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Henrique Schneider
Excerpt
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1 Purpose

This Element is about using digital assets – also called crypto assets – from the portfolio's or investor's perspective. This Element aims to:

- Explain the underlying principles of digital assets.
- Differentiate between the use cases of digital assets and their respective value propositions.
- Expose different metrics, valuation methods, and risk models applicable to digital assets.
- Develop a framework for digital asset inclusion (or exclusion) in an investment portfolio.

You should read this Cambridge Elements on digital assets if you are:

- An investment professional, consultant, executive, and related interested in a practical approach to digital assets or
- Interested in the use cases of digital assets and the economics of this investment space or
- Curious about specific uses of digital assets, such as transactions and payments, decentralized finance, tokenization, and Web 3.0 or
- Studying or researching digital assets from an investment, management, or economic point of view.

1.1 To Know Digital Assets Is to Use Them

How do you use digital assets in an investment portfolio? Responding to this question involves addressing digital assets' use cases, value drivers, and risk profiles. In other words, understanding digital assets means knowing how to use them as an investment in a balanced portfolio. This Element calls this approach to digital assets a "pragmatist stance." It is pragmatic because it looks for the use of digital assets rather than their underlying technology. Naturally, the technology impacts the use case. But as an investor or a portfolio manager, the focus is to know how the digital asset behaves economically – opposite to technically.

This view has some implications. These are, in a nutshell: First, the pragmatist stance acknowledges a technical layer to the understanding of what digital assets are, but it maintains that, at least from the investment point of view, this layer is less important than the use of the digital asset in a market context or process. Naturally, there is a connection between technology and use, but not a deterministic one. For example, Bitcoin and Ethereum differ technically in substantial ways, but both can serve as means of payment. Even Ethereum's other uses are a function of the business case, not its technology. The use case of a digital asset is not determined by its technology but by its economic value added. The technology enables – not determines – adding value and is one of many aspects of a business case.

Second, according to the pragmatist stance, a digital asset's value and risk profile does not necessarily follow from its technical underlying but is the outcome of market processes. Market processes are how subjective preferences and information are aggregated by freely taken decisions to exchange, transforming them into valuations and creating welfare. In digital assets, one asset's specific network is the pivot for that asset's value and risk. For example, Bitcoin's widespread net of users is, at the same time, a driver of its value and the cause of its volatility. Technology can, of course, influence these value and risk profiles. But it remains one aspect among many. Again, a digital asset's specific value and risks depend on its business case and reception in market processes.

Finally, the pragmatist stance views digital assets as an evolving space. We are currently at the beginning of this development. Their use cases are still emerging; even the base technology can undergo several changes. At this stage – well, at any – it isn't easy to choose winners. Even risk assessment is challenging because of the limited timeframe and data volume. With the expansion of the digital assets space, solidifying use cases, and even accumulating its pitfalls and crises, investors will learn more about digital assets, and the models will improve.

1.2 Digital Assets Are Only as Good as Their Use Case

In principle, any investment creates value by making something consumers want. Financial assets facilitate this creation by mobilizing financial resources and directing them to venues for potential value creation. Financial investments often solve specific problems in market processes, such as bridging scarcity in capital, providing liquidity, enabling risk-takers to act, mitigating risk, qualifying and differentiating steps in the chain of value addition, and many more.

Digital assets, viewed as a type of financial investment, are not different. They, too, are addressing a specific need or problem in the market processes. The justification of any – investment-grade – single digital asset is whether it has a feasible business model that adds value and makes customers better off. This value add, or value proposition, is what investors look for when considering a digital asset. Simply put, a digital asset is only as good as its use case.

This Element identifies four layers of use cases. Section 3 discusses them and offers alternative views. CAIA, the Chartered Alternative Investment Analyst Association, developed these four layers. The CAIA has a dedicated program exploring digital assets. For that program, digital assets are understood as layers, each building upon the other. Shares and options are a loose analogy to that approach. Options are a layer of financial instruments presupposing, for example, publicly traded equity or shares. The rationale for CAIA's layering is that "portfolio-grade" investments in digital assets build upon the specific digital asset's use case and feasibility. These, in turn, are interconnected to their ecosystem in several ways. The CAIA's layers are:

- Payments, where the value proposition of digital assets is lowering transaction costs and monetizing investments via their commoditization.
- Token Currencies are digital securities or tokens used as a medium of exchange to store value or access services such as utilities, security, decentralized finance, governance, and non-fungible tokens.
- Decentralized finance, such as decentralized exchanges, oracles, digital lending and borrowing, insurance, yield farming, and derivatives, the value proposition of the digital asset being the elimination of intermediary, offering, instead, a rule-based, transparent, secure, and relatively cheap validation of transactions.
- The next version of the internet, sometimes called iteration, Web 3.0, promises customization of the web to the needs and preferences of the individual user. Gaming, social media, and the metaverse are applications of Web 3.0. The value proposition of digital assets here is to increase user control via Web 3.0 digital assets, payments, identity tools, and financial services.

1.3 Mosaic and Portfolio Approaches

This pragmatist view especially applies to investing in digital assets. Assessing their risk and using valuation methods cannot rely on a metric only. The complexity and dynamic of this investment space are best addressed when different metrics and methods complement each other. This mosaic approach is necessary to understand the multifaceted way in which digital assets create value.

Similarly, because they are multifaceted, investments in digital assets are better thought of within the logic of a portfolio. A portfolio is the combined holdings of various assets owned by an agent. The allocation of investments to the asset class of digital assets has repercussions on the total profile of all asset classes.

1.4 The Way Forward

This Element provides an overview of digital assets in a four-stepped approach. Each step follows in a separate section:

- Section 2 explains the principles of digital assets. While it reflects some of the technology underpinning the space, the task of the section is to achieve a pragmatist-level understanding by focusing on the governance mechanisms of distributed ledgers and blockchains.
- Section 3 expands on the use cases of digital assets. The pragmatist-level understating championed here submits that a digital asset's likelihood of success depends on its value proposition, that is, the real-world problem it solves.
- Section 4 explores risks regarding digital assets and methods for their valuation. Risk and valuation depend on whether an asset generates revenue or cash flow, a quality that separates mere tokens from decentralized finance.
- Section 5 discusses how to include digital assets in an investment portfolio.
- The conclusion is a checklist with a framework for investing in digital assets.

This is a short Element explaining the current state of the digital asset space. Each section, however, can be read independently and comes with a short overview of its contents and some references for further reading. In its content and structure, this Element follows the approach to digital assets favored by CAIA, the Chartered Alternative Investment Analyst Association, in its curriculum. There are other ways of treating this subject, but CAIA's comprehensive view corresponds well with the pragmatic understanding championed here.

To focus the reading of this Element on this pragmatist view, each section has a main premise or message:

- Section 2 claims that using a digital asset presupposes knowing its governance mechanisms.
- Section 3 submits that a digital asset can only create value if it can address users' needs to solve a real-world problem.
- Section 4 argues that a mosaic approach is needed in evaluating and evaluating a digital asset's risk profile.
- Section 5 posits that investments in digital assets should be seen in a portfolio approach involving all asset classes.

2 Principles of Digital Assets

Abstract: One must understand their underlying governance mechanisms to use digital assets effectively. Digital or crypto assets, existing solely in electronic form, serve as the foundational elements for decentralization across various sectors, notably finance. At its core, decentralization involves a peer-to-peer network validating transactions via digital protocols. These transactions are recorded on a distributed ledger – a blockchain. The consensus among these peers ensures transparency and trustworthiness by adding immutable records to the ledger.

> Nevertheless, there is a challenge, often called the blockchain trilemma: achieving decentralization, security, and scalability is difficult. Various digital assets approach this challenge in distinct ways, often by modifying the consensus mechanism or using layered solutions. Within this realm, "tokenization" denotes blockchain's ability to represent ownership, while "smart contracts" are autonomous programs executing on these ledgers.

This section claims that using a digital asset presupposes knowing its governance mechanisms. It reviews the principles associated with digital assets. They are the principles of the governance of decentralization. This section discusses:

- Decentralization
- Governance
- Distributed ledger and blockchain
- Consensus mechanism
- Proof of Work and Proof of Stake
- The blockchain trilemma
- Layers of blockchains
- Tokenization
- Smart Contracts

The best way to read this section is to imagine it as a layered structure. It first relates very general principles and, with each section, deepens the level of analysis a bit. So, for example, if questions about how decentralization works are left open after reading the first section, the following section addresses them. This process continues in the subsequent ones. However, as this Element, this section is mainly concerned with how a portfolio manager or investor can use digital assets. It will, therefore, not go into details of information technology but remain on the level of governance because governance has a direct link to the economic use case of these assets.

2.1 Decentralization

The core promise of digital assets is a decentralized network. This network can be used for transactions in many realms, for example, finance, insurance, other legal contracts, and even in the verification trail needed to approve pharmaceuticals or scientific papers. Decentralization and networks go hand in hand. Instead of entrusting a central entity with responsibility, several entities do the same work in parallel. This work is to maintain an interconnected web. The whole network, maintained by these so-called nodes, takes over responsibility.

Decentralization, as proposed by digital assets, has several advantages. It reduces the risk of unauthorized manipulation or tampering with the records, relies on a consensus mechanism to maintain the records, and submits each intended change to scrutinize this mechanism, consisting of several peer-to-peer nodes. This layout also increases the decentralized system's resilience. Since there is no single point of failure, even if one or some nodes are attacked or fail, the others are left unaffected and can continue to maintain the system without losing information.

A decentralized system, as submitted by digital assets, operates with the immutability of its record-keeping and transparency. Each node stores the whole record of all transactions that have taken place in the network. Participants can independently verify the integrity of the records without going through a central agent or clearing house. Finally, decentralization makes it harder for any single entity or group to control specific transactions or data, let alone all transactions or data.

The decentralized system of digital assets operates a distributed ledger or the blockchain. It is, fundamentally, a way to store immutable data in chronological order. The storing of the data occurs when the several nodes maintaining this decentralized ledger agree on changing it, that is, adding information to it. This system is called the consensus mechanism that governs the network.

Sometimes, the decentralization of the networks of digital assets is said to be trustless. This "trustlessness" refers to the property of a system where participants can engage in transactions and interactions without needing to trust a central authority or intermediary. In traditional systems like financial institutions or centralized databases, users rely on trusted intermediaries to facilitate transactions and maintain records' accuracy. This trust can sometimes be problematic due to the potential for fraud, censorship, single points of failure, or abuse of power by the intermediaries. Distributed ledger technology, especially in public and decentralized blockchains, eliminates the need for trust in a central authority, thus achieving trustlessness. However, trustlessness only means the absence of the need for trust in singular entities. Participants in a network of digital assets trust the network as a system.

Distributed ledger technology is not new. In the late 1980s, Bell Laboratories hired Scott Stornetta, an American physicist, who was actively working to solve the problem of preventing the manipulation of data and information in scientific research. In the 1990s, Stornetta hired computer scientist and cryptographer Stuart Haber. Stornetta and Haber worked together on building a solution to this problem, which sought to create a timestamp verification system for documents. This timestamp would work by using a distributed ledger and cryptographic protocols. The idea behind the solution is that if anything within the document is changed, there would be an immutable trail that scientists could trace back to the original document.

In 2008, the first blockchain application, a specific version of the distributed ledger, was used to create Bitcoin based on Satoshi Nakamoto's whitepaper from 2008. The ignition for Bitcoin's idea was the Financial Crisis of 2007–2009. From the viewpoint of many agents, the crisis is one of trust in centralized systems – banks, insurers, and central banks. Bitcoin's core promise was establishing an alternative currency with decentralized, networked maintenance. Without needing to trust any singular intermediary, Bitcoin's value proposition is that participants can trust the network with its consensus mechanism and algorithm. Since 2009, digital assets have been using distributed ledger technology to deliver on their promise of decentralization. Specific use cases follow in the next section.

2.2 Governance

The principles associated with digital assets are best understood as the governance of decentralization, which enables digital assets to exist in digital or electronic form in a distributed ledger using cryptographic techniques to ensure security, authenticity, and ownership. The governance of digital assets generally shows the following characteristics – each being adaptable to a specific application or use case:

- Decentralization: Digital assets are typically based on a distributed ledger or blockchain technology. Unlike traditional centralized systems where a single authority controls the data, blockchain networks are maintained by several nodes, ensuring no single entity has complete control over the asset's information. This decentralization increases security, reduces the risk of single points of failure, and fosters trust in the system.
- Cryptography: Digital assets use cryptographic algorithms to secure transactions. In doing so, they also ensure and validate the control of ownership and governance implementation. Public-key cryptography is crucial in securing digital asset transactions, allowing users to generate a pair of cryptographic keys (public and private). The public key serves to receive assets, while the private key serves to access and transfer those assets securely.
- Transparency and Immutability: Distributed ledger networks are designed to be transparent and immutable. Every transaction involving a digital asset is recorded on the distributed ledger, and this information is publicly available for anyone to inspect. This transparency ensures accountability and trust among users and provides an auditable history of asset transactions.
- Ownership and Control: In digital assets, ownership is determined by possessing private keys. Users who own the private key associated with a digital asset's public address have complete control and ownership over the asset. This control eliminates the need for intermediaries like banks or financial institutions and empowers individuals to be their custodians.