



**PGIM**  
India Mutual Fund

**MEGATRENDS**

# CRYPTOCURRENCY INVESTING

Powerful Diversifier or Portfolio Kryptonite?

SUMMER 2022

# INTRODUCTION

Red dogs, stump tails and blue pups were just some of the creative names for the ultimately doomed currencies issued by poorly capitalized state-chartered banks during the wildcat banking era in U.S. monetary history from 1837 to 1863 – until Congress finally passed legislation that created a single centrally backed national U.S. currency.<sup>1,2</sup>

History rarely repeats itself, but it often rhymes – and 150 years later we are in an era with thousands of unregulated cryptocurrencies and digital tokens with a collective market cap over \$1 trillion.<sup>3</sup> These cryptocurrencies offer the promise of a frictionless, inclusive and decentralized network powered by blockchains and operated completely independently of central banks, which are increasingly seen as debasing fiat currencies by “printing money.”\*

For institutional investors, cryptocurrencies also offer the allure of extraordinary and diversified returns in a market that is now of sufficient size and liquidity for meaningful institutional positions. Indeed, some market participants estimate that about 5% of total Bitcoin supply are now held by institutional investors via custodial intermediaries.<sup>4</sup>

To understand the investment implications of the evolving cryptocurrency landscape, we have drawn on the insights of more than 30 investment professionals across PGIM’s fixed income, equity and private alternatives managers – as well as leading economists, venture capitalists and crypto investors. Our resulting conclusions:

- While a few cryptocurrencies will endure on the fringes of the monetary system, **the broad replacement of fiat currencies globally by cryptocurrencies is unlikely to materialize. Functionally, cryptocurrencies are unable to meet the basic prerequisites of either a currency**

**or a precious-metal substitute – shortcomings exacerbated by the powerful headwinds from increasing regulatory scrutiny and the growing likelihood of central bank digital currencies (CBDCs)** which provide almost all the functional benefits of fiat-linked cryptocurrencies, but with no liquidity or credit risk.

- Beyond hedge funds exploiting inefficiencies to generate alpha on the other side of “FOMO”-driven, largely retail and speculative flows, there is currently no compelling case for direct ownership of cryptocurrencies as a meaningful share of an institutional portfolio. Theoretically, cryptocurrencies have no ex-ante foundational underpinnings for delivering robust risk-adjusted returns in the future. Empirically, after examining the brief historical data available on crypto, **we find little real-world evidence that cryptocurrencies deliver diversification vs. mainstream assets, are effective inflation hedges, possess the intrinsic characteristics of a safe-haven asset, or advance ESG objectives.** Of course, it goes without saying that bitcoin and many other cryptocurrencies have delivered awe-inspiring returns over the last decade – albeit with frequent and substantial drawdowns – and this speculative momentum could continue for some time.
- In contrast to direct cryptocurrency ownership, **there are attractive institutional investment opportunities in the broader crypto ecosystem and the incidental innovation that has flourished in the creation of bitcoin and other cryptocurrencies.** These include private applications of distributed ledger technology and smart contracts used in financial services (like clearing and settlement of securities and international payment systems) as well as

\* To sharpen our focus, we limit our analysis to crypto assets intended as substitutes for fiat currencies, such as bitcoin, ether and sol, which collectively represent close to 60% of the sector’s market cap. Digital tokens specific to a particular application or sidechain are not our primary focus. We also explicitly exclude regulated central bank digital currencies (CBDCs) and non-fungible tokens (NFTs) from our analysis, except where they intersect with and influence our view on crypto opportunities and risks.

in logistics and supply-chain management. Tokenization could be a next-generation securitization mechanism for real assets. Additionally, the companies providing the essential infrastructure for crypto innovation will have a head start in underpinning CBDCs and other blockchain-powered applications. This collateral innovation has the potential to generate attractive returns for owners of the companies that provide these services but will not necessarily accrue to the owners of cryptocurrencies.

We share analysis to support our hypotheses and unpack the critical investment implications of these conclusions in the rest of this report. Chapter 1 summarizes the cryptocurrency landscape, cutting through the breathless media hype. Chapter 2 explains why cryptocurrencies are deeply inadequate as

currencies. Chapter 3 lays out the empirical evidence for why cryptocurrencies fail to meet most institutional investor objectives around portfolio diversification, risk-adjusted returns, inflation protection and ESG. To “stress test” our conclusions, we also lay out the potential scenarios that would need to materialize for the extraordinary price trajectory of bitcoin and other cryptocurrencies to continue. Our base case is these scenarios are highly unlikely to materialize.

Finally, Chapter 4 argues that enduring value for long-term investors will be found not in cryptocurrency holdings themselves, but in the use cases and applications from the remarkable breakthroughs that are the accidental by-products of the heroic but potentially doomed quest to build a viable decentralized, unregulated peer-to-peer payment system.

## About PGIM

PGIM, the investment management business of Prudential Financial, Inc. (PFI), has a history that dates back over 145 years and through more than 30 market cycles.\* Built on a foundation of strength, stability and disciplined risk management, PGIM's more than 1,300 investment professionals are located in key financial centers around the world. Our firm is comprised of six autonomous asset management businesses, each specializing in a particular asset class with a focused investment approach. This gives our clients diversified solutions from a leading global asset manager with global depth and scale across public and private asset classes, including fixed income, equities, real estate, private credit and other alternatives. For more information, visit [www.pgim.com](http://www.pgim.com).

\* 30 market cycles represents PFI's asset management expertise through PGIM, its affiliates and its predecessors.

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## CHAPTER 1

# UNDERSTANDING THE CRYPTOCURRENCY ECOSYSTEM

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*The ingenuity displayed in bringing together distributed ledgers and cryptographic methods represents a real technological breakthrough.”*

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## CHAPTER I

# UNDERSTANDING THE CRYPTOCURRENCY ECOSYSTEM

**On October 31, 2008, a user with the pseudonym Satoshi Nakamoto posted a link on a cryptography mailing list to a short white paper on bitcoin, setting off the cryptocurrency revolution.<sup>5</sup> The paper envisioned an electronic payment system that allows “any two willing parties to transact directly with each other without the need for a trusted third party.”**

Bitcoin’s focus on real-time transparency, anonymity, security and trustless ownership without government or legacy banking system involvement was perfectly timed for a world still reeling from the Global Financial Crisis and the collapse of Lehman Brothers six weeks before.<sup>6</sup>

Whatever bitcoin’s ultimate destiny, the ingenuity displayed in bringing together distributed ledgers and cryptographic methods represents a genuine technological breakthrough.\* Indeed, fast forwarding to 2022, bitcoin remains the dominant cryptocurrency in circulation, with a market share greater than 40%. And if imitation is the sincerest form of flattery, bitcoin has spawned over 10,000 cryptocurrencies and digital tokens to date!<sup>7</sup>

We identify the key features of this array of cryptocurrencies in this chapter and cut through the industry jargon to understand the underlying innovation behind them as well as the broader and rapidly evolving “crypto ecosystem” – which goes well beyond the digital currencies themselves.

## What are cryptocurrencies?

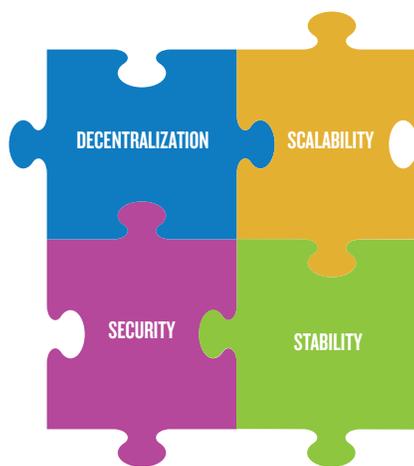
Cryptocurrencies are digital assets maintained and recorded on a blockchain without a trusted intermediary such as a custodian or bank. Every cryptocurrency exists on a blockchain – a decentralized ledger – that records, clears and validates every transaction ever made on that network. Some cryptocurrencies (e.g., bitcoin, ether, Solana) have their own proprietary blockchains; others (e.g., Uniswap, Chainlink, Maker)

use existing blockchains – most commonly the Ethereum blockchain. Cryptocurrencies are inexorably linked to their underlying blockchain; indeed, many of the differences between them can be attributed to the differences in their underlying blockchains.

## The four dimensions of every cryptocurrency

The more than 10,000 successors of bitcoin all make design decisions along four dimensions: decentralization, security, scalability and stability. Taken together, these four dimensions allow one to neatly classify the crowded cryptocurrency universe. Every cryptocurrency (and its underlying blockchain) is a unique and different trade-off between these elements (Exhibit 1).

### Exhibit 1: Four Dimensions of Cryptocurrencies



Source: PGIM Thematic Research.

\* Bitcoin refers both to the digital cryptocurrency as well as the underlying blockchain network.

## Decentralization

Decentralization refers to creating an immutable ledger that does not rely on a central entity for validation of participants and transactions. This is in stark contrast to conventional finance where a trusted financial intermediary (often a bank) clears, verifies and records transactions on behalf of customers. On a blockchain, this key function is instead divided among multiple independent “miners” who are financially incentivized – with utility tokens or cryptocurrencies – to act as independent verifiers of the network’s authenticity. Miners record transactions as well as verify other miners’ transactions. On the bitcoin blockchain, these incentive tokens are bitcoin. This ability to make payments anonymously via a “trustless” network is attractive for those seeking a mechanism that is relatively anonymous and independent of financial institutions or governments.

*Cryptocurrencies are inexorably linked to their underlying blockchain.*

## Security

Security refers to the rigor associated with verifying transactions on the blockchain. The degree of rigor determines the ability of the blockchain to function as expected while defending itself from fraud, cyberattacks,

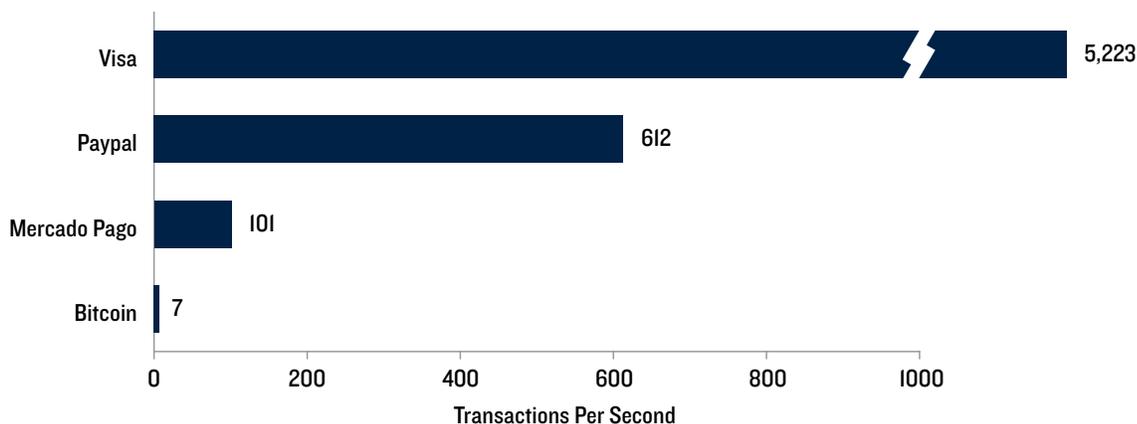
hackers, bugs and other malicious ware. With more nodes recording and validating each transaction, the challenge of corrupting a sufficient portion of the network to hack it or record false transactions becomes more daunting. Blockchains that optimize for security (such as the bitcoin network) are typically highly decentralized. Indeed, though crypto exchanges have been hacked repeatedly, the bitcoin blockchain itself has never been successfully compromised.

## Scalability

Scalability refers to the ability of a blockchain to handle an increasing volume of transactions. Efficiency in transaction speed and the cost of recording and validating transactions are paramount for scalability – which in turn is essential for blockchain technology to become a widespread digital payment system. Without some compromise on decentralization and security – what Ethereum co-founder Vitalik Buterin labels the “blockchain trilemma” – it will not be easy for blockchain networks to get to scale efficiently and compete with traditional networks in convenience, speed and capacity (Exhibit 2).<sup>8</sup>

In response to this significant deficit in processing speed, companies are developing a range of scaling solutions. Some aim to create new, faster blockchains (termed Layer 1 solutions) while others are building applications on top of an existing blockchain to boost its efficiency (termed Layer 2 solutions), essentially by bundling multiple user transactions and recording them in aggregate rather than individually.

**Exhibit 2: Transaction Speed of Payment Networks**



Source: PGIM Thematic Research. Data from 2021 10-K for Paypal, Mercado Pago and Visa; Nasdaq Data for Bitcoin.  
Note: Maximum number of transactions for Bitcoin. Average number of transactions for Visa, Paypal, and MercadoPay.

### Exhibit 3: Leading Cryptocurrencies and Stablecoins

Cryptocurrency	Market Cap (\$ Billions)	Security	Decentralization	Scalability	Stability
Bitcoin (BTC)	\$585	✓	✓		
Ethereum (ETH)	\$278	✓	✓		
Tether (USDT)	\$83			✓	✓
USD Coin (USDC)	\$48			✓	✓
Ripple (XRP)	\$24	✓	✓		
Sol (SOL)	\$22	✓		✓	

Source: PGIM Thematic Research; CoinMarketCap as of May 9, 2022.

Note: Both Tether and USD Coin are backed by cash and money market instruments (commercial paper, Treasury bills, etc.).

For example, Lightning Network is a scaling solution for the bitcoin blockchain and StarkNet is a scaling solution for the Ethereum blockchain. Many of these scaling solutions may be quite relevant for current and future CBDCs as well.

### Stability

All cryptocurrencies face the trade-offs of the blockchain trilemma. But not all cryptocurrencies face tremendous volatility in value. Stablecoins such as Tether, USD Coin and Dai are digital currencies recorded and transacted on a blockchain whose value is explicitly linked to another asset. Many of the most prominent stablecoins are linked to a fiat currency – often, the U.S. dollar (Exhibit 3). Depending on the stablecoin, these reserves can either be “on-chain” (in the form of digital assets) or “off-chain” (in the form of conventional money market assets).<sup>9</sup> Regardless of whether a stablecoin is backed by fiat or digital assets, the reserve mechanisms are not regulated or required to be audited. In fact, management and reporting of reserves is largely left to the discretion of the coin issuer.

### Who are the owners of cryptocurrency?

In understanding the makeup and motivations of cryptocurrency holders, it is probably most instructive to focus on bitcoin, which is by far the largest cryptocurrency by market cap as of March 2022.<sup>10</sup> Roughly a third of bitcoin currently in circulation is held by intermediaries (e.g., exchanges, gambling sites, darknet sites, or brokers) while half are controlled by individual investors.<sup>11</sup> Individual ownership is highly concentrated; at the beginning of 2021, the top 0.25% of owners held about 20% of bitcoin.<sup>12</sup>

It is worth considering what draws individual investors to cryptocurrencies. We believe there are five primary reasons:

1. Retail and high-net-worth investors are attracted to the excitement and remarkable speculative returns possible from holding bitcoins or other cryptocurrencies. Anecdotal media and cocktail party accounts of early adopters who became overnight bitcoin millionaires are now

commonplace.<sup>13</sup> Social media hype from tech entrepreneurs and celebrity investors such as Elon Musk and Cathie Wood has furthered the frenzied momentum around cryptocurrencies.<sup>14</sup>

2. There is declining faith in financial institutions and governments – a growing phenomenon since the Global Financial Crisis.<sup>15</sup> For example, the Edelman Trust index for the U.S. has declined by an additional 10 points from an already-low starting point since 2017.<sup>16</sup>
3. Retail investors are drawn to bitcoin because of its limited supply and inherent scarcity. In particular, crypto enthusiasts view cryptocurrencies as “digital gold” that protects them from the monetary debasement of fiat currencies – a concern that has been heightened with post-COVID inflationary pressures in many economies.
4. Active traders, especially multi-strategy and quant hedge funds, exploit inefficiencies and arbitrage opportunities arising from the wild gyrations in cryptocurrency prices. By mid-2021, about 20%

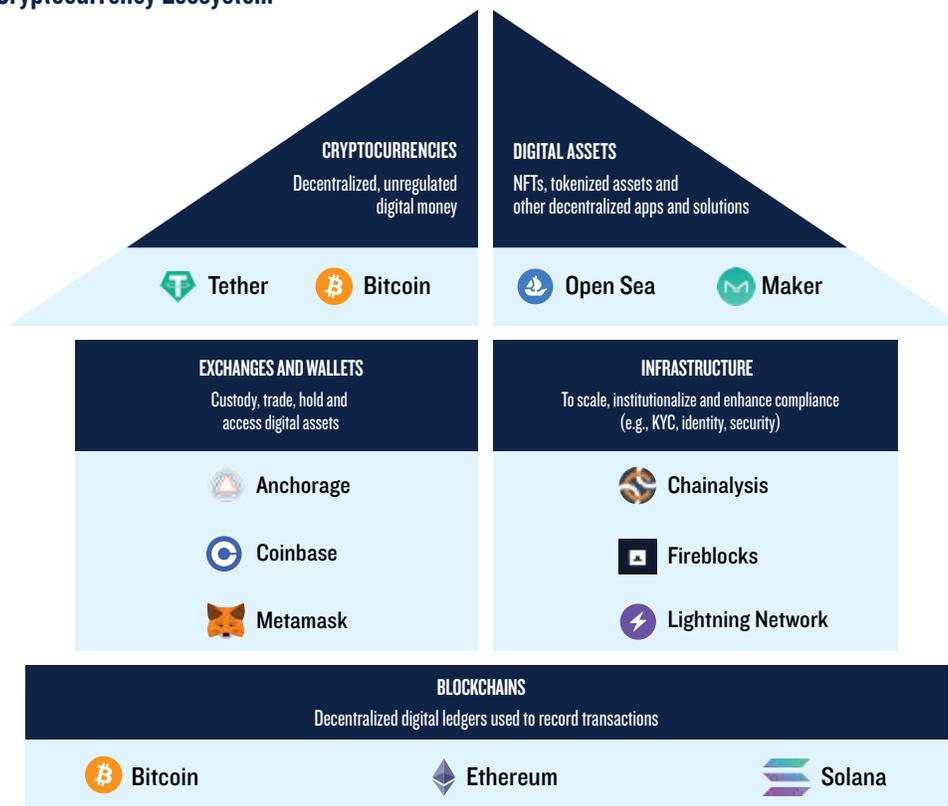
of surveyed hedge funds were actively trading digital assets like bitcoin.<sup>17</sup>

5. Crypto natives are active in the metaverse, where cryptocurrencies and digital tokens are established as the primary medium of exchange. For example, V-bucks is the in-game currency used in Epic’s Fortnite multi-user online game, Shards are the digital token in the online, Pokemon-inspired game Axie Infinity, and ether is widely used to purchase NFTs (i.e., digital collectibles).

## The broader crypto ecosystem

Cryptocurrencies are part of a broader ecosystem (Exhibit 4) that extends well beyond the digital currencies themselves and include the blockchains they are built on as well as the necessary infrastructure to support mining and storage. It also includes the exchanges where cryptocurrencies trade and the wide array of use cases and applications built on blockchains such as non-fungible tokens and cross-border payment networks. Additionally, it encompasses the

Exhibit 4: The Cryptocurrency Ecosystem



Source: PGIM Thematic Research.

*The broader ecosystem has many companies and applications that are likely to endure regardless of the success of the cryptocurrencies that spawned them.*

constellation of compliance, risk management and security tools designed to increase comfort levels within the lightly or unregulated crypto marketplace. Finally, the ecosystem also includes the venture capital investors and initial coin offerings that fund so much of this universe.

Critically for investors, this broader ecosystem – and the tremendous innovation it is generating – has many companies, use cases and applications that are likely to endure regardless of the success of the cryptocurrencies that spawned them. Indeed, many of these use cases are not limited to or reliant on cryptocurrencies at all. The best opportunities for institutional investors may lie in this ecosystem rather than in cryptocurrencies themselves.

Smart contracts are an excellent example of this collateral innovation. They are self-executing digital code that holds an agreement between multiple parties and executes as various terms or conditions are met. Smart contracts can be applied to transactions

involving *any* digital asset – including CBDCs and digitized tokens or securities. The Ethereum blockchain, released in 2015, was built as the first blockchain platform to enable smart contracts. It now powers a range of digital applications designed to manage trade finance, escrow services, supply-chains and even insurance claims without costly and lengthy human or institutional intermediation. Some forward-thinking central banks and regulators are closely following innovation in the flourishing crypto ecosystem – for example, around holding, trading, reporting and security of digital currencies – with an eye on future private-public partnerships that may allow these innovations to power CBDCs.<sup>18</sup>

We will return to the multiple investment opportunities in the broader crypto ecosystem in Chapter 4. But before we head there, let's dive deeper into cryptocurrencies themselves.

The next chapter explains why our base-case scenario is quite bearish about cryptocurrencies as a currency. This bearishness underpins our ultimate thesis, summarized by the California Gold Rush adage, that “the best way to profit is not to speculate on gold, but to sell picks and shovels.”

## CHAPTER 2

# NOT QUITE A CURRENCY

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*No cryptocurrency adequately fulfills the three essential functions of money.”*

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## CHAPTER 2

# NOT QUITE A CURRENCY

Money has taken different forms through the ages, from cowry shells to peppercorns and from silver coins to the greenback, but they all share three common characteristics. They act as (1) a store of value, (2) a widely accepted medium of exchange and (3) a unit of account. Unfortunately, no cryptocurrency to date adequately fulfills these three essential functions. Bitcoin, the most prominent cryptocurrency, for example, has a notoriously unstable price, is a poor medium of exchange and is rarely used outside the crypto-native digital realm as a unit of account. These fundamental inadequacies are rarely acknowledged by crypto enthusiasts, who often conflate bitcoin's phenomenal price appreciation with its actual utility as a digital cryptocurrency.<sup>19</sup>

### Do cryptocurrencies pass any of the three well-defined tests of a currency?

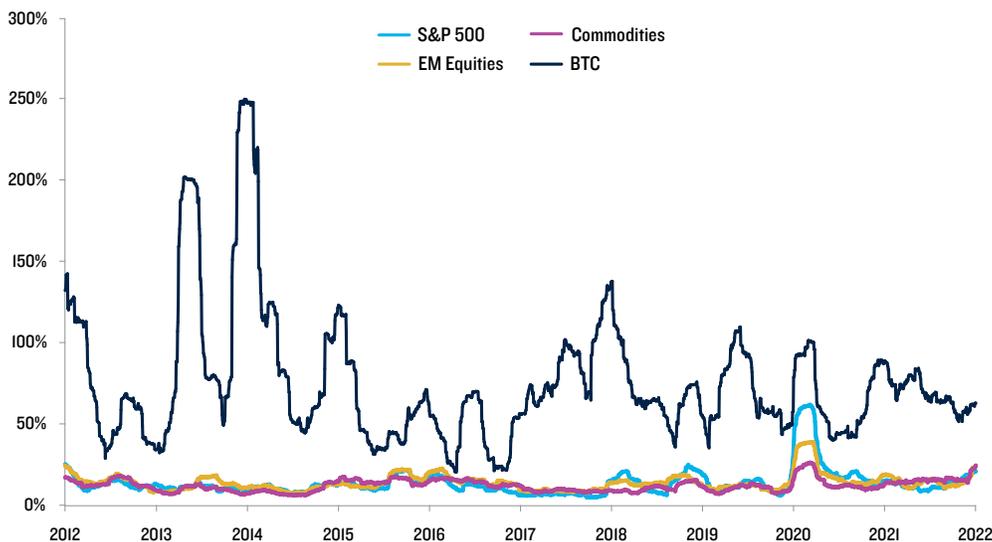
#### Store of Value

Preserving value, at least over short periods of time, is an important function of currency. Fiat currencies can be eroded over time by price inflation. However, outside of extremely rare hyperinflationary environments they have been an efficient store of

*Bitcoin has an unstable price, is a poor medium of exchange and is rarely used outside the crypto-native realm as a unit of account.*

short- and medium-term value. In contrast, the wild price gyrations of many cryptocurrencies make them highly unattractive as a store of value – even in the

Exhibit 5: Rolling 3-Month Volatility of Select Asset Classes



Source: PGIM analysis; Refinitiv and Bloomberg.

Note: Volatility of daily returns, annualized. The Bloomberg Commodity and MSCI Emerging Markets Index were used for Commodities and EM Equities respectively.

very short term. Exhibit 5 demonstrates how the price of bitcoin has remained extremely volatile since its inception. Bitcoin clearly falls short on this first test of a workable currency.

*Central bank digital currencies are not a distant prospect: China has already launched the e-CNY.*

Of course, stablecoins pegged to fiat currencies could function as a more reliable store of value, but they face a potentially existential risk: they would be made redundant once central bank-issued digital currencies (CBDCs) become more commonplace.\*

For example, a digital dollar issued by the Federal Reserve and backed by the U.S. Treasury would provide all the functionality of USD Coin – but without any liquidity or credit risk.<sup>20</sup> And CBDCs are not a distant prospect: China has already launched the e-CNY. The Fed released a long-awaited study on a digital dollar in January 2022 and the ECB will share its findings on the viability of a digital euro in 2023.

Even beyond the threat from CBDCs, there are material risks around the reserve mechanisms of stablecoins – including a lack of transparency and third-party audits. Stablecoins are essentially unregulated money market funds. Even when regulated, the stable value of these instruments remains vulnerable to large outflows under stressed conditions, as was evident during the financial crisis in 2008.<sup>21</sup> This lack of transparency and reliable auditing in prominent stablecoins was apparent in the case of Tether – the largest issuer of stablecoin – which was fined for falsifying reserve reporting.<sup>22</sup>

## Medium of Exchange

Cryptocurrencies are still not close to being widely used as a medium of exchange. It is indeed telling that

even after a dozen years, few commercial enterprises accept them. Using bitcoin as an example, this situation is unlikely to change soon for several reasons.

First, the bitcoin blockchain, optimized for security and decentralization, does not prioritize operational efficiency. Bitcoin's maximum transaction speed of 7 transactions per second (TPS) pales in comparison to the speed of conventional payment networks, which average 1,700 TPS.\*\*

Second, bitcoin transactions are expensive rather than cheap and frictionless. In fact, bitcoin's transaction fees are an intrinsic outcome of the highly secure and decentralized structure of its blockchain and the need to incentivize miners to decipher cryptographic problems. Fees have been as high as \$50 for a single transaction – making bitcoin highly impractical for everyday, small-scale transactions.<sup>23</sup>

*Bitcoin's high transaction fees are an intrinsic outcome of the highly secure and decentralized structure of its blockchain.*

## Unit of Account

Currencies are used to denominate the value of products and services. That is, a haircut, a cup of tea, or a diamond ring are typically priced in euros, pesos or yuan. Fiat currencies serve as a common yardstick to measure value across the wide range of daily economic transactions.

Outside of the deep digital realm, however, cryptocurrencies are only rarely used to price products or services. While a growing number of companies accept bitcoin as a payment option (e.g., Burger King, Microsoft, Norwegian Air, and Pizza Hut, to name a few), *none of them* price their products or services in

\* A CBDC is the digital form of a country's fiat currency. Instead of issuing paper money, the central bank issues electronic coins or accounts backed by the full faith and credit of the government. However, as they are issued by central banks, they are not truly decentralized and not technically considered cryptocurrencies.

\*\* Blockchains optimized for scalability do offer more attractive transaction speeds. For example, the Solana blockchain theoretically offers up to 65,000 TPS. However, even its cryptocurrency falls short in terms of being a store of value or a unit of account.

*Merchants simply accepting bitcoin does not mean it is preferable – or even viable – for wages, prices and assets to all be denominated in bitcoin.*

bitcoin. In other words, virtually no business fixes the price of their product in bitcoin and then converts it into fiat currencies.

Importantly, merchants simply accepting bitcoin does not mean it is preferable – or even viable – for wages, prices and assets to all be denominated in bitcoin.<sup>24</sup> The lone real-world example of a nation adopting bitcoin as its currency, El Salvador, has not gone well so far. Early experience strongly suggests both consumers and businesses have resisted government-mandated adoption and prefer to price merchandise and transact in U.S. dollars anyway.<sup>25, 26</sup>

No matter how robust the evidence on the inadequacies of cryptocurrencies as a currency, it is undoubtedly true that some market actors have invested heavily in cryptocurrencies. The soaring speculative rise of many cryptocurrencies has been dramatic, and it is hard to predict how much further momentum can carry cryptocurrency valuations. Some investors now see cryptocurrencies as a new “digital gold.”

Regardless of their multiple shortcomings as currencies, Chapter 3 discusses if cryptocurrencies have a useful or significant role to play in institutional portfolios – and also lays out some alternative scenarios institutional investors would need to believe under which cryptocurrencies would potentially continue to flourish.

## CHAPTER 3

# CONSIDERING BITCOIN FOR AN INSTITUTIONAL PORTFOLIO

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*The time has come to seriously examine what role bitcoin might play in an institutional multi-asset portfolio.”*

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## CHAPTER 3

# CONSIDERING BITCOIN FOR AN INSTITUTIONAL PORTFOLIO

The spectacular returns, growing scale and market cap of the crypto universe, the search for higher real returns in a yield-starved investment universe as well as their purported role as “digital gold” — a safe haven in volatile times — has led many institutional investors to at least consider allocating a small percentage of their portfolio to cryptocurrencies.

Even for the most hardened skeptics, the time has come to seriously examine what role bitcoin might play in an institutional multi-asset portfolio, particularly in an era of rising geopolitical and inflation risks.

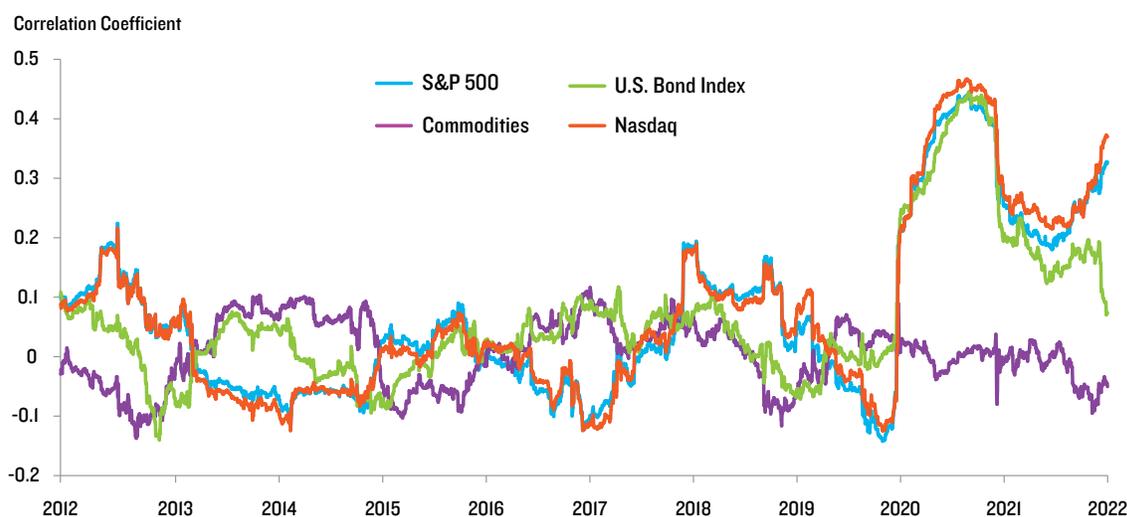
While it would be foolhardy to arrive at a definitive verdict given the brief time period since Bitcoin’s inception and the ongoing evolution of cryptocurrencies, our evaluation of the evidence to date strongly suggests that, despite robust valuations and the conviction of ardent crypto enthusiasts, direct investment in bitcoin or other cryptocurrencies currently offers little benefit to institutional investors and considerable volatility and regulatory risk.

### Are cryptocurrencies an effective portfolio diversifier?

Given its deliberate detachment from sovereign states and monetary institutions, bitcoin would appear to be less impacted by classic macroeconomic factors than conventional asset classes such as equities, bonds or commodities.

Unfortunately, for investors looking for diversification, bitcoin’s correlation with equities and commodities has been unstable and trending higher of late. Between 2013 and 2019, bitcoin had a near-zero average correlation with broad U.S. equities and commodities. Starting in 2020, however, its

**Exhibit 6: Bitcoin Correlation with Various Assets**  
(Rolling 1-year)



Source: PGIM analysis; Refinitiv and Bloomberg.

Note: The Bloomberg Commodity Index and Bloomberg Aggregate Bond Index were used for Commodity and Bonds respectively.

correlation with U.S. equities and commodities spiked sharply and has remained consistently positive since (Exhibit 6). Even the International Monetary Fund has noted the “increased and sizable co-movement and spillovers between crypto and equity markets indicate a growing interconnectedness” that is a growing source of systemic risk.<sup>27</sup> This suggests cryptocurrencies may not be particularly effective as a portfolio diversifier going forward.

*Bitcoin’s correlation with equities and commodities has been unstable and trending higher since 2020.*

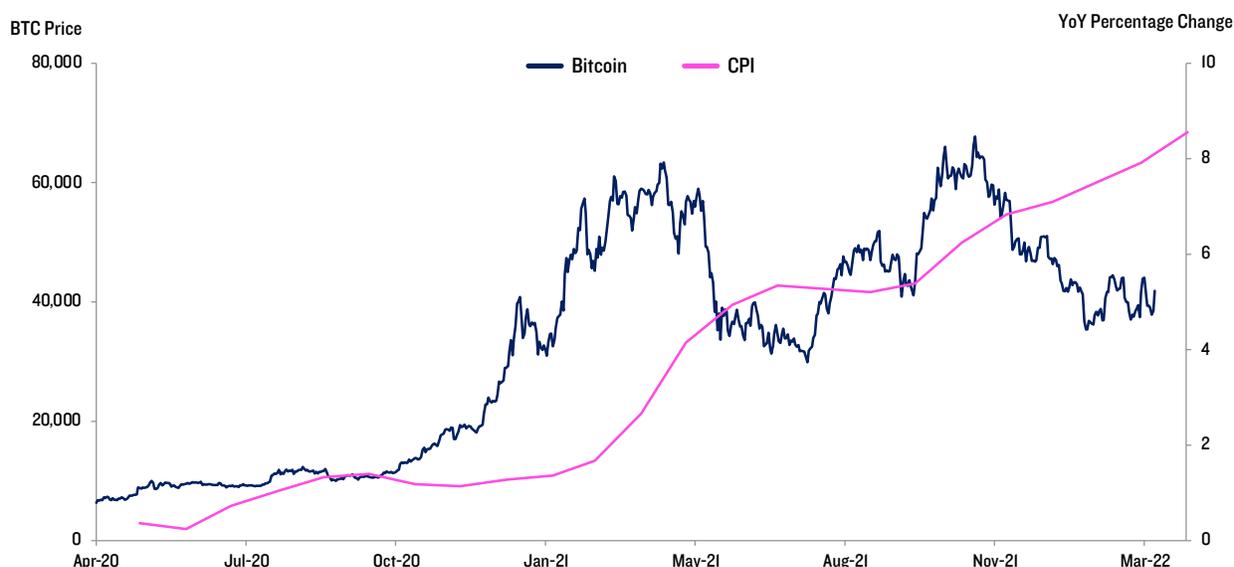
That an emerging asset class has a growing correlation with other assets as it matures is not only theoretically plausible but has historical precedent. Some frontier equity markets have demonstrated a similar tendency in the past. It should therefore come as no surprise that as bitcoin has gone mainstream it has also grown more

sensitive to the broader liquidity and risk sentiment factors that move other assets. In fact, market factor analysis demonstrates that bitcoin has developed a strong “trend following” tendency and more investors view bitcoin as a high-beta, risk-on asset.<sup>28</sup>

## Is bitcoin an effective hedge against inflation?

Bitcoin is scarce. That is, its supply is limited to 21 million coins and this is hard-coded into the bitcoin algorithm. This constraint suggests its value, much like gold, may be resistant to fiat monetary debasement or price inflation. However, there is scant evidence to support this thesis. In the lone episode of elevated U.S. inflation since the introduction of cryptocurrencies, bitcoin provided only limited inflation protection. U.S. prices were whipsawed during the pandemic and inflation began to soar steadily in 2021 and into 2022. The price of bitcoin moved with inflation only for a brief time before falling sharply (Exhibit 7). Gold, on the other hand, has demonstrated since the 1970s that it can be a reasonably effective and reliable long-term inflation hedge.<sup>29</sup>

**Exhibit 7: U.S. Inflation vs. Bitcoin Price**



Source: Bloomberg and Federal Reserve Economic Data.

## How does bitcoin's volatility and risk-adjusted return compare to other assets?

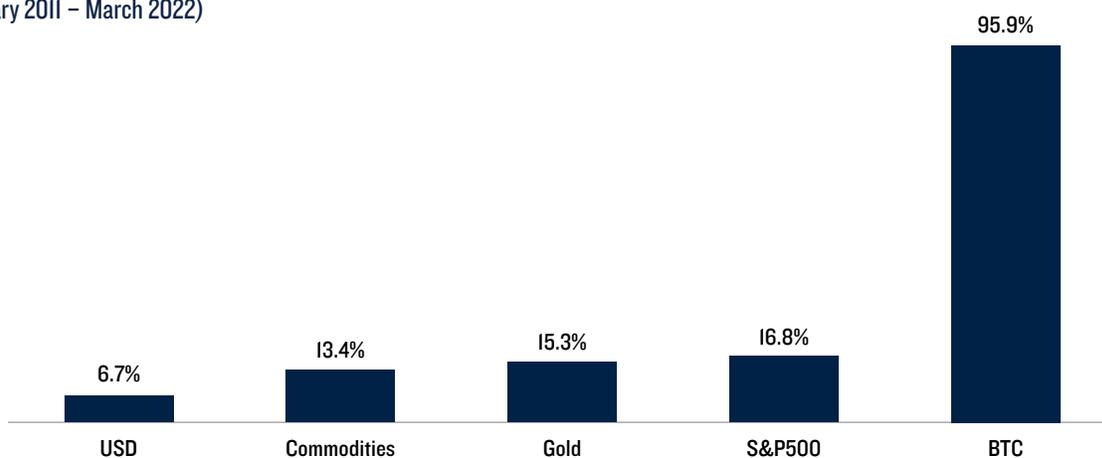
Bitcoin has a justified reputation for being *substantially* more volatile than other asset classes (Exhibit 8).

This extreme volatility manifests itself in far more instances of 10%, 25% and even 50% drawdowns

than either equities or commodities over its brief history. Between June 2010 and March 2022, bitcoin recorded more than 25 episodes of drawdowns of 25% or more. By comparison, equities and commodities recorded just one each (Exhibit 9).

When considering risk-adjusted returns, bitcoin had an extraordinary risk-return profile early on. However, it has not retained this superior performance.

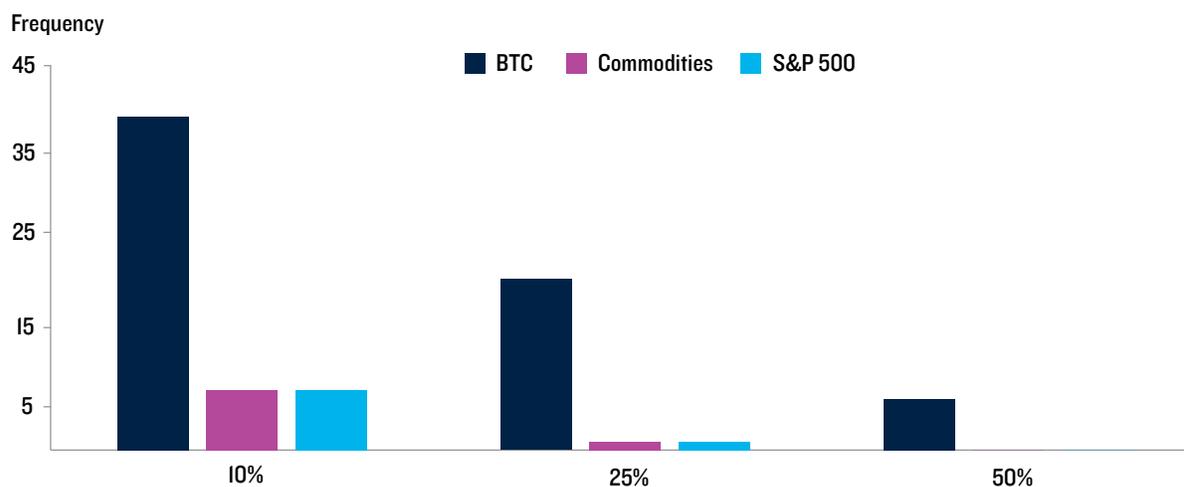
**Exhibit 8: Asset Volatility**  
(January 2011 – March 2022)



Source: PGIM Thematic Research; Refinitiv and Bloomberg.

Note: Volatility of daily returns, annualized. The Bloomberg Commodity Index and London Bullion Market Association Gold Price were used for Commodities and Gold respectively.

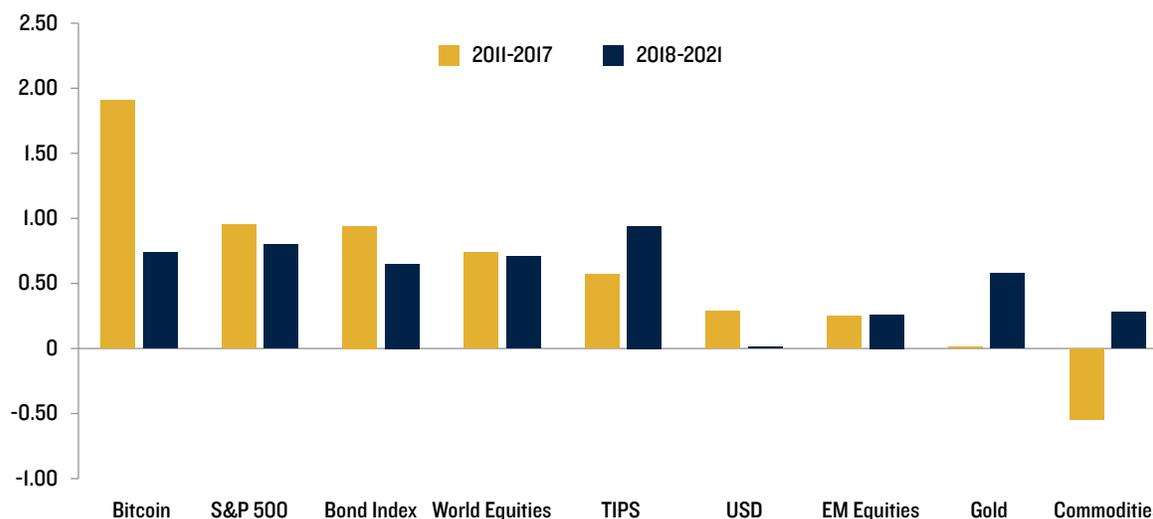
**Exhibit 9: Frequency of Drawdowns**  
(June 2010 – March 2022)



Source: PGIM Thematic Research; Bloomberg and Refinitiv.

Note: Drawdowns calculated over a 3-month rolling window. The Bloomberg Commodity Index was used for Commodities.

## Exhibit 10: Sharpe Ratios of Select Asset Classes



Source: PGIM Thematic Research; Refinitiv and Bloomberg.

Note: The MSCI World Index, Bloomberg Aggregate Bond Index, Bloomberg Inflation-Linked Bond Index, U.S. Dollar Index, MSCI Emerging Markets Index, London Bullion Market Association Gold Price, and Bloomberg Commodity Index were used for Global Equities, Bond Index, TIPS, USD, EM Equities, Gold, and Commodities respectively.

Since 2018, its Sharpe ratio has been similar to other assets (Exhibit 10). Given the frequency and severity of drawdowns and its diminished risk-adjusted performance since 2018, it is not clear what role an asset class offering zero yield and dubious diversification qualities should play in a long-term strategic portfolio allocation.<sup>30</sup>

*Bitcoin had an extraordinary risk-return profile early on, but it has not retained this superior performance.*

### Does bitcoin function as a safe-haven asset? Is it “digital gold”?

Like gold, bitcoin is not issued nor controlled by an institution, central bank, or government. This characteristic has enabled gold to serve as a safe-haven asset during some periods of increased economic or political uncertainty. Does bitcoin share some of those characteristics as well? No, it does not.

For starters, the theoretical foundations of cryptocurrencies as a safe haven are somewhat shaky. A white paper, no matter how elegant, cannot decree a safe haven. In contrast, gold and other precious metals have held some financial status for over 2,000 years.<sup>31</sup> Furthermore, many precious metals have multiple consumer and industrial uses that – unlike cryptocurrencies – give them a non-zero price floor.<sup>32</sup> For example, currently about half of gold production goes to jewelry, one-tenth to industry and a quarter to back central bank reserves.<sup>33</sup>

More importantly, the empirical evidence to date does *not* support the hypothesis of bitcoin as a safe haven. Over its short history, bitcoin has not exhibited stability in its value. Between 2015 and 2022, for example, its volatility was consistently *much* higher than other conventional safe-haven assets such as gold, U.S. Treasuries, or the U.S. Dollar (Exhibit 11).

The true test for a safe-haven asset, however, is how it retains its value during a period of extreme and widespread market volatility. Bitcoin was not exactly a steadying force in early 2020 when global asset prices spiraled downward due to worldwide COVID-induced shutdowns. It did *not* exhibit safe-haven characteristics at that time and held *far less* of its value

than conventional safe-haven assets like gold and the U.S. dollar (Exhibit 12).

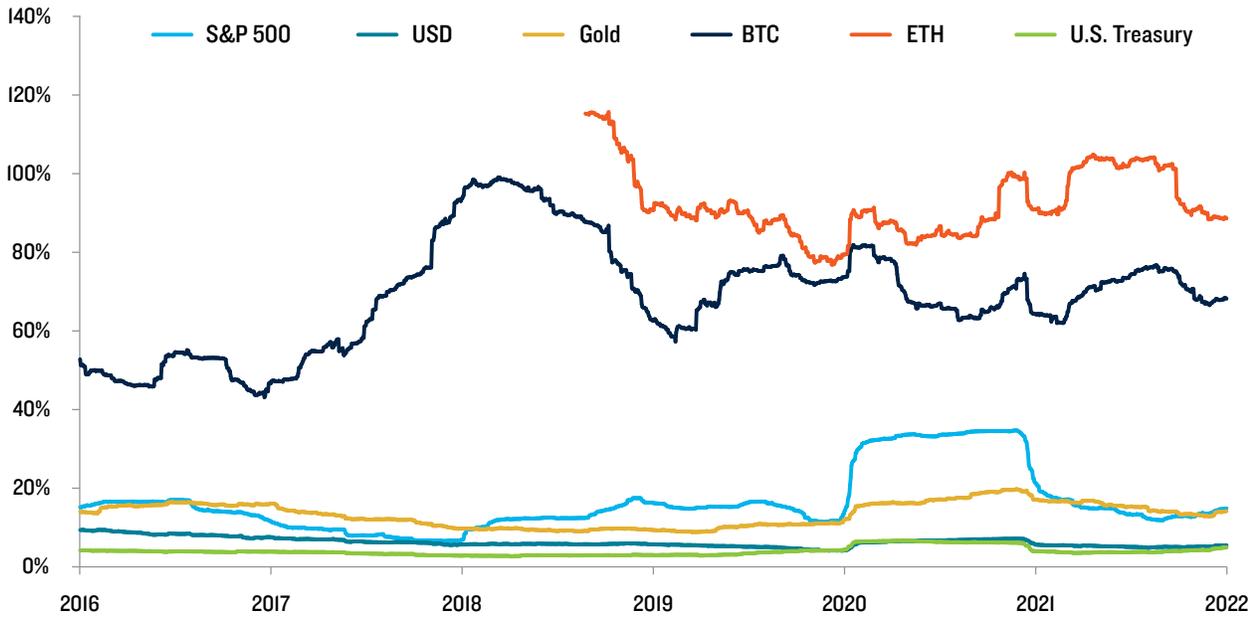
### Does bitcoin offer any short-term alpha opportunities?

Some features of cryptocurrency markets, especially the wild price gyrations, provide opportunities for active trading. In particular, hedge fund strategies

can potentially exploit market inefficiencies and dislocations that arise in these immature, retail- and momentum-driven markets.

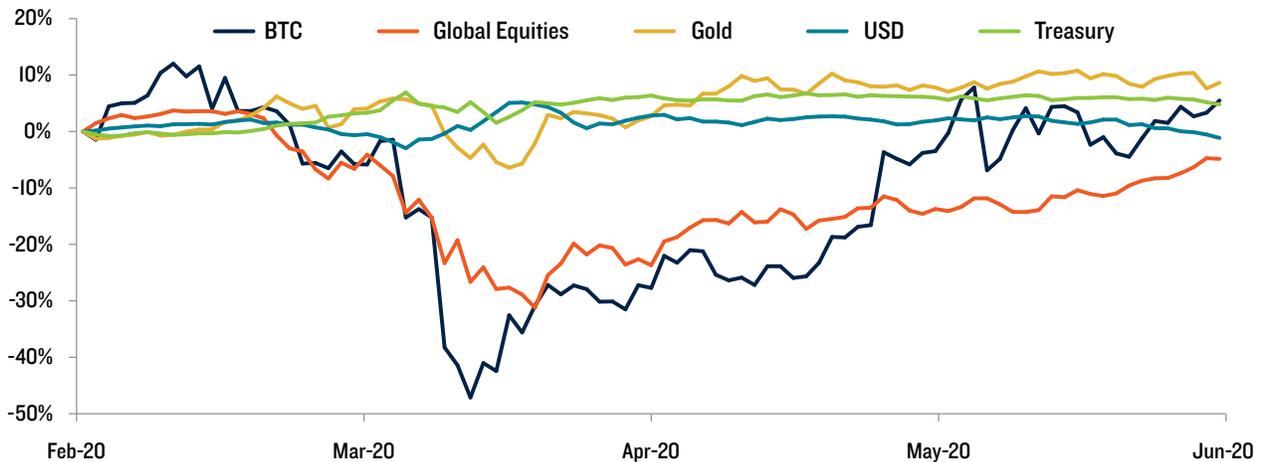
Dislocations in the nascent cryptocurrency market draw comparisons to other less efficient frontier markets. For example, futures contracts for some cryptocurrencies are not standardized and their prices do not always align with spot markets

**Exhibit II: Price Volatility of Select Asset Classes**



Source: Refinitiv and Bloomberg.  
 Note: Annualized rolling 1-year volatility. The London Bullion Market Association Gold Price and Bloomberg Treasury Index were used for Gold and Treasuries respectively.

**Exhibit 12: COVID Market Drawdown**



Source: Refinitiv and Bloomberg.  
 Note: The MSCI World Index, London Bullion Market Association Gold Price, and Bloomberg Treasury Index were used for Global Equities, Gold and Treasuries respectively.

across exchanges, creating arbitrage opportunities that quant hedge funds have been successfully exploiting.<sup>34</sup> In addition, the extraordinary volatility of cryptocurrencies presents a wide range to trade in. Also, similar to frontier markets, liquidity and leverage can be unreliable and scarce in cryptocurrency markets.<sup>35</sup> Such a backdrop provides return potential for market players who have the capability of providing leverage or liquidity to the market when it is needed most. These alpha opportunities are available to a range of multi-strategy and quantitative hedge funds.<sup>36</sup>

*Cryptocurrencies are problematic along multiple dimensions of ESG.*

## How do cryptocurrencies align with overall ESG objectives?

For sustainability-minded investors, cryptocurrencies are problematic along multiple dimensions of ESG.

Environmentally, the most worrying aspect of cryptocurrency is its massive energy consumption. Major blockchains – including bitcoin and the original Ethereum – currently utilize a proof-of-work (POW) mechanism to validate transactions that is extremely energy intensive. With a POW validation structure, miners on the blockchain compete for the right to create the next block in the chain by solving complex computational problems. This race typically involves thousands of competitors and is repeated every 10 minutes or so. Each of the competitors utilize computing power and consume electricity, while only one of them wins and is rewarded with newly minted coins.

Because of this highly decentralized validation process, just a single transaction on the bitcoin blockchain, for example, requires enough energy to power the average American home for over two months and has a carbon footprint equivalent to 2 million transactions on the Visa network (Exhibit 13). The total electrical energy use around bitcoin annually is on par with the power consumption of countries like Thailand, South Africa and Ukraine.<sup>37</sup> In fact, the soaring demand for

electricity from bitcoin miners has given new life to carbon-intensive energy sources – like fossil fuel power plants – as well as raising concerns over diverting scarce renewable energy from other potential uses.<sup>38</sup>

The intense energy consumption around bitcoin mining and validation is a major reason several countries – including China – have banned mining altogether.<sup>39</sup> Indeed, in the wake of the Chinese ban, mining activity has shifted to alternate locations like Kazakhstan, Canada and Texas and has strained power grids in some of these new locations.<sup>40, 41</sup>

Subsequent iterations of blockchain such as Cardano and Solana reduce their energy footprint through the use of different, less energy-intensive validation mechanisms. Indeed, even Ethereum is planning a transition to this proof-of-stake validation process in late 2022. However, critics suggest these less energy-intensive validation protocols may be less secure.<sup>42</sup> Nevertheless, the oversized energy footprint of bitcoin remains a major area of concern for ESG investors.

Socially, cryptocurrencies offer the promise of being more inclusive and accessible, providing a digital platform to underbanked households. However, many mobile phone-based payment services in developing countries (e.g., M-Pesa's domestic money transfers in Kenya and Tanzania or Grameen Bank's international remittance pilots in Bangladesh) have alleviated some of these financial inclusiveness concerns. Mobile phones, of course, are more widely available than high-speed internet service and these payment networks require neither a new currency nor new payment infrastructure.

Furthermore, when it comes to the distribution of wealth, there is no reason to think crypto wealth is less unequal than conventional wealth, and recent empirical research confirms that the distribution of holdings of bitcoin does significantly differ from the distribution of wealth in the U.S. – 0.25% of total global accounts control roughly 20% of the bitcoins in circulation.<sup>43</sup>

Finally, from a governance perspective, the anonymity and difficulty in identifying cryptocurrency ownership raises significant concerns around anti-money laundering (AML) and sanction evasion. Regulatory scrutiny of these risks is growing.

## Exhibit 13: Annualized Bitcoin Power Usage and Carbon Footprint

	ANNUALIZED BITCOIN FOOTPRINTS	SINGLE BITCOIN TRANSACTION
 <b>CARBON FOOTPRINT</b>	<b>Czech Republic</b> The annual carbon footprint of BTC (114 Mt CO <sub>2</sub> ) is comparable to the annual carbon emissions of the Czech Republic.	<b>2 Million</b> A single BTC transaction has a carbon footprint (1,180 kg CO <sub>2</sub> ) equivalent to two million Visa transactions.
 <b>ELECTRICAL ENERGY</b>	<b>Thailand</b> BTC uses as much electricity annually (204 TWh) as the entire nation of Thailand.	<b>73 Days</b> A single BTC transaction consumes sufficient electrical power (2,200 kWh) to power an average U.S. household for 73 days.

Source: "Bitcoin Energy Consumption Index," Digiconomist, March 2022.

For example, South Korean regulators are auditing commercial banks' ties to cryptocurrency exchanges for AML adequacy and U.K. cryptocurrencies now need to comply with AML requirements by April 2022 as well.<sup>44, 45</sup>

On sanction evasion, concerns have escalated with the war in Ukraine. Increased trading between ruble and crypto suggest evasion of financial sanctions. Furthermore, links between sanctioned individuals and cryptocurrency wallets, have culminated in the seizure of multiple crypto accounts.<sup>46, 47, 48</sup>

### Will the risk profile of cryptocurrencies improve or worsen going forward?

Our base case is that (1) regulatory uncertainty will decrease as policy frameworks and legal guidelines catch up with the frenzied pace of growth and innovation in the crypto ecosystem, but with that greater clarity will come more rigor; (2) tougher cryptocurrency regulations may act as a significant headwind on the industry; (3) there may be a real threat to the survival of many cryptocurrencies from central bank digital currencies.

First and foremost, a lack of clear and uniform regulations – both across and within countries – has led to tremendous uncertainty for long-term investors evaluating cryptocurrencies for their portfolio.<sup>49</sup> It remains ambiguous, for example, when a cryptocurrency in the U.S. falls under the regulatory framework of a security – and thus subject to SEC regulations about issuance – and when it is deemed to be an asset like bitcoin and Ethereum have claimed. This lack of clarity around a fundamental question is emblematic of the material policy risks facing crypto investors.

Some regulators are keen to nurture the innovation around cryptocurrencies and blockchain technology. The UK government, for example, is planning to accept stablecoins as a form of payment in a push to become a global hub of crypto innovation.<sup>50</sup> Meanwhile, other regulators view cryptocurrencies as a major risk to both consumers and to the commercial banking systems they oversee.<sup>51, 52</sup>

In addition to unclear regulation and rising scrutiny, cryptocurrencies are facing outright prohibition in some countries. China's abrupt banning of all cryptocurrency trading and mining in the fall of 2021 is a prominent example, but by no means the

only one (e.g., Egypt and Bangladesh).<sup>53</sup> Even when not explicitly prohibited, some countries are taking measures to rein in crypto trading. India, for example, has decided to tax income from the transfer of cryptocurrencies at 30%.<sup>54</sup>

Market manipulation is another area of concern. With almost no regulations around cryptocurrency insider trading or price manipulation, celebrity crypto

influencers can send market prices soaring or tumbling with impunity. In May 2021, a series of tweets by Elon Musk, mentioning personal and corporate activity in bitcoin, sent the price of bitcoin soaring by as much as 10%.<sup>55</sup> This was not the only incident, as supportive tweets around dogecoin led to short-lived 30% gains.<sup>56</sup> This came just two weeks after prior comments sent dogecoin prices into sharp decline.<sup>57</sup>

### Box I: What do investors need to believe to justify cryptocurrency valuations?

What do you have to believe?	Why this outcome is not our base case
<p><b>Spiraling inflation from central banks “printing money” and excessive government debt</b> leads market participants to abandon government-issued fiat currencies for cryptocurrencies across most transactions.</p>	<p>Fighting inflationary pressure remains a key objective for central banks, with a greater risk they overshoot in monetary tightening and rate increases triggering a recession. In any case, persistently high inflation in a few G8 currencies would more likely lead to a shift to other major fiat currencies rather than bitcoin.</p>
<p><b>Cryptocurrency’s extreme volatility turns out not to be a retail-fueled speculative bubble but the price discovery journey of a new asset class</b> that slowly becomes a stable and truly diversifying addition to investor portfolios. In this scenario, bitcoin matures into “digital gold” and takes a significant share of gold’s market share as an institutional asset.</p>	<p>While multiple bitcoin rallies may imply more staying power than typical bubbles, cryptocurrency pricing is likely based on speculative behavior and a fundamental thesis around its value has yet to emerge. Furthermore, with limited evidence that bitcoin is an inflation hedge or safe-haven asset it is unlikely cryptocurrencies will be widely held by institutional investors.</p>
<p><b>Major cyberattacks overwhelm traditional financial institutions as well as wholesale and retail payment networks.</b> With plummeting trust in the formal banking system, market participants turn to cryptocurrencies to seek security and reliability.</p>	<p>Cyberattacks that systematically derail the global payment networks for a sustained period would likely also disrupt the global internet infrastructure – making mining, trading and using cryptocurrencies quite problematic.</p>
<p><b>Major central banks fail to launch CBDCs</b> due to a desire to protect the conventional banking system, technological and operational shortcomings in the public sector, or just general ineptitude. In the absence of major CBDCs, digital stablecoins fill the void.</p>	<p>While some central banks will inevitably lag, nearly all major central banks are exploring how to issue digital currencies. China has already launched a digital renminbi. Active discussions are ongoing in the U.S. and the EU, with our base case that several G8 countries will launch CBDCs over the next five years.</p>
<p><b>Mistrust in governments and institutions by their citizens grows more widespread,</b> perhaps triggered by a global banking sector meltdown. Cryptocurrencies fill the void.</p>	<p>The 2008 financial crisis and COVID pandemic tangibly demonstrated that governments and central banks remain willing and able to support commercial banks under stress. Furthermore, with more than 100 different fiat currencies and central banks, it remains a remote possibility that confidence is depleted in all major fiat currencies simultaneously, so systemic risk in one country or region is more likely to lead to a flight to other fiat currencies.</p>
<p><b>Human activity moves from the physical to the digital realm, where cryptocurrencies dominate.</b> With gaming, eSports, the metaverse, and Web 3.0 accounting for a material share of global economic activity in the virtual realm, cryptocurrencies see explosive growth.</p>	<p>Our base case is that while the metaverse will take up a growing share of people’s entertainment budgets, especially younger millennials and Gen Z, the majority of people will prefer to spend their non-entertainment resources and time in the physical rather than virtual world. Furthermore, if CBDCs are successfully established, even e-gaming and metaverse activity is likely to shift from crypto to fiat digital currencies.</p>

These episodes of market manipulation have drawn the attention of regulators in some jurisdictions who cite this as a primary reason for rejecting new crypto investment vehicles like bitcoin ETFs.<sup>58</sup> In response, a coalition of major cryptocurrency firms – including exchanges, digital asset platforms, and crypto software providers – has launched an initiative to self-regulate the industry. The coalition acknowledges the potential for fraud and manipulation in the cryptocurrency space and is urging digital asset companies to sign a “market integrity” pledge that calls for the industry to protect investors.<sup>59</sup>

Regulators and market participants have also been concerned by the notable and repeated breakdowns in the infrastructure supporting cryptocurrency mining and trading. Centralized cryptocurrency exchanges are one example. These exchanges set prices for various digital assets and take a small fee off every transaction. Only a few countries have appropriate guidelines or regulations in place even though more than 300 exchanges are now operating globally.<sup>60</sup> With the rapid growth in cryptocurrency trading volumes, many exchanges do not have the capital or technical resources to scale up robustly, becoming popular targets for hackers. High-profile hacks of major cryptocurrency exchanges – like Mt. Gox, BitMart, Coincheck, and Binance – have been occurring since 2012 with more than 46 exchanges suffering thefts. The trend appears to be accelerating – overall cryptocurrency theft rose by more than 75% in 2021, totaling more than \$14 billion in stolen assets.<sup>61</sup>

Despite the growing investment mythology surrounding bitcoin, direct investment in it does not currently offer an attractive proposition for institutional investors. Specifically, it has not demonstrated enduring characteristics as a reliable portfolio diversifier, safe-haven asset, or inflation hedge. Its risk-adjusted returns of late are comparable

to other asset classes but come with significantly greater frequency of drawdowns. Furthermore, the unsettled and increasingly harsher regulatory backdrop, the immature operational infrastructure supporting it and its problematic ESG attributes pose significant and material risks for institutional investors.

While this is our base case, it is worth considering the alternative scenarios under which cryptocurrencies continue to rise in valuation and importance. We highlight a few of these potential pathways to crypto-dominance, as well as the counterarguments that lead us to currently consider these scenarios unlikely (see Box 1 on the prior page).

*Despite the investment mythology surrounding bitcoin it does not currently offer an attractive proposition for investors.*

We therefore believe it's important for institutional investors to focus instead on evaluating the potentially more attractive long-term opportunities in the broader crypto ecosystem, beyond cryptocurrencies themselves. Chapter 4 highlights a range of investment opportunities investors will want to evaluate as they consider the more long-lasting and enduring investment ideas in the broader crypto ecosystem that have emerged alongside the cryptocurrency phenomenon.

## CHAPTER 4

# INVESTMENT OPPORTUNITIES IN THE BROADER CRYPTO ECOSYSTEM

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*The most powerful  
applications of blockchain  
may be unrelated to  
cryptocurrencies.”*

### CHAPTERS

1

2

3

4

## CHAPTER 4

# INVESTMENT OPPORTUNITIES IN THE BROADER CRYPTO ECOSYSTEM

**In many ways the cryptocurrency boom resembles the Dutch tulip mania of the 1630s and the internet stock bubble of the late 1990s. But savvy long-term investors willing to look beyond the breathless hype surrounding cryptocurrencies are likely to find enduring investment opportunities around tangible, real-world applications of distributed ledger technology that are likely to generate attractive risk-adjusted returns – even if crypto-mania itself fizzles.**

We lay out four longer-term investment themes that CIOs will want to evaluate for their portfolios as they look beyond cryptocurrencies for sources of long-term value creation.

### 1. Private blockchains and smart contracts

The most powerful use cases for blockchain may be unrelated to the cryptocurrency payment networks. Indeed, blockchains are a highly secure and robust system for verifying and recording transactions. While there is hype around the “blockchain revolution,” investors would be wise to focus on blockchain use cases with well-defined practical applications that address real-world problems today, especially in the financial services sector.

While permissioned private blockchains still require central authorities to authenticate users initially, they can reduce the costs of routine financial transactions as they eliminate the need for counterparty and trade verification as well as transaction and record reconciliation. Because of the centralized authority verifying users, private blockchains can be easily scaled and will likely have the largest near-term impact on financial services firms.<sup>62</sup>

Permissioned blockchains also offer efficiencies in the origination, servicing and trading of assets, especially those (like real estate) with many different participants across the value chain and incompatible legacy

systems. The complexity of the value chain around mortgage origination, securitization and servicing, for example, has led companies to push for a more efficient and real-time process using blockchains. For example, Figure Technologies is a company which originates home equity loans and mortgages as well as securitizes and services them on the Provenance blockchain. This distributed ledger platform is an early example of the greater transparency and efficiency potential of permissioned blockchains targeting specific challenges.<sup>63, 64</sup>

When partnered with self-executing smart contracts, distributed ledger technology offers greater efficiency in the clearing and settlement of securities than current systems. Major global financial institutions are already utilizing private blockchains to enable real-time clearing and settlement of transactions today. In fact, private blockchains are already handling trades with almost no need for humans to verify counterparties, confirm trade instructions or settle transactions. In 2021, for example, JP Morgan launched Onyx, an Ethereum-based blockchain that uses smart contracts, to swap digitized Treasury collateral and digitized cash instantaneously and clears, settles and records billions in daily repo trading.<sup>65</sup>

Furthermore, innovations in smart contracts and the rapidly evolving ecosystem of innovative Layer-2 technologies are rapidly expanding the functionality and creating new and important possibilities for applications in the conventional financial realm.

The next step for settlements could be more complex transactions like OTC derivative contracts and other kinds of bespoke, highly customized transactions.<sup>66</sup>

*Partnered with self-executing smart contracts, distributed ledger technology offers greater efficiency in the clearing and settlement of securities than current systems.*

## 2. The infrastructure and ecosystem supporting blockchain applications and CBDCs

A range of surrounding technology and services will be required to support permissioned blockchains and smart contracts – and many will also play a pivotal role in supporting the adoption and growth of CBDCs. Specifically, investors should focus on two areas which are likely to be especially attractive: (1) blockchain enablers and (2) fraud prevention and regulatory compliance services.

### Key blockchain enablers

The internet didn't really take off and gain widespread adoption until its broad infrastructure had matured and was able to overcome initial challenges. Similarly, the landscape for innovation in blockchain infrastructure is wide open and there is tremendous potential for key enablers to reduce current challenges and barriers.

One such area for blockchain is interoperability. While there already exists a diverse ecosystem of blockchains, these different blockchain networks do not interact with each other in a meaningful way. Their ability to “talk” and transact with each other seamlessly is referred to as interoperability and this innovation will enable a wide range of blockchain-enabled products and services.<sup>67</sup> This innovation could make interoperable smart contracts possible and open up new possibilities for record and document management in healthcare, law and real estate by

allowing important business information to be securely sent back and forth between private and public networks in a customizable and controlled manner.<sup>68</sup> VC-funded platforms like Polkadot and Cosmos are major enablers of interoperability.

Another infrastructure area that has drawn VC investment is Layer 2 technologies that enhance performance and scalability on popular platforms like Ethereum. Polygon, for example, is a company which provides software that lowers the cost and friction of transacting on Ethereum.<sup>69</sup> Another area of innovation in crypto infrastructure is the growth of companies that support the development of decentralized applications, or dApps. For example, Alchemy is software to create cryptocurrency apps that communicate with Ethereum and several other blockchains.<sup>70</sup>

### Fraud prevention, security and regulatory compliance

Given the complicated regulatory environment for cryptocurrencies and concerns raised by decentralized and anonymous transactions, there is a growing field of AML risk assessment and management. A whole slew of PE and VC-funded software firms like Fireblocks and Chainalysis in the US, and Coinfirm and Elliptic in the UK, currently provide services to exchanges, payment providers and custodians to help them conduct due diligence on customers, track transactions and manage these risks. Firms like Simplex in Israel utilize AI to provide crypto and fraud prevention solutions to merchants. Meanwhile Merkle Science in Singapore offers businesses, banks and government agencies tools for crypto threat detection and risk management. As the world of digital assets and CBDCs matures and intersects further with conventional finance and other firms, the need for these services will grow.

## 3. Tokenization: Next-generation securitization of real assets

Tokenization of real assets – essentially fractionalizing ownership into digital tokens on a distributed ledger – represents a potentially game-changing future

application that opens up simpler, more cost-efficient ways to issue, manage, and transact assets and investments.

*Tokenization of real assets opens up simpler, more cost effective ways to issue, manage and transact assets.*

In theory, any real asset – precious metals, real estate, artwork or infrastructure – could be tokenized and substantially reduce frictional costs from transactions and servicing. This would increase liquidity, simplify transactions, enhance price transparency, and allow more granular portfolio construction. It also allows investors to potentially benefit from increased liquidity, shorter and more flexible lock-up periods, and easier proof of ownership.

It is important to note, however, this application remains at a very early stage and significant challenges need to be resolved. First, the lack of clear regulatory, legal and tax guidelines around tokenized assets leads to compliance uncertainties. Second, while distributed ledger technology is already being employed by banks in their clearing and settling operations, it needs to be further refined to work across private assets and at efficient scale under real-world conditions. Third, market participants need to build trust in the new operational mechanisms and governance frameworks and adapt their internal systems to them.

However, when the legal, governance and regulatory frameworks become more settled, tokenization will lead to a more fractionalized ownership model for real assets. For example, institutional investors who are significant participants in real estate funds are accustomed to influencing the contours of the fund's investment strategy. A more fractionalized ownership model could potentially reduce the influence of anchor investors in the covenants or terms for large real estate transactions that could now be broadly syndicated with smaller institutional, high-net-worth

and even retail investors. Tokenization could also lower the transaction costs of holding a significantly more diversified portfolio of real assets as expensive intermediaries in the securitization marketplace are displaced by cheaper blockchain-powered technologies. Indeed, the prospect of fractionalized ownership and better liquidity under a tokenized real asset regime might allow investors and real estate managers to diversify or fine-tune portfolios with greater ease.

#### **4. Monitor the metaverse as a leading indicator of crypto innovation**

Metaverse platforms combine augmented reality (AR), virtual reality (VR), blockchain technology and digital tokens or currencies to create highly immersive digital worlds where people can gather to socialize, play, work, and trade digital goods.<sup>71</sup> While it is unclear whether the metaverse will simply become a part of our entertainment allocation, or become something much more meaningful than that, we believe institutional investors should track new technologies, companies and platforms in the metaverse for three primary reasons.

First, the metaverse is big and will get bigger. Virtual gaming, entertainment (e.g., concerts by major bands) on virtual sites, and advertising in the metaverse generates roughly \$500 billion annually in revenue today – as large as the “real-world” global sports industry – and is growing rapidly.<sup>72, 73</sup> In 2021, even putting aside NFTs, over \$60 billion was spent on purely cosmetic, nonfunctional virtual goods.<sup>74</sup> Given the degree of investment going into real-time 3-D rendered virtual universes, investors should observe how these platforms evolve.

Second, we are not quite there yet, but applications in the metaverse may start leading to tangible improvements in real-world industries. Johns Hopkins recently performed its first pair of surgeries on live patients using augmented reality displays.<sup>75</sup> In the defense sector, the U.S. military has discovered that you can accelerate the learning curve for new recruits looking to fly helicopters with VR goggles, effectively giving them a private helicopter to learn on.<sup>76</sup> And in industrials, BMW's new all-electric vehicle ran a VR simulation for six months before finalizing the actual

layout for the factory – changing 30% of the design from the original during those virtual experiments.<sup>77</sup> Perhaps even more importantly, these new uses of metaverse platforms are spawning innovative technologies, in holographic displays and speech recognition, for example. Investors will therefore want to evaluate opportunities both in metaverse applications – especially in education, training, healthcare and e-commerce – as well as the VR/AR hardware field.<sup>78</sup>

Third, cryptocurrencies and digital tokens are *the* currency in the metaverse. This is a world where crypto natives have chosen to adopt digital currencies and tokens as the sole medium of exchange and unit of account to trade NFTs, buy digital assets in a multiplayer game, or attend a virtual concert. Investors looking to understand the future direction of the broad cryptocurrency and digital token landscape will need to monitor the transaction, payment and currency systems being developed for and in the metaverse.

## Conclusion

It is clear cryptocurrency is not currently (and may never be) ready for prime time. Given its flip-flopping correlations with other assets, frequent stomach-churning drawdowns, a highly unsettled regulatory landscape, immature infrastructure and problematic ESG impact, investing directly in bitcoin and other cryptocurrencies is currently quite unattractive for institutional investors.

Of course, investors will want to monitor developments in the cryptocurrency space in the unlikely event that conditions arise for the mainstreaming of private cryptocurrencies. But regardless of how cryptocurrencies themselves endure, savvy long-term investors will certainly want to capture the emerging constellation of investment opportunities in the broader ecosystem of innovation surrounding cryptocurrencies – many of which will power new trading platforms, smart contracts, central bank digital currencies and next-generation securitization technologies in the years and decades ahead.

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