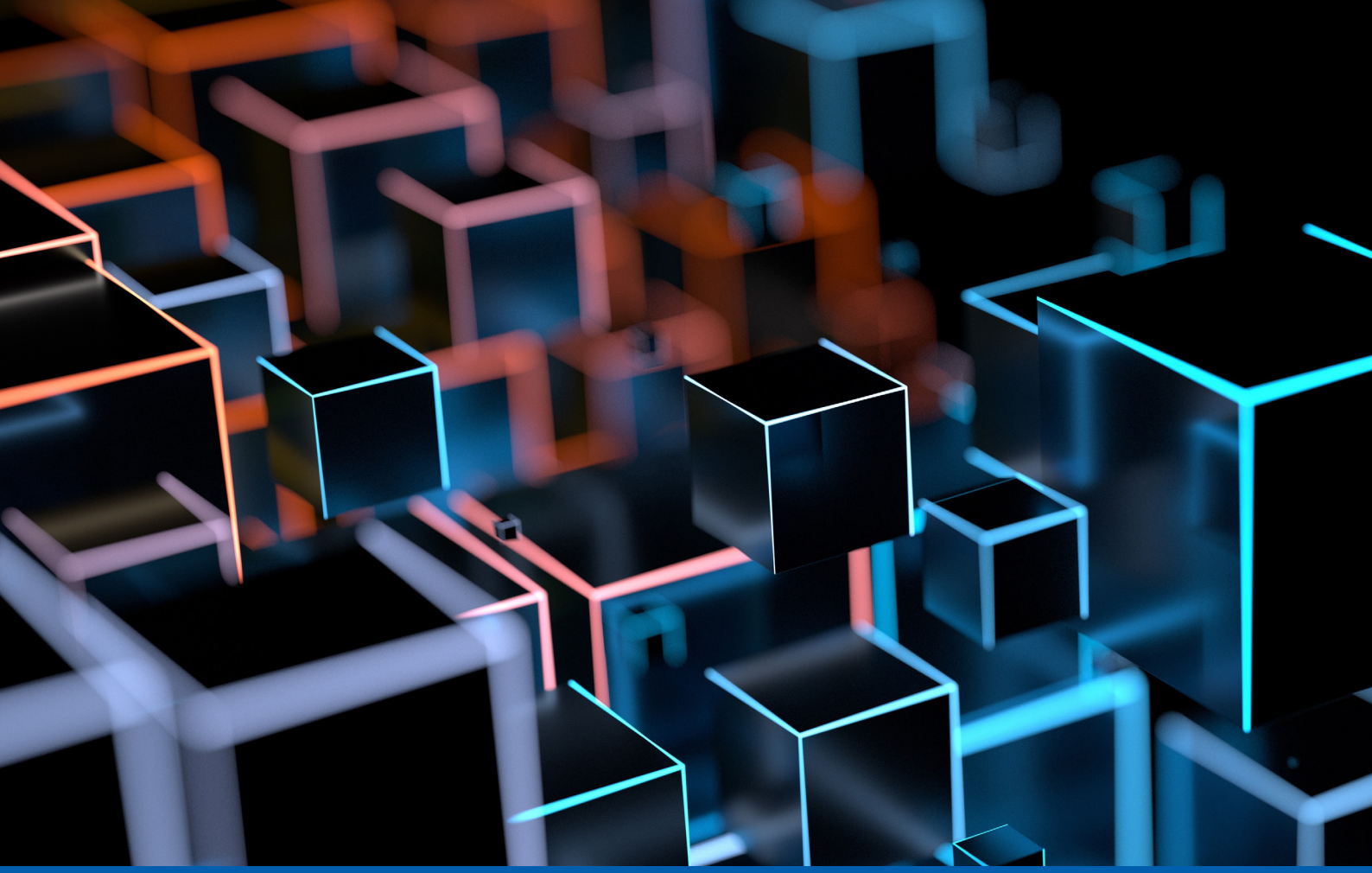

A New Asset Class: Investing in the Digital Asset Ecosystem

July 2022

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Foreword

WisdomTree is a first mover in digital assets. Our company has been through many incarnations over the last two decades. We started as a financial media company, Individual Investor Group, and then transitioned to ETFs when I saw how transformative they were for the investing process compared to mutual funds. The success of ETFs has underpinned our growing and innovative business, which has delivered results to our clients and investors for over a decade.

A few years ago, we assembled a group internally and asked ourselves, "what could disrupt ETFs in a way that ETFs disrupted mutual funds previously?" This led us to take a serious look at distributed ledger technology, blockchain and well-known digital assets like Bitcoin and Ether. We saw the potential for digital assets, and the underlying decentralised crypto infrastructure, to deliver a more accessible, cost-effective and transparent investment experience.

Today, the digital assets branch of WisdomTree is stronger than ever. This report is an example of WisdomTree's ability to leverage its long-standing research and analytical rigour to help our clients and investors better understand the vast opportunities that lie ahead with digital assets. From nothing a decade ago, to USD$3 trillion in market capitalisation recently, the digital asset ecosystem is now a fast-moving and diverse space with many important nuances. This report helps investors understand the space, how digital assets can fit in a portfolio and what kinds of roles digital assets can play in an investment strategy.

Going forward, our mission is simple: first, bring digital asset/crypto exposures into the mainstream financial ecosystem through ETPs and separate accounts; and, second, bring mainstream financial assets into the digital world through blockchain-enabled funds and tokenized assets. In this way, we aim to take the benefits of the decentralised digital asset infrastructure and combine them with the trust that comes from a regulated financial services provider. We call this 'responsible DeFi' and think it represents the next phase in the transformation of financial services.

Jonathan Steinberg

Founder & CEO, WisdomTree

EXECUTIVE SUMMARY

When Satoshi Nakamoto pseudonymously published a whitepaper at the tail end of 2008 (Nakamoto, 2008), one of the objectives was to remove third-party intermediaries when conducting digital monetary transfers, that is, create a decentralised digital currency: Bitcoin. This novel use of blockchain technology started a technological chain reaction that spread far and wide outside the "payment sphere". Blockchains support many megatrends such as decentralised finance (DeFi), Web 3.0[1], the metaverse etc. and the investing community has realised the potential for internet-like disruption. Venture capitalists and private investors invested USD$25.1 billion in the space in 2021. This is nothing short of the birth of a new asset class and presents myriad investing opportunities.

While it is possible to gain exposure through carefully selected companies that develop or use blockchain technology (so-called blockchain equities), investing in digital assets is the main route to access the space's growth potential. But, by construction, this asset class sits outside the traditional financial system, and the learning curve can feel quite steep. This report aims to ease investors' path to digital asset adoption.

The first challenge in investing in digital assets is that the space has grown from one cryptocurrency in 2009 to a diversified ecosystem of hundreds of coins, tokens and projects. In this report, we use the history of digital assets as a map of the investment space and introduce WisdomTree's Digital Assets Taxonomy. This Taxonomy:

+ Classifies digital assets into distinct and easily understandable categories
+ Assists in understanding the investment opportunity of each digital asset through the prism of the category that they belong to (that is the 'use-case')
+ Allows us to build an investment case for each individual asset with its opportunities, risks and relevant metrics to monitor

The second challenge lies in accessing digital assets. The infrastructure they are built on is often different from traditional assets. They don't always use the same exchanges, custodians, and systems. After going through an exhaustive list of ways to invest in digital assets we show that, in Europe, for institutional investors, only physically-backed ETPs can combine an easy operational setup and trading with security and efficient tracking. This is why such products have attracted large investments in the last few years. When it comes to selecting physically-backed digital asset ETPs, experience in other physically-backed ETPs, like gold, can be very useful. Here, we introduce a framework to choose and conduct due diligence on such physically-backed digital asset ETPs.

The final challenge is the portfolio construction itself. Digital assets exhibit large volatility and drawdowns, and finding the optimal allocation can be difficult. However, it is worth noting that digital assets represent around 1% of the Global Market Portfolio. Not investing is, in fact, taking an active decision to underweight digital assets and bet that this entire ecosystem will disappear in the next few years. Using multiple allocation techniques, we show that digital assets:

+ Demonstrate positive skewness, large convexity and strong diversification potential, making them a great addition to portfolios
+ Can be used strategically or tactically in a portfolio
+ Can be combined very effectively in diversified portfolios to create broad market or theme-specific exposures
+ May warrant an allocation of at least 1% to 2% in any portfolio on a risk-return basis, even if their expected return for the next few years is as low as 6% or 7% per annum

Blockchain, cryptocurrencies or digital assets?

The terms used to describe new technologies evolve as the technology evolves. Early on, words describing distinct concepts can be misused as they become buzzwords.

But precise wording is important. In this report, we use:

Blockchain to describe a distributed database on which information is recorded using digital signatures

Digital assets to broadly describe cryptocurrencies and tokens registered on a blockchain that are either a means of payment, native to a protocol (for example, Ether) or representations of traditional assets (for example, shares)

Crypto or **Cryptocurrencies** are often used as a synonym for digital assets but, in this report, we restrict the meaning to a subset of digital assets that only exists on a blockchain

[1] Also sometimes referred to as 'Web3'.

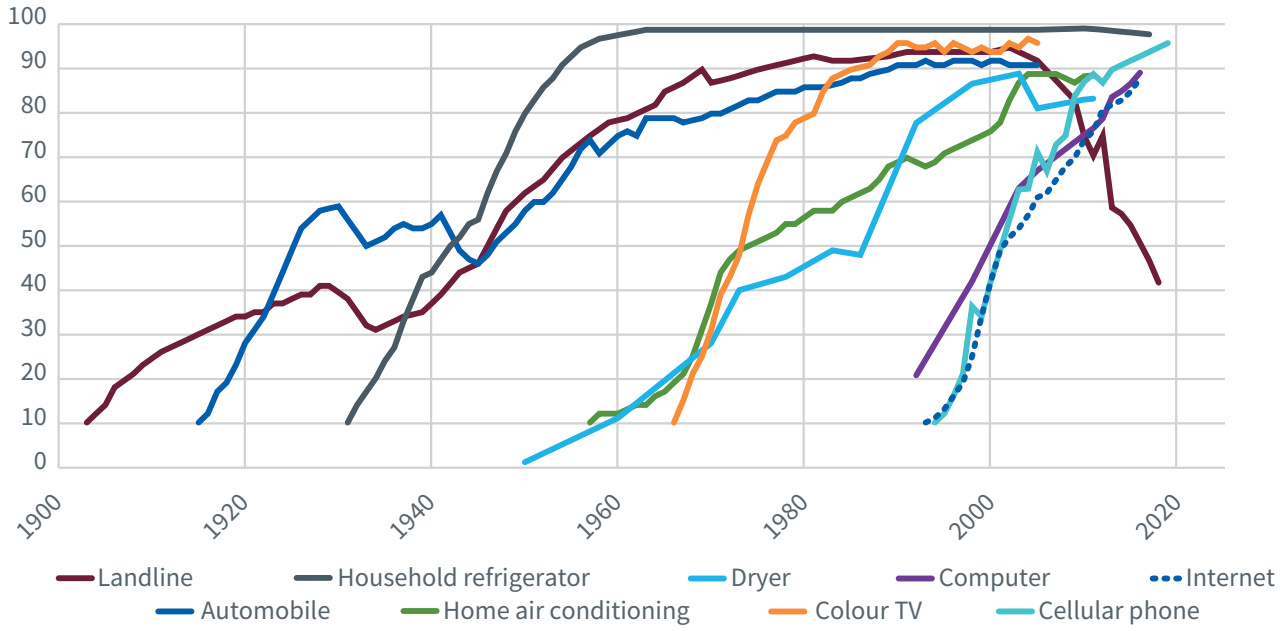
I. THE MANY OPPORTUNITIES OF A NASCENT ASSET CLASS

Blockchain technology is undoubtedly a revolution in the making. Wherever a transparent, immutable and digital record of information could be useful, which is across many industries, blockchain has the potential to disrupt the status quo. The range of potential applications for such technology is wide, diverse, and far-reaching. Similarly to how the internet has changed the world over the past 25 years, some configuration of open source software, public-key cryptography and a distributed ledger ('blockchain') technology is likely to be part of most aspects of our lives within a couple of decades without us even being aware of it.

A. Digital assets: riding the adoption curve

New technologies diffuse throughout society following an adoption curve. The adoption curve's slope is determined by the demand for the technology in question, which is a function of the number and nature of use cases and the supply of the technology (that is, how people can access the technology they wish to use). Digital technologies have, for example, diffused globally to the point where almost everyone has at least an internet-connected cell phone – and most of those are 'smartphones'[2]. Figure 1 illustrates how internet access and cell phone ownership have jumped from virtually zero to 90%+ in the last 20 years. It is worth noting as well that, with each technological revolution, the adoption curve is getting steeper. Digital technologies diffused across societies twice as fast as electricity a century before, aided by their intangible nature and global connectivity via the internet.

Figure 1: Adoption curve of technologies in the last 150 years in the US



Source: Hannah Ritchie and Max Roser (2017) - "Technology Adoption". Published online at OurWorldInData.org

Technology is moving very fast, faster than ever before. Moore's law has brought down the cost of computing power at an incredible rate, with the number of transistors in central processing units (CPUs) deemed to double every 18 months. So too has the cost of data storage and the speed, and ubiquity, of internet access.

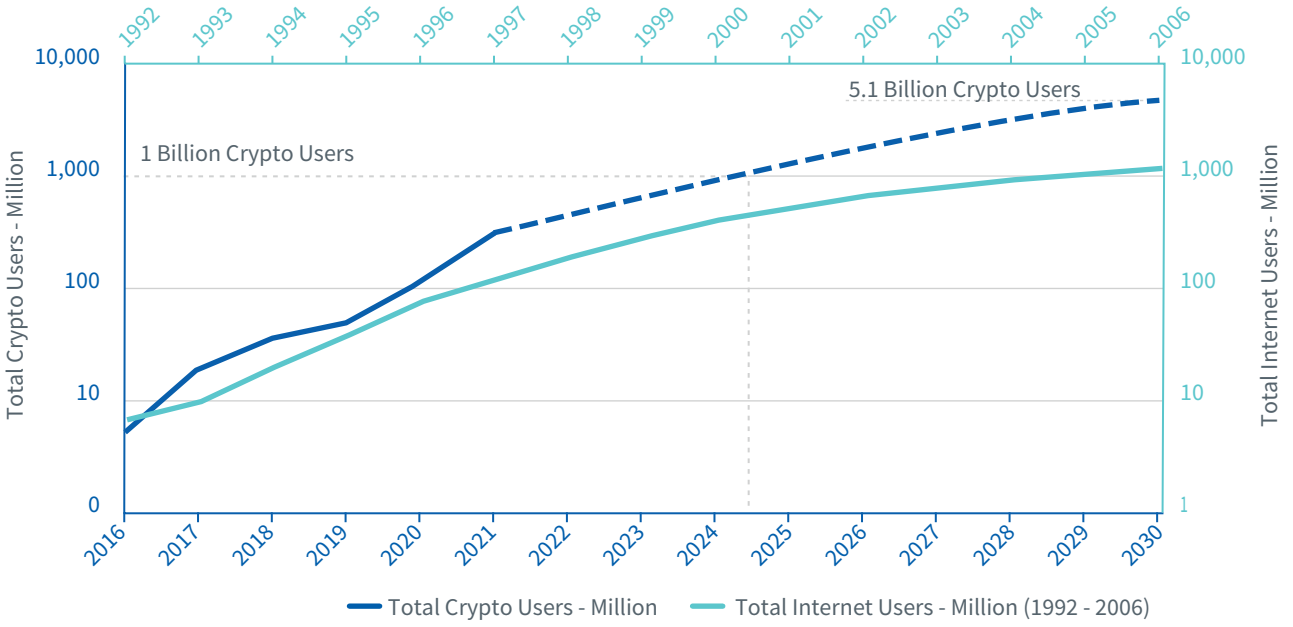
At the same time, even in industrialised economies where populations skew older than emerging economies, the threshold has been crossed where the majority of the population does not know or remember life before the internet[3]. These people have changed expectations of how things should be done and are very comfortable, and literate, with the use of digital technologies. Lewis Mumford contended that it was not enough for new technology to be available, rather, it had to be coupled with, "a change of mind… a reorientation of wishes, habits, ideas, goals"[4], for new industrial processes and technological change to take hold at scale. This is what has happened over the past decade.

[2] https://www.bankmycell.com/blog/how-many-phones-are-in-the-world
[3] https://www.census.gov/data/tables/time-series/demo/popest/2010s-national-detail.html#par_textimage_1537638156 and https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Population_structure_and_ageing#Past_and_future_population_ageing_trends_in_the_EU
[4] Technics and Civilisation

Add to this cocktail of a digitally-native generation and incredible technological advancements, the chronic macroeconomic mismanagements – mainly in emerging economies that brought recurrent hyperinflation, currency devaluation, inaccessible banking systems and capital controls – and you have a recipe for the rising demand for payment, store of value and other decentralised financial service alternatives that various digital asset networks and applications provide.

The overall result is that, in just over a decade, digital assets have gone from nothing to what is now a vibrant, diverse and fast-growing ecosystem. Figure 2 shows that it took the internet 14 years to go from just short of 10 million users in 1992 to 1 billion users in 2006. This is quite a quick pace of adoption compared to earlier technological revolutions, but crypto may be even faster. Crypto has gone from the same 10 million users in 2016 to close to 500 million in late 2021. At this rate, crypto users could reach 1 billion as early as 2024, doing so in eight years only (six years faster than the internet).

Figure 2: Crypto and Internet total number of users over time



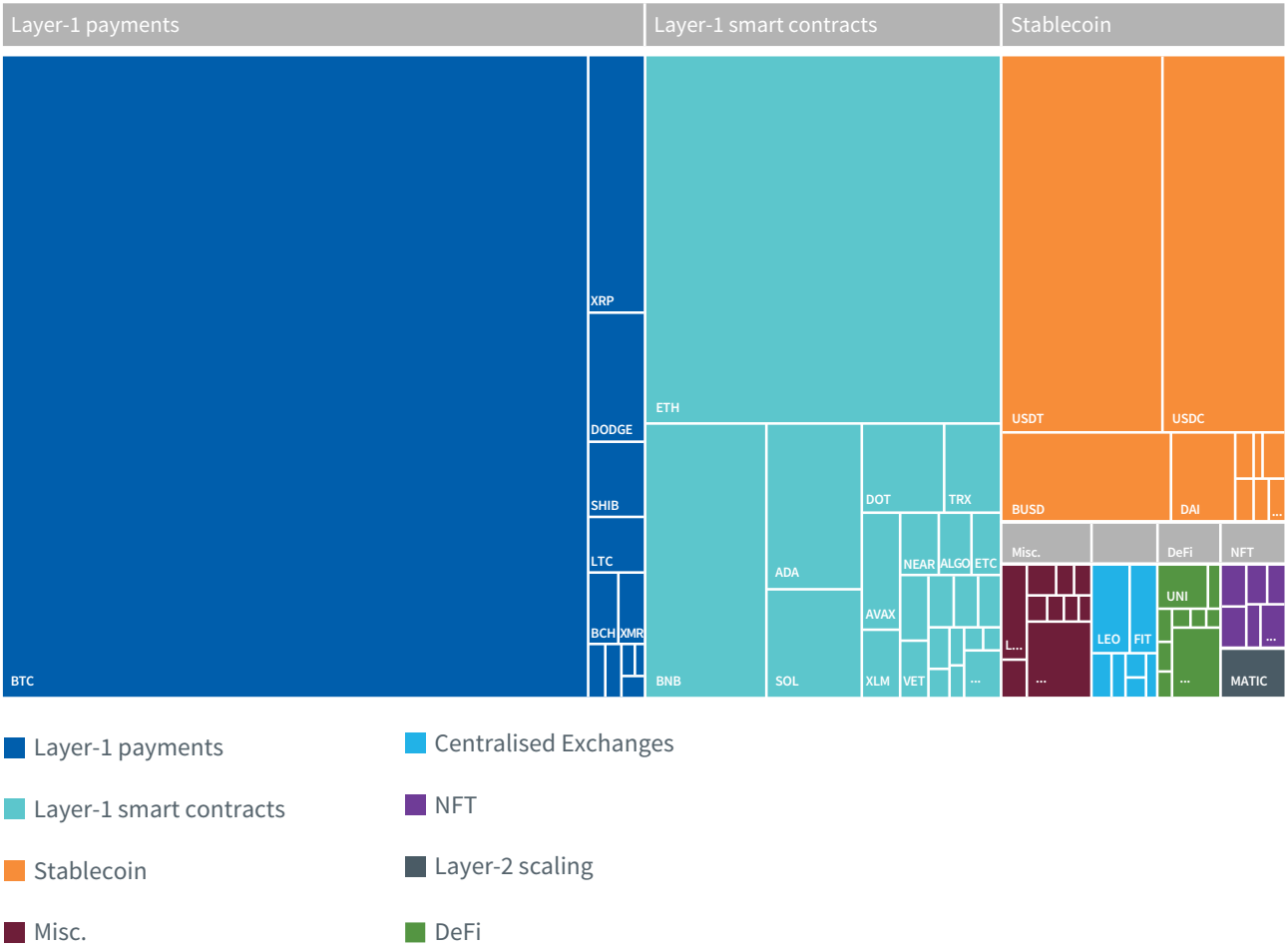
Source: Global Macro Investor.

By other measures, such as market capitalisation, the ecosystem hit its all-time highs of over USD$3 trillion equivalent[5] in late 2021. Using the WisdomTree Digital Assets Taxonomy (see II.B), it is possible to map the digital space by categories. It is interesting to note that cryptocurrencies built for payment, like Bitcoin, while the biggest market segment, are no longer the majority of the market cap. Many other categories and use cases have since appeared to create not just a bigger space but a more robust and diversified one.

This does not even include the value of the businesses built on or using digital asset networks (often called blockchain equities). Even though blockchain equities' valuation have dropped with the recent repricing of all growth equities, it is worth noting that Coinbase was valued at over USD$70 billion[6] only a few month ago. FTX[7] was recently valued at USD$25 billion[8], to give two examples. Moreover, the transactions facilitated by some of these networks clear over USD$100 billion in USD equivalent terms per day[9] – a figure that does not include the transactions conducted within closed-loop services such as Cash App or Blockchain.com.

[5] https://www.coingecko.com/en/global_charts
[6] https://www.google.com/finance/quote/COIN:NASDAQ?sa=X&sqi=2&ved=2ahUKEwiCmsC3ppr0AhWykWoFHdBNCMwQ3ecFegQIChAc As of 11 November 2021.
[7] FTX and Coinbase are two of the largest cryptocurrency exchanges in the world
[8] https://www.finextra.com/pressarticle/89905/ftx-hits-25bn-valuation-on-420m-funding-round
[9] https://www.coingecko.com/en/coins/high_volume

Figure 3: Digital asset space by categories as of 15 June 2022 (in the WisdomTree Digital Assets Taxonomy as described in II.B)



Source: WisdomTree, Messari. As of 15 June 2022. The graph represents the 200 largest digital assets by market cap on the relevant date.

Like railways in the 19th century or cars in the early 1900s, digital assets are on the path to complete adoption. Changes in payments or entertainment could fundamentally alter the society we live in, and this creates huge opportunities for investors. Imagine the returns of an investment in Ford in 1903 or Amazon in 1994. However, as with any innovations, there will be periods of boom and bust along the way, following the process of entrepreneurial trial and error.

B. Digital assets as a thematic investment

Because of their high growth potential, investors often see investment in digital assets or blockchain-related assets as thematic investments. This is a good paradigm to adopt to conceptualise investing in the space. Blockchain technology and digital assets promise to revolutionise the way the world operates. Like Marc Andreessen famously said, now more than ten years ago, "software is eating the world". Today, one could argue that software has eaten parts of the world, like shopping or journalism, and is now coming for financial services. The combination of open-source software, a distributed database, and public-key cryptography ('blockchain') promises increased efficiency, reliability and trust in a unique and innovative way.

1. Blockchain, the disruptor in chief

The variety of applications and use cases for blockchain are becoming apparent. Too often, investors focus on payment systems, but it is far from the only use case. While Bitcoin was the first blockchain created, and aimed to be a revolutionary payment system, the ecosystem has evolved far and wide outside the 'payment sphere'. Recent years have seen use cases emerge in entertainment, cloud storage and gaming. More could follow, as depicted in Figure 4.

Finance is always cited as the first sector targeted by this disruption. This is already well on the way with large crypto native exchanges like Coinbase and Binance, but also numerous decentralised finance ('DeFi') applications aiming to disrupt loan and credit, insurance or trading. For example, potential use cases can be seen in the automobile sector, where blockchain technology is being tested to track auto parts over time. Decentralised energy credits and bootstrapping wireless internet provision are other examples of this developing trend.

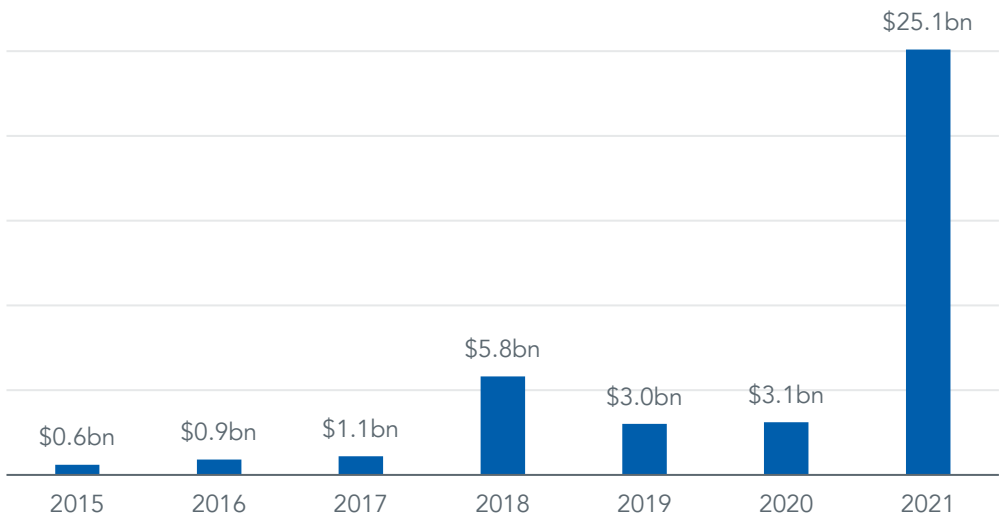
Figure 4: Blockchain could disrupt many economic sectors

Source: https://kalibroida.com/blockchain.php

We expect new use cases for blockchain to emerge over the coming decades as a consequence of trial and error. This will not happen overnight, as many challenges remain to be overcome for this technology; not to mention the issues encountered when displacing incumbents, but the internet didn't reach the mature stage we know today overnight either. It took roughly two decades to get there.

However, the investing community has recently realised the potential for internet-like disruption. Venture capitalists and private investors have been modestly investing in the space for years, but 2021 saw a significant acceleration, as illustrated in Figure 5. 2021 investments totalled USD$25.1 billion of investment, more than the six prior years combined. Such investments have fuelled the crypto ecosystem, providing stable funding to develop projects. In the previous wave of developments in the space in 2017, such institutional funding had been missing, and many projects failed because of this lack of funding. The current crop of venture capital investment recipients will provide the next wave of opportunities in this ecosystem, though many will fail along the way.

Figure 5: Historical venture funding into crypto and blockchain



Source: The Block

2. Megatrends in the digital space

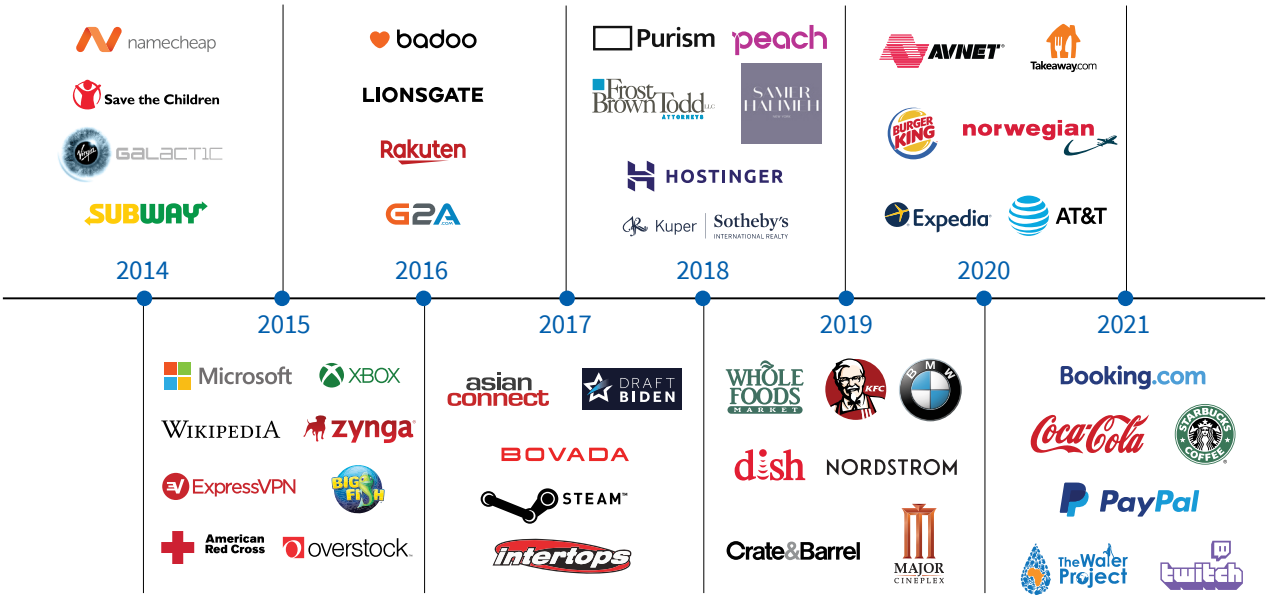
While digital assets are too often seen through the prism of Bitcoin only, the ecosystem has grown significantly larger. In many ways, blockchain technology does not support only one megatrend but several.

a. Disrupting payments

The first one is, of course, the payment revolution. Bitcoin is the first, and most famous, protocol aiming to disrupt the currency system. Bitcoin solved the double-spending problem, permitting digital scarcity in the process. Still, many more blockchain platforms aim to improve payment systems, such as Litecoin, Ripple, Zcash, and Monero (we call them 'Layer 1: Payment' in our WisdomTree Digital Assets Taxonomy, see II.B). Estimating how much crypto assets are used for payment globally isn't easy. Still, it cannot be honestly stated at this stage that cryptocurrencies have established themselves as a mainstream means of payment. However, adoption is increasing, and proof exists that their potential has been recognized by many:

+ The number of companies experimenting with crypto payments has kept rising over the years, including some of the most well-known brands in the world, as illustrated in Figure 6
+ When the legacy financial systems fail, like in Venezuela (hyperinflation), Turkey (hyperinflation) or in Russia/Ukraine more recently, people turn in mass to cryptocurrencies as an alternative

Figure 6: Brands accepting payment in cryptocurrencies



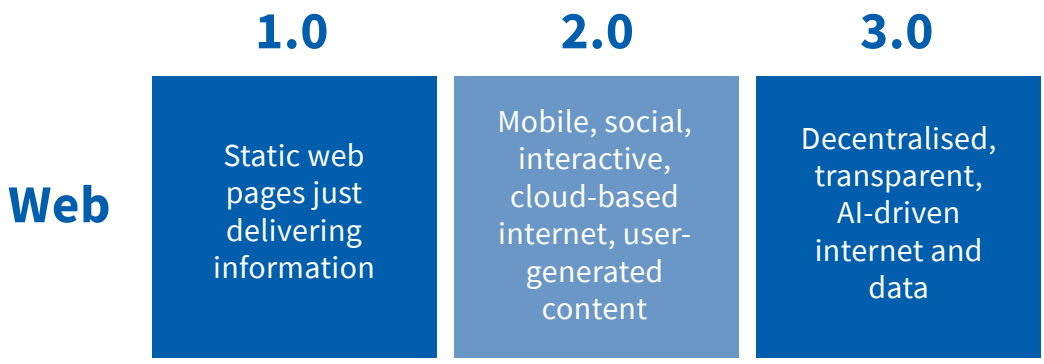
Source: https://triple-a.io/crypto-ownership/

b. Web 3.0

Over the years, the idea of blockchain has been extended to support smart contracts, giving birth to general-purpose blockchains (which we call 'Layer 1: Smart Contracts' in our WisdomTree Digital Assets Taxonomy, see II.B), such as Ethereum. These enable software applications to be built on top of, and record, information on the underlying blockchain and pave the way to what some dub 'Web 3.0'.

Web 3.0 represents a possible next step in the evolution of the internet, owned by everybody, created for everyone and controlled by no one. This idea may seem very abstract, but the advantages it could bring are very real. Relying on a distributed network has many benefits: the service is always up and running, it is secure and immutable, fully transparent and automated, cuts out the middlemen and eventually promises shared data and services without the need to trust any one entity.

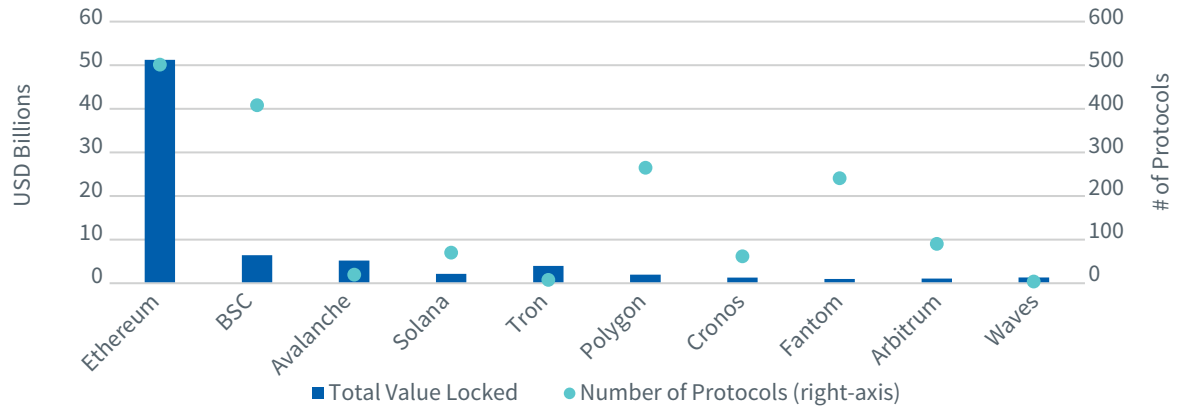
Figure 7: The evolution of the internet and the digital world



Source: WisdomTree

Layer 1 smart contract platforms include Ethereum but also Solana, Avalanche, Cardano etc. and all aim to become the leading smart contract protocol using different approaches and techniques. Their growth has been exceptional over the past few years in terms of the value of their associated coin and usage. However, benefiting from its first entrant premium, Ethereum remains dominant.

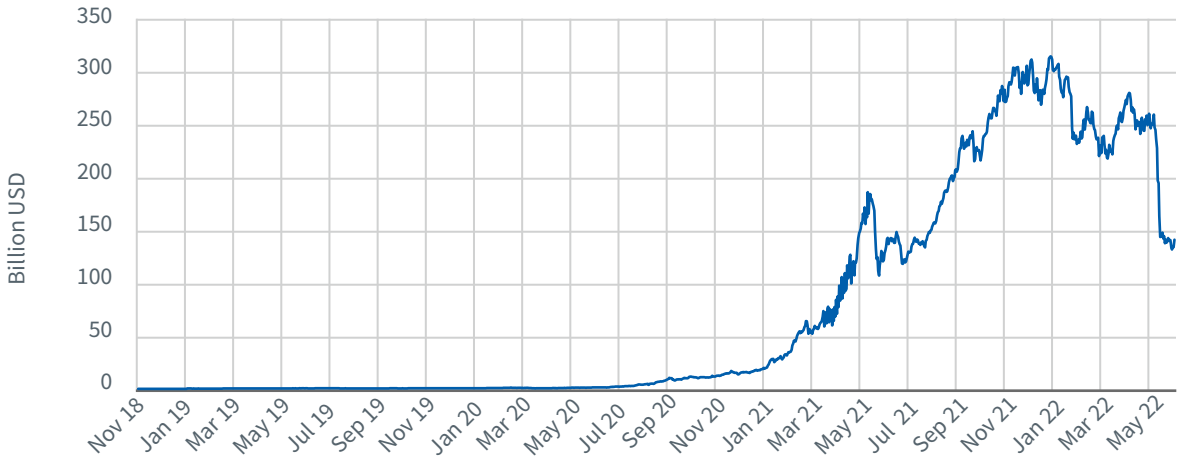
Figure 8: Ethereum hosts more applications and has a higher total value locked



Source: DeFi Llama. As of 15 June 2022.

These platforms have allowed developers to unleash their creativity, bringing all kinds of applications into the crypto universe in ways that would have been difficult to imagine just a few years ago. DeFi was, arguably, the main development of 2020. It unveiled a whole new financial ecosystem, built from scratch, which quickly became an incredible playing field for traders worldwide. Lending protocols, staking, flash loans, automated market makers and decentralised exchanges promise to build a revolutionary, decentralised financial system and offer huge returns for the astute participant. The growth in value directed toward this system has been truly impressive. Total value locked (TVL), that is, the value put to work in DeFi protocols by their users, has grown from virtually nothing in mid-2020 to USD$20 billion by the end of the same year. It is still around USD$150 billion after the recent correction in risky assets, as illustrated in Figure 9.

Figure 9: Historical total value locked in DeFi



Source: DeFi Llama. As of 31 May 2022.

c. Ownership in the digital space: non-fungible tokens

Digital ownership is the logical next step in the evolution of the digital world. Information is free-flowing and, almost by definition, can't be owned. However, with the increasing importance of the digital world in our lives, it was only a question of time before some manifestation of a kind of digital ownership became 'necessary'. But how can we replicate the physical ownership of unique items that we have known forever in an information world? Blockchain solved the puzzle of ownership by tying database entries to digital signatures. The next step allowed the creation of unique digital collectables: non-fungible tokens (NFTs). NFTs were the buzzword of 2021 in the crypto world and saw a very high growth over that year. These representations of ownership of digital items or pieces of art offered a new way for collectors and creators to interact.

The number of collections has kept rising while the price of NFTs skyrocketed in 2021. The largest auction house and luxury firms globally have jumped on the bandwagon. Some examples famously include Beeple's 'Everydays: the First 5000 Days', which sold for USD$69.3 million at Christie's in 2021, or 'Jack Dorsey's First Tweet', which sold for USD$2.9 million in March 2021. Many luxury, sport and other retail brands have also dabbled with NFTs, including Adidas, Louis Vuitton and Givenchy. As the market cooled in late 2021 and 2022, the market price of many NFTs has declined substantially. There is a long road ahead to work out what the most sustainable business models will be in this segment of the digital asset ecosystem.

Figure 10: Everydays: the First 5000 Days by Beeple (Mike Winkelmann), sold for USD$69.3 million at Christie's in 2021

Creators and auction houses are not the only ones to have beneficiated from the frenzy. NFT marketplaces have been generating exponential revenue and attracted significant investments from venture capital (VC) firms. OpenSea, the leading marketplace for NFTs, takes a hefty 2.5% cut of transactions on its service. It attracted USD$100 million in a Series B funding round in July 2021, valuing the platform at USD$1.5 billion, and then another USD$300 million investment a few months later in January 2022, for a valuation of USD$13.3 billion.

C. Digital assets or blockchain equities

There are many options for investors to get exposure to the trends we just outlined. As discussed later in Part III, one can, in theory, choose between a variety of vehicles (ETPs, mutual funds, separately managed accounts, trusts, hedge funds, derivatives etc.) and between various underlying exposures (coins, tokens, equity, debt etc.). This section focuses on comparing native digital assets against blockchain equities. Despite both being linked to blockchain technology, they offer different investment opportunities and are not interchangeable. However, they can both find their place in a portfolio. It is similar to the energy transition megatrend that investors can invest in through battery companies but also through commodities and industrial metals. The investment rationale is the same, and the two exposures are complementary.

1. Blockchain equities are not digital assets

What makes a stock, a stock? A stock represents fractional ownership in a company and entitles shareholders to a share of the company's profits, should the company decide to pay dividends. Different stocks can have slightly different features (for example, voting rights vs no voting rights) but their structure is often very similar.

Where does a stock get its value from? If we refer to the famous Dividend Discount Model (DDM), there are a few significant and well-accepted inputs: future dividends, discount rates, perpetual growth rates etc.

Valuing a stock is a challenging exercise, even more so for stocks of companies involved in cutting-edge new technologies like blockchain, or the internet before that. They often do not pay, nor plan on paying, dividends in the foreseeable future. The limited history of such an industry also makes any estimation of the required rate of return or long-term growth notoriously difficult. Consequently, simple dividend-based models like the DDM are often not suitable. Academics have, for example, been pointing to the rise of the 'intangible economy' and the rising need to incorporate intangibles in the way companies are valued. Nonetheless, the value of the stock remains tied to the underlying company's capacity to effectively conduct its business, provide valuable services and generate cash flows that will eventually turn into profits and be distributed to shareholders.

Investing in blockchain equities is effectively investing in firms for which one believes blockchain technology will have a significant and positive impact on their profits. This can take many forms, whether investing in:

+ Blockchain enablers – the ecosystem itself and, therefore, companies that develop building components for the blockchain ecosystem, such as hardware and software infrastructure and cryptocurrency mining

+ Blockchain engagers – companies that provide blockchain and cryptocurrency services and/or applications (consulting, software, financial services) using blockchain to improve net income through higher sales or improved efficiency and lower costs (for example, supply chain industry, food industry, healthcare)

2. Digital assets are a very different type of asset

In the same way that commodity-linked equities are fundamentally different to commodities as an asset class, digital assets are very different to blockchain equities.

As opposed to equities which are similar in structure, digital assets are very heteroclite. Some do not generate income, such as Bitcoin, while others allow for staking and generate a variable yield. Others can bear voting rights (Uniswap), can be pegged to the value of another asset (Tether), or can be non-fungible (NFTs).

Those characteristics are so different that it makes it virtually impossible to construct a valuation framework that can fit them all, and each asset needs to be analysed in light of its fundamental nature. Part II introduces WisdomTree's Digital Assets Taxonomy with its eight distinct categories that help to highlight those differences.

However, what stands out is that digital assets are not fractional ownership of a company. At the end of the day, there is no company to own. Digital assets are more easily conceptualised as networks in which investors can participate and benefit from the network's growth and the associated network effects.

While both digital assets and blockchain equities get exposure to the same technology (blockchain) and megatrends, this exposure is different in nature. Digital assets get first-hand exposure, while blockchain equities get secondary exposure. This fundamental difference shines through the risk-return profile of both assets. Digital assets tend to benefit from higher returns but suffer larger volatility and drawdowns. Blockchain equities' risk-return profile is closer to that of traditional equities, as highlighted in Figure 11.

3. Risk-return profile comparison

Figure 11 compares a diversified basket of digital assets, a diversified basket of blockchain equities and an equity benchmark, here the MSCI All Country World IMI.

Blockchain equities have significantly higher volatility than broad equities, at 26.1% vs 15.4% annualised. But this level of volatility is not rare and can be found in other corners of the equity space. On the other hand, volatility in digital assets stands on a whole different level at 110.8%. These levels can be found in single stocks but virtually never on equity subsectors. While returns are highly dependent on the timeframe under consideration, it is still interesting to see that, as with volatility, digital assets are in a class of their own, with 113% annualised returns over the period.

The same goes with maximum drawdown, where blockchain equities show a significantly riskier profile than broad equities. Digital assets show drawdown levels that are rare in the equity market.

Figure 11: Risk-return profile for blockchain equities and digital assets

	MSCI ACWI IMI	MSCI ACWI IMI Blockchain Economy	MVIS CryptoCompare Digital Assets 100
Annualised return	10.4%	24.9%	100.0%
Volatility	15.3%	25.9%	111.0%
Sharpe	0.6	0.9	0.9
Max drawdown	-22.4%	-33.7%	-83.3%
Beta	1.00	1.36	1.97
Correlation	1.00	0.80	0.27

Source: WisdomTree, Bloomberg. 30 November 2016 to 31 May 2022. On monthly USD returns. Blockchain Equities are proxied by the MSCI ACWI IMI Blockchain Economy Index. Digital Assets are proxied by the MVIS CryptoCompare Digital Assets 100. **You cannot invest directly in an index. Historical performance is not an indication of future performance and any investment may go down in value.**

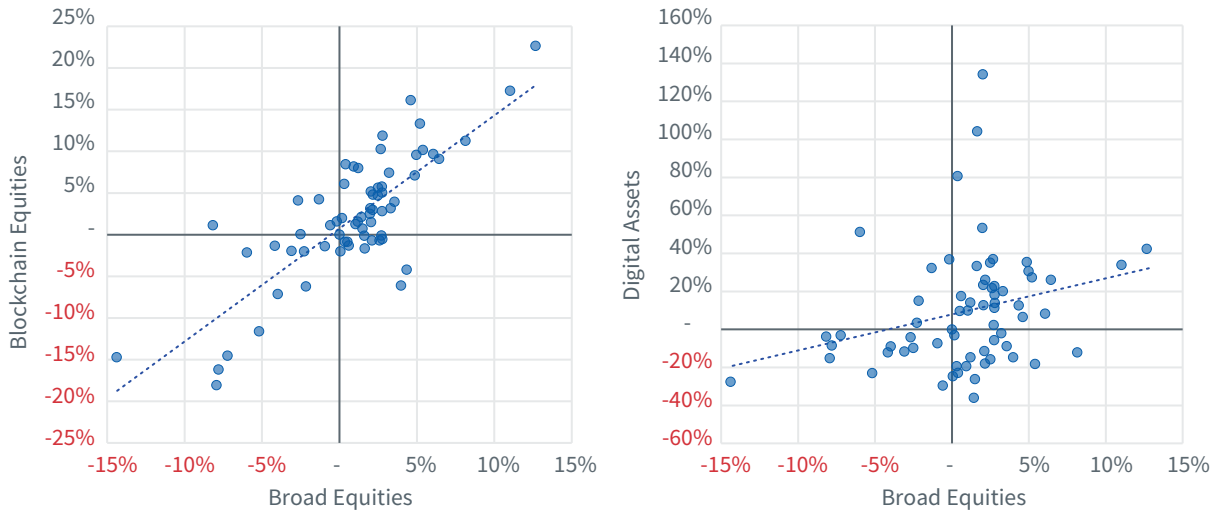
Figure 12: Historical correlation between blockchain equities and digital assets

Ticker	MSCI ACWI IMI	MSCI ACWI IMI Blockchain Economy	MVIS CryptoCompare Digital Assets 100
MSCI ACWI IMI	1.00		
MSCI ACWI IMI Blockchain Economy	0.80	1.00	
MVIS CryptoCompare Digital Assets 100	0.27*	0.20*	1.00

Source: WisdomTree, Bloomberg. 30 November 2016 to 31 May 2022. On monthly USD returns. Blockchain Equities are proxied by the MSCI ACWI IMI Blockchain Economy Index. Digital Assets are proxied by the MVIS CryptoCompare Digital Assets 100. **You cannot invest directly in an index. Historical performance is not an indication of future performance and any investment may go down in value.**

Compared to equities, blockchain equities and digital assets look like high-beta asset classes. However, the correlation of blockchain equities to broad equities is high at 0.80 and statistically very significant. While the correlation of digital assets to broad equities is low at 0.27 and is not statistically significant at the 1% confidence level. Figure 13 illustrates this quite clearly. While the relationship between broad equities and blockchain equities is quite evident, it is not the case for the relationship between digital assets and broad equities. Hence, digital assets should not be interpreted as a higher-risk version of equities. They behave in a significantly different way.

Figure 13: Monthly returns relationship between blockchain equities, digital assets and equities

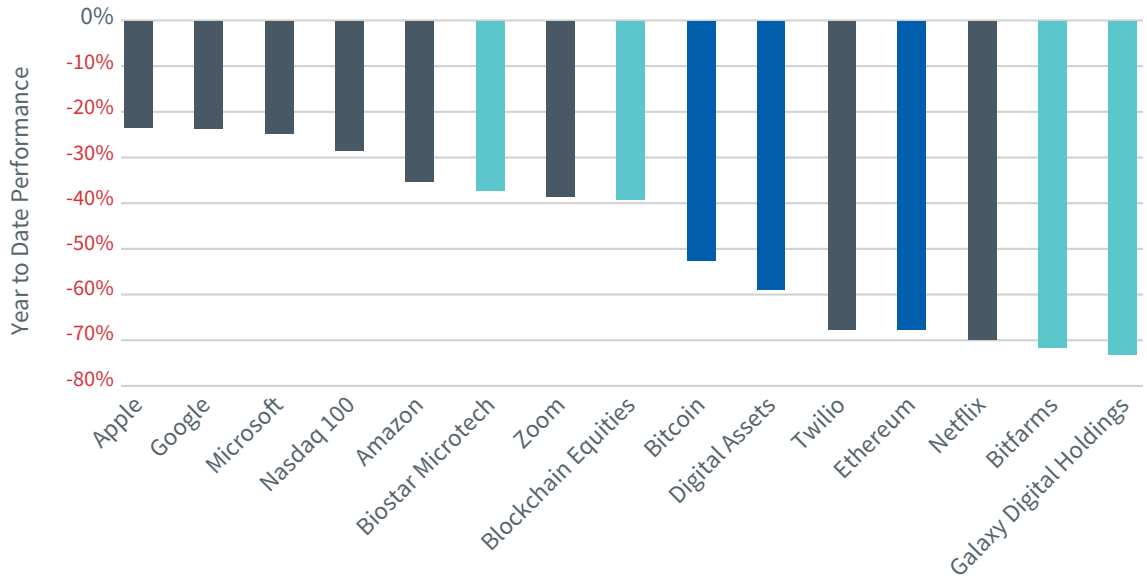


Source: WisdomTree, Bloomberg. 30 November 2022 to 31 May 2022. On monthly USD returns. **You cannot invest directly in an index. Historical performance is not an indication of future performance and any investment may go down in value.**

In early 2022, fear of inflation and central banks' increasingly hawkish stance created the perfect storm for growth stocks. Growth stocks are high duration assets; their value lies in their growth expectations and their capacity to generate increasingly large revenues far in the future. In a rising rate environment, increasing large discount factors make their valuation multiple unsustainable and leads to sharp drops in value, that is, they exhibit large durations. If digital assets were a higher growth, higher beta version of equities, their reaction to the shift in the environment should have been a leveraged version of what tech or blockchain equities suffered.

This is not what Figure 14 shows. Digital assets, while they suffered, did not suffer more than blockchain equities or tech stocks in general. While high duration, they do not appear to have significantly higher duration than tech or blockchain stocks. In other words, they behave differently.

Figure 14: Year-to-date performance of technology, blockchain and digital assets



Source: WisdomTree, Bloomberg, CoinGecko. 31 December 2021 to 15 June 2022. In USD. Blockchain Equities are proxied by the MSCI ACWI IMI Blockchain Economy Index. Digital Assets are proxied by the MVIS CryptoCompare Digital Assets 100. **You cannot invest directly in an index. Historical performance is not an indication of future performance and any investment may go down in value.**

This has important implications in the context of portfolio allocation. Although blockchain equities are less risky than digital assets, they are also unlikely to provide the same level of diversification. While both assets are linked to blockchain technology, these are two very different exposures that can not be used to proxy each other. The difference in behaviour between the two asset classes clearly indicated that they should not be seen as mutually exclusive alternatives to get the same exposure but rather as two investments with very different exposure to risk factors.

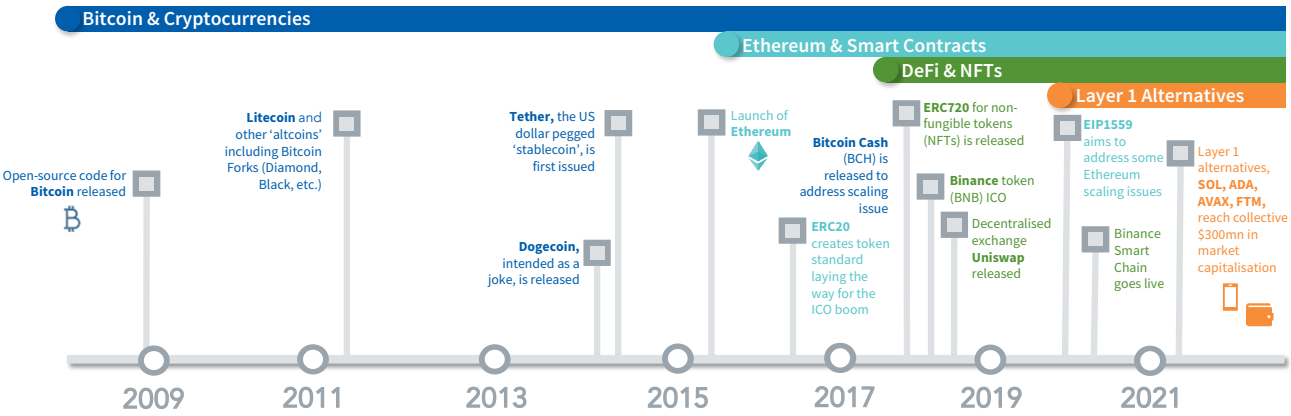
II. MAPPING A NASCENT AND EVOLVING INVESTMENT UNIVERSE

The arrival of Bitcoin in 2009 marked the start of what has now been over a decade of entrepreneurial and technical experimentation, as new use cases were imagined and successfully brought to market. At its core, people use technologies to solve problems they face in life. There is a plethora of issues that different people face across various parts of the world, including high inflation, costly cross-border remittance services, slow banking services and inaccessible financial services. Consequently, the technical underpinnings of digital assets – a combination of public-key cryptography, a distributed database and open-source code – have been used in countless ways by creative and imaginative people worldwide during the past decade. This section tells that story.

It also uses this history to propose the WisdomTree Digital Assets Taxonomy. Such a taxonomy is helpful in understanding the many opportunities available to investors in this evolving space, but also informs how to build investment cases for each of the individual assets, as documented in II.B.2 and II.C.

A. The history of digital assets is a map of the investment space

Figure 15: The story of the digital asset space



Source: WisdomTree. 2022

1. Bitcoin: the beginning

For decades, many attempts have been made at developing a digitally native currency. In the early 1980s[10], David Chaum conceived a digital cash and then set up a company, DigiCash, that ultimately went bankrupt in the 1990s. Jackson and Downey's 'e-gold' was a widely used internet money, introduced in 1996, that grew to several million users before the US Government shut it down in 2008[11]. During the same period, many attempts were made to develop peer-to-peer, decentralised networks for data sharing. Napster was among the most infamous, and most used, in the 1990s due to the publicity linked to the lawsuit brought by the Recording Industry Association of America. Its successor, BitTorrent, had more longevity since it was an open-source protocol, making it less susceptible to Napster's legal issues. Merging the ideas of open-source, decentralised protocols with a digital currency set in motion a technological shift, the consequences of which are still unfolding.

What is a cryptocurrency?

Cryptocurrencies are a way to exchange digital value between users without an intermediary.

Most cryptocurrencies are borderless, durable, irreversible, permissionless and pseudonymous.

[10] Chaum, David (1982). "Blind signatures for untraceable payments" (PDF). Department of Computer Science, University of California, Santa Barbara, CA.

[11] https://www.wired.com/2009/06/e-gold/

In 2009, a pseudonymous message board member called Satoshi Nakamoto posted a whitepaper and open-source code for an electronics payments network[12]. Called 'Bitcoin' (BTC), its first use case was payments and, considering that it uses public-key cryptographic methods for digital signatures, it was eventually dubbed (the first) 'cryptocurrency'. Its creation would mark the end of the decades-long quest to solve the 'double spend problem[13]'. The solution to this problem, a combination of the Bitcoin blockchain, transaction validation, digital signatures, etc. would ultimately usher in the 'digital assets' industry.

What is blockchain technology?

A blockchain is a distributed database. New additions to the database are called 'blocks'. Each block is linked to prior blocks, using hashing, which makes it easy to identify if attempts are made to tamper with past data.

Blockchain thereby creates a trusted data record of past transactions.

At its core, Bitcoin is a combination of public-key cryptography, a distributed database and open-source software. Putting these together permitted the creation of something that combines the finite nature of physical elements with the intangible nature of information. One noteworthy feature of the Bitcoin protocol is that it has a fixed monetary policy - there will only ever be 21 million Bitcoins created. New Bitcoins are created according to a fixed emission schedule whereby the number created every 10 minutes, on average, will half until hitting zero in approximately 2140. Anyone can download and use the Bitcoin Core software; in this way, it is 'permissionless'. The Bitcoin protocol rarely changes. Incremental improvements have been made over the years, according to the highest levels in fault-tolerant software design[14]. The immutable nature of the distributed database (called a 'blockchain') means that entries cannot be reversed or forgotten. This stability, predictability and transparency in monetary policy and functionality are among the network's strengths.

"In this sense, it's more typical of a precious metal. Instead of the supply changing to keep the value the same, the supply is predetermined, and the value changes. As the number of users grows, the value per coin increases. It has the potential for a positive feedback loop; as users increase, the value goes up, which could attract more users to take advantage of the increasing value."[15]

Adoption of new communication technologies takes time to diffuse throughout society. Writing about the telegraph, Standage explains the process from nascent to ubiquitous technology as use cases emerge:

"Spies and criminals are invariably among the first to take advantage of new modes of communication… [then] the information supplied by the telegraph to businessmen was like a drug" and finally, "'the fact is, the telegraph lives upon commerce."[16]

Bitcoin followed a similar trajectory. On the notorious Silk Road darknet marketplace, criminals discovered that Bitcoin worked; they did not have to know their counterparty and could thus transact reliably with strangers. As the years passed, the ecosystem around Bitcoin grew in fits and starts. Companies came and went selling Bitcoin itself, developing ancillary software to facilitate easier access to wallets and creating exchanges to trade Bitcoins for other emerging coins.

What is a (hard) fork?

Developers sometimes disagree on how a network should be run and, if they cannot settle their differences, the ultimate step is to create a (hard) fork in the network. One side will take a copy of and modify the original open-source software, while those who wish to continue running the existing network will rely on the older client version. It means that two different versions of the network emerge based on different principles and with different user bases. Forks can take place for a number of reasons including concerns over outdated and insecure software, a need to reverse the log of transactions following a hack or a need to return investors' funds to them.

What is Bitcoin mining?

Mining is the action of adding new transaction blocks to a distributed ledger using 'Proof of Work'. "Mining" involves computers solving difficult math problems. Miners receive rewards, in the form of Bitcoin, as reward for the computing power allocated to the Bitcoin mining process.

[12] Bitcoin whitepaper, https://www.ussc.gov/sites/default/files/pdf/training/annual-national-training-seminar/2018/Emerging_Tech_Bitcoin_Crypto.pdf

[13] Physical commodities do not have a double spend problem – when one person gives gold to another person the gold cannot be spent again by the original holder. The subsequent gold holder can easily prove that he/she indeed physically holds the gold. Information is different – as it can be copied at almost zero marginal cost – and one needs to be able to track transactions of information over time to know who holds what.

[14] Akin Fernandez (beautyon_), https://medium.com/@beautyon_/bitcoin-and-software-reliability-d681367a49b2

[15] https://satoshi.nakamotoinstitute.org/posts/p2pfoundation/3/

[16] Standage T., 'The Victorian internet: the remarkable story of the telegraph and the nineteenth century's online pioneers'

2. Above and beyond Bitcoin: altcoins

One of the features of open-source software is that it can be read, downloaded, copied and modified by anyone. This means that people can create a copy and make changes according to their wishes. This is called 'forking'. Witnessing the spread of Bitcoin, various groups of software developers attempted to create their own alternative cryptocurrencies by 'forking' the original Bitcoin code[17]. For instance, Bitcoin Cash (BCH) involved taking the core technical components of Bitcoin (public-key cryptography, a distributed database and open-source code) and then speeding up the transaction rate via larger database entries. Attempts like these to usurp new technology standards are not unusual; think back to Tesla's alternating current vs Edison's direct current battle (except with less electrocuted elephants[18]) or the Betamax vs VHS battle in the 1970-80s[19]. The outcomes of these battles are determined by a myriad of forces, including timing, technical specifications, funding, public opinion etc. In Bitcoin Cash's case, the original group of developers fractured into two groups (Bitcoin ABC and Bitcoin SV) as they could not agree on the optimal size of the transaction blocks. While both networks continue to run to the present day, neither has reached the scale and activity of the original Bitcoin network.

Another example is Litecoin (LTC), the code base of which was originally a fork of Bitcoin. Litecoin has served, at times, as a testing ground (testnet) for possible future improvements to Bitcoin and has continued to function reliably since its creation. Other alternative coins (altcoins) came and went over the years. We saw Bitcoin Diamond, Bitcoin Gold and Bitcoin Black, but none overtook the original. Network effects played a heavy role in this outcome, "increased numbers of people or participants improve the value of a good or service".[20] The availability of high-quality developers also played a role – when success and failure can come down to a single software vulnerability, then the best developers are essential to long-term survival[21].

3. Smart contract platforms: Ethereum

Conceived in 2013, then developed and released in 2015, Ethereum led to the creation of a new digital asset family: smart contract networks. Based largely on the thoughts of Vitalik Buterin, the Ethereum (ETH) network takes the three technical components of Bitcoin but layers a 'Turing complete[22]' coding language on top. This technical addition permits the creation of decentralised applications (dApps) using so-called 'smart contracts'. These dApps are built on and use an underlying layer 1 network infrastructure (such as Ethereum) and, at times, are referred to as layer 2 or layer 3 applications.

What is a smart contract?

Smart contracts are scripts that act like contracts or agreements.

In cryptocurrencies the blockchain is used to store the outcomes of smart contracts in an immutable way.

With smart contracts, more complex actions than a simple exchange can be stored. It allows not just FX transactions but all kinds of interactions to the digital space, all while eliminating the need for middlemen.

It took time for developers to tinker and experiment with the capabilities that this coding language permitted. This process of experimentation was relatively quick, owing to the open-source nature of the software code. Rather than waiting for technologies to come off patent, as with refrigeration or pharmaceuticals, the software code spread quickly from person to person. Each person can build on the work of others. One of the defining features of the open-source community is the regular developer conferences (DevCons), where people assemble to present and debate code improvement proposals before implementing what is determined as the best path forward. Bit by bit, new open-source standards were created, which other developers could build on and use. This process of trial and error saw new use cases emerge, and failed use cases disappear. Once standards were in place, and use cases had been identified, the ecosystem's growth rapidly picked up.

The most important early standard was the Ethereum Improvement Proposal 20 (EIP-20)[23]. This allowed the creation of tokens, which can be thought of as versatile digital units that can be programmed to give their holder different kinds of benefits. In essence, tokens provide the technical underpinning for incentive systems ('tokenomics') that are intended to encourage/discourage holders from activities linked to the application in question. Some tokens permit the holder to participate in governance decision making, akin to voting rights. Others give the holder a claim to cashflows or yields. Having a token standard gave developers the means to solve two problems: fund-raising and avoiding the need to exit the crypto ecosystem.

[17] Open-source software can be read, copied and modified by anyone. A fork of open-source code involves someone copying the original code base then making modifications on their new 'forked' version.
[18] Long T. (2008), "Jan. 4, 1903: Edison Fries an Elephant to Prove His Point", https://www.wired.com/2008/01/dayintech-0104/
[19] https://en.wikipedia.org/wiki/Videotape_format_war#:~:text=The%20main%20determining%20factor%20between,also%20of%20higher%2Dquality%20construction.
[20] HBS, 'What are network effects?', https://online.hbs.edu/blog/post/what-are-network-effects
[21] Akin Fernandez (beautyon_), https://medium.com/@beautyon_/bitcoin-and-software-reliability-d681367a49b2
[22] If something is 'Turing complete' it means that it can be used to solve any computation problem.
[23] https://eips.ethereum.org/EIPS/eip-20

Developers wished to raise investment to fund their technology experiments. However, investors perceived the crypto ecosystem as too risky, if one could even land a meeting with them. This led to the creation and issuance of hundreds of different Initial Coin Offering (ICO) tokens, almost all using the EIP-20 token standard. In 2017 one estimate points to 435 successful ICOs, with the total raised amounting to USD$5.6 billion[24]. By contrast, Commscan estimated that dot-com web companies raised a total of (non-inflation adjusted) USD$1 billion in 34 IPOs in 1997, rising to USD$2 billion in 45 deals in 1998, and then USD$24.1 billion in 292 IPOs in 1999[25]. Most ICO projects promised nothing more than the potential for the tokens to appreciate if the project in question provided enough utility to users in the future. As is part and parcel of the entrepreneurial process, the vast majority failed as inexperienced teams raised too much money, made poor operational decisions or simply could not reach critical mass or product-market fit. In the aftermath of 2017-18, the overall digital asset market collapsed 80% from its peak, making the 2018 cryptocurrency crash worse than the dot-com bubble's 78% collapse[26]. The successful projects, of which there were a few, ended up creating an immense amount of value during the next wave of digital asset innovation.

Web 3.0

A vision of a new iteration of the internet, based on the blockchain where data and content are decentralised, compared to Web 2.0, where power is centralised in a handful of internet giants.

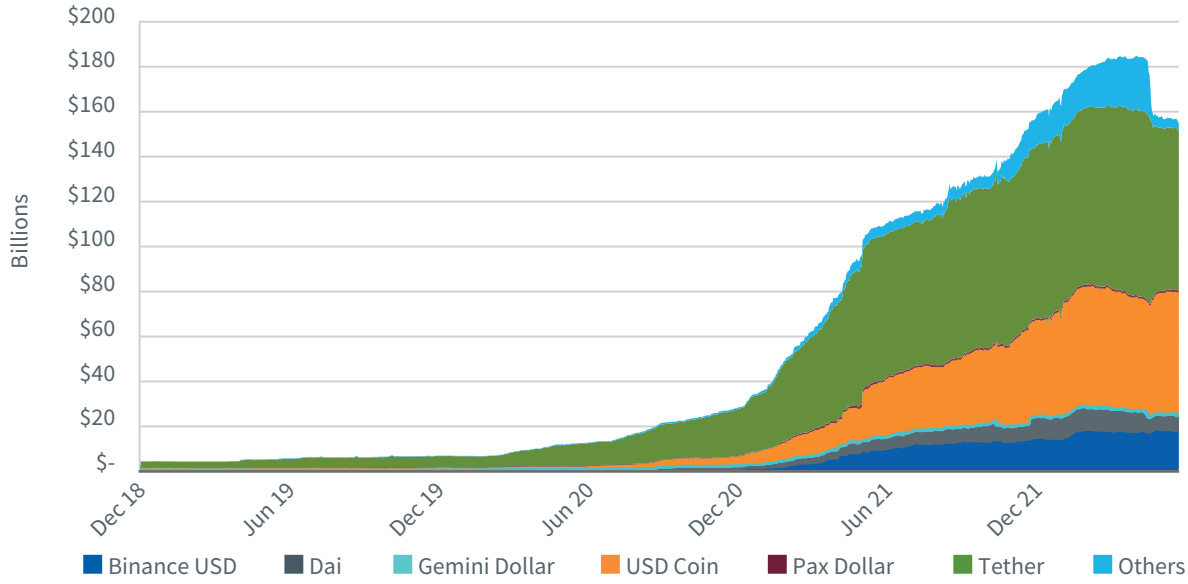
Trading coins and tokens has been popular since the earliest days of crypto. Mt. Gox was one of the earliest, and ill-fated, exchanges where such trading could be undertaken[27]. Traders faced a perennial problem – they primarily wanted to trade crypto coins and tokens but, at times, wanted to be able to store their holdings in a form that was pegged to a fiat currency without having to exit the exchange and move funds back to the traditional banking system. This need led to the development of, perhaps humorously termed, 'stablecoins' - tokens pegged to currencies like the US Dollar[28]. As digital asset infrastructure, like mobile wallets, has improved in functionality and usability, the use of these pegged tokens has grown. 2021 saw extremely rapid growth from around USD$10-20 billion in 2020 to USD$150 billion by the end of 2021, as illustrated in Figure 16.

Coin vs tokens

Cryptocurrencies or 'crypto coins' are created by layer 1 networks. They are the reward for mining, under Proof of Work, or validating, under Proof of Stake.

Tokens, on the other hand, are created through smart contracts, which are applications that are built on top of layer 1 smart contract networks.

Figure 16: Total historical stablecoin supply



Source: Messari, WisdomTree. 1 December 2021 to 24 May 2022. **Historical performance is not an indication of future performance and any investment may go down in value.**

[24] https://static1.squarespace.com/static/5a19eca6c027d8615635f801/t/5a73697bc8302551711523ca/1517513088503/The+State+of+the+Token+Market+Final2.pdf
[25] https://money.cnn.com/2000/11/09/technology/overview/
[26] https://www.wsj.com/articles/bitcoin-falls-below-4-000-as-cryptocurrency-collapse-worsens-1543241154
[27] https://en.wikipedia.org/wiki/Mt._Gox
[28] An interesting thought experiment asks whether it is the cryptocurrencies/tokens that are volatile or the fiat currencies in which they are often priced.

Exchanges also realised that they could couple the demand for crypto trading with the ERC-20 token standard to create a new revenue stream. Major exchanges like Binance, OKEX and Huobi began to issue their own centralised exchange tokens, which owe their name to how these exchanges more closely resemble centralised stock exchanges than the non-custodial decentralised exchanges to come. The utility of these centralised exchange tokens was obvious to traders: they could be used in trading pairs with other cryptocurrencies to receive discounted trading fees compared to Bitcoin or Ether trades. Over time some exchanges, like Binance, took this a step further by developing their own digital asset networks on which they could issue their own tokens (and on which they set the rules – including how the codebase developed and who could and couldn't use the infrastructure). This created another opportunity. Instead of budding crypto companies bootstrapping their ICO funding from the ground up, companies could issue their 'Initial Exchange Offerings' (IEOs) on the centralised exchanges and have both the backend infrastructure taken care of and receive added marketing, publicity and immediate listing via the exchanges.

4. Decentralised applications and decentralised exchanges

Decentralised applications (dApps) also solved one of the thorniest problems crypto traders had faced for years. The exchanges where they traded with one another, called 'centralized exchanges', had a nasty habit of going bust or being hacked. In finance terms, this is called 'counterparty risk'. To use these centralized exchanges, one had to send one's digital assets to the exchange, which had to be trusted to keep the assets safe from hacking, remain solvent and be run by people who would not run off with the assets. This was, sadly, rarely the case.

Proof of Work vs Proof of Stake

Digital asset networks require a way for nodes on the network to agree on the correct order of entries on the distributed ledger (blockchain). This method is called 'the consensus mechanism'.

In a Proof of Work (PoW) consensus mechanism, mining computers use electricity to solve difficult math problems to create new blocks. Nodes on the network check that this work has been done, that it is correct, then validate the new block. In return for doing this intensive computational work, the miners are rewarded with newly created cryptocurrency. If the work is not correct, the nodes reject the false block and the miner incurs the cost of expended electricity.

In Proof of Stake (PoS) protocol, there is less computational work being done. Instead, validator nodes on the network are chosen at random to create new blocks on the distributed database. When selected to create a new block, the node compiles a set of transactions and signs them with a private key. Other validator nodes on the network check that this is all correct and, if so, the node is rewarded with newly minted cryptocurrency. If the work is not correct, then the node incurs a penalty (called 'slashing'), which results in some or all of the stake being destroyed.

The solution to these problems involved designing systems that never require someone to deposit their digital assets, preventing the need for trust in a counterparty. Such self-custody[29] arrangements could be written in code using the scripting functionality of the Ethereum network. These decentralised exchanges (DEXs) are essentially online stock exchanges with no physical location, no trading floor, open 24/7 and globally accessible. There were several attempts to get this model off the ground, but the first decentralised exchange making the model work was Uniswap (UNI) in 2018. The key successful feature was that users of Uniswap were rewarded for providing liquidity with UNI tokens, which could then be bought/sold for other digital assets. As is typical for the digital asset space, being open-source code, Uniswap was eventually forked. One notable fork, SushiSwap (SUSHI), adjusted the prior Uniswap model to allow SUSHI holders to have certain abilities to govern the decentralised network and receive a cut of trading fees generated on the exchange.

[29] Self-custody means that a person possesses the private encryption keys that allow one to 'access' an account. Another arrangement involves giving these private keys to a different entity, which must then be trusted not to lose or abuse said keys.

5. DeFi writ large

Once the decentralised exchange model was proven, a series of operational needs for these exchanges emerged. The constellation of decentralised applications, at times termed 'money Legos', was eventually dubbed 'decentralised finance' (DeFi). DeFi provides the kinds of services that participants in the traditional financial system take for granted (for example, liquidity provision etc.) but implemented in a decentralised way with as few intermediaries as possible.

Total value locked (TVL)

Assets that are currently 'locked up' in a specific protocol or decentralised application.

Soon there was a whole new crop of digital asset networks, protocols and services. Chainlink (LINK) started early on with a product that helped put the 'smart' in 'smart contracts'. On their own, smart contracts are fairly dumb scripts. They cannot 'know' anything that happens outside them. Chainlink solved this problem by creating curated data streams ('oracles'), like the prices of digital assets at points in time or provably random numbers, that can be used as input variables for the smart contracts. Aave (AAVE) evolved from the ETHLend platform (LEND) to allow people to lend their digital assets to other traders for liquidity provision. The original idea was that people might want to lend their digital assets to anyone for a return, rather than have said assets sit around idle. By 'locking up' assets, people could collect a return while smart contract scripts mediated the exchange of digital assets between multiple parties, almost none of whom knew one another. The idea caught on, and AAVE went from a platform with less than USD$1 billion in total value locked (TVL) to over USD$20 billion in one year.

6. NFTs, gaming and metaverse

Part of the genius of the original Bitcoin was how a combination of technologies made it possible to have something simultaneously non-physical as well as scarce and fungible. Taking this formula and modifying it, in 2017, the Ethereum Improvement Proposal 720 allowed for the creation of non-fungible tokens (NFTs). If something is non-fungible, then it is unique – it cannot be 1-for-1 exchanged for anything else. NFTs are entries on a distributed ledger that confer ownership of the unique digital item because the person with the private key can prove that they are the one who controls the item. Many people have experimented with this new functionality, searching for a business and operational model that worked. Eventually, they found it.

In 2020 people began exchanging non-fungible tokens that they'd been sent a few years earlier. Thousands of people flooded onto platforms like OpenSea or Veve to buy and sell digital collectables. Some of these teams would sell computer-generated art, others would post their original art. Some of these teams built communities around their artwork and engaged in a kind of collective creative effort to provide backstory and personalities around their jointly-created intellectual property. NFT sales on OpenSea alone during August 2021 amounted to around USD$320 million[30]. Major brands quickly took notice and, before long, came piling into the space with digital collectables based on their existing trademarks and copyrights (for example, Marvel, Chicago Bulls etc.). Within just a few months, OpenSea went from USD$100 million to USD$3.6 billion in monthly revenue. That kind of growth is hard to sustain and began cooling quickly. However, a smaller but, on average, more dedicated group of people still contribute to these marketplaces. Whatever they experiment with now could become the next wave of change in the digital asset space.

After years of experimentation, it was eventually found that non-fungible tokens coupled with video games was an operational business model that could work. Axie Infinity (AXS), which started working with non-fungible tokens early in 2017, discovered that people enjoy playing a game with collectable and upgradable digital animals, and being rewarded with AXS tokens for their time and effort. After years of small revenue generation, AXS shot to USD$450 million in monthly revenue in August 2020. Gaming started to intersect with 'metaverses'[31], which are less exotically described as online spaces where people interact in various ways (for example, social networks). Facebook's rebranding as 'Meta' set off rapid growth in games where NFTs and digital assets are used. One example is The Sandbox (think RuneScape meets Minecraft), where the native crypto token (SAND) had a current market capitalisation in November 2021 of around USD$2 billion equivalent[32]. Another virtual world, Decentraland, has a token (MANA) valued at around USD$3.4 billion in market capitalisation terms[33]. The video gaming industry has been bigger than Hollywood in terms of revenue for years[34]. Social networks have grown to massive market capitalisations and are now talking of integrating digital assets into their platforms.

[30] https://dappradar.com/ethereum/marketplaces/opensea
[31] https://www.wisdomtree.com/blog/2021-11-11/welcome-to-the-metaverse
[32] https://www.coingecko.com/en/coins/the-sandbox
[33] https://www.coingecko.com/en/coins/decentraland
[34] https://www.marketwatch.com/story/videogames-are-a-bigger-industry-than-sports-and-movies-combined-thanks-to-the-pandemic-11608654990

7. More layer 1 alternatives

'Layer 1' digital asset networks, like Bitcoin and Ethereum, are designed in ways that must weigh different technical constraints against required functionality. This leads to situations where trade-offs must be made – for instance, transaction speed has to be traded off against desired levels of centralisation[35]. By mid-2020, the success of Ethereum exposed some of its shortcomings, particularly its potential to scale. In short, it became a victim of its own success, with transaction fees spiking to levels beyond that which many (potential) users could afford. To address this issue, Ethereum's developers have made technical changes, such as EIP 1559, and continue to make changes, such as the Ethereum Consensus shift to Proof of Stake, to the network[36].

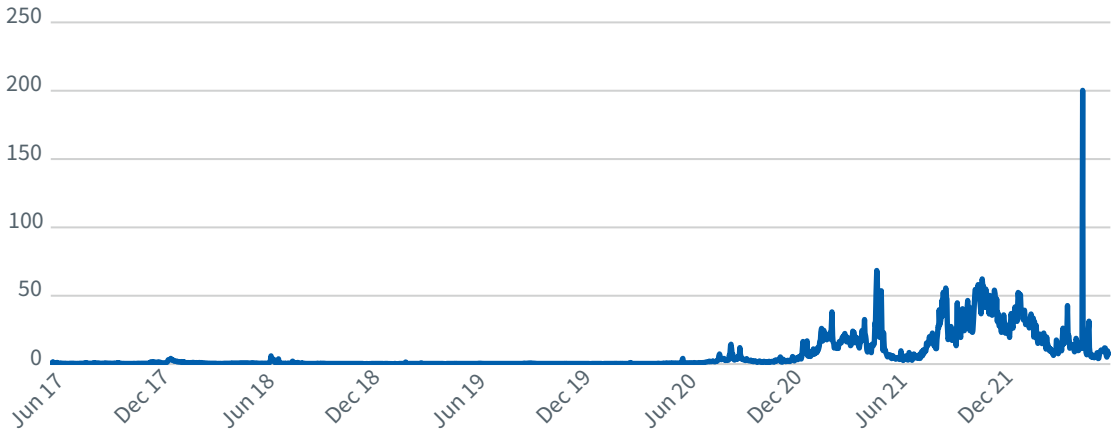
Moreover, scaling solutions like Polygon, Optimism and Arbitrum have also emerged to meet this need. Nevertheless, this created an opportunity for other companies or open-source teams to develop and grow new and, in some cases, complementary networks, which could be termed 'Ethereum alternatives'. Examples of these alternative layer 1 networks at the end of 2021 include Solana, Cardano, Avalanche and Fantom.

Layer 1 and layer 2s

Similar to the way that the internet involves infrastructure, application and software layers, digital asset networks are layered. The 'layer 1' is the underlying software and database infrastructure (for example, Bitcoin, Ethereum) while 'layer 2' are built on and make use of the underlying infrastructure layer (for example, Bitcoin Lightning, Arbitrum, decentralised applications like exchanges).

There is some debate whether decentralised applications (dApps) should rather be termed 'layer 3' as more and more layer 2 scaling solutions continue to be developed for networks like Ethereum.

Figure 17: Historical Gas Price (cost of transaction) for Ethereum



Source: Messari, WisdomTree. **From January 2017 to 18 June 2022.**

Many decentralised applications also reached critical mass and user scale between late 2020 and 2021. Faced with the technical constraints imposed by certain layer 1 networks (such as Ethereum), the developers of these applications began to develop greater interoperability with different layer 1 networks via 'bridges' and wrapped tokens. This is reminiscent of how railway lines were built one by one and then were connected to one another via different means (for example, central stations, standardized gauges) to derive the most utility from the totality of the network[37]. For instance, Chainlink is now integrated into hundreds of applications[38]. Curve, the largest decentralised exchange at the end of 2021, was interoperable with seven different protocols. SushiSwap, at the same time, was interoperable with thirteen protocols[39]. Aave made it so that their lending/borrowing protocol could be used across the Ethereum, Polygon and Avalanche layer 1 networks. Greater interoperability and integration across networks lead to more permutations of different technical capabilities and greater numbers of users to be plugged into individual applications. This creates new possibilities and opportunities that could not be pursued for most of the prior decade.

Standing in 2022 and looking back, it is striking to see the outcome of over a decade of technical and entrepreneurial experimentation in the digital asset ecosystem. The space has expanded and contracted over these years due to this experimentation. With venture capital flowing into the space at all-time highs, and many networks having reached a critical mass of users and use cases, the future looks promising. There will be many more evolutions in this space in the future and probably a few -50% drawdowns, but the space appears secured in its existence and usefulness. Though difficult to predict at the outset, one can start to form hypotheses about what the future holds and what potential opportunities might be like by taking a holistic, data-driven view of the ecosystem.

[35] Faster transaction speeds typically require bigger blocks, which means greater size requirements of the blockchain database, which raises the cost to set up and run a node.
[36] https://hackernoon.com/ethereum-tokenomics-2021-impact-of-eth2-eip-1559-and-l2-scaling-solutions-on-demandsupply-gx5034tw
[37] https://www.wisdomtree.eu/en-gb/blog/2021-11-10/digital-asset-networks-are-like-train-lines
[38] https://www.chainlinkecosystem.com/ecosystem/
[39] https://defillama.com/protocols

B. WisdomTree's map to the digital investment universe

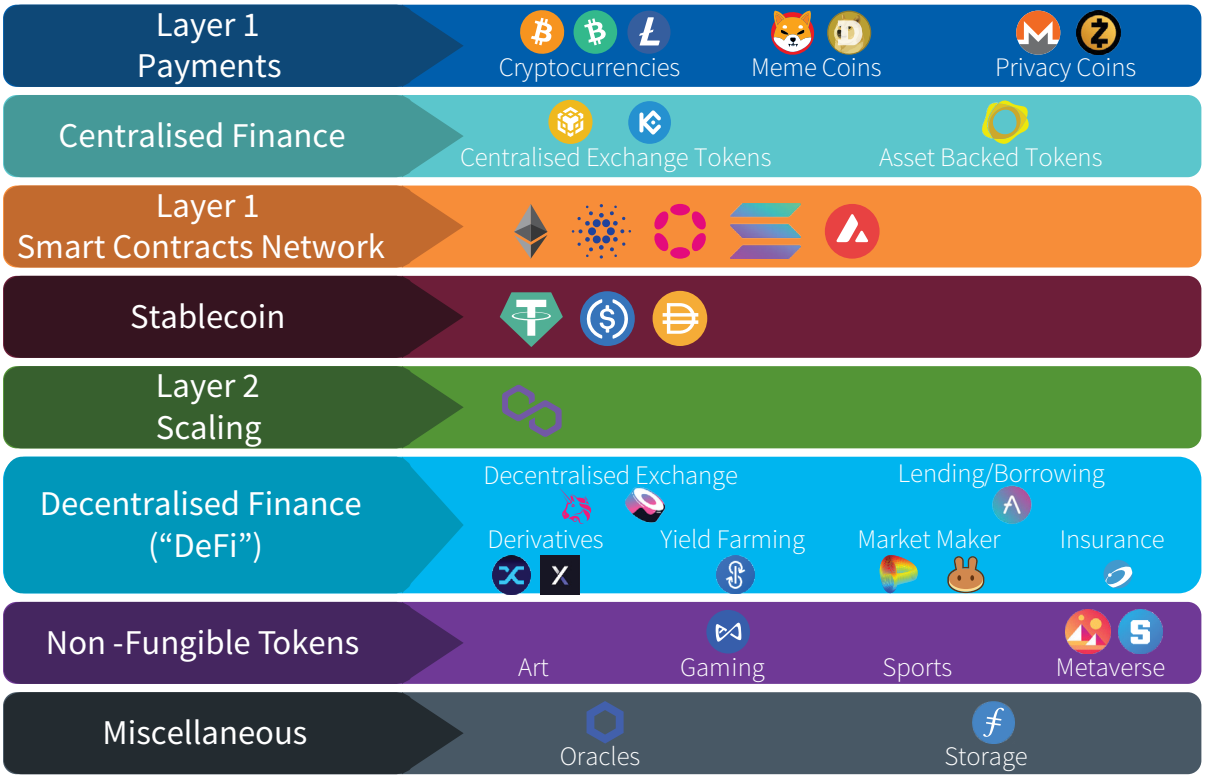
The evolution of the technology underpinning digital assets has led to a diversified ecosystem. Different layer 1 digital asset networks, layer 2 scaling solutions, decentralised applications (dApps) and various interoperability solutions coexist to offer a large panel of investment opportunities.

Part III and IV aim to offer clear indications on how to leverage these opportunities in your portfolio. Still, before doing so, the first step is to provide a clear map of the digital asset space.

1. WisdomTree's Digital Assets Taxonomy

The recurring theme that drove the evolution of new networks and new applications in the digital space was their use case, that is, why people use digital asset networks. With every new potential use, new digital assets appeared. This is a helpful way to develop a taxonomy because it identifies the value propositions of each network or application which, in turn, points to where the greatest return potential resides now and in the future. Put simply, it answers the question, "what do people do with it?" or "what utility do people get from it?". These use cases helped us map the space and led us to the WisdomTree Digital Assets Taxonomy with its eight categories.

Figure 18: WisdomTree's Digital Assets Taxonomy



Source: WisdomTree. 2022.

Before we dive into the taxonomy itself, a clarification on terminology is necessary. The term 'layer 1' refers to a base layer protocol. Some of these layer 1s permit decentralised applications (dApps) to be built upon them. Think of it the way that email runs on one of three protocols (Simple Mail Transfer Protocol (SMTP), the Post Office Protocol (POP) and the Internet Message Access Protocol (IMAP)), then applications that make use of these email protocols can be 'built on top' (for example, Microsoft Outlook). Over time, as the use of a protocol increases, sometimes capacity constraints are reached. This requires additional 'layer 2' scaling solutions, which are developing as digital asset networks continue to move along the adoption curve and, as implied, the use of these networks increases.

a. Layer 1: payment

The 'original' digital asset category seeks to allow people to transact digitally rather than using the traditional payment rails provided by MasterCard, Visa or other ancillary payment providers, for example, PayPal. They use open-source computer code to provide a faster, cheaper and more accessible alternative to the last generation payment rails. They make possible direct, irreversible and instantaneous money transfers when traditional payments involve multiple fee-charging intermediaries and take days to settle. At this stage, we can sort them into three main sub-categories:

+ Cryptocurrencies: native to the digital asset network on which they are issued, these coins are fungible, divisible and developed with technical specifications designed for exchange between transacting parties. Examples: Bitcoin, Bitcoin Cash, Litecoin.

+ Privacy coins: seeking to preserve some of the benefits that one gains when exchanging cash, as opposed to the traceable open blockchain designs of other payments networks, these coins are designed in a way where technical specifications obscure the sender, recipient and/or amount of the coins being transacted. Examples: ZCash, Monero.

+ Meme tokens: whether you like it or not, it is possible to fork digital asset networks and create one's own coin. The coin can be branded as one wishes and, from time to time, one of these brands resonates with people on the internet. Argue all you like about the utility of such coins – they exist, and people like them. Examples: Dogecoin, Shiba Inu.

b. Centralised finance

Often overlooked and direct competitors to traditional financial service providers, these tokens are issued by private companies and used on or issued using digital asset technology stacks. Think of them as traditional finance but with upgraded back-office infrastructure.

+ Centralised exchange tokens: some corporate crypto exchanges issue their own token to incentivise traders to use their platform. The tokens can be redeemed for benefits, like lower trading fees, or traded against additional pairs not available for other coins/tokens. These tokens are also sometimes used as collateral for developing and financing new applications. Examples: Binance Smart Chain, Kucoin.

+ Asset-backed tokens: representations of underlying assets, these tokens are meant to be redeemable for some other asset, for example, another cryptocurrency, a fiat currency, gold etc. Often these tokens are a 'wrapped' form of a digital asset, which simply means that computer code is used to 'wrap' and thereby digitally lock the underlying asset in such a quantity that corresponds to the desired asset. Example: Pax Gold.

c. Layer 1: smart contract networks

Building on the technology first pioneered in Bitcoin, smart contract networks layer a Turing complete coding language to allow people to build sophisticated 'decentralised applications' (dApps) on the base software layer. There are several competing and complementary smart contract platforms now operating at scale. Each has its own eco-system of dApps, which often overlap or interoperate across networks. Below are some of the ways in which people have developed uses for these smart contracts through applications, many of which have become large and established in their own right. Examples: Ethereum, Solana, Avalanche.

d. Stablecoins

Tokens issued via a digital asset network's fungible token standard, these coins are designed to mimic some fiat currency, for example, US dollar. The way in which the peg of 1-to-1 with the fiat currency in question is maintained can differ at a technical and/or organisational level. They are the bridge between the digital asset world and the physical world. Examples: Tether, USDC, Dai.

e. Layer 2: scaling

Over time, as the use of a protocol increases, sometimes capacity constraints are reached. This requires additional 'layer 2' scaling solutions, which are also protocols, and increases capacity on the underlying layer 1 networks without changing anything at that technical level. Example: Polygon.

f. Decentralised finance

Mimicking traditional financial services, they are the next iterations of the centralised finance category. They are provided for and managed by computer code, and this space now provides services such as trading, lending/borrowing, options, derivatives etc. Note that some applications/protocols have multiple functionalities, which means they can be placed in multiple categories.

+ Decentralised exchange-based tokens: issued by decentralised exchanges, which are computer codes that provide functionality that mimics centralised stock exchanges, these tokens are used to incentivise traders (for example, lower trading fees), provide a yield derived from trading fees and can sometimes be used as a vote in governance decisions surrounding the development of the codebase. Examples: Uniswap, SushiSwap.

+ Lending/borrowing: these platforms allow people to lend their digital asset holdings to others with various terms (for example, collateralised or uncollateralised, fixed or variable interest payments etc.). The 'smart contract' computer code manages each step of the loan, repayment and liquidation processes. Example: Aave.

+ Derivatives: again, mimicking a traditional financial concept, these platforms allow for the creation and issuance of derivatives on cryptocurrencies, tokens or assets such as stocks, currencies and commodities. Examples: Synthetix, dYdX.

+ Yield farming: it is possible to perform the same lending activities across various exchanges. However, the yield that one receives for this lending can differ across exchanges. These 'yield farming' platforms automate the arbitrage process of search and investment for borrowers and lenders. To use these platforms, one must possess the relevant platform's token. Example: Yearn Finance.

+ Automated market maker: liquidity in decentralised markets is automated via a mathematical formula to price assets, people can then stake their coins/tokens in return for the output of the formula. These are called liquidity pools. Put more simply, "users are not technically trading against counterparties – instead, they are trading against the liquidity locked inside smart contracts[40]." Examples: Uniswap, PancakeSwap, Curve.

+ Insurance: in the absence of the traditional insurance industry providing cover for protocol failure or exchange hacking, applications have been delivered to allow people to stake their tokens against contracts linked to the performance of the protocol or exchange in question. If the person thinks that the protocol or exchange is robust against failure, they stake the tokens to that contract in return for a portion of the premium. If the protocol/exchange fails, the staked tokens are lost as part of a claim. Examples: Etherisc, Nexus Mutual.

g. Non-fungible tokens

In what could be likened to digital collectables, these tokens are a ledger entry corresponding to some unique digital, or perhaps physical, item.

+ Art: widely used amongst creatives to fund and sell digital artwork, an artist will often create, or computer generate, a collection of themed works and then sell them to buyers on digital markets. Sometimes a community emerges to exchange these collectables and/or further develop the intellectual property surrounding the art.

+ Gaming: digital games in which people can purchase assets, land, weapons, skills etc. and/or be rewarded for their achievements with tokens native to the game. Example: Axie Infinity.

+ Metaverse: as the name suggests, a 'meta' world in which digital assets, fungible tokens and non-fungible tokens make up different parts of the world. Think virtual worlds with virtual, digital assets sprinkled throughout them. Examples: The Sandbox, Decentraland.

+ Sports: in the past, there were 'baseball cards'. Now there are digital equivalents that span across sports and the brands of popular sporting teams.

h. Miscellaneous

+ Oracles: so-called 'smart contracts' aren't very smart. They need data inputs from other sources to trigger the terms of their code. Oracles provide these third-party data feeds but do so in a way that aims to guarantee the integrity and accuracy of the data. Example: Chainlink.

+ Storage: rather than storing data in a data centre provided by, for example, Amazon Web Services, people can store their data across a decentralised database. They use the coin native to the network on which their data is stored to pay for this service. This fee ultimately accrues to the network nodes that mine and store data on the network. Examples: Filecoin, Ocean Protocol, Storj.

[40] https://www.coindesk.com/learn/2021/08/20/what-is-an-automated-market-maker/

2. The economics: differing value propositions for different assets

While the WisdomTree Digital Assets Taxonomy is useful for making sense of this diversified ecosystem, it is also key to understanding the investment opportunity digital assets represent. For a company, its business plan and strategy inform investors of the potential and investment opportunity. But not all companies are the same; the same reading grid cannot be used for a tech company or healthcare company. So, the company's sector also informs investors. Similarly, in the digital space, each digital asset carries its own opportunities and challenges. But the category to which the asset belongs is also key. The forces pushing higher the price of a layer 1 payment asset are not the same as one driving the performance of a DeFi token. By organising the space, the taxonomy can help investors better understand which data and information are important to the future of a given asset, and which are not.

a. The economics behind digital assets or 'tokenomics'

Think of digital asset networks, applications, cryptocurrencies and tokens as economic experiments. Each has its own internal incentive system, which can change over time. Sometimes this incentive system is termed 'monetary policy' – particularly for payments where the emission schedule determines the supply of cryptocurrencies at a point in time, akin to how central banks might make decisions to influence the supply of money at a point in time. A different term is also used, particularly for distributed applications (dApps) - a portmanteau of 'token' and 'economics': 'tokenomics'[41].

In some cases, these tokenomic incentive systems bestow cash flow generating abilities, the ability to vote in governance decisions around changes to open-source code, or countless other rights to holders. These incentive structures are designed to encourage certain behaviours, discourage or penalise others and ultimately generate some economic value to holders of the coins/tokens and (participants of) the network. Grasping how and why each of these incentive systems are structured in the way they are, and how they might change in the future, is essential when trying to understand the different value propositions across the digital asset ecosystem and examining investment cases for different digital assets.

b. Tokenomics per category

The main variables in such 'monetary policies' are staples from an economist's toolkit, plus a few more from open-source software development:

- The emission schedule of new coins/tokens
- If, and how, coins or tokens can be removed from circulation
- Whether there is a maximum number of coins/tokens that can be created
- Accrual of return for holding or staking coins/tokens
- A proportion of fees levied on activity occurring on the network or the application
- Participation in the governance of the open-source network's development, etc.

These 'economics' are an extremely important determinant of the price evolution and long-term resilience of different digital asset networks. Each category tends to have its own broad economics. But even within a given category in the taxonomy, there are sometimes variations in how the monetary policies/incentive systems are set. Moreover, the ability to change the incentive system, and who can do so, varies over time.

Layer 1 payments usually work around an incentive system based on diminishing supply and increased demand. With participants' increasing use of the network to transfer money and transact, the demand for the relevant coin or token increases. In parallel, supply is strictly controlled using two main tools: capped supply and diminishing rewards. For a successful payment asset, increasing demand paired with decreasing supply tends to lead to price appreciation. The number of transactions or used wallets on a given network can be a good indication of its current and future success.

	Incentive system
Bitcoin	Capped supply: 21 million coins issued maximum written in the code The number of coins created halves every four years to reach zero over time
Litecoin	Capped supply: 84 million coins issued maximum written in the code The number of coins created halves every four years to reach zero over time
Bitcoin Cash	Capped supply: 21 million coins issued maximum written in the code The number of coins created halves every four years to reach zero over time

[41] https://www.wisdomtree.eu/es-es/blog/2021-10-26/different-digital-assets-different-monetary-policies

Central finance tokens are built, in many ways, like loyalty schemes. They offer users many advantages, discounts or rewards to engage in the 'centralised' services offered by the platform. These can be lower trading fees, higher interest rates and higher credit card rewards. It is worth noting that some of the coins have a hybrid business model where they can also act: as payments if partnerships are agreed upon for them to be used on other platforms and service; as layer 1: smart contracts if 'centralised' dApps can be built on that specific blockchain like it is the case for Binance, for example.

Volume and liquidity at a given exchange can be a good indication of the current and future success of the coin.

Binance Coin[42]	Capped at 200 million at any one time. Binance performs quarterly burns until it buys back and destroys 100 million Binance coins – 50% of the total supply.	Users of Binance Coin receive a discount in transaction fees on the Binance Exchange as an incentive.
Crypto.com coin[43]	Capped at ~30 billion.	Stake CRO tokens to receive lower trading fees, higher staking interest rates, and higher credit card rewards.
FTX token[44,45]	Capped at 350 million.	Users receive trading fee discounts and OTC rebates based on their holdings of FTT in a tiered system.

Layer 1 smart contract network's tokenomics are quite varied but, at their core, they work around an incentive model similar to utilities. The more applications that use the protocol (the 'pipes'), the more the network and, therefore, the coin will be worth. Extra incentives can also be built on top to reward users of the coin, like rewards to pass messages across chains, locking coins, or staking coins. In this category, demand is driven by the ecosystem's growth running on the protocol, that is, the increase of use cases and dApps built on the network. The supply side is controlled through the issuance policy of the network: capped or uncapped supply, variable inflation rates, staking rewards (for Proof of Stake networks), destruction of coins to pay for transaction fees etc. Any data that can assess the vitality of the ecosystem on the chain is key for this category: number of transactions, number of dApps, market cap or total value locked of all the dApps on the chain.

Ethereum	Uncapped, 18 million new Ether per year. Implies supply growth rate tends to zero. Burning of transaction fees, introduced in 2021, can influence new, short term supply creation.	New use cases create greater demand, which needs to over-whelm supply to increase the price. The addition of staking, possibly in 2022, will grant periodic returns to stakers.
Cardano	Capped, 45 billion.	Cardano operates a PoS blockchain protocol which means token holders can receive rewards for either delegating ADA or running a staking pool.
Solana	Uncapped, 10% new each year.	Earn rewards and help secure the network by staking tokens to one or more validators.
Polkadot[46]	Uncapped, falling inflation rate until at 1.5% (current ~7%).	• Governance — token holders can vote for protocol upgrades and new feature proposals. • Staking — you can stake your tokens in favour of Polkadot's security model. The network is rewarding honest validators for their stake. • Bonding — parachains are winning their slots by locking up DOT tokens. • Fees — for message passing between the parachains.

Decentralised finance tokens usually serve two purposes: a governance one and an economic one. Those tokens often offer the possibility to influence upgrades and new features/services through the governance structure based on token ownership. Token holders often benefit from direct economic rewards: a cut of trading fees or liquidity providers' rewards. The long-term value of the coin is linked to the increase in the use of the dApps itself through the distribution of the reward.

[42] https://corporatefinanceinstitute.com/resources/knowledge/other/binance-coin-bnb/
[43] https://www.investopedia.com/crypto-com-review-5209370
[44] https://messari.io/asset/ftx-token/profile/supply-schedule
[45] https://messari.io/asset/ftx-token/profile
[46] https://polkadotters.medium.com/what-is-polkadot-85d4af1b2fe7

Total value locked is one of the main indicators used for this category of digital assets. It represents the value of all the coins locked or staked in the application.

For some applications, such as Maker (the automated market maker application), it has become apparent that there can be a conflict between the interests of short-term token holders and long protocol users[47]. In short, the token holders are interested in generating short-term yields, whereas the protocol users are interested in taking part in the governance process to ensure long-term protocol sustainability and returns. Confronted with this and other shortcomings from existing incentive systems, changes are either made to the application in question, or new applications are developed and released that iterate on the existing application. This has been seen with SushiSwap, which builds on Uniswap by adding a cut of the trading fees to token holders, or with Curve, which builds on Maker by rewarding long term governance participants with additional tokens. There are many other examples, particularly if one goes back historically. Those that get the incentive structure right for their given use case(s), have found longer-term success. Those that do not quickly run into trouble as users of the network or protocol do not behave in ways that are conducive to long-term success.

Uniswap[48,49]	• Initially capped at 1 billion. • The perpetual inflation rate of 2% after four years.	Governance — token holders can vote for protocol upgrades and new feature proposals.
SushiSwap[50,51]	Capped at 250 million. This is a recent change that was introduced and passed by governance members.	Governance — token holders can vote for protocol upgrades and new feature proposals. Also, introduce the SUSHI token as an additional reward for liquidity providers and farmers. SushiSwap rewards liquidity providers with 0.25% of pool fees + 0.05% paid to SUSHI token holders.
Aave[52]	Capped at 16 million.	• Stake AAVE to the safety module to receive protocol fees and rewards. • Governance — token holders can vote for protocol upgrades and new feature proposals.

Oracles look very similar to decentralised finance from a tokenomic point of view.

Chainlink[53]	Capped at 1 billion.	LINK is used as both a payments token and a work token. As a payment token, LINK is used to pay Chainlink node operators for providing oracle services. As a work token, LINK can be staked by node operators as collateral to provide oracle services.

As the base layer of Ethereum has encountered issues around scaling and transaction costs, a series of 'layer 2 scaling' solutions have emerged. Some of these (for example, Arbitrum, zkSync etc.[54]) do not have a native cryptocurrency. One example, which is technically a side-chain but still intended to provide scalability to the Ethereum network, is called Polygon. Another, Optimism, is rolling out an airdrop of tokens in Q2 2022 and beyond. These two examples have different underlying tokenomics, owing partly to their technical differences but also due to the kinds of behaviour they wish to incentivise in the future.

Polygon[55]	Capped at 10 billion.	MATIC is used in three ways: to pay for gas on the platform; to secure the ecosystem and its individual networks via staking to validators and delegators; and as a means of exchange when users trade and convert MATIC to other tokens on the platform.
Optimism[56]	na[57]	The OP token will be used for a 'bicameral' governance model, which will oversee decisions related to the development of the Optimism network.

Tokenomics or incentive systems explain and inform the long-term potential of the many digital asset networks and applications. Each coin can then be assessed separately using the relevant framework based on the coin's category. Below are the investment cases for just a few networks and applications.

[47] The Block end of year 2022, p102-3
[48] https://phemex.com/academy/uniswap-vs-sushiswap#what_is_the_uni_token
[49] https://uniswap.org/blog/uni
[50] https://phemex.com/academy/uniswap-vs-sushiswap#what_is_the_uni_token
[51] https://kriptomat.io/cryptocurrencies/sushiswap/what-is-sushiswap/
[52] https://medium.com/aave/aavenomics-eeab650cccc2
[53] https://messari.io/asset/chainlink/profile/token-usage
[54] https://ethereum.org/en/layer-2/
[55] https://medium.com/everstake/polygon-matic-network-overview-scaling-the-ethereum-blockchain-6b8986027236
[56] https://thedefiant.io/optimism-op-airdrop/
[57] As of 27 April 2022

C. Single asset investment cases: a few examples

1. Bitcoin

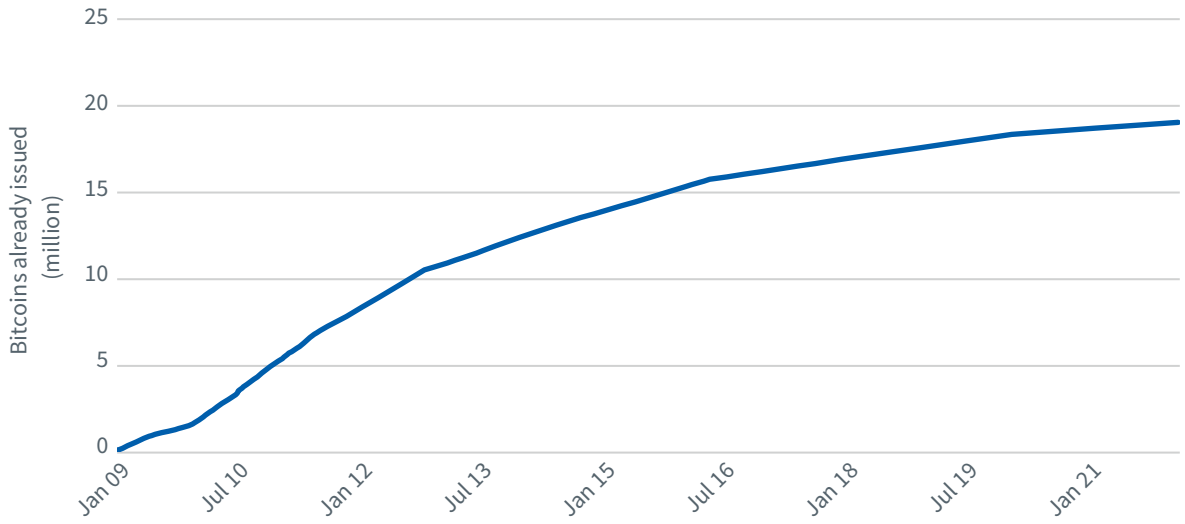
The original Bitcoin core has survived and thrived thirteen years after its creation. Still the largest by market capitalisation, presently occupying approximately 40% of the whole eco-system, Bitcoin is now used to clear the equivalent of USD$40 billion per day. Bitcoin has a level of brand awareness worldwide that some multinational enterprises would be jealous of and an open-source software developer community that can verge on fanatical about its continued success. Over 10,000 nodes run the Bitcoin network, making it highly decentralised and resilient to attack. How Bitcoin can be purchased and used continues to increase as new companies and new software are built on and around Bitcoin. This, in turn, drives increased demand for Bitcoin, which, when put against its unchangeable and capped supply, drives its market price in the medium to long term. Its survival is a testament to the high level of fault-tolerant software development that has gone into its open-source codebase. The development of Bitcoin is slow, and intentionally so. Nevertheless, improvements made over the past decade demonstrate that the protocol can evolve and make improvements to scalability and privacy.

The salient points in the Bitcoin monetary policy are:

- Capped supply at 21 million BTC
- Halvings where the reward paid to miners is cut in half every four years or so, slowing the supply of BTC over time

A Bitcoin investment relies on the continued increase of the proportion of payments using the Bitcoin network over time. In the future, there will be a (continued and perhaps greater) need for irrevocable international payments and person-to-person digital payments in an alternative currency with an unchanging monetary policy. Bitcoin benefits also from the capped supply. As highlighted in Figure 19, more than 19 million Bitcoin have already been issued.

Figure 19: Bitcoins already issued (out of 21 million)



Source: Blockchain.com. As of 19 May 2022.

Bitcoin's auditable open-source code can be downloaded and used by anyone with a cell phone and internet connection, which means it can onboard many users quickly. On top of the fact that Bitcoin is borderless and irreversible, it also stands out because it is virtually instantaneous. When 'paying' with a credit card, while the user feels that the payment is instantaneous, it is not. When touching the card, the user authorises a transaction that will need to be carried out by five different financial parties over multiple days. The credit card network, the merchant, the merchant's bank, the cardholder's bank and the payment processor all need to act and take a fee to make the payment 'real'. The effective settlement of the money transfer can take multiple days. On the contrary, Bitcoin, or other cryptocurrencies, deliver instantaneous settlement of money transfers with zero intermediaries involved. Technologically this is revolutionary.

Bitcoin benefits from structural advantages making it the overwhelming leader in the digital space:

+ First digital currency
+ Fully decentralised, permissionless and secure

However, there are also risks associated with such an investment, mainly around

+ Scalability issues on the base protocol layer (that is, layer 1)

2. Ethereum

The Ethereum network was first released seven years ago and, since then, has established itself as the largest smart contract platform in the digital asset ecosystem. It has managed to avoid the pitfalls that many peers fell into during this time related to security and software development quality. At the same time, a large and active open-source developer community contributes to the development of the Ethereum protocol itself. There are myriad companies that have used the Ethereum network to provide many services (for example, decentralised finance, stablecoins, non-fungible tokens etc.) with distributed applications (dApps) numbering over 2800[58], total value locked now over USD$110 billion equivalent[59] and daily transactions regularly above 1 million[60]. The network's evolution shows that it can change in profound ways, which gives it a greater probability of overcoming its scalability issues and subsequently maintaining market share even in the face of competitors (for example, Solana, Avalanche etc.).

The salient points in Ethereum's monetary policy are:

+ No maximum supply cap. ETH supply increases according to a disinflationary mechanism.
+ Staking: with the merge to Ethereum Consensus that should occur in 2022, ETH can be on a validator node. In return, ETH stakers receive more ETH cryptocurrency. This also constrains the circulating supply of Ether as validator nodes 'lock-up' Ether.
+ The issuance rate of ETH under Ethereum Consensus will decrease as a consequence of the amount of ETH staked against the number of validators, and the extent of bad behaviour by those validators.
+ EIP 1559: the fees paid by users of the ETH network are now burned (that is, taken out of supply) rather than paid to miners. This has led to constraints on the supply-side of ETH.

Figure 20: Ethers burnt for fees over time

Source: Etherscan.com. From August 2021 to 15 June 2022

[58] https://consensys.net/blog/news/ethereum-by-the-numbers-may-2020/
[59] https://defillama.com/chains
[60] https://etherscan.io/chart/tx

An investment in the Ether cryptocurrency relies on the continued growth of the Ethereum network and its surrounding ecosystem. As the network scales and more use cases appear, it will create more demand for Ether. Ether benefits from structural advantages, making it the most likely smart contract platform to occupy a large proportion of, or perhaps all, dApp activity:

- First platform to incorporate smart contracts
- Largest open-source developer community
- Proven ability to evolve in the face of changing market demands
- Institutional and enterprise support with many multinationals joining the Enterprise Ethereum Alliance

However, there are also risks associated with such an investment, mainly around:

- Scalability issues
- High level of decentralisation
- Monetary policy, since the supply is not capped
- Increased competition by new layer 1 smart contract protocols

3. Solana

The Solana network was launched in April 2019. Still, in beta, it is a relative newcomer to the digital asset ecosystem. A smart contract platform, like Ethereum, Solana's goal is to provide a foundation for more scalable decentralised applications (dApps). Solana introduces a novel combination of architectural design choices that attempts to offer faster transaction settlement times and an infrastructure that enables developers to write and launch customisable applications in multiple programming languages.[61] Backed by a substantial amount of venture capital financing (48% of the initial SOL allocation was made to the team, company and venture capitalists), this increases the probability that the network will successfully navigate its ambitious roadmap. Suppose it can deliver on its goal of scalable dApps. In that case, exclusive use cases may emerge that allow the Solana network to occupy a strong market position vis-à-vis competitors (for example, Ethereum, Avalanche etc.). The Solana network has suffered a number of outages between October 2021 and April 2022. Technical failures such as these demonstrate the still-experimental nature of the network and uncertainty around its future growth trajectory.

The salient points in Solana's monetary policy are:

- No maximum supply cap
- SOL can be staked to a validator node – in return, SOL stakers receive more SOL cryptocurrency
- The issuance rate of SOL will decrease as a consequence of the inflation curve of new SOL being created, and the circulating amount of SOL should decrease as the number of validators increases
- The inflation schedule is still subject to change

An investment in the Solana cryptocurrency is predicated on the network's main selling point: its high transaction throughput relative to competitors (for example, Ethereum). This scale would permit a large proportion of market share to be occupied. This increased demand will absorb the increased SOL issuance each year, assuming the monetary policy does not change as Solana goes out of beta stage. This uncertainty around the development path of Solana would be expected to contribute to greater price volatility in the short term. The ability to stake SOL, in return for running a validator node on the network, creates an ongoing and compounding yield, which, in the future, may also benefit from price appreciation linked to increased demand for SOL.

[61] https://www.wisdomtree.eu/en-gb/strategies/crypto-education/what-is-solana#tab-74361B34-088E-42D2-99EB-5C01D0D69649

Solana benefits from:

- A strong development team and a large, venture-backed community of developers
- Highly scalable technology that differentiates it from other peers
- An emerging ecosystem

However, there are also risks associated with such an investment, mainly around:

- High level of centralisation
- Low level of current revenues compared to peers
- Unknowns around the uptime stability and security of the protocol, which is still in beta

4. Polkadot

Founded by Gavin Wood (a co-founder of Ethereum) alongside co-founders Peter Czaban and Robert Habermeier in 2016, Polkadot was finally launched in 2020. It introduces several novel technical features aimed toward its goal to incentivise a scalable, interoperable global network of computers where users can launch and operate their own blockchains. At a technical level, Polkadot operates two types of blockchains: a main network, called a relay chain, where transactions are permanent, and user-created networks, called parachains. Users gain the added benefit of being able to customize many parachains for many different uses. Parachains are one way in which interoperability can be implemented between blockchain networks. This combination of interoperability, scalability and customizability is thought to be the key to a diverse ecosystem built on Polkadot.

The salient points in Polkadot's monetary policy are:

- An uncapped supply, which adjusts according to the participation rates of users
- Staking results in constraints to the circulating supply at various points in time

Staking is an important piece of the Polkadot investment case. The DOT cryptocurrency is staked by those who run the network itself in one of three roles: validators, nominators and collators. In return, DOT stakers receive rewards in the form of more DOT cryptocurrency (effectively a variable income cash flow). Moreover, those who hold DOT can propose changes to the network and approve or reject major changes proposed by others (similarly to how shareholders can vote on matters regarding a listed company). Finally, DOT holders can use the cryptocurrency to connect a chain to the Polkadot Relay chain as a parachain. This is called a 'crowd loan' and is a way to lock up cryptocurrency transparently, thereby ensuring that funds are used for the stated development purposes.

As a multi-chain digital asset environment becomes more and more probable, the need for interoperability between networks is becoming more important. Facilitating interoperability is precisely the goal of Polkadot. Achieving this goal of being a hub for all digital asset networks would place Polkadot at the centre of an eco-system requiring the DOT cryptocurrency, which would drive its price in the medium to long term.

Polkadot benefits from:

- A strong development team with a proven track record of delivering
- The potential to be the centre of an eco-system of different digital asset networks

However, there are also risks associated with such an investment, mainly around:

- Low uptake of the Polkadot network by other projects/companies in the future
- Competition from other interoperability networks and solutions (for example, bridges)
- The possibility that the digital asset eco-system converges to just one or two main networks, thereby obviating the need for interoperability

5. Chainlink

Created in 2017, Chainlink provides decentralised data feeds to power decentralised applications. At its core, Chainlink solves a problem created as a consequence of the widespread and growing use cases for smart contracts. For smart contracts to execute, they require outside sources of data (off-chain data feeds). This data must be reliable, otherwise the smart contracts will not execute correctly. Moreover, reliable data can be difficult to provide in a decentralised form due to incentives to provide false or incorrect data to take advantage of malfunctioning smart contracts.

Chainlink solves these interconnected problems in a few ways. It incentivises the development and maintenance of 'oracles', which are sources of data external to a smart contract. The data feeds provided by oracles could be price feeds, random numbers etc. Chainlink also incentivises the provision of accurate, timely data by rewarding good oracles with more LINK tokens and punishes untrustworthy nodes by confiscating part or all of the LINK stake that oracle providers must supply to set up and operate their oracle.

The salient points in Chainlink's monetary policy are:

- A finite supply of LINK tokens
- A system of staking that takes LINK tokens out of circulating supply

With over 1000 integrations across the digital asset ecosystem[62], in areas ranging from DeFi to NFTs, Chainlink has established itself as the gold standard in decentralised data feed provision. Having been operating for many years, it is now an intrinsic, secure and trusted component in the ecosystem and is unlikely to be displaced from this central role in the years to come.

Despite this strong position, the LINK token has underperformed other DeFi tokens recently. Perhaps more accurately understood as infrastructure or a utility, its token value may not scale with the number of integrations. This may translate into changes to the tokenomics of the network in future years, which would create uncertainty around long-term value capture.

6. SushiSwap

SushiSwap is a decentralised exchange where users can make trades with one another without a central intermediary. Decentralised exchanges emerged as a response to the problem of centralised exchanges losing users' cryptocurrency due to hacks. At no time does the user of a decentralised exchange have to provide their private keys to the exchange. In this way, they are 'non-custodial'.

SushiSwap is a fork of the Uniswap open-source codebase. The creator of SushiSwap, the pseudonymous 'Chef Nomi', thought that users should receive a portion of the trading fees levied on traders. The code was forked, this perk was added to the code and SushiSwap came into existence.

The salient points in SushiSwap's monetary policy are:

- A finite supply of 250 million tokens, which has changed in the past
- A system of staking, called 'lockup', that takes SUSHI out of circulating supply and rewards those who lockup their SUSHI in SushiSwap farms

Holders of the SushiSwap token can take part in the governance of the application. Holders are given voting rights and can make proposals for future software development and vote on others' proposals. Aside from trading, users can also provide their cryptocurrency to different liquidity pools and receive SUSHI tokens as a reward for having provided this liquidity. Additionally, SUSHI token holders can stake their tokens on the 'Sushi bar' in return for additional xSUSHI tokens. The xSUSHI tokens are bought from the open market using fees levied on-exchange trading.[63]

[62] https://www.chainlinkecosystem.com/ecosystem/
[63] https://www.kraken.com/en-gb/learn/what-is-sushiswap-sushi

With between USD$1 billion and USD$2 billion in total value locked and integrations with ten different digital asset networks[64], SushiSwap has reached scale in terms of users and activity. While far from being the largest decentralised exchange by TVL or activity, and subject to the same competitive dynamics that gave rise to its own genesis (that is, forking), the SushiSwap token provides a clear cashflow and utility to holders.

Figure 21: Total value locked in SushiSwap over time

Source: Defi Llama. From 5 September 2020 to 16 June 2022.

[64] https://defillama.com/

III. HOW SHOULD INVESTORS ACCESS DIGITAL ASSETS?

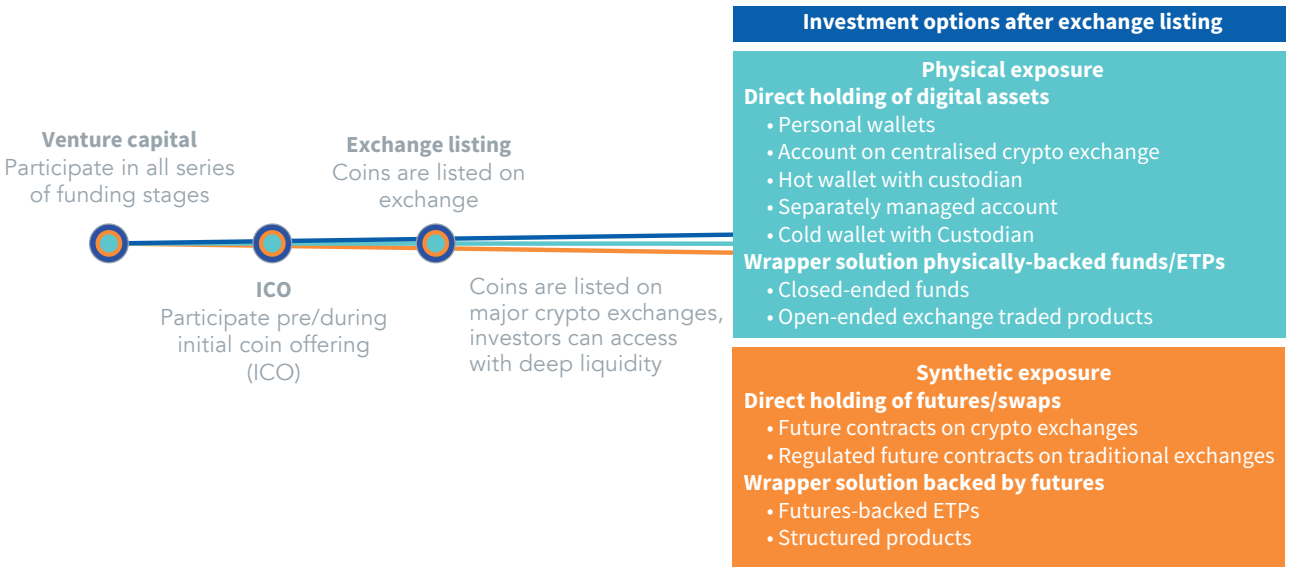
The first two sections of this paper focused on the incredible investment opportunities that digital assets can represent for investors. However, one of the main challenges to face when investing in digital assets is that the infrastructure is completely different from other asset classes. Equity, bonds, and commodity futures contracts are all traded on similar exchanges or through the same market makers and brokers. Digital assets, by definition, live in their own, newly created corner of the world and, therefore, accessing them can be difficult. However, this is changing. With the ecosystem's maturation, links are being created between the old world and the new. Regulators are starting to open some doors for digital assets to join the traditional finance world. Still, finding the right vehicle can be difficult.

This section aims to discuss an exhaustive list of ways to invest in digital assets and focus on their pros and cons for an institutional investor. This complete review shows that good investment options in digital assets are currently few and far between. Physically-backed ETPs combine an easy operational setup and trading with security and efficient tracking. This is why such products have attracted large investments in the last few years (Figure 29). III.B will finally propose a framework to choose and conduct due diligence on such physically-backed digital asset ETPs. When such vehicles are unavailable, separately managed accounts can also provide a route to market for investors.

A. The exhaustive list of how to invest in digital assets

In theory, a large spectrum of investment solutions exists when it comes to accessing digital assets, as illustrated in Figure 22. An investor's preferred choice will depend on their investment objectives and, more importantly, their investment infrastructures and processes. Each solution bears its advantages and disadvantages and will offer different levels of flexibility, security and performance which we will discuss in further detail below.

Figure 22: Digital assets investment options



Source: WisdomTree

On a broad level, investors can get physical or synthetic exposure to digital assets:

- Physical means that the investors' money is either used to purchase digital assets directly into a dedicated account or to purchase a wrapper, such as an ETP or a fund, which is physically backed by digital assets, that is, it owns physical assets
- Synthetic means that exposure to digital assets is obtained by buying derivatives such as futures contracts or swaps or purchasing a wrapper, such as an ETP or a fund, backed by futures contracts or swaps

There are also various stages an investor can get involved in digital assets:

- Participating in the venture capital (VC) series funding stage
- Participating pre or during initial coin offering (ICO)
- Buying digital assets once they have been emitted and are trading freely

This section focuses exclusively on this latter option.

1. Physical exposure – investing directly in digital assets

a. Direct ownership

Direct ownership of digital assets is the most hands-on way to invest. Investors can trade directly on crypto exchanges and set up their wallets to store assets. A more advanced approach is to set up a custody account, a managed account or a segregated mandate to trade and hold the digital asset.

This option allows investors to access a vast array of digital assets covering most categories and sectors like payments, smart contract networks, NFTs, DeFi, metaverse tokens and so on. This solution gives a lot of flexibility in terms of investment and trading strategies; however, it's quite complex to set up operationally and to defend from a cybersecurity point of view. This setup requires new legal agreements (with the crypto custodian, for example) and a new system and infrastructure (to link with crypto exchanges and gather crypto trading data). Investors will also need to consider:

- How safely the assets are stored. Are they kept in a hot wallet, which is lightly secured versus theft and hacks? Are they kept in a cold wallet with added security? How are the keys stored and protected from theft and hacking?
- How to choose the right counterparty to sign up for the service.
- How to manage the trading aspect in the 24/7 crypto market.
- What digital assets to invest in and whether the decisions are made actively or in a systematic index.

It is worth noting that in some jurisdictions like the US, where regulation has prevented registered investment vehicles from being made available, direct indexing (through a separately managed account, 'SMA') remains the most viable option for getting diversified exposure to digital assets. Direct indexing has been a trend in equity investments as customization of exposure has grown, and the cost of trading individual stocks has come down. Those solutions can be used to invest in digital assets.

Recently, Gemini, one of the largest crypto custodians, purchased a platform called BITRIA[65] to make direct ownership of digital assets more readily available to financial advisers. Another platform, OnRamp Invest, has developed portfolio management and rebalancing features that can plug into multiple custodians such as Gemini or PrimeTrust. Crypto indexes can be integrated into both platforms to help facilitate the regular management and maintenance of exposures.

[65] BITRIA is the platform for wealth managers and asset managers to engage in the digital asset ecosystem.

b. Wrapped solutions

A more hands-off approach for getting physical exposure to digital assets is wrapped solutions. This includes, for example, closed-end investment funds or trusts, ETPs and structured products. These products are regulated wrapped solutions that can be used directly in existing trading and investment platforms, making them readily available to investors and bringing digital assets under the same umbrella as the other asset classes, funds and ETFs.

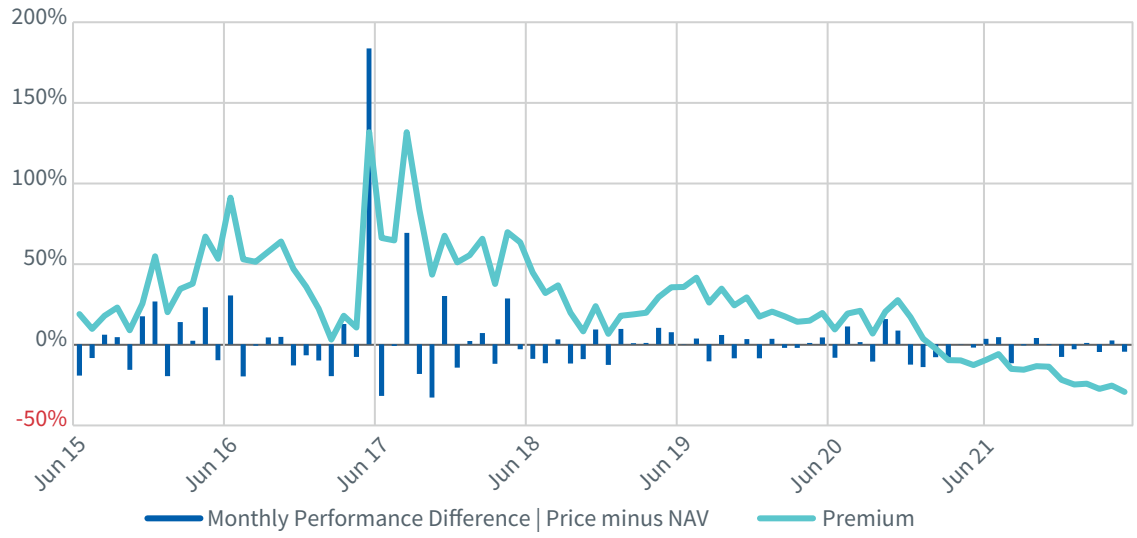
All those different wrapped solutions have their pros and cons:

+ Closed-end investment trusts are popular in the US market, where physical ETPs tracking digital assets have not been approved. They vary from the large tracker in mutual funds to more boutique crypto hedge funds with qualitative or quantitative strategies. They are often Cayman or Bahamas domiciled structures. Due to their closed-end structure, they are subject to dilution levy, lock-in period and restricted trading windows, which can cause liquidity concerns and redemption risk.

+ Investors are also subject to premiums and discounts versus the net asset value (NAV) of the fund when trading, leading to performances that vary widely from the performance of the underlying digital asset. Figure 23 shows that the difference between the price of a closed-end fund like the Grayscale Bitcoin trust and the price of Bitcoin itself can be very large. Depending on the environment and the flows in the fund, a share in the fund can trade at a significant premium or discount to the price of Bitcoin.

+ In 2017, because of the lack of competition in the space, shares in the fund were in high demand and were trading at a premium of up to 125%, that is, investors were paying more than twice the actual price of a Bitcoin. More recently, with the apparition of futures-based Bitcoin ETPs in the market charging significantly lower fees, the shares traded at a discount. This means that the performance of this 'tracker' does not, in fact, track the performance of Bitcoin. As illustrated by the blue bars in the graph, the fund's performance varies significantly from the performance of Bitcoin every single month. On top of those structural aspects, high fees and tracking errors are also large drawbacks for investors. However, depending on the domicile and local regulations, these funds may be less restricted on which digital assets they can hold, providing more exposure and strategies for investors to choose from.

Figure 23: Grayscale Premium introduces an additional layer of risk



Source: WisdomTree, Bloomberg. May 2015 to May 2022. On monthly USD returns. **You cannot invest directly in an index. Historical performance is not an indication of future performance and any investment may go down in value.**

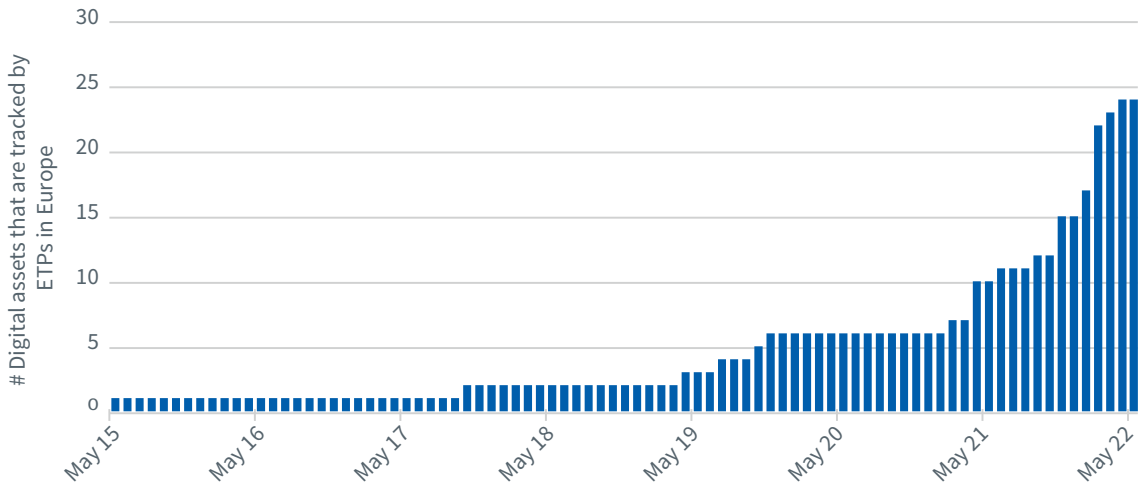
+ Open-ended ETPs are a popular option in the European market. Those ETPs are very similar to the commonly used exchange-traded commodities (ETCs), like physical gold ETCs. A physical Bitcoin ETP, for example, is fully backed by holdings of Bitcoins; the exact number of Bitcoins entitled to the ETP are stored at a custodian in cold wallets. When traded by investors, the ETP, via the Authorised Participants, adjusts its holdings of Bitcoin to reflect the inflows and outflows. The investors are effectively gaining exposure to the underlying assets while outsourcing the custody and trading of the underlying digital assets to the ETP provider for a management fee.

Physically-backed exchange-traded products offer:

+ High security through cold storage, dealing with cybersecurity issues on the investors' behalf
+ Precise tracking thanks to their physical backing (no roll yield driven loss)
+ Seamless integration into existing systems
+ Efficient trading, by doing so directly on exchanges with multiple Market Makers and Authorised Participants. Investors only pay a bid/ask spread to trade instead of the high premium/discount observed on closed-ended investment trusts
+ Low cost
+ Transparency, for example, WisdomTree publishes coin entitlement and index constitution information daily on our product pages

However, because these products are listed on exchanges, they are only liquid and priced during market hours. While digital assets trade 24/7 this is not the case for exchange traded products. Those products are also bound by the exchange listing rules regarding which digital assets can be tracked. This means that, at this stage, ETPs often have limited selections of coins to track. However, the authorised universe is expanding rapidly thanks to providers' collective effort to work with exchanges to expand the allowed assets. As illustrated in Figure 24, up to 2017, only Bitcoin could be wrapped in an ETP in Europe. Then Ethereum was added to the list. Since then, the list has constantly been increasing, with new assets added every month. As of the end of April 2022, it was already possible to invest in 24 different digital assets using an ETP. This does not even consider assets that would be part of a crypto basket tracked by an ETP.

Figure 24: Evolution of the number of digital assets being tracked by ETPs in Europe over time



Source: WisdomTree. As of 31 May 2022. **Historical performance is not an indication of future performance and any investment may go down in value.**

2. Synthetic exposure – investing in derivatives linked to digital assets

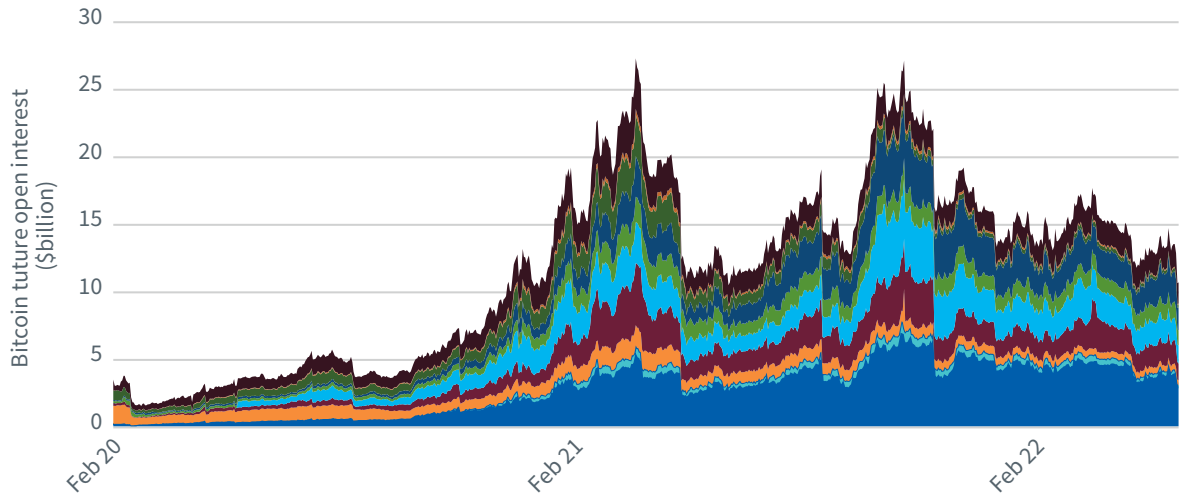
a. Perpetual swaps and futures contracts

Derivatives for digital assets are developing rapidly. Futures contracts can be traded on crypto native exchanges or more classic exchanges like the Chicago Mercantile Exchange (CME). Like traditional derivatives markets, crypto futures contracts are offered in many formats:

- Physically-settled futures (monthly/quarterly/semi-annually contracts)
- Cash-settled futures (monthly/quarterly/semi-annually contracts)
- Perpetual swaps

CME Group, for example, offers a monthly cash-settled Bitcoin futures contract denominated in USD, which is widely used by traditional institutional clients and several Bitcoin futures ETF products (see below). Crypto-native exchanges such as Binance, FTX, Bybit, Bitfinex and BitMEX account for a large volume of open interests.

Figure 25: Bitcoin open interest per exchange in USD



Source: CoinGlass, WisdomTree. February 2020 to June 2022. **Historical performance is not an indication of future performance and any investment may go down in value.**

While traditional exchanges only offer futures contracts on the largest coins like Bitcoin and Ethereum, crypto-native exchanges also offer futures and perpetual swaps on mid and small-cap assets. Futures contracts on traditional exchanges are popular instruments among institutions as they give investors access to digital assets through the usual piping with no need for additional infrastructure or systems. The roll yield is the major drawback of accessing digital assets through future contracts. In most periods, this roll yield is negative (the curve is in contango), creating a negative drag on the performance and leading to significant underperformance compared to direct or physically-backed exposure. See III.A.2.C.: “Why Bitcoin futures contracts underperform Bitcoin most of the time” below.

b. Futures-backed ETFs

Since October 2021, the Securities and Exchange Commission (SEC) has approved several futures-backed ETFs on Bitcoin. The products quickly gained large assets under management (AUM) inflows driven by the investors’ appetite for exchange-traded digital asset solutions. These products usually hold the CME Bitcoin futures contract and roll them monthly. These ETFs use regulated futures as a proxy to give Bitcoin exposure to investors and do not invest in or seek direct exposure to the spot price of Bitcoin.

While being the only currently available option in the US for exchange-traded investment in digital assets, contrary to Europe, where physically-backed ETP exists, futures-backed digital asset ETFs also suffer from negative roll yield in most periods. When compared side-by-side, the physically-backed exchange-traded note (ETN), therefore, outperforms a future backed ETF over most periods.

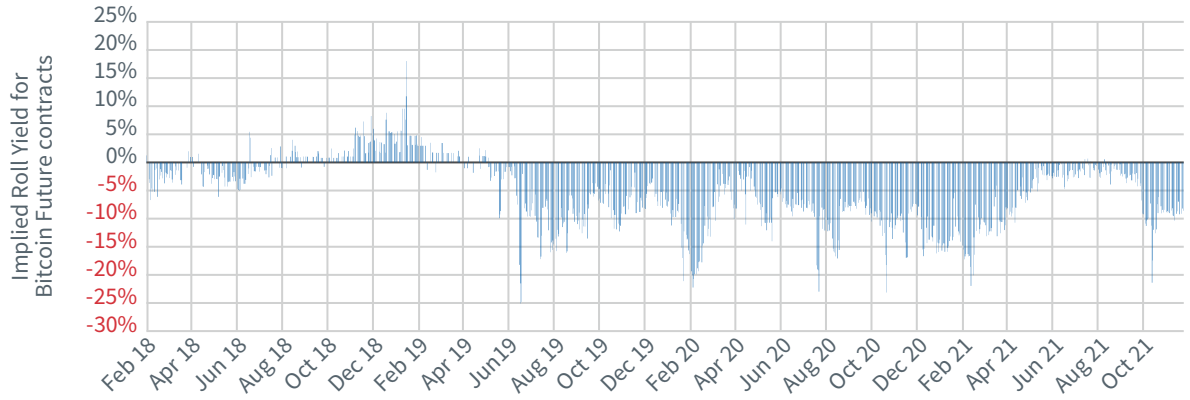
c. Why Bitcoin futures contracts underperform Bitcoin most of the time

A futures curve is in contango when the futures contracts' prices are higher than the spot price and when the futures contracts with a longer-term expiration are priced higher than futures contracts with a shorter-term expiration. Investors will incur a negative yield overtime when the curve is in contango as the contract price converges towards the spot. Since futures-backed ETFs invest exclusively in futures contracts, they would suffer from the same negative roll yield when the curve is in contango.

The Bitcoin futures curve is mostly in contango due to the upward trend anticipation of the Bitcoin price in the long term and because of an imbalance between long interest and short interest in that market. This contango tends to persist for a relatively long time, as evidenced in Figure 26. Since 2020, the Bitcoin futures curve has been in contango 80% of the time.

In Figure 26, the implied roll yield is computed using the price difference between the front-month futures contract and the second-month futures contract. This data is calculated daily from February 2018, and the result is annualised. The result shows that investors rolling Bitcoin futures or investing in futures-backed ETFs incurred a loss for most of the last three years. This loss averaged around -7% per annum compared to a physically-backed investment in Bitcoin and had reached -25% annualised in some intense periods.

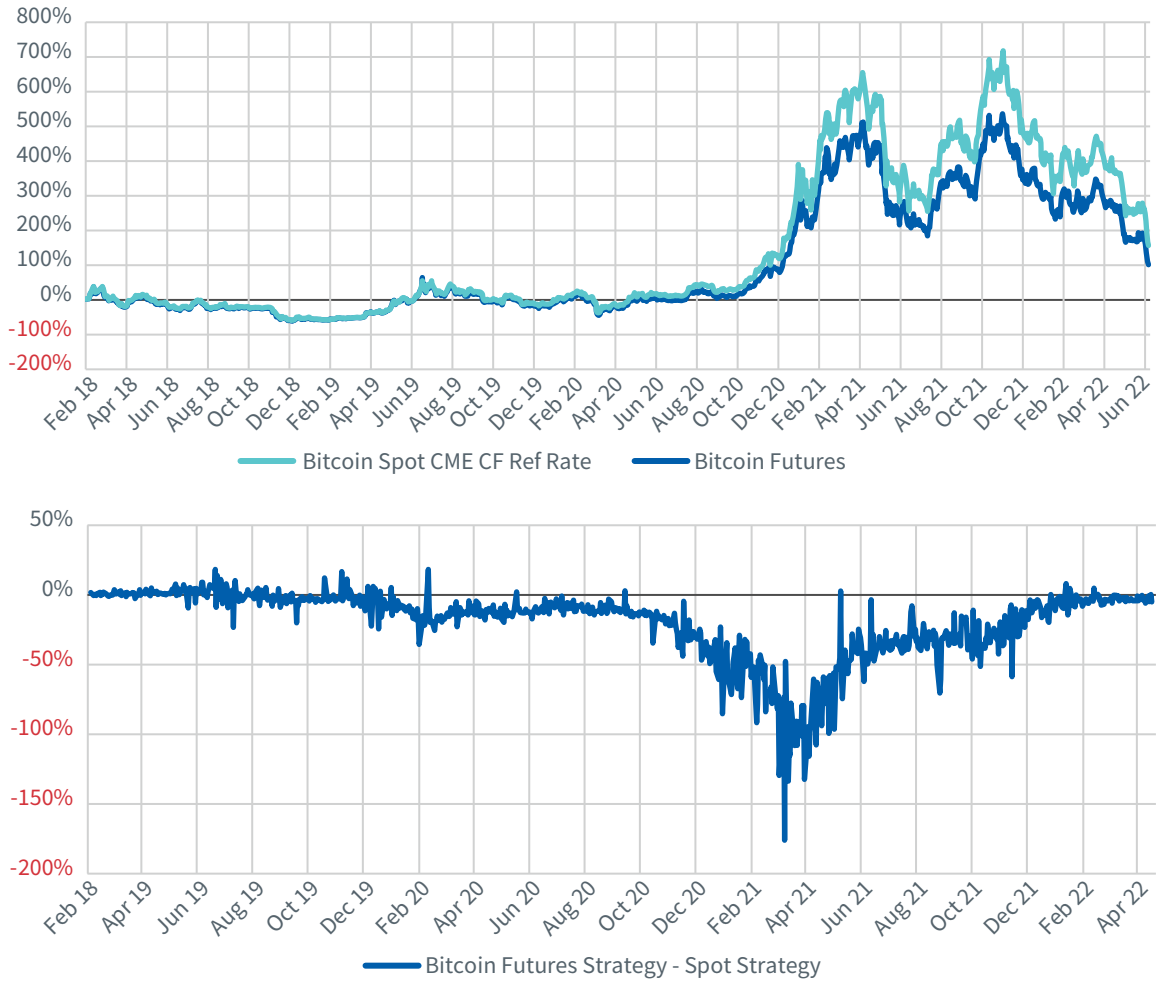
Figure 26: Historical implied roll yield for an investor investing in Bitcoin futures contracts



Source: Bloomberg; WisdomTree. From 8 February 2018 to 15 June 2022. **Historical performance is not an indication of future performance and any investments may go down in value.**

In Figure 27, the standard front-month rolling futures series is used to proxy an investment in Bitcoin through futures contracts or a futures-backed ETF. The CME CF Bitcoin Reference Rate (BRR) benchmark is used to proxy an investment in physically-backed Bitcoin. Due to the negative roll yield, the derivative-based investment in Bitcoin has consistently underperformed the physically-backed strategy. Additionally, the futures strategy has consistently underperformed the physically-backed Bitcoin on a 12-month rolling basis. The difference in performance between the two strategies reached -175% for periods including the March and April 2021 bull market.

Figure 27: Performance of rolling Bitcoin futures compared to a physically-backed investment in Bitcoin



Source: Bloomberg; WisdomTree, From 8 February 2018 to 15 June 2022. **Historical performance is not an indication of future performance and any investments may go down in value.**

Investors seeking digital asset exposure would have materially benefited from using the physical Bitcoin route-to-market.

3. Solutions for institutional investors

Figure 28 summarizes the pros and cons of the different methods (or routes to market) to invest in digital assets. While numerous, the choice for institutional investors is, in fact, quite constrained:

+ Physical exposure through direct investment in crypto native exchanges is quite risky as digital assets are kept in hot wallets.

+ Physical exposure through direct investment stored with a custodian in a cold wallet is tedious to set up but offers a lot of guarantees. Separately-managed accounts can be a good solution when physically-backed ETPs are not available.

+ Physical exposure through physically-backed funds/ETPs is a turnkey solution that combines an easy operational setup and trading with security and efficient tracking.

+ Synthetic exposure through futures contracts can be useful when leverage is needed, but the negative roll yield is detrimental for medium to long term investments.

+ Synthetic exposure through futures-backed ETFs is suboptimal compared to physically-backed ETPs.

Overall, for a long-only institutional investor, the physically-backed ETP route appears the most robust and the easiest to set up. This is why institutional inflows in such products have significantly picked up since they have been available.

Figure 28: Pros and cons of the different methods to invest in digital assets

	Direct ownership/ managed account	Futures contracts	Investment funds	Future-backed ETPs	Physically-backed ETPs
Description	• Hot wallet with exchange • Cold wallet at custodian • Need to set up an account • KYC[65]/AML[66] and onboarding process is necessary	• Cash-settled or crypto-settled futures contracts or perpetual swaps • Traded on a traditional exchange or crypto-native exchanges	• Non-listed wrapped solutions like closed-end investment funds or index funds	• Listed wrapped solutions: open-end exchange-traded instruments like exchange-traded notes • Tracks future contracts on digital assets	• Listed wrapped solutions: open-end exchange-traded instruments like exchange-traded notes • Tracks digital assets directly
Pros	• Direct exposure • A wide range of coins offered • Sophisticated strategy possible	• Capital efficient (margin trading, leverage) • Ability to take both long/short positions • Risk management tool	• Active management • Sophisticated strategy possible	• Secondary market liquidity • Transparency of methodology and holdings • Listed on regulated exchanges & existing brokerage platform • Standardised point of access	• Secondary market liquidity • Storage in cold wallet • Transparency of methodology and holdings • Listed on regulated exchanges & existing brokerage platform • Standardised point of access
Cons	• Hot wallets are not secure • Setting up a cold wallet is tedious and time-consuming • Does not plug easily into existing trading systems • Limited access to liquidity across exchanges	• Rolling contracts often generate negative yield ('contango bleed') • High funding rates - cost to borrow • Limited coin choice on traditional exchanges • Can only trade during market hours	• High product management cost • Often trade at a high premium to NAV[67] • Liquidity risk • Non-transparent fund holdings • Nascent track record • Can only trade during market hours	• Rolling contracts often generate negative yield ('contango bleed') • Limited coin choice: Bitcoin and Ethereum • Can only trade during market hours	• Limited but rapidly expanding coin choice: Bitcoin and Ethereum • Can only trade during market hours
Key characteristics	• Hot wallets are more common to a retail audience • Dedicated custody requires a long setup process and suits the need of very large investors	• Plugs in existing investment platforms for large institutions • One-stop solution for accessing crypto exposure • Large performance drag • Low diversity of assets	• Plugs in easily in existing trading/ investment platforms • One-stop solution for accessing crypto exposure • Liquidity risk and high premium/ discount to NAV	• Plugs in easily in existing trading/ investment platforms • One-stop solution for accessing crypto exposure • Large performance drag	• Plugs in easily in existing trading/ investment platforms • One-stop solution for accessing crypto exposure

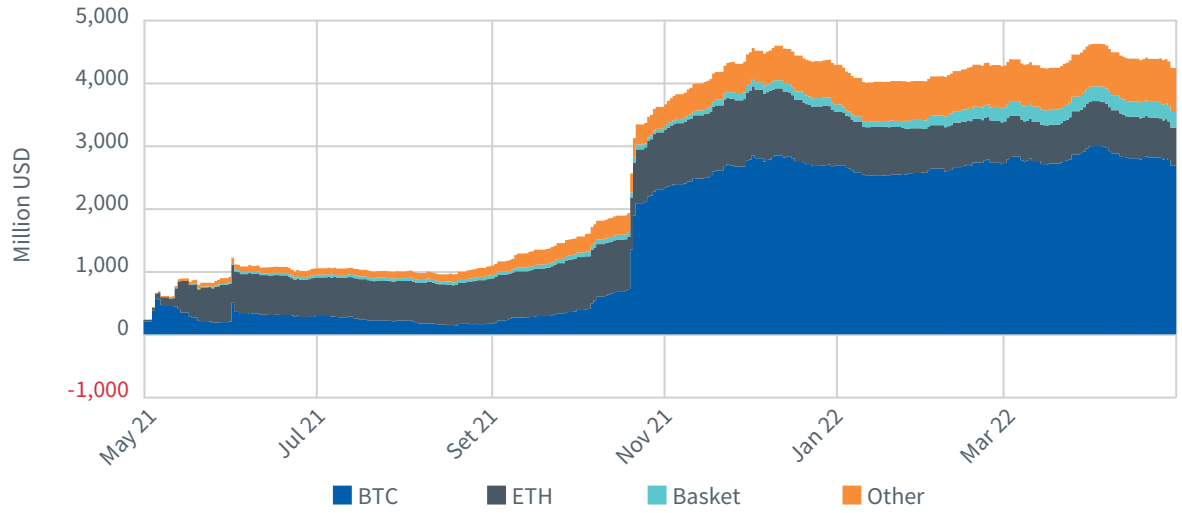
[66] Know your customer
[67] Anti-Money Laundering
[68] Net asset value

4. The growing adoption of physically-backed ETPs to invest in digital assets

Crypto exchange-traded products (ETPs) have achieved significant growth and traction since Q2 2021. Cumulative flows now stand at around USD$4.2 billion. As institutional investors started to invest in digital assets, ETPs became recognised as the institutional route-to-market option of choice, allowing for convenient and safe access to the asset class.

Most digital asset ETPs give investors institutional-grade trading and custody services, addressing investor concerns such as hacking, theft of the private keys or not being able to access liquidity across various crypto exchanges. Most importantly, ETPs can seamlessly plug into existing trading and brokerage platforms. ETPs can be easily implemented for client advisers as part of an advised client's multi-asset portfolio, whereby the adviser would have visibility of the asset allocation and can rebalance and incorporate the digital asset exposure in the client's risk budgeting and investment policy statements (IPSs).

Figure 29: Global inflows in digital asset ETPs in the 12 months up to the end of April 2022



Source: Bloomberg; WisdomTree, April 2021 to April 2022. **Historical performance is not an indication of future performance and any investments may go down in value.**

B. Selecting the right digital asset ETP for your needs

Physically-backed ETPs offer high security through cold storage, precise tracking thanks to their physical backing (no roll-yield-driven loss), seamless integration into existing systems, efficient trading and low cost. While physically-backed ETPs for digital assets are recent, the offering is already large enough to require a clear selection process and due diligence process.

1. How to choose a physically-backed digital asset ETP?

Investors are familiar with traditional equity, bond and commodity ETFs. The due diligence checklist is well established for such products, with total expense ratio (TER), tracking error, tracking difference, liquidity, spread of the ETF and liquidity of the underlying assets on top of the list. For other types of exchange-traded products, the list may look different. The custody setup is a key consideration for physically-backed ETCs, like physical gold ETCs. Similarly, digital ETPs must be selected based on their unique characteristics and require both similar and new considerations.

In this section, we present a holistic framework to approach crypto ETP selection, intending to provide clear steps for understanding the components that matter the most to investors:

+ Security & custody
+ Issuer & product structure
+ Cost of holding
+ Lending and staking
+ Primary and secondary trading ecosystem
+ Considerations for digital asset basket products

a. Security & custody

The number one concern when it comes to digital assets is cybersecurity. Crypto hacks make the news regularly, and it is front of mind for investors. However, it is worth noting that in almost every single case of digital assets being stolen, the asset was stored in a hot wallet, that is, a virtual currency wallet that is accessible online. The gold standard is storage in a cold wallet, managed by recognized custodians for institutional investors.

The most common setup for physically-backed digital asset ETPs is a cold wallet (that is, storage held offline). It needs to combine:

+ Safe storage of private keys in a secured physical location (cold storage)
+ Geographic and human redundancies to allow secured and constant access
+ A robust approval process for moving the assets with multi-approval technology (multi-approval technology works by an "M-of-N" system[69], meaning that M approvers out of N known approvers must approve a transaction to sign the transaction)

It is critical to have a safe custody solution and a robust process for approving any transfers. The crypto custody landscape consists of established crypto-focused businesses like Coinbase, traditional regulated banks/custodians like Swissquote or Fidelity Digital Assets and small start-up firms. WisdomTree chooses to work with 3rd party custodians who specialise in institutional-grade crypto custody.

When analysing the custody setup, an investor should pay attention to the custody provider, the storage solutions, their relationship with the crypto ETP issuer and the security practices for when coins are transferred in or out of the wallet.

b. Issuer & product structure

As digital assets develop into a new asset class, a completely new ecosystem is created with many new actors entering various economic sectors. Digital asset ETPs are no exception. While digital assets are new, managing physically-backed exchange-traded products is not. Over the last two decades, many issuers have honed their skills with physically-backed gold or silver ETPs. Choosing an issuer with recognized expertise in creating and running physically-backed listed financial products and a track record in managing their trading and liquidity, particularly in a crisis, can deliver important peace of mind to investors.

It is also important to see if the issuer has a diversified range of products (not only digital assets) to mitigate the risk. Indeed, if their business is only digital assets, it creates a business risk for this company which could impact the investors, such as termination of the product due to the company going out of business. It is key to select an issuer that can leverage their past expertise in physically-backed products and cryptocurrency partner expertise and, at the same time, has a diversified business across asset classes.

Similarly to a physically-backed gold ETP which is backed by gold bars held in a bank vault, private keys allowing for the transaction of digital assets are held in highly secure locations and on highly secured hardware to back physically-backed digital asset ETPs. This is generally opposed to synthetic replication, by which a financial instrument like an ETP or an ETF does not hold the underlying asset which it is supposed to represent, but achieves representation by other means, usually through holding derivative instruments. In digital assets, as discussed in the previous section, this synthetic replication has a very high tracking difference due to the negative roll yield in the futures contract. So, investing in physically-backed ETPs can achieve superior performance to synthetic replication.

Counterparty risk is also a key consideration. Structured products, for example, carry the counterparty risk of the issuer; the assets are, in most cases, not ring-fenced. Investors take the solvency risk to the issuing entity (usually a bank) on top of the investment risk of the digital asset. Choosing an ETP issued by a management structure, whose only purpose is to issue those products, eliminates much of the counterparty risk. The assets backing those ETPs are ring fenced inside a single-purpose vehicle, thereby reducing the credit risk further. The contamination risk between the different business activities of the issuer is removed, since the issuer is only performing one activity. A note issued by a bank, and guaranteed by a bank, is exposed to the counterparty risk of the bank. The note could suffer from anything happening in other parts of the bank and could give rise to a default. The note could default when the digital asset investment could, in fact, have performed well, leaving the investor significantly out of pocket. It is key to choose a product structure that limits the counterparty risks.

[69] M of N involves a modification of the SO PIN, User PIN or Domain secrets. M of N causes the PIN or Domain secret to be divided and shared (or "split") among several PED Keys of one type ("split-knowledge access control").

c. Cost of holding

For physically-backed digital asset ETPs, all the direct costs should sit in the total expense ratio (TER) of the ETP. There should not be any other hidden cost. Such TER is usually taken as a percentage of digital assets physically held by the product. Therefore, the lower the TER, the fewer coins the issuer takes and the more coins per share are left for the investor.

In a volatile asset like Bitcoin or Ethereum, even a small difference in cost can compound over time into a large difference in performance. The benefit of a lower TER is often underestimated. If Product A has a TER of 0.95% and Product B has a TER of 1.45%, the cost saving is not just 0.5%, but rather 0.5% times the performance of the relevant digital asset spot price over the holding period. In a year when the Bitcoin's spot price doubles, which historically has not been a rare occurrence, then the difference in performance between Product A and B could be 1%. If Bitcoin triples, it could be 1.5% and so on. So, TER is very important.

When comparing two ETFs, investors pull up a Bloomberg COMP screen and visually compare the NAV performances and tracking differences. The expectations are that the one with the higher NAV over time is a better product, that is, cheaper and tracking the underlying more efficiently. However, when it comes to digital assets, things are slightly different. The main reason is that digital asset products often don't use the same reference price for the underlying. Therefore, on the same day, one product can be referencing a much higher unit price for a coin than the other just because it has been observed at a different time of day.

Physical digital asset ETPs' NAVs are computed as

NAV = Pricing Reference per Bitcoin x Coin Entitlement

Let's assume Product A and B have the same amount of Bitcoin per unit of ETP (coin entitlement) and that Product A references the 4pm BRR index[70], which shows USD$39,963 per Bitcoin, whereas Product B references the 24-hour volume-weighted index, which shows USD$40,125 per Bitcoin for that day. Despite the products containing the same number of Bitcoins, Product B would show a higher NAV than Product A on that day. Does it mean that Product B is cheaper or a better tracker than A? No, tomorrow the situation could be inverted depending on the path followed by Bitcoin during the day. It is not the price but the underlying coin entitlement that matters. Therefore, products with a lower cost will provide the investors with more units of coins at the end of the holding period, hence better performance.

The overall cost of holding such an ETP comprises the TER and trading costs. Fundamentally, digital asset ETPs trade in exactly the same way as any other ETF:

+ The creation and redemption of a large number of shares are often done on the primary market, where the Authorised Participants (APs) transfer the underlying coins, and the issuer creates new shares or redeems existing shares of the ETP
+ Investors trade in the secondary market, on exchanges or via over-the-counter (OTC) and pay a bid/ask spread when buying and selling

Secondary market bid/ask spreads are impacted by many factors: the liquidity of the ETP on the exchanges, the depth of the order book, volatility profile of the coins, inventory level, AP's ability to source liquidity, the number of market makers etc. For most efficient trading, it is always best to discuss with the Capital Markets team of the issuer to request an analysis when planning for large trades.

d. Lending & staking

For equity ETFs, investors have become familiar with security lending. This feature can apply to digital asset ETPs as well. The coins that should be held as backings to the product are lent out to counterparties in exchange for additional yield. This additional yield could then subsidize the issuer, enhance the product's performance, or both. While potentially improving the returns for investors, this activity can be quite risky for digital assets. It brings:

+ Additional credit/counterparty risk vis-à-vis the entities the coins are lent to
+ Additional process risk regarding the transfer and the custody of the lent coins — digital assets are the most at risk when they are on the move since they have to come out of cold storage and move to a hot wallet

[70] Bitcoin Reference Rate

It is also worth mentioning that lending can facilitate short-selling which, in turn, could lead to increased volatility in coin prices.

Certain physically-backed crypto ETP prospectus' allow for crypto lending, while others do not. Therefore, investors should check the details accordingly with the issuer.

Staking, on the other hand, is a unique feature of certain digital assets and, therefore, of certain digital asset ETPs. Staking needs to be enabled by the technology of the blockchain itself. It applies only to the Proof of Stake tokens, such as Cardano, Solana, Algorand etc. The coins are set aside in the network (aka 'put at stake') to facilitate transactions on the blockchain. This contrasts with Proof of Work coins, like Bitcoin, where staking is not possible.

Here, existing holders of the coins can choose to stake their holdings and participate in the running of the protocol. There is no counterparty/credit risk, as the coins are staked within the network, and the process is codified as part of the consensus model. The existing coin holders obtain staking rewards for securing the network. However, there are also some potential risks in staking such as:

+ Slashing risk. Under Proof of Stake, validator nodes on the network (that is, the nodes with a stake in the network) are chosen at random to create new blocks on the distributed database. The probability of being chosen is usually higher if more cryptocurrency has been staked. When selected to create a new block, the node compiles a set of transactions and signs them with a private key. Other validator nodes on the network check that this is all correct and, if so, the node is rewarded with newly minted cryptocurrency. If the work is not correct then the node usually incurs a penalty (called 'slashing'), which results in some or all of the stake being lost. Slashing does not apply to all networks though and can be minimized by 'running' the validator nodes well or delegating this to a reputable agent.

+ Liquidity risk. Staking rewards are not paid continuously, but at the end of fixed periods that vary from network to network. During one of those periods, the staked assets can be locked in the network, therefore creating liquidity risk for the ETP that owns the asset. This risk needs to be managed though a sensible risk management process by the ETP issuer.

Overall, staking is many orders of magnitude less risky than lending, even if the reward for staking can be as high or higher. However, the operational setup of the issuer to deal with staking is an important criterion when selecting an ETP tracking a Proof of Stake asset.

e. Primary and secondary trading ecosystem

How the Authorized Participants (APs) trade the underlying coins to facilitate the creation and redemption of the shares within a crypto ETP is critical for a due diligence process. Normally when an investor initiates a large subscription order, new shares will need to be created for the order. APs would usually source the number of coins required and deposit them at the designated custodian during this process. After a verification/confirmation process, the ETP issuer would issue the new shares to reflect the newly deposited coins. The AP would take these shares and complete the trade with the investor. In the end, the investor would obtain the shares as per subscribed, and cash is settled as per required for this trade.

This is a high-level description generalised for the European crypto ETP products, and the details may differ for each issuer. When completing due diligence for the AP process, it's key for the issuer to be able to present the subscription/redemption process in detail and make sure the workflow is understandable to the investors. A credible AP process would entail a couple of key factors:

+ No dilution of existing holdings

+ Digital assets are sourced and deposited under custody before new ETP shares are issued

+ Robust regulated entities acting as AP

+ Multi-level security process

f. Operational considerations for digital asset basket products

The first five considerations above apply to all digital asset ETPs. This last one is more specific to basket ETPs. The majority of the current digital asset ETP market focuses on single asset trackers: Bitcoin ETP, Ethereum ETP etc. However, the most efficient tools in a portfolio context are digital asset basket ETPs. For such products, two extra considerations will determine their intrinsic quality:

+ The construction of the basket itself
+ The operational implementation

Regarding the basket's construction, it is important to acknowledge that digital assets are not equities or bonds. Therefore, a digital asset portfolio may look different to a traditional market-cap index. The design of the index or portfolio tracked by the ETP is of utmost importance to the strategy's success. Section IV.C.1.b, "WisdomTree's framework for diversified digital assets investments", details WisdomTree's approach to such an endeavour.

Second, the volatile nature of digital assets often sees the price of one asset go up drastically, and it is not unusual to see a crypto project rising from #121 to #5 market cap within a year (Solana is a good recent example). Also, technological and tokenomics-related events such as sharding, airdrop, token unlocking etc. can materially impact the coin price. Rebalancing the portfolio to stay 'up to date' with current market conditions is very important. The operational arrangement around these is a key consideration:

+ When it comes to rebalancing frequency, it is necessary to find the right balance between capturing market changes and cost. Frequent trading of the underlying digital assets can be costly.
+ When rebalancing, the coins need to be moved from a storage wallet to a hot wallet for trading. Hot wallets are online and linked to the exchanges, although the risk is limited, the account could get hacked during the rebalance period; the recent news of thefts to exchange wallets is a risk factor to consider when rebalancing is frequent. This is one reason why looking at the operational mechanics around rebalancing should be high on the list of priorities for investors.

How often is best? As discussed above, it is not necessarily the case that the more frequent the rebalance, the better it is. This depends on the index exposure and what the product is trying to achieve. A small-cap index would probably require more frequent rebalancing, whereas a large-cap product would not require as frequent rebalancing.

2. Digital asset ETP selection: due diligence framework

In light of the six main components when choosing a digital asset ETP, you can find below a due diligence checklist that investors can use for reference when developing their own digital investment framework:

Issuer

Does the issuer have the expertise and a track record in physically-backed exchange-traded products?

Does the issuer have expertise in digital assets?

Does the issuer have a proper governance process, and how experienced are the board of directors in the ETP and crypto industries?

Product structure

What is the structure of the issuer? What is the counterparty risk in the product?

Does the product provide leveraged or delta one exposure?

Who are the counterparties providing trading, indexing and pricing references?

Who are the administrator and custodian?

Is the product backed by physical holdings of the coins or backed by derivatives?

How competitive is the product TER versus other similar products?

Does the product authorise lending? What's the lending policy (counterparty risk management)?

Does the product authorise staking, if relevant? What's the staking policy (liquidity management and process risk management, reward sharing)?

What is the reference rate for NAV calculation? How is the reference rate calculated?

How is the coin entitlement calculated? Is the data available and transparent to investors?

For index products:

What is the index methodology (selection criteria, additional risk screen, rebalance frequency)?

Who is the index provider (access to high-quality crypto data, expertise in indexing)?

What is the index governance (who owns the intellectual property of the index — the index provider or the ETP issuer — what is the index committee charter)?

What is the operational setup around rebalancing?

Custody

Who provides the custody service for the ETP (expertise, reputation, total assets under custody)?

Does the custodian only serve the issuer (conflicts of interest, concentration risk)?

How are the coins stored (cold wallet vs hot wallet)?

How are the coins secured against hacks/theft/loss?

When new coins are added/withdrawn from the custody account, what is the security procedure?

Are the coins stored in segregated accounts as per product and are such accounts ring-fenced from the custodian's creditors in the event the custodian becomes insolvent?

Is there an insurance facility?

Trading

Assess the secondary market liquidity for the ETP (bid/ask spread, ADV, depth of the order book), assess the underlying market liquidity (liquidity for the underlying coins).

Who are the Market Makers (for secondary market ETP trading) and Authorised Participants (for primary market ETP creation/redemption)?

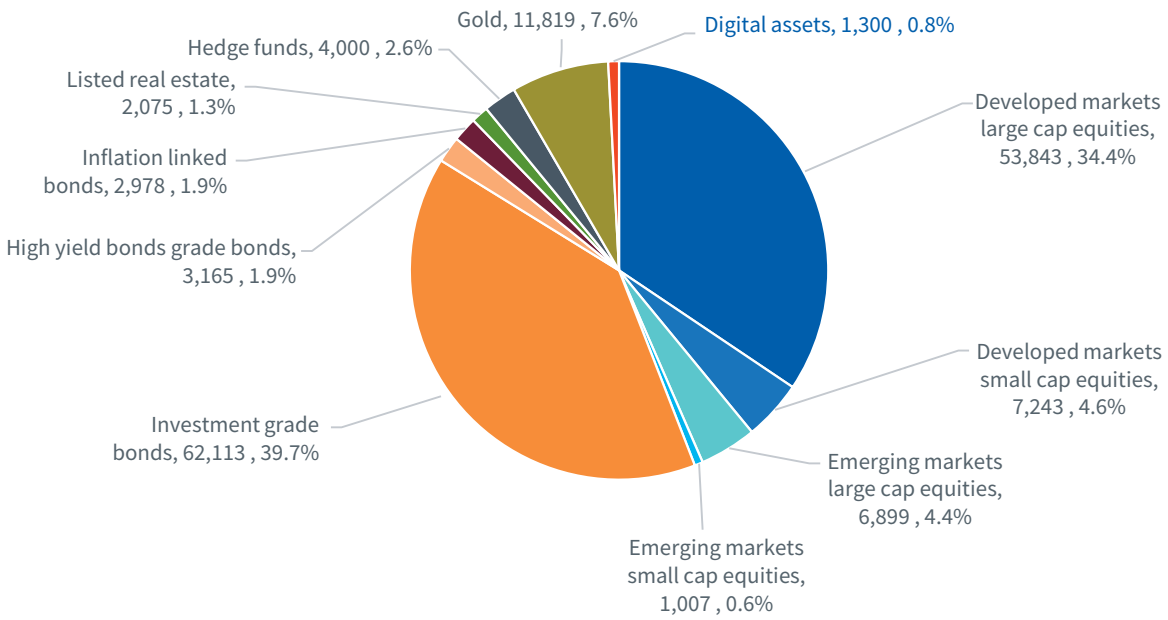
Does the issuer charge for the creation/redemption of ETP units?

Armed with a good knowledge of the digital asset space and the different ways to access it, the only thing left to do is discuss their place in an asset allocation and the sizing of allocation. This is the purpose of the last section of this paper.

IV. DIGITAL ASSETS' PLACE IN AN ASSET ALLOCATION

Despite the growth potential of digital assets, many investors are still sitting on the fence. In many cases, investors feel that the asset class is too young and that they don't know enough to invest. However, the opposite is true. Digital assets have reached a peak of USD$3 trillion of market cap recently, and the ecosystem and use cases are growing steadily. Digital assets' size is now on par with emerging market small-caps, listed real estate investment trusts (REITS), or global high yield bonds. Figure 30 showcases the current market portfolio, that is, the different listed assets available to investors weighted by their total market capitalisation. The total market represents around USD$160 trillion after the recent drop in risky assets, and digital assets represent around 1% of that. To minimize this deviation from the Market Portfolio, a passive investor or an uninformed investor should have around a 1% investment in digital assets. Not investing is, in fact, taking an active decision to underweight digital assets: reflecting a belief that the digital asset space will not make it and will disappear over time.

Figure 30: Today's Market Portfolio.



Source: Bloomberg, WisdomTree. WisdomTree. As of 31 May 2022. Market caps are shown in US Dollars billion. **You cannot invest directly in an index.**

For more active investors that would like to deviate from the market portfolio, the following section will delve into three main asset allocation questions:

+ **What are digital assets' main characteristics that could make them a strong add-on to a given asset allocation?**
  First, digital assets stand out because they demonstrate positive skewness leading to a higher likelihood of above-average gains, as illustrated in Figure 31. Second, their payoff is like that of a call option with a defined downside, being the amount invested, and high potential upside. Third, they exhibit low correlations to existing asset classes (Figure 33), increasing the diversification in investors' portfolios.

+ **How do the different coins interact, and how can they be used effectively in a portfolio?**
  While the asset class itself is now installed, many new coins and tokens are still emerging, and the future winners are still unknown. The different projects benefit from their own idiosyncratic drivers leading to some diversification inside the digital asset world, as highlighted in Figure 38. To benefit strategically from the growth in digital assets, diversification is key. More tactically, this bubbling ecosystem could offer many possibilities. As highlighted in Figure 47, a simple price momentum strategy would have outperformed an equal-weight portfolio and improved the risk-return profile.

+ **How much to allocate to digital assets?**
  Using multiple quantitative techniques to assess what proportion of digital assets would best leverage their characteristic, we find that a 1% allocation in a multi-asset portfolio gives a good balance between risk and opportunities. Looking forward to the next few years, such a 1% allocation could be justified on a risk-return basis as long as the anticipated digital assets return is more than 6% or 7% a year, which is quite a low bar to clear (Figure 56). It would also allow investors to expand their knowledge of an asset class that may be a lot more than 1% in their portfolio ten years from now.

A. Digital assets, an asset class that stands out

Digital assets are mainly talked about because of their growth potential. Currently, their upside potential is an order of magnitude larger than any other asset class. Part I laid out the case for how blockchain technology, and digital assets by extension, could revolutionize our economy in the same manner as the internet and social media. However, the investment case for those assets is not unidimensional. While expected growth is, of course, key it is not the only important factor. Digital assets stand out on three other fronts.

1. They exhibit an asymmetric payoff both statistically but also longer term

2. The payoff of an investment in digital assets is like that of a call option with limited downside and large convexity

3. They exhibit a low statistical correlation with traditional asset classes

1. The advantages of asymmetry and positive skewness

In finance textbooks, the distribution of returns is always assumed to be normally distributed. Doing so helps to apprehend market behaviours more easily, but also helps for the calculations. The reality, however, is quite different. Equities, for example, exhibit negative skewness and high positive kurtosis versus a normal distribution. The negative skewness means that the distribution leans to the left, to the negative side. The probability of a large below-average return is higher than the probability of a large above-average return. The large kurtosis means that those probabilities of large returns (positive or negative) are higher than a normal distribution predicts.

Looking at digital assets' short history, we notice that the distribution is again different. As illustrated in Figure 31, digital assets have historically exhibited positive skewness and a large kurtosis. Their return distribution has even fatter tails than equities leading to even more frequent extreme movements, but the distribution leans to the right. This is very interesting as it means that extreme movements are more often than not on the positive side, skewing the results in favour of investors.

Figure 31: Moments of the return distribution for S&P 500 and digital assets

	Digital Assets	Bitcoin	S&P 500
Skew	1.41	0.57	-0.40
Kurtosis	3.83	0.16	1.12

Source: Bloomberg, WisdomTree. From 31 December 2014 to 31 May 2022. Calculated in USD on monthly returns. Digital Assets are proxied by the MVIS CryptoCompare Digital Assets 100. **You cannot invest directly in an index. Historical performance is not an indication of future performance and any investment may go down in value.**

Since December 2014, equities have suffered through two very negative months (where the return was lower than two times the volatility of the S&P 500) and through two very positive months (where the return was higher than two times the volatility of the S&P 500). Digital assets did not suffer any monthly losses that were higher than two times the volatility but benefited from four very positive months (where the return was higher than two times the volatility of digital assets).

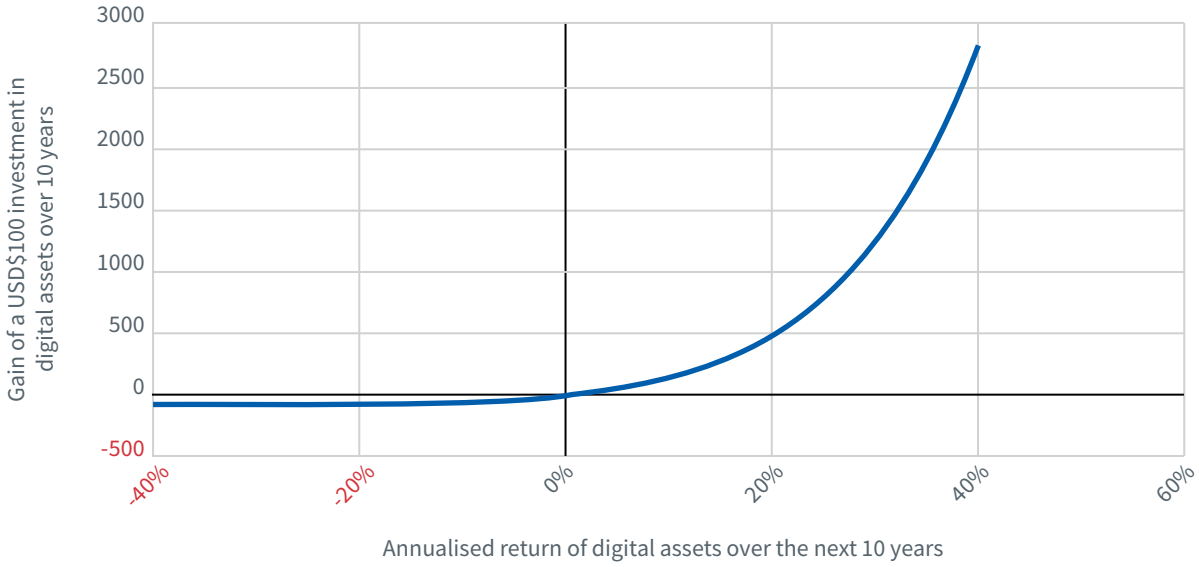
2. A call option on the future

The growth potential of digital assets, while not unlimited, is very large. We discussed earlier how digital assets could be considered a thematic investment. Still, the main difference with other thematics is that digital assets become investable very early in their life cycle. Companies tend to remain private, accessible to only large investors or venture capitalists, for a relatively long time. They are only accessible to most investors when they first list in their initial public offering (IPO) as a relatively mature company. Digital assets don't really suffer from this dichotomy between private and public markets. Viewed from today, many of them can be considered venture capital investments. So, USD$100 invested today could be worth ten times that by the time blockchain technology reaches 90 or 95% adoption in society.

Of course, venture capital investments are risky, but the loss is capped. Mechanically, the maximum downside for any (non-leveraged) investment is the total amount of money that has been invested. This leads to an asymmetry in the potential payoff in digital assets that investors can use to their advantage.

Figure 32 illustrates the potential payoff of a USD$100 investment in digital assets over the next ten years. The worst-case scenario is that the space fails and disappears, leading to a loss of USD$100. However, if the space grows by 10% a year, USD$100 would turn into USD$259, a gain of USD$159. If the space grows by 20% a year over the next ten years, USD$100 would turn into USD$520 and so on.

Figure 32: Profit and loss profile of a USD$100 investment in digital assets over the next ten years



Source: WisdomTree. For illustrative purposes only. **Historical performance is not an indication of future results and any investments may go down in value.**

3. A risk-on diversifier

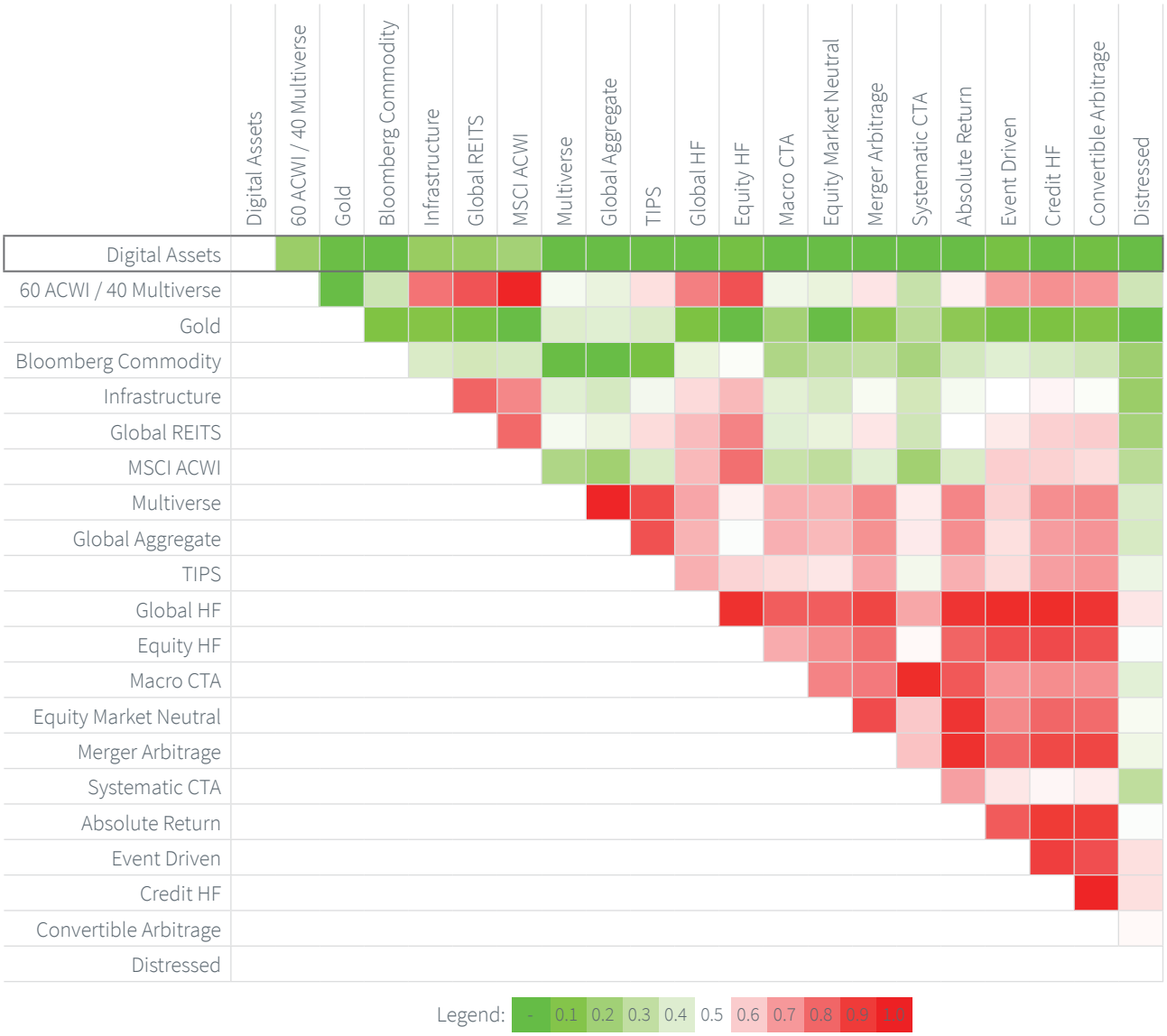
Diversification is one of the most prevalent concepts in portfolio management. Almost more important than returns themselves, the correlation between assets is what can make an asset more or less valuable in the context of an asset allocation.

Contrary to most financial assets, digital assets developed outside the financial sphere. Therefore, they do not fit in the usual boxes. Users and developers do not always behave like classic actors. While it is disconcerting and could explain the significant hurdle to institutional adoption, it is also a strength. Digital assets can stand on the side of other financial assets and potentially offer diversification. Mathematically, digital assets show a low correlation of returns with all traditional asset classes and all alternative exposures usually used for diversification (for example, commodities, real estate or hedge funds).

Figure 33 shows a correlation heatmap on USD monthly returns between a diversified basket of digital assets and a wide array of traditional exposures, including equities, bonds, commodities and alternatives (such as real estate or hedge funds). Most asset classes in the table correlate to at least one other asset class. This is not the case for digital assets. The correlation between digital assets and any traditional asset class remains below 20%.

This strong decorrelation paints digital assets as a great addition to the alternative bucket in any asset allocation.

Figure 33: Correlation matrix



Source: Bloomberg, WisdomTree. From 31 December 2014 to 31 May 2022. Calculated in USD on monthly returns. All Country World Index (ACWI), Real Estate Investment Trust (REIT), Treasury inflation-protected securities (TIPS), Hedge Fund (HF), Commodity trading advisor (CTA). **You cannot invest directly in an index. Historical performance is not an indication of future performance and any investment may go down in value.**

Despite the relatively short history used for these calculations (7 to 8 years), such a powerful result should be enough to prompt investors to look further into the diversification benefits of digital assets. However, many investors still dispute these findings based, very often, on some misconceptions. The main pushbacks revolve around:

+ The correlation supposed instability over short periods
+ The increased correlation in stressed markets

Figure 34: Source of data used in part IV		
Short Name	**Full Name**	**Bloomberg Ticker**
Digital Assets	MVIS CryptoCompare Digital Assets 100	MVDA Index
Bitcoin	Spot Exchange Rate - Price of 1 XBT in EUR	XBTEUR Index
MSCI ACWI	MSCI All Country World Net Total Return	NDUEACWF Index
S&P 500/US Large Cap	S&P 500 Net Total Return	SPTR500N Index
European Large Cap	MSCI Europe Net Total Return	M1EU Index
Emerging Markets Equity	MSCI Emerging Net Total Return	NDUEEGF Index
Multiverse	Bloomberg Multiverse Total Return	LF93TREU Index
World Government Bonds	Bloomberg Global Aggregate Treasuries Total Return	LGTRTREU Index
Bloomberg EUR Agg	Bloomberg EuroAgg Total Return	LBEATREU Index
Euro Inv Grade Corp Bonds	Bloomberg Euro Aggregate Corporate Total Return	LECPTREU Index
Euro High Yield Bonds	Bloomberg Pan-European High Yield Total Return	LP01TREU Index
Long US Treasury	Bloomberg US Long Treasury Total Return	LUTLTRUU Index
Global Aggregate	Bloomberg Global-Aggregate Total Return	LEGATREU Index
TIPS	Bloomberg Global Inflation-Linked Total Return	I01550EU Index
Gold	LBMA Gold Price PM	GOLDLNPM Index
Bloomberg Commodity/Broad Commodities	Bloomberg Commodity Index Total Return	BCOMTR Index
Listed Infrastructure	MSCI World Infrastructure Net Total Return	M1WO0INF Index
Global REITS	FTSE EPRA NAREIT DEVELOPED Total Return	RUGL Index
Global Hedge Funds (Global HY)	HFRX Global Hedge Fund Index	HFRXGL Index
Macro CTA	HFRX Macro/CTA Index	HFRXM Index
Equity Market Neutral	HFRX EH Equity Market Neutral Index	HFRXEMN Index
Merger Arbitrage	HFRX ED Merger Arbitrage Index	HFRXMA Index
Systematic CTA	HFRX Macro Systematic Diversified CTA Index	HFRXSDV Index
Absolute Return	HFRX Absolute Return Index	HFRXAR Index
Event-Driven	HFRX Event Driven Index	HFRXED Index
Credit HF	HFRX Fixed Income Credit Index	HFRXFIC Index
Convertible Arbitrage	HFRX Relative Value Fixed Income Convertible Arbitrage Index	HFRXCA Index
Distressed	HFRX ED Distressed Restructuring Index	HFRXDS Index

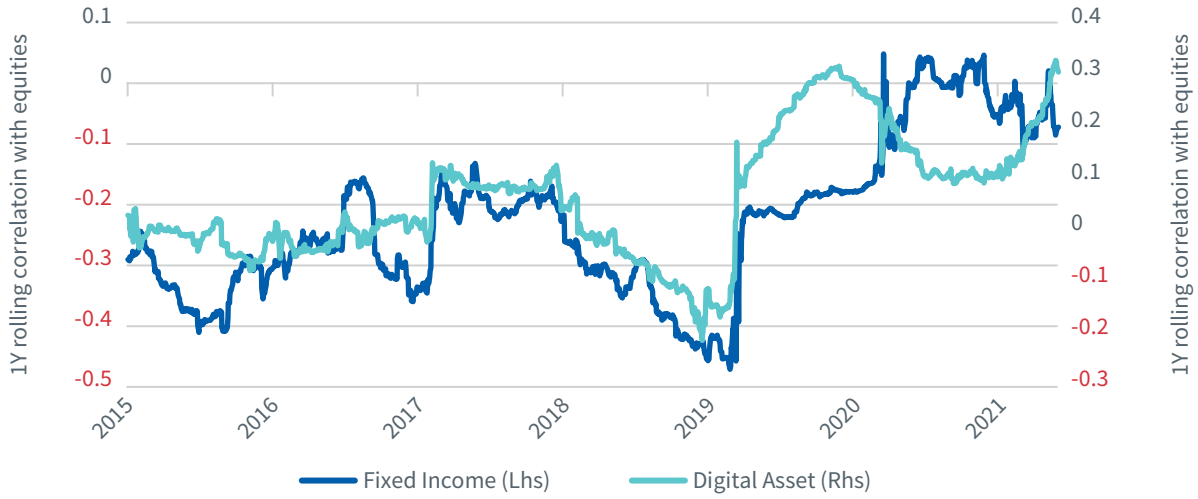
a. Correlations are unstable across all asset classes, not just digital assets

Short-term correlations between digital assets and other asset classes are, indeed, not stable over time. When calculated at two different points in time, the result will be different. However, this is a notorious problem for all asset classes. Correlation and covariance matrices are notoriously unstable, and this is not a 'digital asset' specific issue.

Taking the two biggest assets in any asset allocation, equity and fixed income, Figure 35 shows that their correlation also varies over time. Over the last seven years, it oscillated between -0.47 and +0.05, an amplitude of 0.52. When looking at the 1Y rolling correlation of digital assets and equity, we observe the same amplitude of 0.52 between the minimum and maximum correlation.

So, while 'technically' the correlations between digital assets and traditional asset classes vary, they do not do so more sharply or often than the correlation between traditional asset classes. Therefore, the matrix in Figure 33 still stands and points to the strong diversifying power of digital assets.

Figure 35: 1Y rolling correlation with equities



Source: Bloomberg, WisdomTree. From 31 December 2014 to 31 May 2022. Calculated in USD on daily returns. Fixed Income is represented but the Bloomberg US Aggregate Index. Equities are represented by the S&P 500 net TR Index. **You cannot invest directly in an index. Historical performance is not an indication of future performance and any investment may go down in value.**

b. Digital assets are decorrelated, but they are not a safe-haven asset

Diversification is a misunderstood concept. This misconception stems from the confusion between diversification in the context of an asset allocation and the concept of safe-haven assets and protection against macroeconomic risk.

In an asset allocation, diversification, as defined in modern portfolio theory, points to lowering the portfolio's overall volatility by combining multiple assets that are not perfectly correlated without sacrificing return. In other words, it points to the possibility that, by combining two assets with an expected return of 5% and a volatility of 15%, it is possible to create a portfolio with the same expected return of 5% but with a volatility lower than 15%. The less correlated the two assets, the more the portfolio volatility can be reduced.

The fact that two assets tend to fall simultaneously in response to an external stimulus, like a geopolitical crisis or macroeconomic event, indicates that both assets are risk-on or risk-off, but it does not negate the fact that they may offer each other diversification.

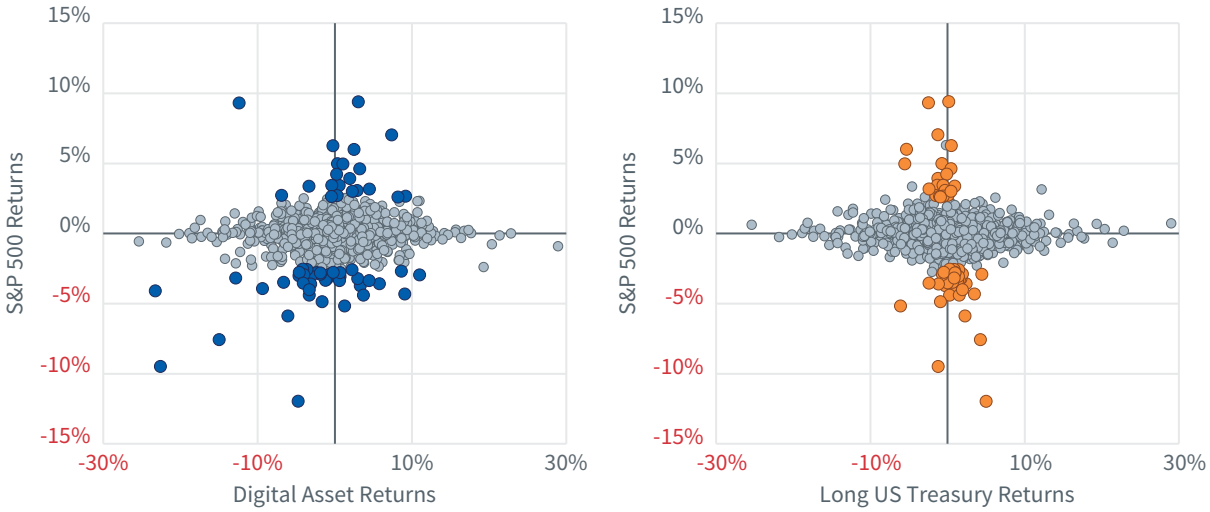
So, "can digital assets act as a safe-haven asset?" and, "do digital assets offer diversification to a portfolio of traditional assets?" are two different questions. Let's try to answer both.

The right-hand graph in Figure 36 exhibits the relationship between the daily returns of the S&P 500 and long duration US Treasury bonds since December 2014. The days where the S&P 500 moved the most (up or down) are highlighted in orange. It is quite clear from the orange pattern that US Treasury tends to gain when US equities drop significantly during a day and, similarly, tends to lose when equities gain. This is the typical pattern of a safe-haven or risk-off asset.

The left-hand graph shows the same analysis for digital assets, but we do not observe a risk-off behaviour. Here, we observe the pattern of a mostly risk-on asset, that is, that goes up and down in line with equities when such equities experience big daily moves. However, we still observe many 'off-pattern' days where digital assets and equities do not move in line with their risk-on relationship. In fact, 30% of days with large S&P 500 moves are off-pattern for digital assets when only 27% are for US Treasury.

So, while digital assets are risk-on assets at this stage in their development, they exhibit a certain versatility that points to a strong capability to diversify risk.

Figure 36: Daily returns distributions for the S&P 500, long-duration US Treasury and digital assets



Source: Bloomberg, WisdomTree. From 31 December 2014 to 31 May 2022. Calculated in USD on daily returns. You cannot invest directly in an index. **Historical performance is not an indication of future performance and any investment may go down in value.**

Our second question deserves a little experiment. Since December 2004, the S&P 500 index has exhibited a volatility of 18.4%[71] and the Bloomberg US Aggregate index one of 3.8%. In an equal weight portfolio of both assets, the volatility should be 11.1% over the period without any diversification. However, bonds and equities are negatively correlated most of the time. This means that some of their respective volatility would have disappeared when put together in a portfolio. The portfolio would have exhibited, in reality, a volatility of 9%. The diversification effect 'removed' 2.1% of volatility in the portfolio, allowing an investor to take more risk in other parts of the portfolio.

Similarly, we could add 10% of digital assets to this same portfolio. Leaving us with 90% in an equal weight portfolio between equity and bonds with a volatility of 9% and 10% in digital assets that have exhibited a 74.5% volatility. Without any diversification effect, the resulting volatility for the portfolio should be 15.6%. But, thanks to the low historical correlation and, therefore, the diversification effect, the portfolio's volatility is, in fact, 11.6%. The diversification made 4% of volatility disappear.

Having looked at the available data, it appears that digital assets are, therefore:

+ Showing diversification potential in the context of a strategic asset allocation
+ Offering to investors an asymmetric payoff, positively skewed
+ Exhibiting low correlation to traditional asset classes over long periods
+ Demonstrating a correlation's stability over time which is on par with other asset class
+ Expressing a somewhat risk-on behaviour in crisis around two-thirds of the time

All of these combined point to digital assets being a strong addition to portfolios, even if in small quantities.

71 As of 31 May 2022.

B. Where does a digital asset fit in a portfolio?

Thinking about digital assets as a thematic investment is a good framework for understanding the investment case. It helps to frame it properly as this once in a generation opportunity.

But, when it comes to portfolio construction, it is easier to think about them as an alternative investment. They can sit alongside commodities, gold, real estate, infrastructure or private equities. They can be:

+ A portfolio diversifier, like broad commodities
+ A source of growth like private equities or venture capital (VC) investments

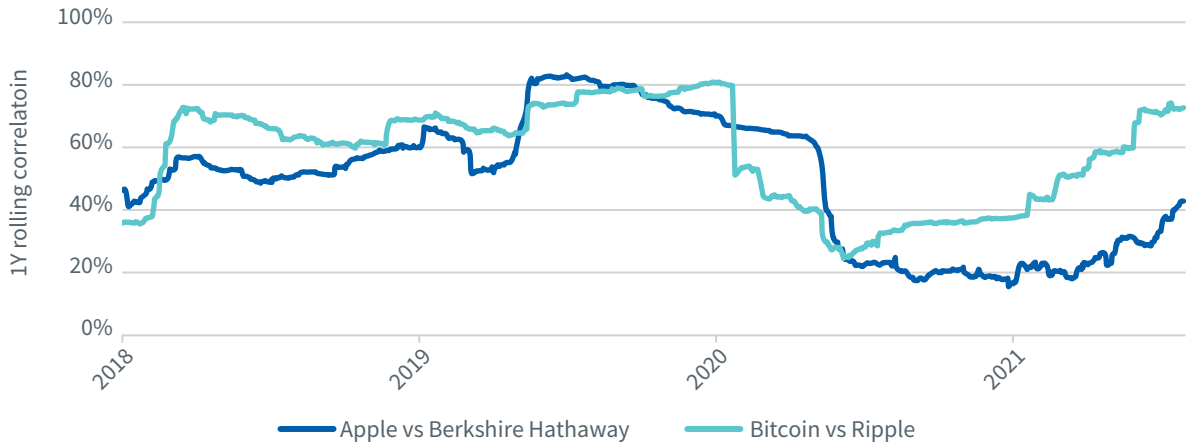
C. Investing strategically, investing tactically

As discussed in a previous paper on thematic investment[72], it is possible to invest in megatrends strategically to benefit from the long-term growth inherent to investing in world-changing trends or, tactically, trying to benefit from the hype cycle that such changes can go through. The same holds true for digital assets. However, depending on the investor's objectives, different approaches will need to be used to extract the most value added.

The previous section discussed the low correlation between digital assets and traditional asset classes. But, as highlighted in Part II of this paper, digital assets represent a vast ecosystem of widely different investment propositions. The WisdomTree Digital Assets Taxonomy and, in particular, the different economics attached to the different categories, show an obvious diversification potential between 'coins'. Even if each of those assets will have some beta exposure to the digital space, they will all react to different tailwinds and challenges that might provide significant diversification.

When looking at the digital assets space from an investor's perspective, it is hard not to make a parallel with the equity world. Each company is different and driven by its own idiosyncratic circumstances. Similarly, each protocol is different and is driven by its economics, the capacity of its team to execute and the growth rate of users/clients. Figure 37 clearly illustrates how two digital assets can be as decorrelated as two stocks.

Figure 37: 1Y rolling correlation between two US stocks and between 2 digital assets



Source: Bloomberg, Messari. WisdomTree. From 30 October 2017 to 31 May 2022. Calculated in USD on daily returns. **You cannot invest directly in an index. Historical performance is not an indication of future performance and any investment may go down in value.**

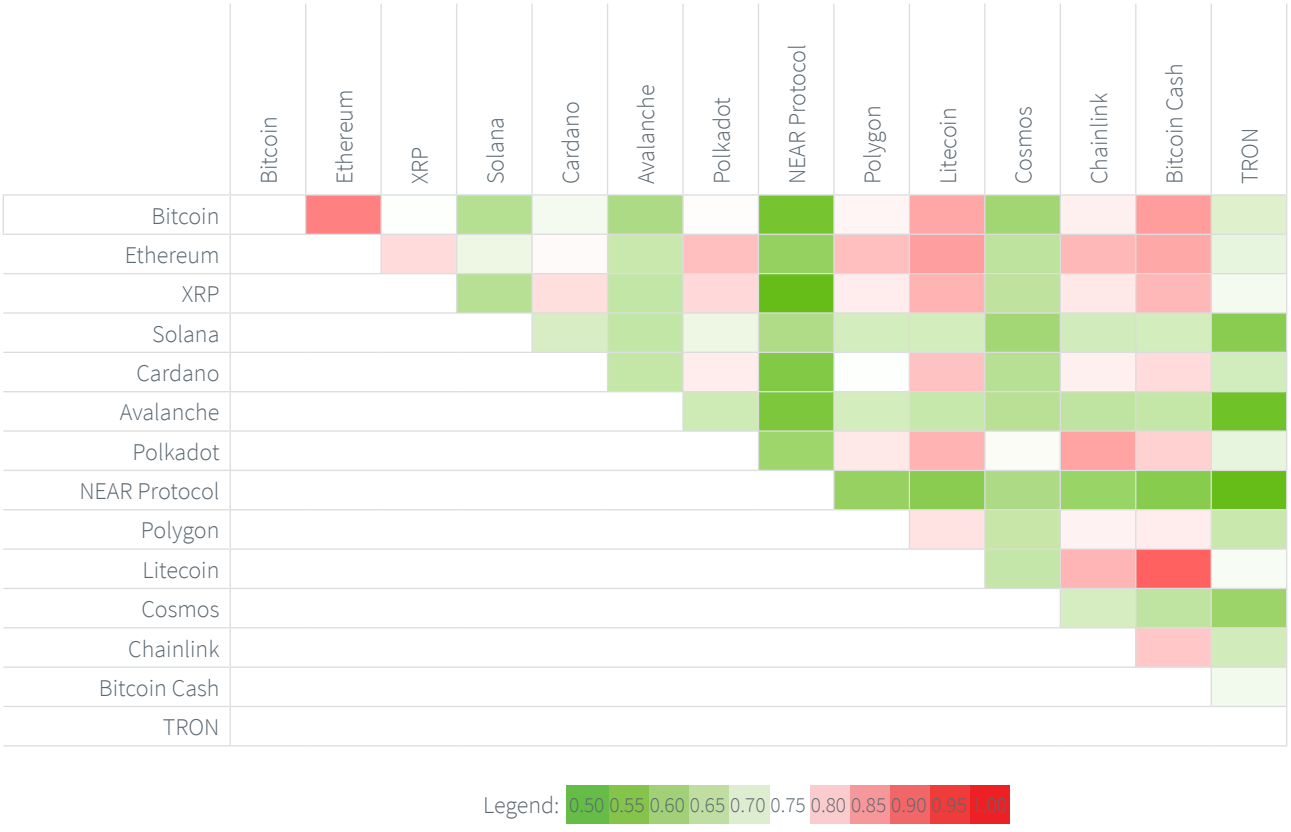
[72] P. Debru and E. Kuramshina, 'Thematic Universe: How to harness the power of megatrends in your portfolio?' Apr 2021.

In the digital assets space, like in equities, there are larger caps (Bitcoin, Ethereum) and smaller caps (Waves, Tezos). There are also sectors, like gaming, metaverse or DeFi.

When it comes to investing in equities, most strategic investors lean toward a relatively large and diversified portfolio of stocks, spread across countries and sectors. More tactically, investors may focus on stock picking and concentrated portfolios. Keeping to this analogy, investors in digital assets would probably be wise to apply the same principles.

Starting from Bitcoin in 2009, the number of digital assets has grown very quickly to reach multiple thousands. While each coin or token is part of the ecosystem, they also react to events related to their blockchain and use case. In other words, they exhibit a beta to the digital space as well as idiosyncratic risks that are specific to them. Mathematically this translates into a relatively diversified matrix of correlation. Figure 38 shows a heatmap of USD daily returns between different digital assets over the last 12 months. Correlation ranges from 0.4 to 0.9 depending on the asset's beta to the space.

Figure 38: Last 12 months correlation matrix of 15 of the largest digital assets



Source: Messari, WisdomTree. From 16 June 2021 to 16 June 2022. Calculated in USD on daily returns. **You cannot invest directly in an index. Historical performance is not an indication of future performance and any investment may go down in value.**

These results are in line with academic findings. (Chuen, Guo, & Wang, 2017), (Alessandretti, ElBahrawy, Aiello, & Baronchelli, 2018) and (Ma, Ferhana, Miao, & Zilong, 2020) argued that the addition of multiple cryptocurrencies could lead to better portfolio performance. Such diversification allows lowering risk strategically by combining a wide range of coins across categories and focusing on tactical opportunities in different parts of the space.

1. Strategic investments in digital assets

a. How to build a diversified investment in digital assets

A strategic investment in digital assets aims to benefit from the long-term growth of the space. The strategic investor is investing in the belief that blockchains, cryptocurrencies and tokens will evolve from a state of nascent adoption to full adoption. This is the same logic as investing in equity markets as a whole in your pension funds to beat inflation and grow wealth for the long term. A financial adviser would never recommend investing your pension fully in Apple stocks but would recommend investing it in an MSCI World ETF. Similarly, such a strategic investment in digital assets should fully use the existing diversification in the space. The golden rule should be to combine assets across market caps and across categories in the taxonomy, creating a robust portfolio that benefits from the growth and controls the risk.

So, how can a diversified portfolio or index of digital assets be created? For equities, a market capitalisation-weighted portfolio is the default. It was created many decades ago with great success. Quite logically, it became the default when looking at a new asset class. But, for most asset classes except equities, it is a disputable choice:

+ In fixed income, while market-cap weighting is also the standard it, by construction, gives the greatest weight to the most indebted entities, which is both counterintuitive and problematic.

+ In commodities, the 'best' indices have been developed specifically for that asset class. Moving away from market capitalisation, the weighting is based on liquidity and production data.

Moving on to digital assets, at this stage of their development at least, pure market capitalisation weighting is problematic:

+ First, contrary to equities, market cap and liquidity don't go hand in hand with digital assets. Some assets can be quite big and, at the same time, illiquid.

+ Second, not all digital assets are the same (see WisdomTree Digital Assets Taxonomy), so some filtering needs to be applied. The price of Stablecoins is meant to remain 'stable' and, therefore, these are not a long-term investment. Meme coins are not usually a sound long-term investment either.

+ Third, market capitalisation's volatility is also quite high, while the S&P 500 holdings and weights are relatively stable over time. This would not be the case for a digital asset 500 portfolio, which would see large turnover and many deletions and additions.

b. WisdomTree's framework for diversified digital assets investments

Therefore, a specific framework is needed for digital assets. At WisdomTree, we believe that a certain number of steps should be applied consistently:

Defining index eligibility

+ The goal here is to identify which digital assets are established & investable. This can be done using a series of quantitative criteria. For all digital assets, this will include standard metrics (market capitalisation and volume) but may also include other metrics where deemed appropriate (for example, total value locked for DeFi). We look at both the current and historical values for the metrics looking for sustained adherence to the criteria.

+ This is a mainly systematic approach. However, in such a nascent asset class, some subjectivity needs to be applied through a risk screen for assets on the edge of the inclusion criteria, for example, you may not want to drop an exposure simply because its market cap dipped below a threshold the day before reviewing eligibility.

Construction of parent indices

+ For a given index, it is important to start by defining an investment objective and map this to the relevant categories within our taxonomy. The index is then constructed by selecting all coins within those categories that meet the index eligibility criteria. There may be some additional exclusions made based on the investment objective. For example, an alt-coins basket would be constructed by selecting most layer 1 payments and layer 1 smart contracts and excluding Bitcoin and Ethereum.

+ This creates a theoretical index representing the 'market segment' the index represents. In an ideal world, this is what the index should ultimately look like; however, access to a given coin is not universal, nor is it uniform across different wrappers, jurisdictions or service providers. As a result, we need to construct investable indices that take into account the use case in the real world.

+ Weightings of such an index will also need careful consideration. In a space where volatility can reach triple-digits easily, market capitalisation moves very fast. A simple market cap-weighted approach could lead to high turnover and numerous additions or deletions in the index. Therefore, a well thought out approach is necessary to maintain the investability and representativeness of the basket.

Construction of investable indices

+ Investable indices are, in essence, a subsection of a given parent index that considers the practicalities associated with specific use cases. This is driven by support from the ecosystem related to the implementation, for example, when building an investable index for an ETP, we need to consider what exposures are supported by custodians, exchanges, clearing houses and Authorised Participants.

The end result of such a process is a collection of investable indices that can best represent the full space, or some slice of it, in a diversified manner.

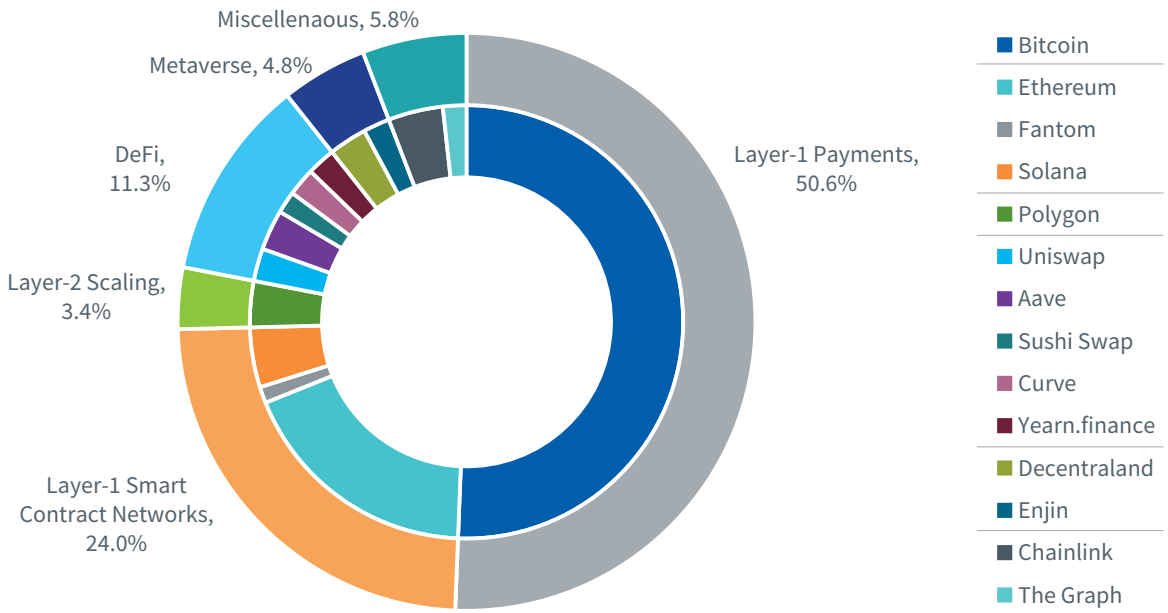
c. An example: WisdomTree Ritholtz Wealth Management Crypto Index (RTREE index)

One example of this approach is the WisdomTree/Ritholtz Wealth Management Crypto Index (RTREE Index), launched in November 2021. It seeks to provide broad and diversified exposure to digital assets, spanning layer 1 networks (for example, payment systems, smart contract platforms), layer 2 protocols, oracle networks, crypto indexing services, decentralised finance (DeFi) and the metaverse.

The Index includes digital asset constituents through a committee-led methodology and process that considers use cases and importance to the crypto ecosystem. Each digital asset either plays, or has the potential to play, an essential role within the crypto ecosystem and/or supplies necessary services for the crypto ecosystem to flourish.

The Index at conception captured approximately 64% of the total crypto market capitalisation, providing diversified exposure to the overall crypto economy while seeking to present unique growth opportunities.

Figure 39: RWM WisdomTree Crypto Index - Current holdings



Source: WisdomTree, Messari, as of June 2022. Ritholtz Wealth Management (RWM)

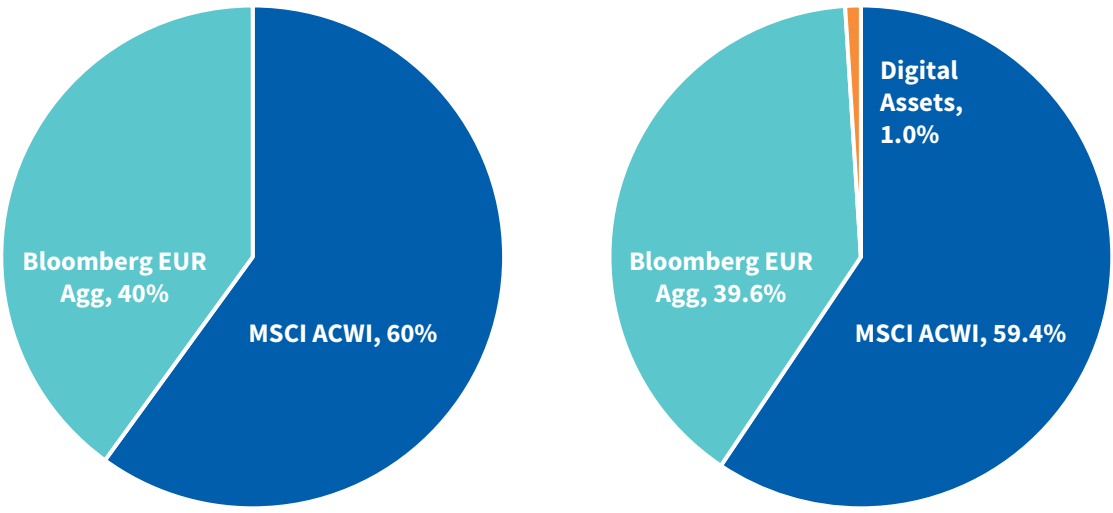
In addition to the RTREE Index, WisdomTree has launched other indices to offer clients the ability to strategically allocate within their cryptocurrency portfolio to themes like the metaverse and DeFi, as well as broad altcoins to build an allocation outside of any existing Bitcoin and Ether holdings. By offering these 'building blocks' to a crypto portfolio, clients are able to better position themselves within the space based upon their market views on these themes.

d. The advantages of a strategic investment in a diversified basket of digital assets

The next section focuses on the impact of investing a small portion of a portfolio into a diversified basket of digital assets. Academics have been looking at the potential benefits of adding Bitcoin and digital assets to various portfolios using a variety of optimisation techniques. On average, most of them found an improvement in risk-return profile of the investment. Without going for an exhaustive list this is, in particular, the case for (Wu & Pandey, 2014), (Brière, Oosterlinck, & Szafarz, 2015), (Eisl, Gasser, & Weinmayer, 2015), (Gangwal, 2017), (Andrianto & Diputra, 2017), (Aggarwal, Mayank, & Prateek, 2018), (Guesmi, Saadi, Abid, & Ftiti, 2019), (Kajtazi & Moro, 2019), (Akhtaruzzaman, Sensoy, & Corbet, 2019), (Platanakis & Urquhart, 2019), (Bakry, Rashid, Al-Mohamad, & El-Kanj, 2021) and (Petukhina, Trimborn, Hardle, & Elendner, 2021).

For this example, the focus is on a euro-based multi-asset portfolio. For simplicity's sake, the base portfolio is a mix between 60% equities and 40% bonds. To ensure a large diversification in the portfolio, the equity bucket invests in the MSCI All Country World (MSCI ACWI), a market cap index that comprises almost 3000 companies spread across 47 countries (23 in developed markets and 24 in emerging markets). The fixed income bucket invests in the Bloomberg Euro Aggregate Index (Bloomberg EUR Agg), which regroups government bonds, corporate bonds, government-related bonds and securitized bonds in an index comprised of more than 6,000 investment-grade bonds. Our constant proportion portfolios will then add 1%, 3% and 5% of a diversified digital asset portfolio, rebalanced every month.

Figure 40: Example, multi-asset portfolios, allocating a constant proportion to digital assets



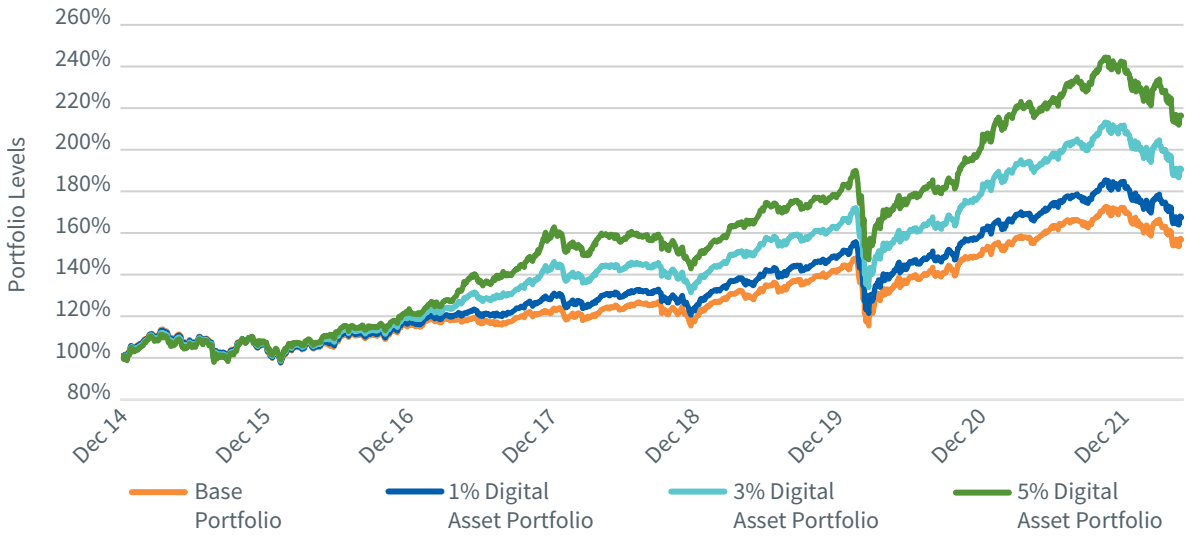
Source: WisdomTree. **You cannot invest directly in an index.**

When running the portfolio for the last seven and half years, we observe that adding digital assets to the portfolio significantly improved the overall returns. Adding 1% of digital assets increased the annualised return by 1%. Adding 3% increased the annualised return by almost 3%. Despite the recent correction in digital assets, you could say that this is not a big surprise.

However, where it gets more interesting is on the risk side. Despite the elevated volatility of digital assets, adding 1% to the base portfolio only increased the volatility by 0.1%. Even when adding 5% of digital assets, the volatility only increases by 1.5%. This means that the portfolios' risk-return profile with digital assets is significantly improved. The return benefits significantly outweigh the added risk. Consequently, the Sharpe ratio is improved across the board. The 1% digital asset portfolio exhibits a Sharpe of 0.85, and the 5% digital asset portfolio exhibits a Sharpe of 1.1, compared to 0.75 for the base portfolio.

The resulting information ratio of 1.2, that is, the ratio between the annualised outperformance and the tracking error to the base portfolio, is even more impressive.

Figure 41: Historical performance of the constant mix portfolios



	Annualised return	Volatility	Sharpe ratio	Max drawdown	Information ratio
Base Portfolio	6.2%	8.7%	0.75	-22.2%	
1% Digital Assets Portfolio	7.2%	8.8%	0.85	-22.3%	1.22
3% Digital Assets Portfolio	9.1%	9.3%	1.00	-22.5%	1.22
5% Digital Assets Portfolio	11.0%	10.2%	1.10	-22.6%	1.23
MSCI ACWI	10.0%	13.6%	0.76	-33.4%	
Bloomberg Barclays Multiverse	0.2%	3.9%	0.14	-12.9%	
Digital Assets	85.5%	97.0%	0.88	-87.0%	

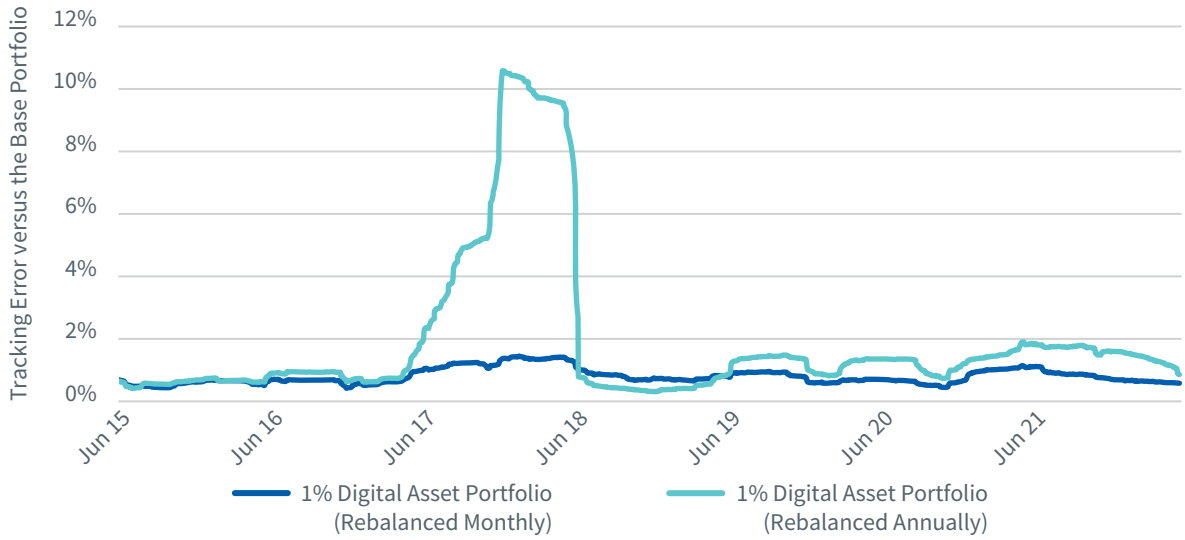
Source: Bloomberg, WisdomTree. From 31 December 2014 to 31 May 2022. Calculated in EUR on daily returns. **You cannot invest directly in an index. Historical performance is not an indication of future performance and any investment may go down in value. For illustrative purpose only.**

Expanding on those results, it is worth mentioning that if an investor wants to improve the base portfolio, a logical solution would be to replace market cap indices with active managers. Going from passive to active management to seek alpha is a classic move. By doing so, the investor would accept some tracking error to the benchmarks in the equity and the fixed income buckets to allow for outperformance. The typical tracking error for an active equity fund is between 4% and 7%. For a bond fund, it is around 1% to 2%. So, overall, the tracking error of the 'active' base portfolio would easily reach around 3%. Empirically, this is the observed historical tracking error of the portfolio investing around 4% of its assets in digital assets. What about the reward for such risk?

For active managers, an information ratio of 0.5 is considered pretty good. Anything above 1 is very rare. So, in all likelihood, the active base portfolio would have delivered around 1.5% to 2% of outperformance per annum for the 3% tracking error versus the (passive) base portfolio. We know (from the above) that, historically, using the same risk budget to invest 4% in digital assets would have created a 4% annualised outperformance. Almost twice the extra return. This is because the risk taken in digital assets has been repaid through a very high information ratio of 1.2.

With an asset that is as volatile as digital assets, the implementation of even a simple constant proportion strategy is key. Without frequent rebalancing, the weight of digital assets could grow significantly, leading to a higher risk than expected and wished. Figure 42 compares the rolling one-year tracking error to the base portfolio of two portfolios using the same target weight in digital assets. However, one rebalances monthly, and the other rebalances yearly. While the monthly rebalanced portfolio investing in 1% of digital assets exhibits a very limited average tracking error of 0.8%, the yearly rebalanced portfolio exhibits a tracking error of 3%. In their riskiest twelve months, the difference in risk is phenomenal. When rebalancing monthly, the worst tracking error is 1.4%, but 10.6% for a yearly rebalance portfolio.

Figure 42: Rolling tracking error between the 1% Bitcoin portfolio and the base portfolio depending on the rebalancing frequency

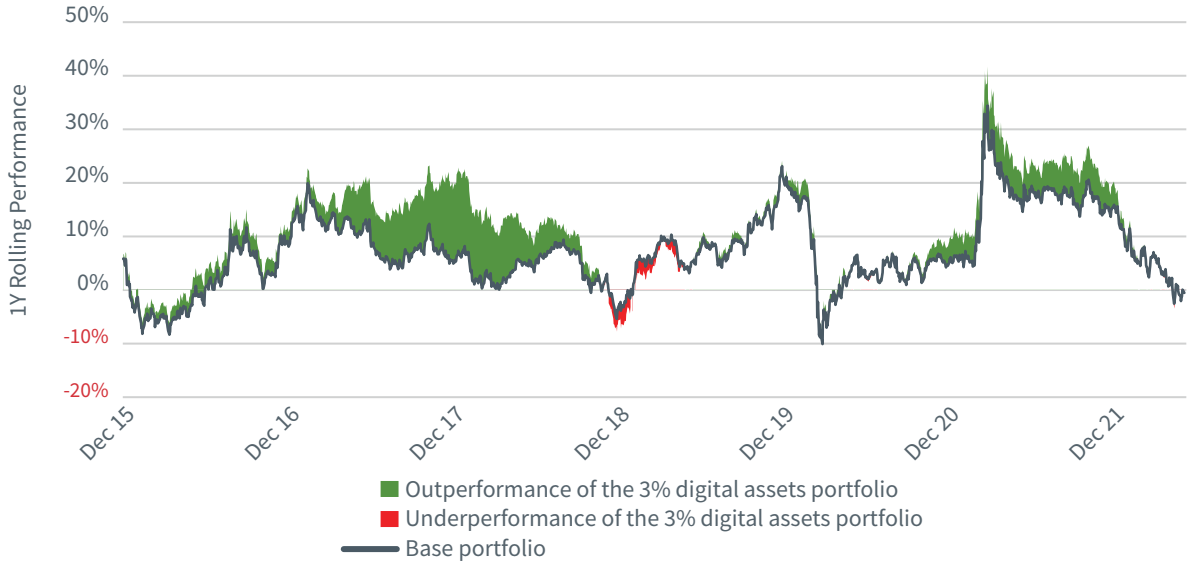


Source: Bloomberg, WisdomTree. From 31 December 2014 to 31 May 2022. Calculated in EUR on daily returns. **You cannot invest directly in an index. Historical performance is not an indication of future performance and any investment may go down in value.**

A systematic approach benefits from the return asymmetry of the asset. It reduces the reliance on discretionary decisions and helps avoid behavioural pitfalls.

When combined, regular rebalancing and positive skewness can deliver very nice results. Figure 43 shows the periods of outperformance and underperformance of the 3% digital assets portfolio versus the base portfolio. The periods of outperformance dwarf the periods of underperformance. But, more importantly, digital assets have suffered large drawdowns over the last seven years. The max drawdown of digital assets over this period is -87%. At one point, USD$100 invested in digital assets turned in only USD$13. And yet, you would not guess it from Figure 43. There is no catastrophic loss in the 3% digital assets portfolio thanks to a combination of contained investment in digital assets, frequent rebalancing and positive skewness of the asset class.

Figure 43: Outperformance and underperformance pattern of the 3% Bitcoin portfolio



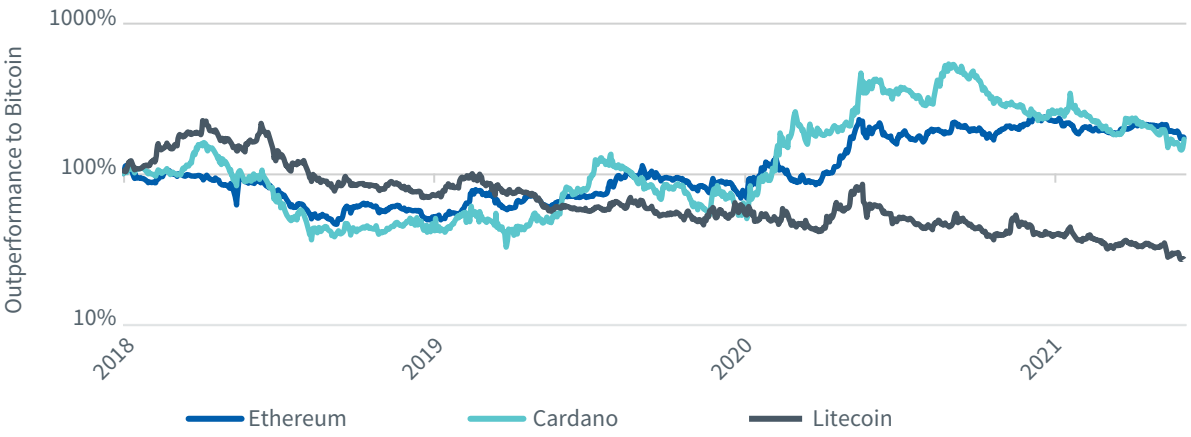
Source: Bloomberg, WisdomTree. From 31 December 2014 to 31 May 2022. Calculated in EUR on daily returns. **You cannot invest directly in an index. Historical performance is not an indication of future performance and any investment may go down in value. For illustrative purpose only.**

2. Tactical investments in digital assets

While a strategic allocation in equities is enough for most investors, some investors like to pick stocks, digging deep into the inner workings of a company and figuring out if it can beat its peers and make its shareholders rich. Investing in all internet stocks in the 1990s was the right thing to do: investing in AOL would have been catastrophic but investing in Google or Amazon would have been genius!

The same is true for digital assets. While the space itself benefits from rapid growth and is looking forward to rapid growth, some projects/coins/tokens will lead, and some will fail. Figure 44 illustrates the distinctive performance of three different projects: Ethereum, Cardano and Litecoin. All three projects are subject to their success and failures, which drive their price.

Figure 44: Outperformance of 3 different projects over Bitcoin



Source: Bloomberg, CoinGecko, WisdomTree. From 31 December 2018 to 31 May 2022. Calculated in USD on daily returns. **You cannot invest directly in an index. Historical performance is not an indication of future performance and any investment may go down in value. For illustrative purpose only.**

One exciting example illustrating the potential of tactical investment in digital assets is the use of price momentum and price reversal in the construction of tactical portfolios. In equities, (Jegadeesh & Titman, 1993) showed that over short horizons (less than one year), stock markets are affected by a momentum effect where past winners tend to continue to perform well. They also show that long-term reversal is observed over longer horizons, with past winners shedding some of those gains. A similar analysis on digital assets (Dobrynskaya, 2021), performed with a sample of the 2,000 biggest cryptocurrencies over six years, shows similar results, but with a significantly shorter horizon. In digital assets, the reversal appears quickly, for a horizon longer than a month.

In Figure 45, we try to reproduce this analysis by focusing on 205 of the largest coins in the universe. We gather weekly returns for as many of those coins from October 2016 to today and run a systematic analysis on a long-short portfolio. We calculate the return of each coin for the past J weeks (lookback period) and then we create a portfolio with a long position in an equal-weight portfolio of the 30% coins with the best returns and a short position in an equal-weight portfolio of the 30% coins with the worst returns. We then invest in that long-short portfolio for K weeks (holding period). In the top left corner (green) we observe that strategies with short lookback periods and short holding periods deliver positive average returns showing a clear momentum effect. In the bottom right corner (red), strategies have negative returns, demonstrating a clear mean reversal effect as soon as lookback (J) and holding (K) periods get over 6 or 7 weeks.

Figure 45: Average weekly returns of the long-short portfolio

K/J	1	2	3	4	5	6	7	8	9	10	11	12
1	-1.7%	1.4%	1.2%	0.5%	-0.5%	-1.1%	-1.0%	-0.7%	-1.1%	-0.9%	-1.6%	-1.0%
2	1.9%	1.7%	0.8%	0.3%	-0.5%	-0.4%	0.1%	0.6%	0.0%	-0.5%	-1.0%	-1.0%
3	1.4%	1.2%	0.5%	0.2%	-0.2%	0.1%	0.3%	0.1%	0.0%	-0.2%	-1.3%	-1.0%
4	1.5%	1.3%	0.2%	-0.3%	-0.6%	-0.5%	-0.3%	-0.4%	-0.6%	-2.2%	-1.5%	-4.7%
5	1.1%	0.7%	0.3%	-0.3%	-0.2%	-0.1%	-0.1%	0.0%	-1.3%	-2.1%	-2.0%	-4.0%
6	1.2%	0.9%	0.8%	0.1%	0.3%	0.3%	0.4%	0.0%	-0.5%	-1.5%	-2.9%	-3.7%
7	0.6%	0.2%	-0.2%	-0.8%	-0.9%	-0.8%	-1.2%	-1.6%	-2.3%	-3.0%	-3.0%	-3.8%
8	0.2%	0.0%	-0.5%	-1.1%	-1.1%	-1.0%	-1.3%	-1.7%	-2.5%	-2.5%	-3.1%	-2.8%
9	0.0%	-0.4%	-1.1%	-1.3%	-1.4%	-1.4%	-1.5%	-2.0%	-2.5%	-2.9%	-2.9%	-3.3%
10	-0.3%	-0.7%	-0.9%	-1.2%	-1.5%	-1.4%	-1.7%	-2.1%	-2.7%	-2.5%	-2.8%	-3.2%
11	-0.2%	-0.4%	-1.0%	-1.5%	-1.9%	-1.4%	-1.2%	-1.4%	-1.2%	-1.9%	-2.7%	-2.9%
12	-0.3%	-0.5%	-0.8%	-0.9%	-0.9%	-0.8%	-1.0%	-0.6%	-1.2%	-1.3%	-1.6%	-1.7%

Source: Messari, WisdomTree. From 24 December 2016 to 11 June 2022. Calculated in USD on weekly returns. Returns are windsorised at 0.05%. **You cannot invest directly in an index. Historical performance is not an indication of future performance and any investment may go down in value.**

Digging further, we want to clarify if the momentum and mean-reversion effects in the long-short portfolios are driven by the long leg, the short leg or both. We re-run a similar analysis but focusing on the performance of the long side of the portfolio only. The average weekly performance of this long-only portfolio is compared to the performance of an equal-weight portfolio investing in all available coins over the K weeks considered. Figure 46 shows that the momentum and mean reversal effect are also clearly observable on the long leg only. This opens the possibility of creating simple, long-only tactical strategies.

Figure 46: Average weekly returns of the long-only portfolio

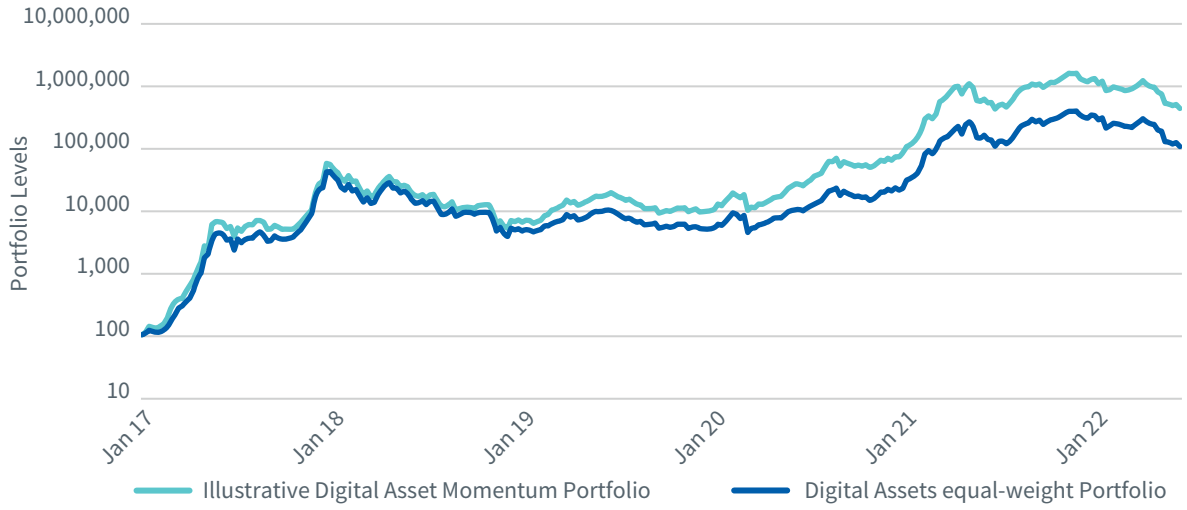
K/J	1	2	3	4	5	6	7	8	9	10	11	12
1	0.3%	0.7%	0.4%	0.5%	-0.3%	-0.5%	-0.7%	-0.6%	-0.9%	-1.0%	-1.1%	-0.6%
2	1.1%	0.7%	0.1%	-0.1%	-0.7%	-0.5%	-0.3%	-0.2%	-0.5%	-0.9%	-0.8%	-1.0%
3	0.8%	0.5%	-0.1%	-0.1%	-0.5%	-0.4%	-0.3%	-0.4%	-0.6%	-0.7%	-1.1%	-1.5%
4	0.8%	0.3%	-0.2%	-0.3%	-0.7%	-0.6%	-0.6%	-0.8%	-1.1%	-1.7%	-1.8%	-2.6%
5	0.4%	0.0%	-0.5%	-0.7%	-0.6%	-0.4%	-0.3%	-0.5%	-1.0%	-1.5%	-1.7%	-2.0%
6	0.3%	0.0%	-0.2%	-0.5%	-0.5%	-0.3%	-0.3%	-0.8%	-1.2%	-1.4%	-1.8%	-2.0%
7	0.2%	-0.4%	-0.6%	-1.0%	-1.2%	-1.2%	-1.5%	-1.9%	-1.9%	-2.1%	-2.2%	-2.3%
8	-0.1%	-0.3%	-0.2%	-0.4%	-0.6%	-0.6%	-0.9%	-1.3%	-1.5%	-1.5%	-1.8%	-1.5%
9	-0.1%	-0.5%	-0.7%	-1.0%	-1.4%	-1.3%	-1.5%	-1.9%	-1.9%	-2.1%	-1.9%	-2.2%
10	-0.1%	-0.5%	-0.4%	-0.6%	-0.9%	-0.8%	-1.2%	-1.4%	-1.6%	-1.4%	-2.0%	-2.1%
11	0.0%	-0.4%	-0.7%	-0.9%	-1.4%	-1.1%	-1.2%	-1.5%	-1.2%	-1.6%	-1.6%	-2.1%
12	-0.1%	-0.5%	-0.6%	-1.0%	-1.1%	-1.2%	-1.1%	-0.6%	-0.7%	-0.8%	-0.9%	-1.2%

Source: Messari, WisdomTree. From 24 December 2016 to 11 June 2022. Calculated in USD on weekly returns. Returns are windsorised at 0.05%. **You cannot invest directly in an index. Historical performance is not an indication of future performance and any investment may go down in value.**

In Figure 47, we choose to run a simple momentum-driven strategy using a two-week look back period and a two-week holding period. On even weeks, 50% of the portfolio is invested in an equal-weight portfolio of the 30% coins with the highest momentum over the previous two weeks. This part of the portfolio remains invested for two weeks, that is, until the following even week. On odd weeks, the remaining 50% of the portfolio is invested in an equal-weight portfolio of the 30% coins with the highest momentum over the previous two weeks. This part of the portfolio remains invested for two weeks, that is, until the following odd week. The performance of the illustrative digital asset momentum portfolio is compared to a simple equal-weight portfolio that rebalances its holdings every week to invest in every asset available in the universe.

The result shows that this simple momentum strategy would consistently return better than a naïve equal-weight basket. The volatility is increased, but the Sharpe ratio remains better for the momentum strategy.

Figure 47: Historical performance of a simple momentum strategy (two weeks lookback, two weeks holding)



	Annualised return	Volatility	Sharpe ratio	Max drawdown	Information ratio
Illustrative Digital Asset Momentum Portfolio	374.1%	135.9%	2.75	-90.9%	2.49
Digital Assets qual-weight Portfolio	264.9%	122.9%	2.15	-91.0%	

Source: Messari, WisdomTree. From 24 December 2016 to 11 June 2022. Calculated in USD on weekly returns. Returns are windsorised at 0.05%. **You cannot invest directly in an index. Historical performance is not an indication of future performance and any investment may go down in value.**

D. How much to allocate to digital assets?

Previous sections have highlighted the many reasons to add digital assets to a multi-asset portfolio, whether tactically or strategically. However, one main consideration remains: how much weight should we allocate to this asset class?

While the growth potential is immense, at this stage of its development, considering its high volatility and drawdowns, most investors would pick a relatively small allocation to digital assets. Many readers may question whether they should bother at all if the result is only to incorporate a percent or two of digital assets. The reality is that:

+ Even 1% can make a big difference in a portfolio, as demonstrated in the previous section. 1% per annum over the last seven years of extra performance is not inconsequential.

+ Digital assets are here to stay. In contrast to five years ago, most crypto sceptics have now accepted that the space is too big; the ecosystem has become too developed for digital assets to just evaporate into thin air. So, a small allocation now could be the perfect way to gain knowledge on this completely new asset class in prevision of a future where digital assets are mainstream, and the allocation is not small anymore.

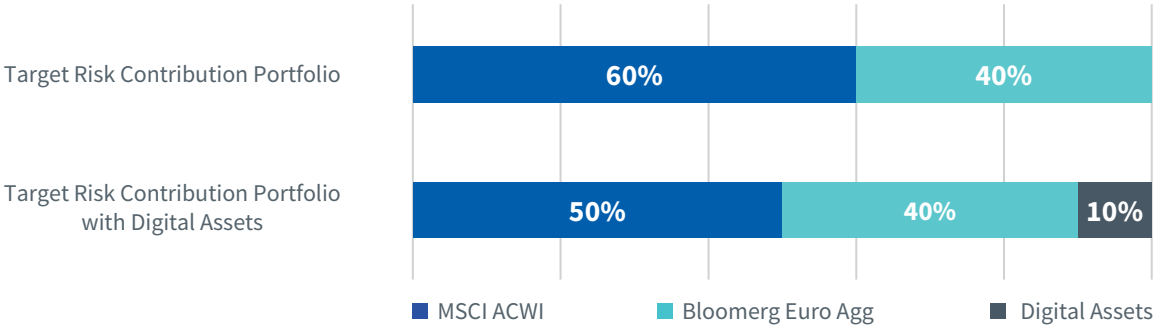
This section aims to assess what is a reasonable allocation to digital assets in the context of a multi-asset portfolio, by using a variety of techniques and angles. Many asset allocation techniques developed over the last decades are based on estimated expected returns. Obtaining such expected returns is difficult for any asset, but it is almost impossible for a nascent asset class like digital assets. This is why we concentrate on risk-based frameworks.

1. Digital assets in a target risk contribution

The previous section illustrated the advantages of adding digital assets in a constant proportion over time. While efficient, it is a tad simplistic. In this next iteration, the objective is to consider the evolution of the risk associated with digital assets (that is, the evolution of the covariance matrix) in the allocation scheme.

In this first approach, the focus is on a euro-based portfolio investing in equities across the globe and euro-denominated investment grade bonds. The portfolio weights are recalculated quarterly, based on the past 24 months' covariance matrix, to target a similar level of risk for each asset. The benchmark portfolio, the 'target risk contribution portfolio', aims for 60% of the risk to be allocated to equities and 40% to fixed income, instead of allocating 60% of the weight to equity and 40% to fixed income. This approach is more dynamic and incorporates the current market environment in the weighting of the portfolio.

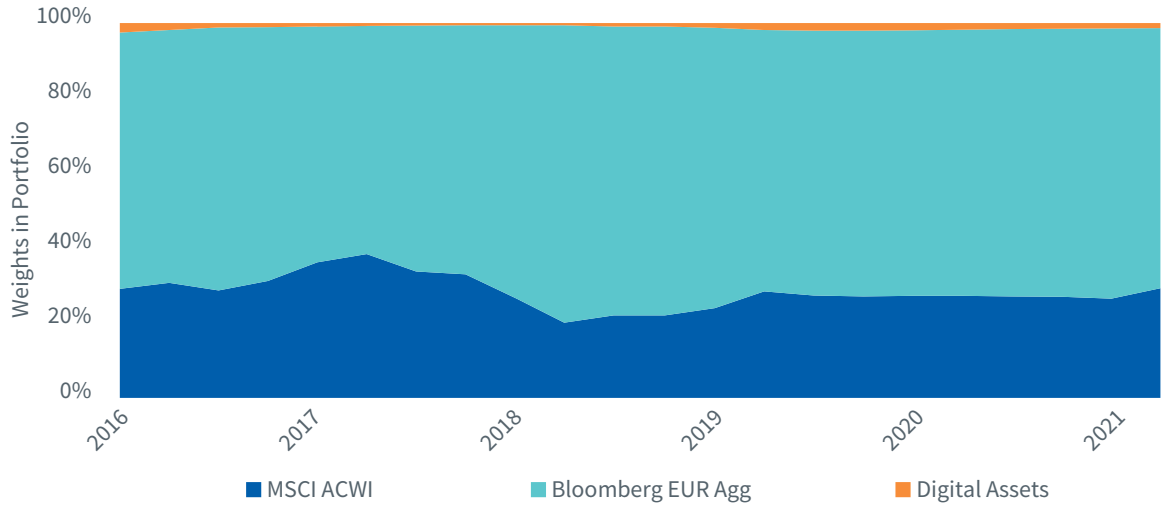
Figure 48: Target risk contribution by asset class in the portfolios



Source: WisdomTree. **Historical performance is not an indication of future performance and any investment may go down in value.**

The second portfolio, 'target risk contribution portfolio', reallocates 10% of the risk to digital assets. Since digital assets have been significantly more volatile than other assets over the last seven years, the allocation to such digital assets is quite restrained when aiming to represent 10% of the portfolio's risk. In Figure 49, the allocation to digital assets varies between 0.5% and 2.5%, with an overall average of 1.3%.

Figure 49: Quarterly weights in the target risk contribution portfolio with digital assets over time

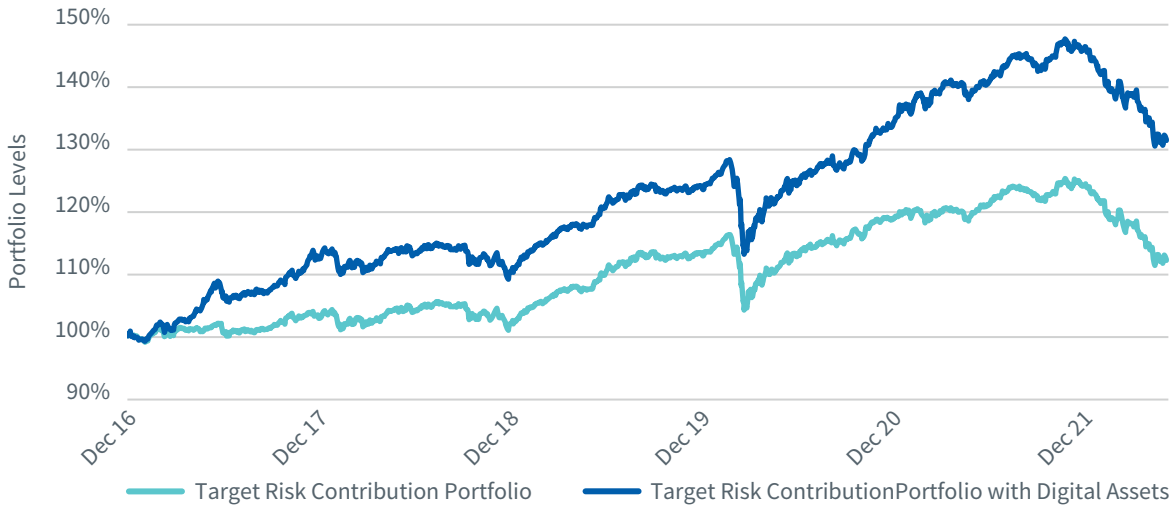


Source: Bloomberg, WisdomTree. From 31 December 2014 to 31 May 2022. Calculated in EUR on daily returns. **You cannot invest directly in an index. Historical performance is not an indication of future performance and any investment may go down in value. For illustrative purpose only.**

The historical performance of such a strategy investing in digital assets is quite impressive. Over the period, this small allocation in digital assets improved the annualised returns of the portfolio by 3.1%, while adding only 1% to the volatility. The overall drawdown has only increased by 0.4%, despite digital assets suffering from large drawdowns (80%+).

Looking at the risk-return profile, the portfolio's tracking error is only 2.1%, and it has been rewarded quite well with an information ratio of 1.5. As discussed in section IV.C.1.d, such a high information ratio would have been difficult to achieve with other means.

Figure 50: Historical performance of the target risk contribution portfolios



	Target risk contribution portfolio	Target risk contribution portfolio with digital assets
Annualised Return	2.1%	5.2%
Volatility	4.8%	5.8%
Sharpe	0.53	0.96
Tracking Error		2.1%
Information Ratio		1.48
Max Drawdown	-9.5%	-9.9%

Source: Bloomberg, WisdomTree. From 31 December 2014 to 31 May 2022. Calculated in EUR on daily returns. **You cannot invest directly in an index. Historical performance is not an indication of future performance and any investment may go down in value. For illustrative purpose only.**

Overall, the above approach can offer many advantages to investors:

+ Adapts to changes in the risk structure of the different assets
+ Does not incorporate expected returns assumptions
+ Easy to implement
+ Can be plugged into a discretionary approach through the repartition of the target risk to the different assets
+ Historical results have been very strong

2. Digital assets in the alternative bucket

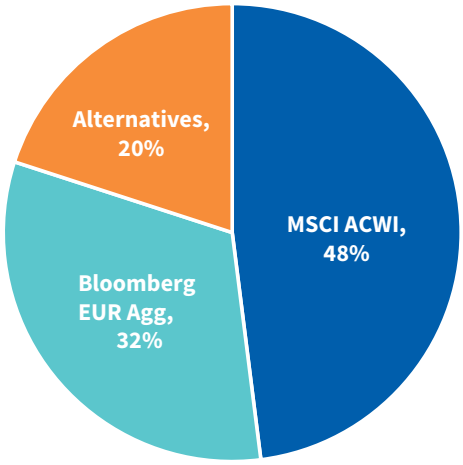
Digital assets fit nicely in the alternative part of a portfolio. They share many characteristics with such investments:

+ Correlation close to zero
+ Small allocation warranted
+ Improve diversification

In this second approach, the focus is on a EUR based portfolio investing in equities across the globe, euro-denominated investment grade bonds and a basket of alternative investments. The portfolio gets exposure to hedge funds, global REITS, global listed infrastructure and broad commodities. The portfolio weights are allocated quarterly as follows:

+ 80% in a 60/40 (equities/bonds) portfolio.
+ 20% in the alternative bucket.
+ All asset classes contribute the same amount of risk in the alternative buckets. That is, based on the past 30 months' covariance matrix, the alternative bucket is constructed following an equal risk contribution approach.

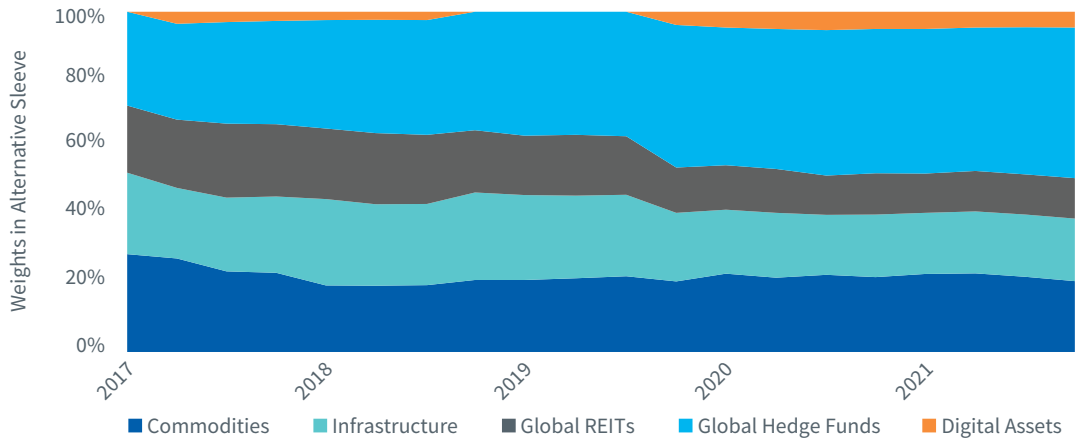
Figure 51: Weights in the portfolios



Source: WisdomTree.

The average allocation inside the alternative sleeve is 22% for broad commodities, 21% for listed infrastructure, 16% for REITS, 37% for hedge funds and 3% for digital assets. Digital assets' weight goes as high as 6% inside that sleeve historically. Looking at the full portfolio, it translates into an average weight of digital asset 0.6%.

Figure 52: Historical weights in the alternative sleeve of the portfolio with digital assets

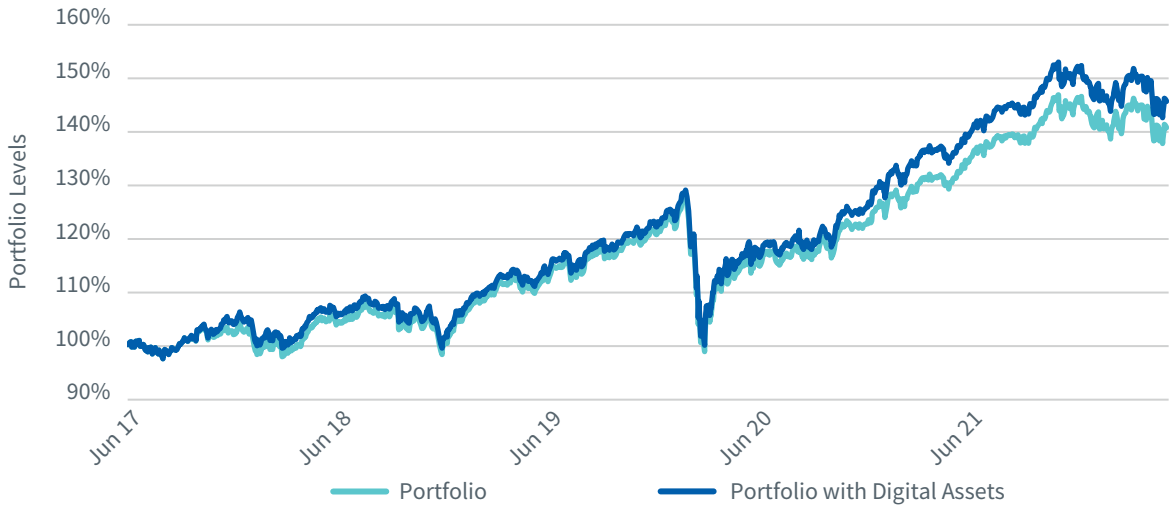


Source: Bloomberg, WisdomTree. From 31 December 2014 to 31 May 2022. Calculated in EUR on daily returns. . REITs stands for Real Estate Investment Trusts. **You cannot invest directly in an index. Historical performance is not an indication of future performance and any investment may go down in value. For illustrative purpose only.**

The added historical performance of using digital assets in such a strategy is also quite strong. Over the period, this small allocation in digital assets improved the annualised returns of the portfolio by 0.7%, while adding only 0.2% to the volatility. Inside such a portfolio, digital assets play their full role of 'diversifier', which explains the very small added volatility to the portfolio. The overall drawdown has only increased by 0.05% despite digital assets suffering from large drawdowns (80%+).

Looking at the risk-return profile, the portfolio's tracking error with digital assets is only 0.8%, and it has been rewarded quite well with an information ratio of 0.9.

Figure 53: Historical performance of the portfolios with alternative investments



	Portfolio	Portfolio with Digital Assets
Annualised Return	7.2%	7.9%
Volatility	8.4%	8.6%
Sharpe	0.90	0.97
Tracking Error		0.8%
Information Ratio		0.89
Max Drawdown	-12.81%	-12.81%

Source: Bloomberg, WisdomTree. From 31 December 2014 to 31 May 2022. Calculated in EUR on daily returns. **You cannot invest directly in an index. Historical performance is not an indication of future performance and any investment may go down in value. For illustrative purpose only.**

Overall, the above approach can offer many advantages to investors:

+ Adapts to changes in the risk structure of the different assets
+ Does not incorporate expected returns assumptions
+ Easy to implement
+ The alternative's sleeve brings very strong diversification to the overall portfolio
+ Historical results have been very strong

3. Digital assets in a maximum Sharpe ratio portfolio

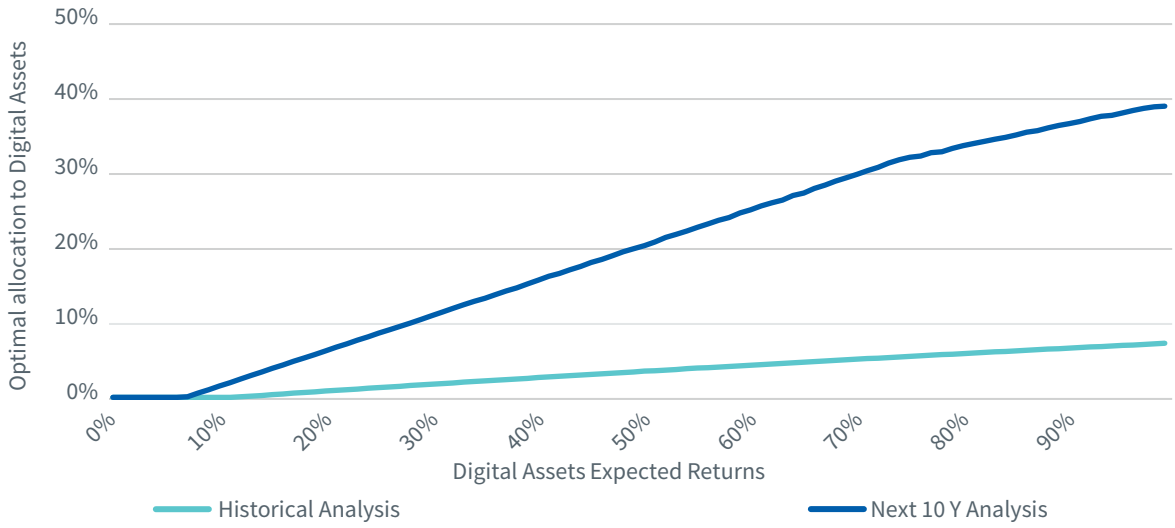
If an investor had decided to invest in December 2014 into a portfolio with global treasuries, EUR corporate investment grade and high bonds, global equities, broad commodities and digital assets, the allocation maximizing the Sharpe ratio would have included 7% of digital assets[73]. In 2014, this would have been a pretty big bet. Even today, it would look like a sizeable allocation, and many investors would argue that 99% annualised return over multiple years is unlikely.

When calculating the portfolio with the maximum Sharpe ratio possible using a certain universe of assets, it is necessary to know the return of each asset and the covariance matrix between them. As discussed previously, guessing the future return of digital assets is hard. So, instead of guessing, the analysis in Figure 54 tries all the possibilities. For each possible annualised return for digital assets from 0% to 100%, we calculate what would have been the optimal allocation to digital assets.

The teal line represents this optimal allocation to digital assets when using historical returns for all other assets and the historical covariance matrix. We find the 7% allocation asymptotically on the right end side of the graph since the historical return of digital assets over the period was 99%. We also note that an allocation to digital assets would have been warranted even if they had returned only 12% annualised since 2014.

The blue line represents this optimal allocation to digital assets looking forward instead of backward. The J.P. Morgan Asset Management Long-Term Capital Market Assumptions 2022 (LTCMAs) are used to 'predict' return and risk for the next ten years for all the other assets in the portfolio. J.P. Morgan predicts that the next ten years will be a lot more difficult for risky asset returns compared to the last ten. This explains why, for any level of digital assets' expected return, the optimal allocation is a lot higher going forward than it would have been looking back. A 10% annualised return in the next ten years would warrant 1.5% in digital assets, and 20% would warrant 6%.

Figure 54: Optimal allocation to digital assets depending on their returns



Source: Bloomberg, WisdomTree. From 31 December 2014 to 30 April 2022. Calculated in EUR on daily returns. **You cannot invest directly in an index. Historical performance is not an indication of future performance and any investment may go down in value. For illustrative purpose only.**

[73] As of 31 May 2022.

Figure 55: Return and volatility levels used in Figure 54				
	Historical metrics from Dec 2014		**Expected metrics next 10Y**	
	Annualised return	**Volatility**	**Annualised return**	**Volatility**
World Government Bonds	1.9%	6.0%	1.0%	7.0%
Euro Inv Grade Corp Bonds	0.7%	4.1%	1.5%	4.7%
Euro High Yield Bonds	3.0%	7.4%	2.9%	8.8%
US Large Cap	13.5%	14.9%	2.8%	14.2%
European Large Cap	6.4%	14.4%	5.1%	14.6%
Emerging Markets Equity	5.9%	14.5%	5.6%	16.9%
Commodities	5.8%	14.0%	1.3%	13.8%
Digital Assets	?	96.8%	?	97.0%

Source: Bloomberg, WisdomTree. From 31 December 2014 to 31 March 2022. Calculated in EUR on daily returns. **You cannot invest directly in an index. Historical performance is not an indication of future performance and any investment may go down in value. For illustrative purpose only.**

4. The perfect allocation to digital assets is…

a. A reasonable starting point for any investor

Predicting the future returns of digital assets for the next year, or the next ten years, is an incredibly difficult task. While digital assets are still early in their adoption cycle, and growth is firmly on the horizon, the exact growth trajectory is unknown. Therefore, assessing the right weight to allocate to digital assets based on return expectations is a bit of a fool's errand.

Our analyses in the previous section show that:

+ The market portfolio comprises around 1% of digital assets
+ A portfolio aiming to allocate 10% of its risk to digital assets would have allocated 1.3% to digital assets historically
+ A portfolio investing 20% of its assets in a diversified basket of alternatives would have allocated 0.7% to digital assets historically

Of course, there are no magic numbers to solve this allocation conundrum for every investor. Depending on each investor's risk appetite and belief in the speed of digital assets adoption in the overall economy, the right allocation to digital assets will vary. However, it is clear that a minimum allocation of 1% to digital assets in a balanced asset allocation appears more than reasonable for someone who does not know much. For more advanced investors with specific knowledge of the space, increasing the allocation to a few percentage points could be advantageous.

b. Is allocating to digital assets risky?

In this last section, the objective is to assess the real risk of allocating to digital assets. The main investor's pushback when it comes to investing in digital assets is usually the volatility and the drawdown risk. However, such worries tend to overlook two important facts:

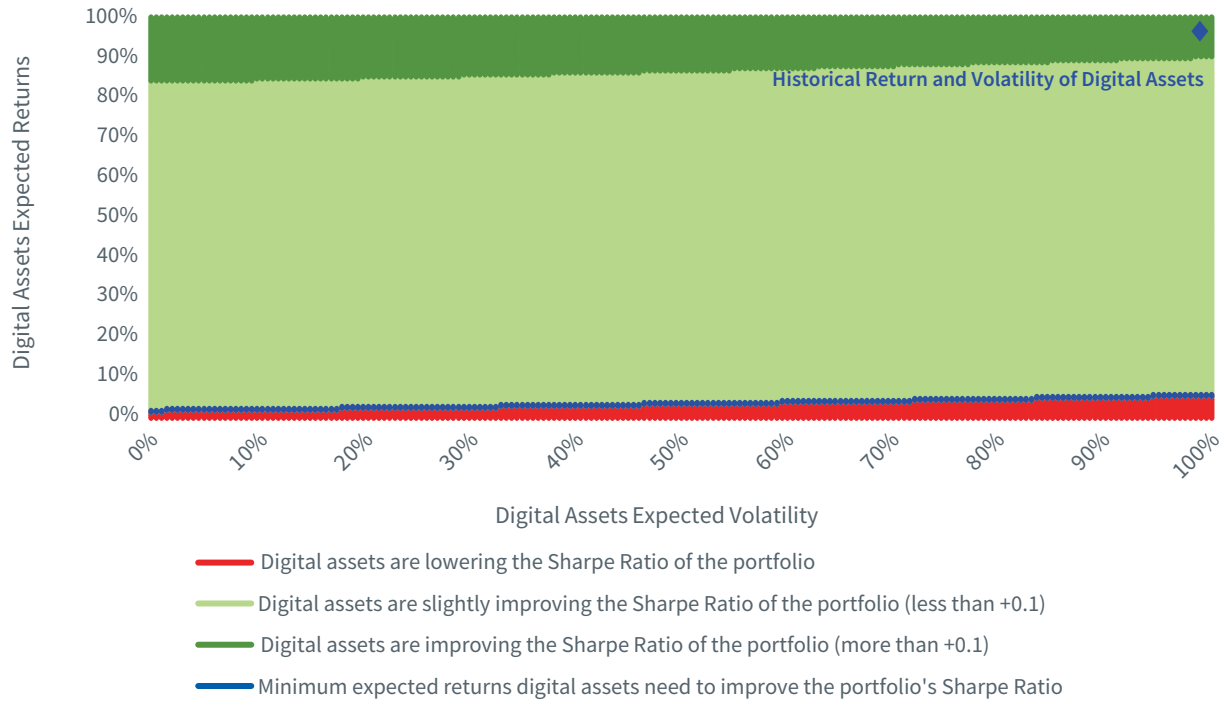
+ Whatever the volatility of digital assets, if an investor invests only 1% in digital assets, the maximum loss is 1%. In the context of a multi-asset portfolio, losing 1% happens multiple times per month because of equities or any other risky asset.
+ The return required to justify digital asset-like volatility is not as high as investors expect. Digital assets growing north of 6% a year is more than enough to justify investment in any portfolio.

Figure 56 shows the difference in Sharpe ratio of a portfolio investing 1% in digital assets, compared to a portfolio without digital assets, depending on digital assets return and volatility over the next ten years. The portfolio invests consistently:

+ 59% in the MSCI All Country World
+ 40% in the Bloomberg EUR Agg
+ 1% in digital assets

The performance and risk of equities and fixed income are estimated using J.P. Morgan Asset Management's Long-Term Capital Market Assumptions (LTCMAs) 2022. These assumptions aim to estimate returns, volatility and correlation for the next ten years. The correlation of digital assets with equity and fixed income used is the historical one. Finally, in Figure 56, we vary the annualised performance and volatility of digital assets from 0 to 100%.

Figure 56: Digital assets' future volatility and return would need to change dramatically not to benefit a multi-asset portfolio



Source: Bloomberg, WisdomTree. From 31 December 2014 to 31 May 2022. Calculated in EUR on monthly returns. **You cannot invest directly in an index. Historical performance is not an indication of future performance and any investment may go down in value. For illustrative purpose only.**

For most levels of digital assets' volatility and returns, the Sharpe ratio of the portfolio benefits from their inclusion ('green' in Figure 56). Digital assets returned 99.2% per annum for 97% volatility in the last seven years or so. Whether digital assets can perform like that for the next ten years is doubtful but, according to this analysis, assuming that the volatility remains the same (99%), a 60/40 portfolio could benefit from the inclusion of digital assets as long as they return at least 6 or 7% per annum.

In many cases, investors argue that it is too late to invest in digital assets and that exponential growth is behind us. However, from an asset allocation point of view, this is not that relevant. Looking at Figure 56, the only relevant question is:

Will digital assets grow by more than 6% or 7% going forward?

If the answer is "yes", then they deserve some allocation.

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The case for investing in broad commodities

GLOSSARY[74]

Airdrop: when new tokens are created and distributed to wallets 'for free', that is, based on past behaviour that is deemed to have been in the interest of the application's development.

Altcoin (short for alternative coin): any cryptocurrency other than the original cryptocurrency, Bitcoin, is known as an altcoin. Altcoins range from relatively well established and popular coins, like Ether, to joke currencies like Dogecoin. The term is also sometimes applied to stablecoins or tokens representing a stake of ownership, such as a security token. As the Ethereum network grows, it is increasingly being excluded as an altcoin.

Blockchain: a type of distributed database. It is a growing database of time-stamped transactions that cannot be altered. Each new addition to the database is a 'block' of data that contains transactions. These transaction blocks are verified by a network of computers and added to the chain. Also termed 'distributed ledger'.

Bridges: a way in which to enable interoperability between digital asset networks. Bridges can either be 'trusted', involving a centralised intermediary or network, or they can be 'trustless' via smart contracts and algorithms[75].

Consensus mechanism: the algorithm used by nodes on a network as they reach an agreement on the correct order of transactions on a distributed ledger ('blockchain').

Cryptocurrency or crypto-coin: a cryptocurrency that lives on its own independent blockchain. The prefix 'crypto' refers loosely to the use of cryptographic methods to create the digital currency/coin. Examples include Bitcoin and Ether. Distinct from a token.

dApp: short for 'decentralised application', it is a computer application that runs on a decentralised network.

Decentralised finance (DeFi): an umbrella term for a collection of projects that use dApps (via 'smart contracts') to mimic the functionality or service typically provided by a centralised financial intermediary, for example, a bank or an exchange.

Decentralised exchange: sometimes referred to as a DEX, these allow users to buy and sell digital assets directly with each other, bypassing intermediaries that might impose fees, such as an exchange or clearinghouse.

(Hard) Fork: developers sometimes disagree on how a network should be run and, if they cannot settle their differences, the ultimate step is to create a (hard) fork in the network. One side will take a copy of and modify the original open-source software, while those who wish to continue running the existing network will rely on the older version. It means that two different network versions emerge based on different principles and with different user bases. Forks can occur for several reasons, including concerns over outdated and insecure software, a need to reverse the log of transactions following a hack, or a need to return investors' funds to them.

Gas fees: the fees users pay to compensate for computing energy needed to verify a transaction on the Ethereum network. They are intended to prevent nefarious actors from spamming the network. Prices can rise and fall depending on demand.

ICO: like an initial public offering, an initial coin offering is a tool for fundraising. Investors get some of the new tokens instead of stock in the company.

Layer 2: a secondary network or technology built on top of an existing layer 1 network to improve its efficiency. For example, some blockchains like Bitcoin and Ethereum cannot handle vast quantities of trades at high speed, affecting the users of some dApps. A layer 2 network can handle the bulk of the transaction processing legwork so that the original blockchain can scale.

Mining: the act of employing a large network of computers to work together to solve cryptographic calculations that verify cryptocurrency transactions. Typically, one party will solve the puzzle, known as a hash, that creates the next block in the chain. The others will verify it. In return for maintaining the network, miners are rewarded with new cryptocurrency for being the first to solve the cryptographic proof. They also collect transaction fees.

NFT: a non-fungible token. An entry is stored as a token on a distributed network, usually Ethereum. However, it is not fungible — meaning it cannot be interchanged one for one with another token.

Node: a computer that runs software as part of a distributed network. A node collects, verifies and/or distributes information for a distributed database.

Proof of Stake: a consensus mechanism used to validate transactions and when mining new coins. This methodology is based on the size of the cryptocurrency holdings (or 'stake'). [76]

Proof of Work: a consensus mechanism used in Bitcoin that has the participants in a network solve a cryptographic proof to validate transactions on the network or when mining new coins.[77]

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[74] This short glossary borrows at times from the Financial Times glossary on the same topics. See: ft.com/content/df9f5795-2aaf-4088-a76e-304056db61ef

[75] https://ethereum.org/en/bridges/

[76] Adapted from: https://www.wellington.com/en/insights/evaluating-cryptocurrencies-asset-class-us/

[77] Adapted from: https://www.wellington.com/en/insights/evaluating-cryptocurrencies-asset-class-us/

Smart contract: a computer script with the ability to execute actions if certain conditions are met. That could include transferring funds or sending notifications.

Stablecoin: tokens that are pegged to other assets, usually the world's biggest currencies (for example, US dollar). Some are supposed to have a fixed price and be backed by reserves at all times, allowing users to redeem them. Others use algorithms to buy and sell to keep themselves fully backed.

Token: a unit built on an existing network using a smart contract. The best-known example is ERC20, a token on the Ethereum network used to build many other digital assets. Distinct from a coin.

Wrapped token: a token pegged to the value of another token. They have identical values but enable one token to be used on a network that it was not issued on. For example, the Bitcoin and Ethereum blockchains cannot 'talk' directly to each other; but a wrapped token can act as a bridge between the two.

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