethereum (Goerli Testnet)	Corn, Soy, Wheat & Rice Future Yields	N/A	Claim to Future Farmland Yields for Respective Crops	N/A	N/A (LNDX)
	Paxos	Y	2012	USA	$507	101-250	Ethereum	Stablecoin Pegged to the Value of Gold (PAXG)	$485 (PAXG)	260,663 Troy Ounces of Gold in Custody	$506	N/A
	Tether	N	2014	British Virgin Islands, Hong Kong	N/A	11-50	Ethereum	Stablecoin Pegged to the Value of Gold (XAUT)	$475 (XAUT)	246,524 Troy Ounces of Gold in Custody	$487	N/A

Notes: Platforms refer to companies and protocols that offer tokenization services to third-parties.
[1]*Market capitalization (Mcap) based on on-chain USD value of circulating token supply, as of writing.*
[2]*Lists all assets backing respective tokenized OCA product(s), including OCAs, crypto-native assets (e.g., BTC, ETH, etc.) and other OCA-backed digital tokens (e.g., USDC).*
[3]*USD figures represent USD value (as of writing) of all assets backing respective tokenized OCA product(s) based on most recently available self- or third-party reporting.*
Sources: Official company documentation & attestations, Daistats.com, Coingecko, Crunchbase, Dune, Pitchbook, The Block Research.
Data as of June 26, 2023.

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structure as a decentralized autonomous organization (DAO), but also as a pioneer in incorporating government bonds, structured investments and even private lending/credit transactions with a variety of counterparties (covering ~$1B in OCA value).

Commodities

Commodities are basic goods or raw materials, such as oil, gold, or agricultural products. Physical gold-backed tokens are the most prominent type of digital asset in this sub-sector. The largest operator is Paxos with its gold-backed PAXG tokenized offering. Attestations as of late-April, 2023 indicate 260,663 troy ounces of gold stored in LBMA-approved vaults with a market price of $506mm USD, compared to an on-chain circulating market capitalization of $485mm USD for the PAXG token. Tether also has a comparable physical gold-back token offering, XAUT, with $487mm USD worth of physical gold in custody (based on spot market price in June, 2023). Significantly smaller offerings from Kinesis include both tokenized gold (KAU) and silver (KAG). KAU and KAG trade on a marketplace operating on an application-specific blockchain, which is an open source fork of Stellar.[6]

Landx is an example of a more experimental/innovative platform aiming to bring farmland commodity yields on-chain. Landx still operates on a testnet and has the tall task of aligning incentives across a variety of market participants (farmers, investors, 'validators' and regulators). However, it provides a general sense of the breadth of untapped potential for tokenized OCA applications.
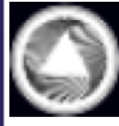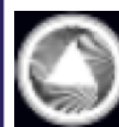
3.2: Securities Based Tokenized OCA Issuers
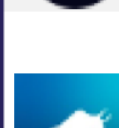
Securities represent a wide diversity of assets that range from liquid instruments, such as publicly traded stocks, government bonds, and money market funds, to relatively illiquid instruments, for example private funds, structured debt and others. We see significantly more experimentation with a wider variety of tokenized OCA products in this category, as shown in Table 3.2.

We separate tokenized securities offerings into three sub-sectors, based on their underlying: i) equities and indices, ii) debt, bonds and MMFs and, iii) alternative/illiquid products, all of which are further described below.

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2   Application-specific blockchains and tokenized OCA products are discussed further in Part 4 of the report.

Table 3.2 Security-based Tokenized OCA Issuers

		Tokenized OCA Issuer/Platform Details						OCA Product(s), On-Chain Metrics & Token Backing				
	Organzation	Plat-form (Y/N)	Founding Year	Head-quarters	Funding Raised ($mm)	Head-count	Blockchain Ecosystem	Tokenized OCA Product(s)	On-chain Mcap of Tokenized OCA Product(s) ($mm)[1]	Backing for Tokenized OCA Product(s)[2]	USD Value of Backing For Tokenized OCA Product(s) ($mm)[3]	On-chain Mcap of Protocol Token ($mm)[1]
Equities & Indices	Backed	N	2022	Switzerland	NA	1-10	Ethereum/EVM-compatible, Gnosis Chain	Equities (S&P 500 Tracker, Coinbase, and Others)	$1.1 (bCSPX) $0.6 (bCOIN)	iShares Core S&P 500 (CSPX) & Coinbase Global Inc. (COIN)	$1.1 (CSPX) $0.6 (COIN)	N/A
	Swarm Markets	N	2021	Germany	NA	NA	Polygon	Equites (Apple and Tesla)	$0.015 (swAAPL) $0.013 (swTESLA)	Apple, Inc. (AAPL) Tesla, Inc. (TSLA)	$0.015 (AAPL) $0.014 (TSLA)	$3.2 (SMT)
Debt, Bonds & MMFs	Backed	N	2022	Switzerland	NA	1-10	Ethereum/EVM-compatible, Gnosis Chain	Gov't and Corp. Debt (Short-, Medium-Term Treasuries and Others)	$9.6 (bIB01) $1.6 (bIBTA)	US Treasury 0-1yr (b1B01) US Treasury 1-3yr (b1BTA)	$9.6 (IB01) $1.6 (IBTA)	N/A
	Franklin Templeton	N	2023[4]	USA	NA	5001-10000	Polygon	MMF	N/A	OnChain U.S. Government Money Fund	N/A	N/A
	MatrixDock (Matrixport subsidiary)	N	2023[4]	Singapore	$138	101-250	Ethereum	Gov't Debt (Short-Term Treasuries)	$85 (STBT)	US Treasury Securities (=<6mos), and US Treasury Collateralized Repos	$85	N/A
	Ondo Finance	N	2021	USA	$34	1-10	Ethereum	Gov't Debt (Corporate Debt & MMF Planned)	$131 (OUSG)	US Short-term Treasuries	$131	N/A
	OpenEden	N	2023[4]	British Virgin Islands	NA	NA	Ethereum	Gov't Debt (Short-Term Treasuries)	$13 (TBILL)	US Short-term Treasuries (<6mos)	$13	N/A
Alternative/Illiquid Products	BSOS	Y	2018	Taiwan	$1	11-50	Permissioned Entriprise Blockchain	Supply-chain Financing	N/A	Varies	N/A	N/A
	Centrifuge	Y	2017	Germany	$15.8	11-50	Ethereum & Centrifuge (Polkadot Parachain)	Structured Debt	$209	Varies	$209[5]	$97.9 (CFG)
	Defyca	Y	2021	Luxemborg	$1.3	NA	Avalance, Ethereum, Solana & others (Testnet)	Private Credit	N/A	Varies	N/A	N/A
	Goldfinch	Y	2020	USA	$37.7	1-10	Ethereum	Structured Debt	$101	Varies	$101[5]	$9.8 (GFI)
	Intain	Y	2018	USA	$1.5	11-50	IntainMARKETS (Avalanche Subnet)	Structured Debt	N/A	Varies	N/A	N/A
	Maple	Y	2018	Australia	$2.7	1-10	Ethereum & Solana	Private Credit & Lending	$36	Varies	$36[5]	$31 (MPL)
	Obligate	Y	2019	Switzerland	$10.7	11-50	Polygon	Debt Securities	N/A	Varies	N/A	N/A
	Polymath Research	Y	2017	Barbados	$59	11-50	Polymath (Ethereum) Polymesh (Polkadot Parachain)	Structured Securities & Others	N/A	Varies	N/A	$115 (POLY) $86 (POLYX)
	Re	N	2022	USA	$14.0	1-10	Avalanche Subnet (Not Live Yet)	Insurance Premiums	N/A	Varies	N/A	N/A
	RealT	Y	2019	USA	NA	11-50	Gnosis chain	Real Estate	$3	Rental Property Portfolios	$3[5]	N/A
	Securitize	Y	2017	USA	100	51-100	Blockchain-agnostic; Compatible w/ Public & Private Networks	Private Debt and Equity (Feeder Funds For EOFV, HCSG II, and others)	N/A	Equity Opportunities Fund V (EOFV) by Hamilton Lane; Healthcare-focussed Fund (HCSG II) by KKR & Co.	$2,100 (EOFV) $3,790 (HCSG II)	N/A

Notes: *Platforms refer to companies and protocols that offer tokenization services to third-parties. Market capitalization (Mcap) of tokenized OCA products are listed as 'N/A' for some platforms as they are dependent on individual offerings deployed on each.*

[1] *Mcap based on USD value of on-chain circulating token supply, as of writing.*

[2] *Lists assets backing respective tokenized OCA product(s), including OCAs, crypto-native assets (e.g., BTC, ETH, etc.) and other OCA-backed digital tokens (e.g., USDC).*

[3] *USD value (as of writing) of assets backing respective tokenized OCA product(s) based on most recent self- or third-party reporting. For debt/equity/fund offerings (EOFV, HCSG II and Franklin Templeton MMF), value represents total fund size in USD, not just the portion that is tokenized on-chain.*

[4] *Year refers to when on-chain tokenized OCA product was first available to the market.*

[5] *Refers to active loans tokenized on the platform.*

Sources: Official company documentation and attestations, Coingecko, Crunchbase, Daistats.com, Dune, Defillama, Pitchbook, RWA.xyz, The Block Research.

Data as of June 26, 2023.

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Equities and Indices

Equities represent ownership shares in a corporation, providing investors with a claim on part of the company's assets and earnings. Indices on the other hand, usually represent a basket of stocks that serve to follow the benchmark performance of specific market sectors or the market as a whole. This sub-sector provides two examples for organizations that issue tokenized OCAs representing publicly traded, highly liquid assets. Backed issues tokenized securities, covering liquid and publicly traded equity, such as bCOIN and an equity index (bCSPX). bCOIN ($0.6mm on-chain market capitalization at the time of writing) tracks the value of Coinbase Global Inc. (COIN). bCSPX ($1.1mm on-chain market capitalization at the time of writing) is a tokenized S&P 500 index tracker. Both are transferable across self-custodied wallets and therefore allow for 24/7 market trading. However, although bTokens can be freely transferred, they can only be issued and redeemed after completing KYC procedures.

Swarm is another entity that issues tokenized equities (swAAPL, swTESLA and others).[7] While these offerings are relatively small (less than $100,000 market capitalization) they are notable for introducing a compliant decentralized finance solution via an on-chain compliance layer for the secure and regulated trading of tokenized OCAs. The company's goal is to allow for advantages from DeFi, such as self-custody and on-chain transparency while providing necessary protections of traditional finance such as regulatory compliance.

Debt, Bonds and Money Market Funds (MMFs)

Debt, bonds, and MMFs represent fixed-income investment vehicles that offer predictable returns, encompassing publicly traded, liquid instruments like government and corporate bonds, treasury bills, and short-term debt securities.

Ondo finance is a platform of note as one of the first protocols to tokenize treasury and corporate bonds across a suite of four fund products: OMMF (money market fund), OUSG (short-term US government bonds), OSTB (short-term investment grade bonds), and OHYG (high yield corporate bonds). Ondo has established relationships with US-regulated asset managers (BlackRock), custodians (Coinbase), and fund administrators to compliantly offer its tokenized OCA products to KYC'ed customers. Similarly, Backed, Matrixdock and OpenEden issue tokenized short-term US government debt (bIB01, STBT and TBILL, respectively).[8] Finally, Franklin Templeton is another pioneer with its Franklin OnChain US Government Money Fund (FOBXX), which is the first US-registered mutual fund to use a public blockchain (Polygon) as a parallel transaction registry and share ownership recording.

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7   Swarm also offers tokenized OCA debt products. However, at the time of writing it appears that the main focus is equities.

8   Backed also offers a tokenized medium-term US government debt ('bIBTA') and high-yield corporate bond ('bHIGH').

Alternative/Illiquid Products

The largest sub-sector (by number of organizations covered) is 'Alternative/Illiquid Products'. For the purposes of this report, we define 'alternative/illiquid' as a wide range of private equity and credit instruments which can be based on peer-to-peer (P2P) lending, crowdfunding, invoice trading, asset-based financing, etc. We also include traditional asset classes like debt securities if they may be considered illiquid (as for example a bond issued for a small company). Alternative investments may take place outside of the traditional financial system, involving non-bank entities and are often characterized by their flexibility, and rapid execution, but may remain relatively illiquid in secondary markets. Overall, the goal of most companies/protocols described in this sub-sector is to bring suppliers, buyers, borrowers, lenders, financial institutions, debt issuance management and most importantly, the associated payment rails together on one platform as an end-to-end solution.

A key player in this sub-sector is Securitize, which aims to give access for market participants to invest in tokenized private market OCAs and provide companies with an end-to-end suite of compliant funding solutions using blockchain technology. It uses feeder funds[9] to provide access to alternative investment funds, such as Hamilton Lane's Equity Opportunities Fund V on the Polygon blockchain. A feeder fund opens the door to a much larger pool of qualified investors with a recent change in the minimum investment requirement being lowered to $20,000 (from $5mm USD). Securitize also issues a fund tokenizing interest in KKR's Health Care Strategic Growth Fund II ('HCSG II') on the Avalanche public blockchain. These examples show that there is significant interdisciplinary cooperation between established regulated TradFi entities, tokenization service providers and blockchain platforms breaking ground to experiment with blockchain-enabled financial services in a compliant manner.

Similar to Securitize, Polymath Research aims to provide a platform for building financial applications and tokenizing OCAs while taking care of the complexities of smart contracts. Polymath operates as a decentralized platform with its own governance tokens POLY (on Ethereum) and POLYX (on Polkadot).

Next, consider Centrifuge, Goldfinch, and Maple, which are decentralized finance lending platforms with approximately $209mm, $36mm and $101mm USD in total outstanding loans, respectively (as of June 2023). In general, they use tokenized off-chain assets as collateral to secure loans. Unlike in 'traditional' DeFi protocols, the value of these OCAs doesn't necessarily have to be overcollateralized (with crypto-native collateral) because the value isn't subject to the same kind of volatility as cryptoassets. Hence, the approach has also been labeled 'undercollateralized lending'. However, the assets' value still needs to be assessed and validated. All three protocols enable undercollateralized lending involving (off-chain) risk assessment and management. As an example, Case Study 2 in Appendix 2 provides a more in-depth description of Centrifuge's tokenization strategy.[10]

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9   A feeder fund is an investment vehicle, for example a limited partnership, that pools capital commitments of investors and invests or 'feeds' such capital into another fund.

10   A related interesting development involves collaboration between Aave (a prominent DeFi lending/borrowing application) and Centrifuge, launching their first set of permissioned pools. Select Aave depositors can earn yield from relatively stable, uncorrelated off-chain collateral. Aave's OCA market integrates with 7 pools from Centrifuge's Tinlake protocol and includes a wide variety of OCA types, ranging from bridge loans to inventory and revenue-based financing.

Next, Intain, Defyca, and Obligate are notable examples for tokenized debt issuance in this sub- sector. IntainMARKETS (a subnet on Avalanche) is one of the first structured credit marketplaces that integrate tokenized debt issuance and investment with comprehensive on-chain data and administration. Defyca, which currently still operates with a testnet, aims to address issues related to liquidity and slippage in private credit markets with a cross-chain liquidity aggregator. Obligate provides a regulated debt securities marketplace on the Polygon network. It recently announced its first native on-chain bond issuance from Muff Trading AG, a Swiss commodities trading firm.

Finally, we cover three organizations which aim to provide investors with access to rather exotic and inaccessible markets: insurance, real estate, and supply chain finance. Re is a decentralized protocol for investors to gain exposure to insurance premiums, which is a large and uncorrelated asset class.[11] The protocol aims to allow investors to supply capital for reinsurance to back an index of insurance programs spanning multiple industries. RealT tokenizes real estate. This allows investors around the globe to buy into the US real estate market. In addition, tokenized properties can be used as collateral for loans on the platform. BSOS is an example for a company that helps address the trade finance gap mentioned in Part 2 of this report. Their SUPLEX platform connects tokenized OCAs from multiple industries with capital providers for supply chain financing.

Other OCA Innovation of Interest (not covered in Table 3.2)

Beyond the organizations categorized above, there is a wide degree of experimentation in the tokenized OCA space. Examples of protocols are spread across diverse applications such as, carbon credit, energy markets, and even real-world experiences (e.g., BrightMoments and MADworld). The following are a few interesting areas that are at the cutting edge of OCA tokenization:

- **Carbon-credit tokenization and renewable energy finance**: There is growing interest in the area of carbon credits (CC), where services include one or more of the following: 1) identify and acquire high quality CCs to be custodied and tokenized, 2) create a blockchain marketplace to maximize CC liquidity, 3) provide a turn-key process for entities to track CC transfers and offsets and, 4) connect investors with developers to fund new projects (renewable energy finance). For example, the focus for Flowcarbon is on a global CC marketplace, while platforms like Ecowatt aim to directly fund renewable power generation and reforestation projects.

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10   A related interesting development involves collaboration between Aave (a prominent DeFi lending/borrowing application) and Centrifuge, launching their first set of permissioned pools. Select Aave depositors can earn yield from relatively stable, uncorrelated off-chain collateral. Aave's OCA market integrates with 7 pools from Centrifuge's Tinlake protocol and includes a wide variety of OCA types, ranging from bridge loans to inventory and revenue-based financing.

11   The protocol plans to go live in the coming months.

- **Unique assets/collectible-backed tokens**: A number of protocols are catering towards tokenizing physical collectible items (e.g., trading cards, wine, stamps, watches, art, etc.). Collector and Tangible enable users to digitize their collections by transferring custody to regulated entities, who generate tokens representing ownership rights that can then be traded or used as collateral on-chain.

- **OCA data services**: Direct access to trustworthy data is critical for many OCA-linked applications. Chainlink and Securitize (also featured in Table 3.2) are both critical tools on this front. Securitize is already integrated in a wide variety of existing OCA protocols for KYC/AML. Chainlink is a dominant data oracle for smart contract-enabled blockchains to supply DApps with off-chain data.

Summing up, in Part 3 of the report we categorize the landscape of organizations OCAs into i) non-security/commodity-based tokenized OCA issuers and ii) securities-based tokenized OCA issuers. At this point, stablecoins represent the largest sub-sector for tokenized OCA issuance. USDT and USDC alone have a market capitalization of $111.4B USD. Furthermore, commodity backed assets, particularly gold, have been gaining some prominence. Finally, we also find growing interest in tokenized OCA offerings across various securities categories. As mentioned in Part 2 of this report, the potential benefits of tokenizing OCAs are likely most pronounced in areas that have so far been difficult to access for most market participants, such as private market investments. In line with this, we see most innovation and experimentation in the alternative/illiquid sub-sector, which features the largest number of protocols covered in this report.
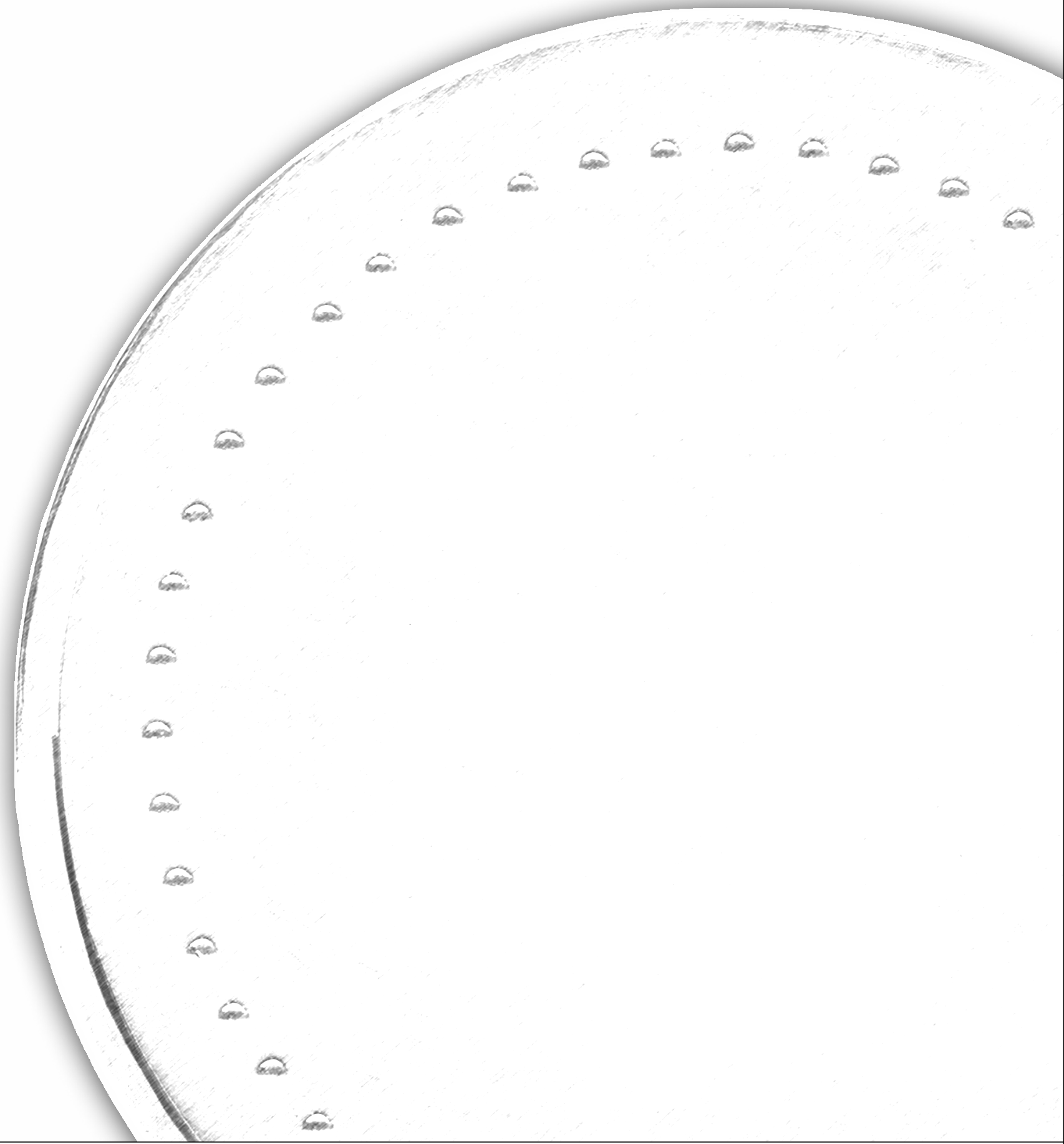
PART 4
CONCLUSION
&
OUTLOOK

"The integration between DeFi and traditional finance is crucial. It will clean up DeFi, unlock opportunities, and allow for a more professional and regulated environment. In this integration, DeFi should focus on being the infrastructure and rails underneath, rather than trying to be customer-facing products or financial wizards."

Paperimperium, working on and around MakerDAO

In this report we shed light on the dynamic space of tokenizing OCAs, exploring the advantages and obstacles. We also delve into innovative projects and protocols in this field. The most important potential benefits from OCA tokenization across different economic sectors are improvements in asset management and administration, risk diversification, as well as market efficiency, and liquidity. However, several hurdles remain that must be overcome for the OCA tokenization space to continue growing and realize the above benefits. The most prominent blockers for the industry are legal uncertainties and regulatory challenges. Regarding the current landscape of OCA tokenization, stablecoins are by far the most important use-case.

As the digital asset class continues to mature, we expect tokenized OCAs to play a much more significant role. Based on our findings, we see three key developments on the horizon.

First, as outlined in Part 3, there is healthy experimentation exploring the sea of possible applications of tokenized products backed by a wide variety of asset types, in particular regarding alternative/illiquid products. Bringing such a diverse array of OCAs on-chain requires interdisciplinary and industry expertise, leading to collaboration between TradFi, niche experts (e.g., insurance, trade financing, etc.) and blockchain entrepreneurs. Going forward, driven by growth and adoption of the space, we see OCA tokenization at the center of significant cross-industry collaborations.

Second, unlocking the OCA tokenization space through appropriate legal and regulatory frameworks will help propel adoption of specific sub-categories analyzed in this report such as illiquid OCA debt markets. A significant portion of global wealth is locked in illiquid assets. All else equal, illiquid assets usually trade at a discount, have limited trading volumes, and thus have inefficient price discovery mechanisms, relative to liquid assets. Traditional means for fractionalization (e.g., ETFs and REITs) have not provided a suitable solution for a wide variety of assets within private markets and alternative/ illiquid products that are burdened by laborious, sluggish, and non-transparent administration, along with elevated overhead costs. Furthermore, aligning capital with investment opportunities is a significant challenge due to inaccessible markets that are often geographically constrained. As outlined in Part 2 of the report, OCA tokenization may turn out to be beneficial for addressing these challenges. Given an appropriate legal and regulatory framework, we expect tokenization of illiquid OCAs in particular, to gain significant traction, bringing institutional players and institutions-focused product developers into the digital asset class, and eventually eclipsing today's major use-case (stablecoins).

Third, once OCA tokenization starts becoming a major blockchain use-case, there will be feedback effects on the infrastructure rails. As mentioned previously, institutional investors have set their eye on investing in the space. This point is important because the principles of decentralization, permissionless access and pseudonymity in public networks like Bitcoin and Ethereum are factors that (in some instances) may be considered problematic by regulated financial institutions. For example, financial institutions may want privacy of transactions and ensure they don't provide services to sanctioned entities –this may require a more tailored approach regarding blockchain infrastructure. While most of the OCA tokenization protocols covered in Part 3 of the report use public and permissionless blockchain rails with fixed design features, going forward, there may be increased demand for more bespoke blockchain integrations such as application-specific chains.[12]

Instead of an ecosystem of DApps reliant on a single-threaded blockchain with fixed attributes (e.g. permissionless access), application-specific blockchains can allow fine-tuning of design parameters for a specific use-case with native interoperability in an ecosystem of chains.[13] This approach can give institutions control over critical design criteria affecting compliance, consensus mechanism, interoperability with traditional systems, permissioning, privacy, scalability, and security among others. Major players in the public blockchain industry (e.g., Avalanche, Cosmos, and Polkadot) are competing to provide software development kits (SDK) that target institutional entities. Note that dedicated layer-2 blockchains, such as Arbitrum, Optimism, and zkSync, have also rolled out toolkits that may offer similar trade-offs among design choices.[14]

Going forward, it remains to be seen how the massive growth opportunity of OCA tokenization affects demand for underlying blockchain infrastructure. Will the app-specific approach face similar adoption challenges as enterprise blockchain? Alternatively, will large parts of the OCA tokenization market run on its rails? Or will network effects of public and permissionless blockchain ecosystems (with fixed design features) prevail and drive development of solutions that fulfill regulatory and institutional requirements while leveraging its infrastructure? Once the main hurdles for scaling are overcome, the market will decide.

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12 See The Block's report titled 'Comparing Layer-1 Platforms' for more details on application-specific chains and various blockchain network architectures.

13 For example, the group behind the Polymath network utilized Polkadot's ecosystem (Substrate SDK) to develop a purpose-built permissioned blockchain (parachain) called Polymesh. Similarly, Intain and Deloitte both launched their permissioned subnets (IntainMarkets and Green Dot, respectively) in the Avalanche ecosystem.

14 Also see, among others, Aztec or Polygon for ZK-based approaches that allow for permissioning, privacy, and scalability in the Ethereum ecosystem.

Appendix 1:
Case Study on US Securities Law and Digital Assets

Case Study 1: US Securities Law and Digital Assets

When tokenizing OCAs, it is crucial to understand the difference between security and utility tokens.[15] Security tokens represent an investment in a project or company and are subject to more stringent regulatory requirements in the United States. Utility tokens, on the other hand, typically grant access to a product or service and face fewer regulatory constraints. The US Securities and Exchange Commission (SEC) uses the <u>Howey Test to determine</u> if a digital asset is a security. At a very high level, digital asset may be considered a security if a number of conditions, including, for example a 'reasonable expectation of profits to be derived from the efforts of others', <u>are jointly satisfied</u>.

Issuing security tokens requires compliance with securities regulations, which protect investors and ensure issuers are sophisticated and trustworthy. When determining a token's classification, the SEC considers the citizenship of individual participants, including purchasers, issuers, and investors. Given the regulatory uncertainty surrounding token classification in the United States, some businesses choose to launch their tokens in other jurisdictions.

Security tokens are typically issued through a Security Token Offering (STO) and come in various forms, each with different fundraising limits, jurisdictions, filing requirements, and investor criteria. Combining different types of securities in a single offering is also possible, such as launching a token to US investors (under Reg D) and international investors (under Reg S).

A notable example of a security token can be found in the Centrifuge platform (as referenced in further detail in Appendix 2). Centrifuge's product offering occurs under both Reg D and Reg S exemptions, allowing access for accredited US investors and international investors, respectively.

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15 For a discussion on token classification see, for example, <u>here</u>.

Appendix 2:
Case Studies on OCA Tokenization

We dive a bit deeper to highlight the approach and design choices for OCA tokenization of two organizations, Centrifuge, a decentralized protocol, and Intain, a (centralized) company.

Case Study 2: Centrifuge Protocol

Centrifuge initially started as Tinlake on Ethereum in 2017, raised $15.8mm in funding and has active loans of $~210mm USD on its platform. The Centrifuge App was released in May 2022, succeeding Tinlake. Private placements from all pool issuers are conducted under Reg D or Reg S of the US Securities Act of 1933, which means US investors must be accredited, and all investors must clear standard KYC checks.

How OCAs are onboarded and represented: Borrowers (asset originators) mint an on-chain representation of real-world assets (e.g., invoices, mortgages, etc.) that are tokenized as NFTs. An NFT contains essential information required for pricing, financing, and valuation, that are accessible to the public. Confidential information regarding OCA NFTs are encoded in the private data layer of the Centrifuge protocol that pool issuers and investors may access. This private data is hashed and appended to the NFT's metadata as a verifiable link. Minted NFTs can then be locked into pools on the Centrifuge protocol as collateral representations to be borrowed against.

KYC/KYB and legal structure: KYC is carried out via ShuftiPro for investors. Each pool is associated with a special purpose vehicle (SPV), which can be incorporated in Delaware. The SPV separates the business of the asset originator from the financing activity underlying the pool and ensures that the pool's assets are bankruptcy remote.

Protocol Stakeholders:

Pool Issuer: The legal entity that 'holds' the assets, draws financing from the protocol, issues TIN/DROP tokens in exchange for investments, and legally manages the pool. Pool issuers are onboarded by Centrifuge.

Asset Originator: To receive financing, the Asset Originator originates OCAs and pledges them to the Pool Issuer. Asset Originators may establish a dedicated SPV as the issuer for particular pools. A Pool Issuer may also have multiple Asset Originators to populate assets for a pool.

Investors: Investors provide the liquidity that Pool Issuers use to populate their pools. In return, investors earn yield and CFG (the protocol's native token) rewards. In each pool, investors can invest in two different tokens (TIN and DROP), which is comparable to the junior/senior investment schemes used in traditional finance.

Appendix 2:
Case Studies on OCA Tokenization (Cont.)

Case Study 3: Intain

Intain aims to innovate on asset securitization in the financial services sector that involves the aggregation of financial assets (e.g., loans) that are subsequently segmented into tranches of debt and marketed to a diverse group of institutional investors. About $6B in loan pools are already administered on IntainADMIN (IA), their platform specialized in structured finance. Moreover, their IntainMARKETS (IM) aims to combine advantages of on-chain administration and tokenization such as, an effective, affordable, and transparent process for the entire lifecycle of an asset-backed security.

Collateral onboarding process: Both IA and IM function hand-in-hand. IA facilitates and automates data operations for structured finance deals. It makes loan data and documents from the Issuer available to a verification agent (if the deal terms allow) and thedata can then also be made available to underwriters.

IM serves as a digital hub for structured finance, integrating on-chain token issuance, investment, administration, data management and asset trading. Trusted intermediaries is usually required for tokenized OCAs. For example, a token backed by 'real-world' loans inherently requires assurance from trusted third parties. IM is a private blockchain with US-based infrastructure and permissioned validators designed specifically for existing regulated entities in the structured finance space. Using IM, intermediaries, such as verification agents, underwriters, trustees, custodians, and service providers can interact with investors/lenders and issuers in a compliant and friction-free environment to issue a range of tokenized asset-backed securities.

How OCAs are represented: Loans on IM are certified after review of documents (e.g., funding agreement, legal acknowledgment letter(s), settlement agreements, etc.) by verification agents and/or IM's automated systems. After certification, these loans are then converted into NFTs that are mapped into pools representing asset-backed securities. The NFT establishes a smart contract-based linkage for each loan within their respective pools.

KYC/KYB and legal structure: IM is a private blockchain that has KYC/KYB requirements for all stakeholders interacting with its platform.

Disclosures

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Beginning in 2021, Michael McCaffrey, the former CEO and majority owner of The Block, took a series of loans from founder and former FTX and Alameda CEO Sam Bankman-Fried. McCaffrey resigned from the company in December 2022 after failing to disclose those transactions.

While this report aims to provide an overview of the off-chain asset (OCA) / real-world asset space (RWA), it is not intended as an exhaustive compilation of all firms operating in the OCA space. If you believe that your company or project was miscategorized or would like your project to be considered for next year's report, please contact research@theblock.co.

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