

Intended and Unintended Crypto Exposures

Funds with intentional and unintentional exposure to digital assets.

Morningstar Quantitative Research

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Corrections and Clarifications

[Correction](#) issued March 13, 2023.

Executive Summary

Digital assets, which include cryptocurrencies and other tokenized forms of value, are increasingly gaining attention as part of the alternative portion of investment portfolios, with a belief that they offer diversification, potential for higher returns, and a hedge against inflation. However, digital assets are a relatively new asset class and face several challenges, including regulatory uncertainty, liquidity issues, challenges in custody, and a lack of transparency. Investing in digital assets often comes with higher levels of risk compared with traditional assets. There is also a growing number of public companies that provide various services enabling blockchain and crypto adoption. As such, these equities and associated managed investments demonstrate a higher level of risk. It is crucial that investors carefully consider the role of these exposures in their overall investment strategy and perform thorough due diligence during the investment selection process.

The aim of our research paper is to establish a framework for identifying tangential exposure to digital assets in managed investments and common stocks. To this end, we explore the ways in which investors may be exposed to digital assets even when there is no intention on the part of the fund manager to invest in this asset class. We also test the hypothesis that tangential exposure could be a bet against inflation. Our study will be relevant to financial advisors, investors, and other researchers who seek to comprehend the extent to which their equity/fund portfolio is intentionally or unintentionally exposed to digital assets.

Key Takeaways

- ▶ Investing in digital assets is associated with various challenges, including a lack of liquidity, high volatility, regulatory hurdles, and custodial issues. Because of underlying volatility, digital assets may not be appropriate for the average investor.
- ▶ There are more crypto-based exchange-traded products and notes in Europe than in the United States primarily because of differences in the regulatory environments.
- ▶ Using our ARNA — Aggregate, Regress, NLP, Aggregate — methodology, we identified that there are managed investment funds to the tune of \$250 billion in assets under management that provide investors with either intended or unintended crypto exposure.
- ▶ Tangential stock exposures are detected most within technology, communications, consumer cyclical, and financial sectors in order of weighting.
- ▶ Analyzing holdings of global equities funds, we find that the majority of intentionally exposed digital asset funds are domiciled in the United States. In contrast, unintended exposure was detected in funds domiciled across multiple countries in the Americas, Asia, and Europe. It is

also worth noticing that many funds with unintended exposure to blockchain are from the universe of thematic funds.

- ▶ Contrary to popular belief, we do not find supporting evidence that investing in digital assets or in assets with tangential exposure to digital assets provides an effective hedge against inflation.
- ▶ Investing in stocks and funds with tangential exposure to digital assets can result in investors being exposed to unwanted risks that may not be apparent when analyzing asset and factor exposures alone. To avoid unintended risks, investors should scrutinize their investment choices carefully and discuss their selection with financial advisors.

Introduction

Over the last decade, digital assets or cryptocurrencies have experienced rapid growth due to their focus on decentralization, which offers new and innovative ways to store, transfer, and invest wealth. There is a widely held belief by some investors that digital assets provide an effective hedge against inflation, enabling portfolio diversification and the potential for higher returns. As a result, the asset class has witnessed innovation with the launch of various coins/tokens such as utility tokens, nonfungible tokens, stablecoins, decentralized apps, and more. Consequently, the total market capitalization of all cryptocurrencies has grown to over \$1 trillion in 2023 from approximately \$1 billion in 2013, indicating a strong growth trend.

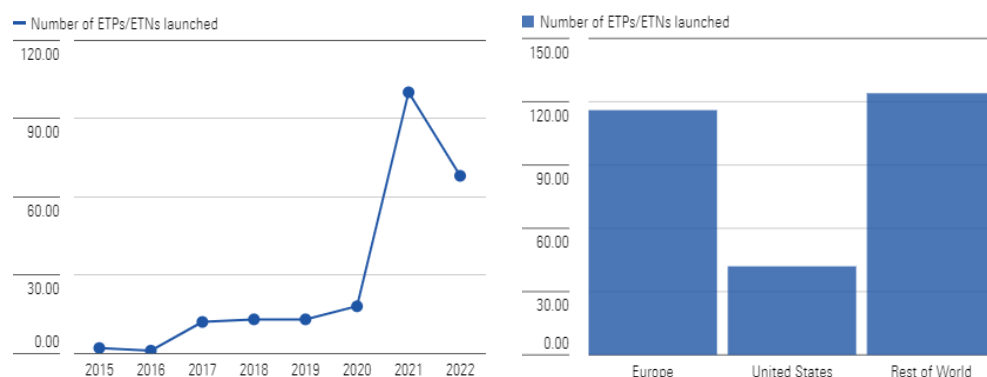
However, investment in digital assets is not without risks driven by these factors:

1. **Market volatility:** Digital assets demonstrate significantly higher volatility than broad equities, leading to extreme investor outcomes. Bitcoin, the poster child of this asset class, witnessed growth to \$60,000 in 2022 from \$1 in 2011 before retracing to \$16,000 by the end of 2022. The level of volatility may make it unsuitable for everyday investors.
2. **Custodial risks:** Digital assets are stored on blockchain networks, which are vulnerable to hacking and cyberattacks. Investors have lost millions of dollars over the past five years when investing in insecure wallets or exchanges. The past couple of years saw big heists such as the ones on Ronin Network (\$614 million) and on Poly Network (\$611 million). Another notable example is the collapse of the QuadrigaCX exchange in 2018 after the sudden death of its CEO, Gerald William Cotton. Because Cotton held the password to offline cold wallets, investors were unable to make withdrawals.
3. **Lack of regulation:** Digital assets are largely unregulated and unrecognized across major economies. This means that investors may not have the same level of protection as they do in traditional financial markets. In 2022, billions of dollars in investor wealth was washed away by the Three Arrows Capital and FTX bankruptcies and other failures.
4. **Liquidity risks:** Some digital assets, especially those with smaller market capitalizations, can be illiquid, which means that there may not be enough buyers or sellers in the market to trade the asset quickly and easily. This lack of liquidity can also make it difficult to accurately price cryptocurrencies. Without a deep and liquid market, the price of a cryptocurrency may be subject to large price swings, which may be detrimental to investor outcomes.

5. Legal and tax risks: The legal status of cryptocurrencies can vary from country to country, and in some cases, the legal and tax landscape may be unclear or ambiguous. As a result, investing in cryptocurrencies can carry legal risks, including the potential for regulatory crackdowns, legal challenges, or restrictions on the use or trading of digital assets. Investing in cryptocurrencies can also carry tax risks, as the tax treatment of digital assets can be complex and subject to change. In many countries, the tax treatment of cryptocurrencies is still evolving, and there may be uncertainty around how to report and pay taxes on gains or losses from cryptocurrency investments.

The next section outlines the different ways to access digital assets. It is crucial to approach the following analysis with a degree of caution because the digital market is constantly changing and expanding.

- Direct Purchase: This involves investors buying digital assets (coins/tokens) directly. Some common examples include bitcoin and ethereum. These coins can be bought directly on cryptocurrency exchanges, on peer-to-peer marketplaces, at cryptocurrency ATMs, and via over-the-counter trading. As of February 2023, there are over 12,000 active coins, with a total market cap of over \$1 trillion. Direct purchase is prone to issues with custodians and liquidity and requires significant oversight on the part of investors.
- ETPs/ETNs: Exchange-traded products and exchange-traded notes are financial instruments that are traded on stock exchanges and designed to track the performance of an underlying asset such as stocks, bonds, commodities, or cryptocurrencies. Unlike ETPs, ETNs are unsecured debt securities issued by banks that promise to pay the return of an underlying index, benchmark, or strategy. Cryptocurrency-based ETPs and ETNs are a subclass of these financial instruments with cryptocurrencies as the underlying asset. These products include single or multiple coins, as well as leveraged long or short coin products. In recent years, cryptocurrency-based ETPs and ETNs have gained popularity, especially in Europe, partly because of the permissive regulatory environment there compared with the United States. The European Union has taken a more hands-off approach to regulating cryptocurrencies, allowing for greater innovation and experimentation in the space. In contrast, the U.S. Securities and Exchange Commission has been more cautious, taking a more restrictive stance on cryptocurrency products and services. As shown in Exhibit 1, around 100 such unique funds were launched in 2021 alone, with over 40% of all ETPs/ETNs being launched in Europe. 21Shares launched the largest number of such products. As of December 2022, the total assets under management of these ETPs and ETNs is over \$30 billion. They resolve some of challenges of direct purchase but still carry a relatively high level of risk.

Exhibit 1 New Products Launched by Year and Region

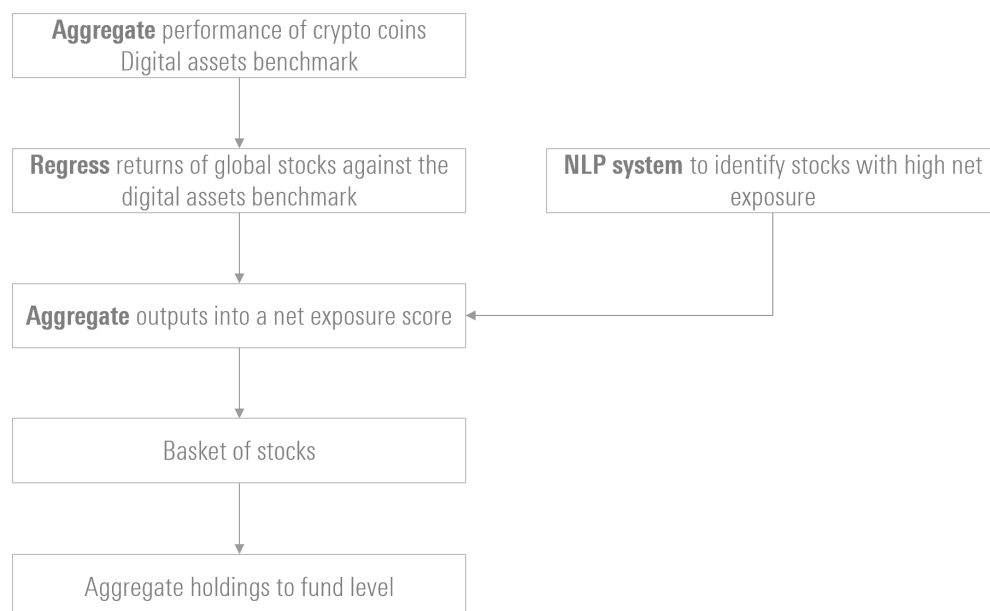
Source: Morningstar.

- **Tangential Assets:** This refers to stocks and funds that provide a certain degree of exposure to digital assets. This is partly due to companies providing services such as enabling crypto and blockchain adoption through crypto mining, yield farming, or providing platform and hardware solutions. Investing via tangential assets resolves part of the challenges associated with investing in digital assets—especially the challenges with custodians and liquidity that are more pronounced with direct purchase or investing through ETNs/ETPs. Given their association with digital assets, they carry a relatively higher level of risk than equity markets. Through our ARNA methodology, we have identified a list of 79 stocks and over 150 funds with intended or unintended exposure to digital assets. To this end, we define *intended exposure* to digital assets as managed investments having mention of the association in either the fund name, key investment document, or investment strategy. *Unintended exposure* is defined as the absence of related association in fund filings but exposure nevertheless to digital assets in the underlying holdings.

The upcoming sections of this paper will concentrate on tangential exposure of equities and funds to digital assets. We will begin by outlining the quantitative-based ARNA methodology used to identify tangential exposure in equities, followed by a detailed analysis of the underlying companies. Next, we will aggregate the results at the fund level and identify funds that are highly exposed. Following this, we discuss the outcome of our study and highlight funds that have unintentional exposure to cryptocurrencies because of their holdings. Finally, we will explore the hypothesis of whether tangential exposure could be an effective hedge against inflation.

ARNA Methodology

In this section, we first discuss tangential asset-exposure detection methodology in detail. The premise of our methodology is that there are companies engaged in building, enabling blockchain networks, providing technology and hardware capabilities, or holding digital assets. These associations could be explained either through the return attribution or through mentions in company text filings, research and development efforts, news, and social-media mentions.

Exhibit 2 Overview of ARNA Methodology to Identify Tangentially Exposed Stocks and Funds

Source: Morningstar.

We define our methodology as a four-step process:

► **Step 1: Digital Assets Benchmark Creation (Aggregate coin performance)**

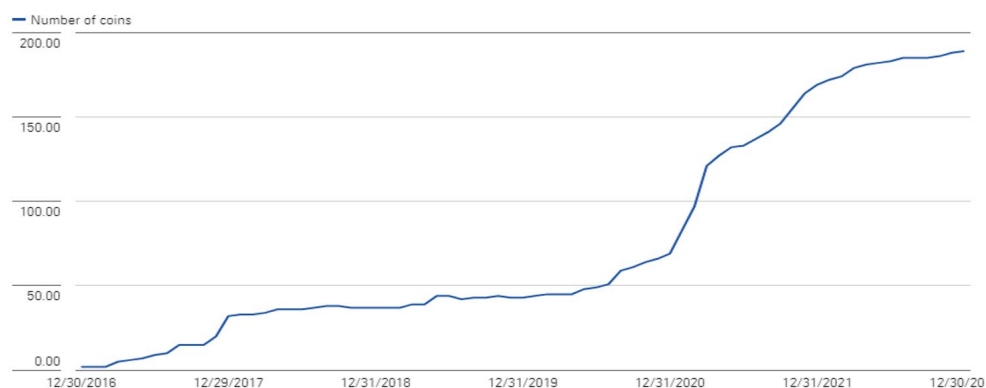
We start by first creating a digital assets benchmark that will serve as a standard measure of value and performance of the asset class. The benchmark will give a reliable reference point for return attribution of equities. To this end, we use digital coin market data as the building block of our digital assets benchmark. We start with all the 12,000-plus active coins (leveraging Coinbase data) as of Jan. 31, 2023, with the earliest data tracing back to 2013. Our analysis also covers coins that are no longer in existence, and there is expected to be no survivorship bias. To ensure the investability of the assets included in the universe, we establish certain criteria for determining minimum thresholds on market capitalization and trading volume of these coins. Academic researchers usually use \$1 million as the market-capitalization threshold, but we believe that is too small. We therefore use the average market capitalization of all the companies in the Russell 3000 Index as a reference point. We create a market-cap threshold such that all the coins included in our index are bigger than at least the smallest 300 companies in the Russell 3000 Index. Since 2014, the bottom 300th company in the Russell 3000 Index has had a market capitalization of about \$250 million. We shall use this number as our threshold for the market cap to be included in the digital assets benchmark. For trading volume threshold, we calculate the ratio between three-month average daily trading volume and market cap for Russell 3000 constituents and coins. The median values for the ratio are about 1% for equities and 8% for cryptos. A higher value indicates higher volume and, therefore, higher liquidity. The crypto space appears to be much more active than equity. This is not surprising, as crypto exchanges operate 24/7 globally and leverage trading is more prevalent. Accordingly, we choose the median value of 8%, which is at \$20 million, as the trading volume threshold.

We use the following rules to construct our benchmark:

- A. Monthly rebalance: any addition/deletion happens only at the end of each month
- B. For a coin to be added to the benchmark, it needs to satisfy the following conditions:
 - a. Three-month average market cap of at least \$250 million
 - b. Three-month average daily trading volume of at least \$20 million
 - c. It should not be a stablecoin (an asset tracking fiat currency such as USD)

As of the last rebalance (Jan. 31, 2023), a total of 185 coins cleared our threshold; put together, these 185 coins cover about 97% of the total market cap tied to digital assets. Exhibit 3 shows the number of coins at each rebalance date.

Exhibit 3 Total Number of Coins in Digital Assets Benchmark



Source: Coinmarketcap Data as of January 2, 2023

Once we have established these rules, we create a monthly rebalanced market-cap-weighted return series (Exhibit 4) of all the coins that satisfy these conditions.

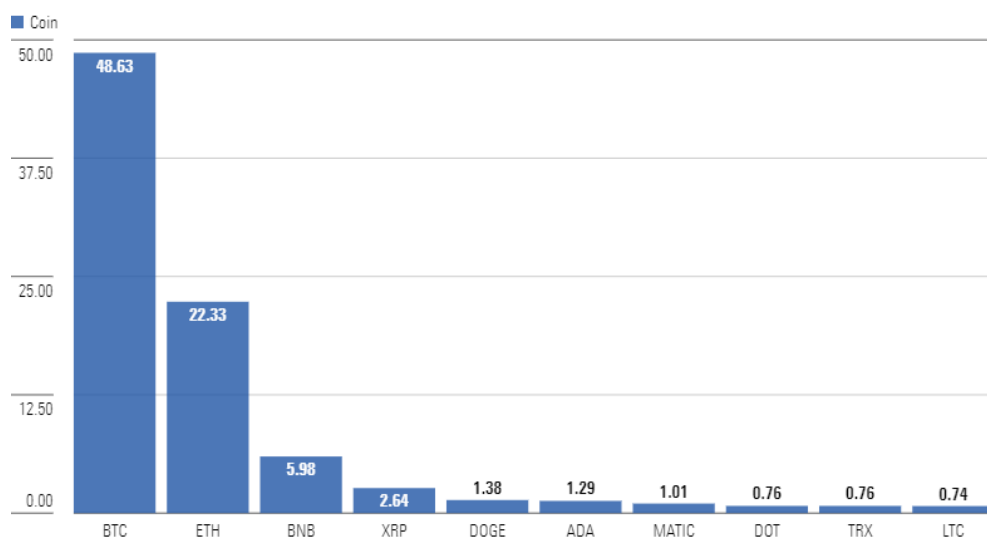
Exhibit 4 Market-Capitalization-Weighted Digital Assets Benchmark



Source: Coinmarketcap Data as of January 2, 2023

Exhibit 5 shows the top 10 holdings of our digital assets benchmark with their respective weights in the benchmark as of the last rebalance.

Exhibit 5 Top 10 Holdings



As expected, bitcoin and ethereum hold the largest weights, making up almost 70% of the total portfolio weight. The top 10 coins make up about 85% of the total weight.

Exhibit 6 demonstrates the performance of the benchmark over time and compares it with the performance of bitcoin. As bitcoin makes up a major percentage of the benchmark throughout time, the performance of the return series is highly correlated.

Exhibit 6 Value of \$100 Inverted (Benchmark vs. Bitcoin)



It is interesting to note that in most bull runs, the benchmark has outperformed bitcoin. When investors become more optimistic (as in October 2017 and November 2020) about the growth potential

of the cryptocurrency market, they start to shift their investments away from bitcoin and toward altcoins that they believe have greater growth potential. Launches of altcoins—the terminology for coins serving as alternatives to bitcoin—may notably be a bull-market phenomenon. Compared with bitcoin and ethereum, they have added risks of failure and liquidity issues. The past few years have seen significant failures pertaining to altcoins such as BitConnect and Paycoin (2018) and OneCoin (2019). These coins were launched with a lot of promise during the bull market but later turned out to be Ponzi schemes. During bear markets, though, bitcoin generally outperforms the benchmark because risk aversion leads investors to opt to hold on to bitcoin as a safe-haven asset while selling off other, smaller coins.

► **Step 2: Regression (Regress stock returns for attribution analysis)**

The returns of the benchmark created in Step 1 can be thought of as the daily factor returns (or premiums) of a digital assets factor. As the next step, we want to identify stocks that are the most exposed to this digital assets factor—that is, stocks that have returns attributed to this benchmark after controlling for traditional equity factors. To this end, we perform a three-year rolling simple linear regression of daily returns of all the stocks in the universe against the digital assets factor while controlling for the Fama-French 5 factors—namely, market beta (market risk), size, value, profitability, and investment.

We then remove all the stocks that have either a low rolling adjusted R-squared improvement (less than 40%) or a low rolling F-statistic (less than 3.95). This helps us select only those stocks that generate meaningful results. Next, we drop all stocks that have a low rolling p-value (lower than 0.05) for the digital assets factor—meaning that any stock that does not have significant exposure to the factor is dropped. We are then left with only those stocks that exhibit a meaningful and significant factor exposure to the digital assets benchmark.

Some of these stocks might be micro market-cap companies or may have low liquidity, making them unsuitable for investment. To tackle that, we added a filter to get only the companies that are constituents of the Morningstar Global Total Markets Exposure Index (representative of all the stocks in the global universe) as of Jan. 31, 2023.

► **Step 3: NLP exposure² (NLP system)**

To strengthen our analysis, we further apply natural language processing techniques to identify stocks that are best exposed to digital assets. Such exposure may creep up by companies being involved in activities related to crypto and blockchain such as yield farming, crypto mining, offering payment solutions, and providing hardware and solutions. By leveraging this information, several fund managers have created strategies such as VanEck Crypto and Blockchain Innovators UCITS ETF. Morningstar has a rich history of such fund holdings in its database. Further, Morningstar has a methodology³ for tagging thematic funds based on intentionality of holdings. This methodology uses the Morningstar TRON, or Theme Retrieval on Natural Language, model to identify the funds that belong to a certain theme based purely on intentionality. As the first step, we identify the funds associated with the blockchain theme using this model.

Our hypothesis of equity exposure to specific themes is based on the existence of equities with high frequency within funds exposed to specific themes. As an example, Block, a company with strong exposure to the blockchain theme, is visible in most fund holdings tagged to the blockchain theme. We refer to this metric as the *common ownership score*. To arrive at a common ownership score for equities, we aggregate the holdings of all funds aligned to a theme and then create a frequency score that is indicative of a specific equity present across holdings of multiple funds. The higher the frequency of occurrence of the company, the higher the common ownership score. Exhibit 7 describes the process for creating a common ownership score for equities pertaining to the luxury-goods theme.

Exhibit 7 Equity Common Ownership Score Example

iShares Blockchain and Tech ETF	Holding Weight		Stock	Common Ownership Score
Block	15.68		Block	3
Riot Platforms	8.06		Riot Platforms	2
Applied Digital	1.72		Bitfarms	2
Bitfarms	1.33		Global Payments	1
			MicroStrategy	1
CI Galaxy Blockchain ETF	Holding Weight		Silvergate Capital	1
MicroStrategy	10.79		Micron Technology	1
Block	8.05		Applied Digital	1
Silvergate Capital	5.82			
Micron Technology	1.25			
Fidelity Crypto Industry and Digital Payments ETF	Holding Weight			
Block	16.15			
Riot Platforms	5.90			
Bitfarms	2.84			
Global Payments	1.83			

Source: Morningstar.

Likewise, we get the common ownership score for all the stocks associated with funds tagged to the blockchain and crypto theme. The score is normalized by dividing with the total number of funds associated with the theme. The higher the normalized common ownership score, the higher the exposure to the digital assets.

► Step 4: Aggregation (**Aggregate** results from NLP system and regression)

Finally, we aggregate the results from Step 2 and Step 3 to establish a list of just 77 stocks—stocks that are confirmed by two methodologies to be exposed to the digital assets space. This is done to avoid false positives. To this end, we only consider stocks that are in the top 50 percentile of the thematic frequency score as well as the top 50 percentile of the regression exposures. Our holding composition is also limited to Morningstar Global Market universe constituents.

Results

Exhibit 8 shows the list of the 77 top stocks that we believe are exposed to digital assets. The stocks are listed in order of decreasing net exposure. On top of the list, we have names like Silvergate Capital,

Block, Coinbase Global, and so on—companies that work explicitly in the digital assets space. Moving down the list, we have companies like Microsoft, PayPal, Nvidia, Alphabet, and others that either enable the digital assets space or are involved with it in some other form. We classify all the companies into six categories: technology provider, fintech, payment platforms, mining, hardware, and asset owners. Exhibit 9 shows the definitions of these categories.

Exhibit 8 List of Stocks With the Highest Exposure to Digital Assets (as of January 2023)

Company	Company	Company
Block	Applied Digital	Infosys
Silvergate Capital	Overstock.com	JD.com
Coinbase Global	Accenture	Ebang Intl Hldgs
Galaxy Digital Hldgs	Oracle	Alibaba Group Holding
Marathon Digital Holdings	CME Group	Tesla
Riot Platforms	SBI Holdings	Salesforce
Bitfarms	TeraWulf	Siemens
Canaan	Samsung Electronics Co	VMware
Hut 8 Mining	Meta Platforms	Banco Santander
NVIDIA	Micron Technology	Bank of New York Mellon
Cleanspark	Tencent Holdings	DBS Gr Hldgs
Advanced Micro Devices	Intel	Deutsche Boerse
HIVE Blockchain Techs	GMO Internet group	Globant
PayPal Holdings	Northern Data	ING Groep
Visa	Alphabet	Mercedes-Benz Group
Bakkt Hldgs	Robinhood Markets	NTT Data
Core Scientific	Goldman Sachs Group	Aker
Iris Energy	JPMorgan Chase	BC Technology Group
Signature Bank	SAP	Rakuten Group
MicroStrategy	Cisco Systems	Bitcoin Group
Bit Digital	Cipher Mining	Swisscom
Argo Blockchain	Walmart	Digital Garage
IBM	Amazon.com	Greenidge Generation Hldg
Mastercard	Baidu	WisdomTree
Taiwan Semiconductor	Citigroup	Wipro
Microsoft	BIGG Digital Assets	

Source: Morningstar.

Exhibit 9 Category Definitions

Category	Definition
Technology Provider	Companies working on enabling Crypto and Blockchain adoption through development of solutions in areas of platforms, Web3, Metaverse. Examples: Alphabet, Baidu
Fintech	The Company's business lines include trading, asset management, investment banking, principal investments. It offers services in the digital asset, cryptocurrency, and blockchain technology. Example: Coinbase, Galaxy Digital Holdings
Payment Platforms	Companies providing services that allows businesses to accept payments in cryptocurrencies. This form of online payment system provides secure and transparent transactions. Example: Visa, PayPal
Mining	Companies that use computers to solve complex computational problems to validate transactions on a blockchain and generate new cryptocurrency coins. Example: Argo Blockchain, Bitfarms
Hardware	Companies involved in developing intensive hardware, tech solutions, GPUs that help optimize the Crypto mining processors. Examples: Samsung, Taiwan Semiconductor
Asset Owner	Companies having Crypto asset as part of investment portfolio that's dedicated to digital or tokenized assets on a blockchain space like NFTs and cryptocurrencies. Example: Microstrategy, Tesla

Source: Morningstar.

Exhibit 10 plots the performance of a monthly rebalanced equally weighted basket of the result of this approach against the digital assets benchmark. The high degree of correlation between return series is indicative of a basket having meaningful exposure to the digital assets space.

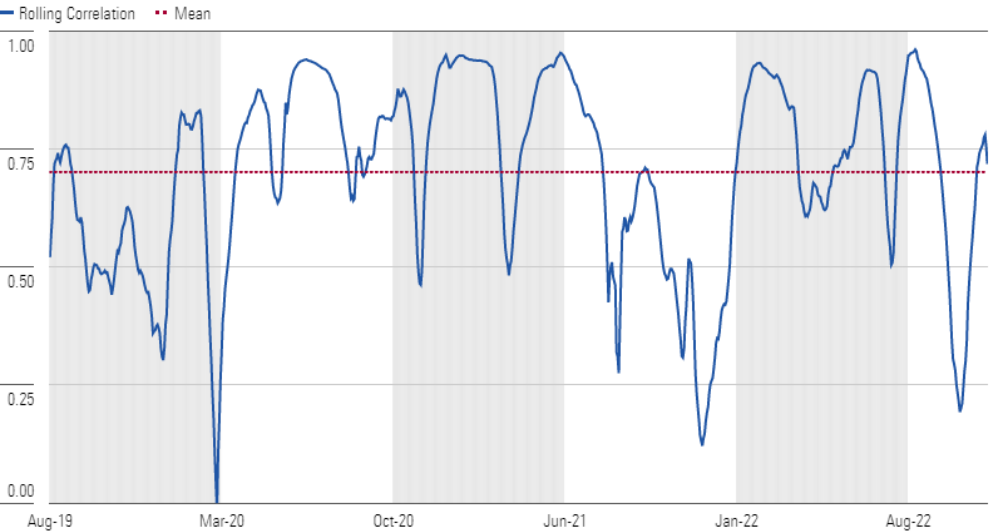
Exhibit 10 Basket Performance

Source: Morningstar Data as of January 31, 2023.

The benchmark has a much higher scale of volatility when compared with the basket of stocks because stocks are generally confined to a daily ceiling and floor, and movements as extreme as those in digital

assets are almost never seen in stocks. Exhibit 11 shows the three-month rolling quarterly returns' correlation between the basket and the benchmark.

Exhibit 11 Quarterly Return Three-Month Rolling Correlation Between the Benchmark and the Basket

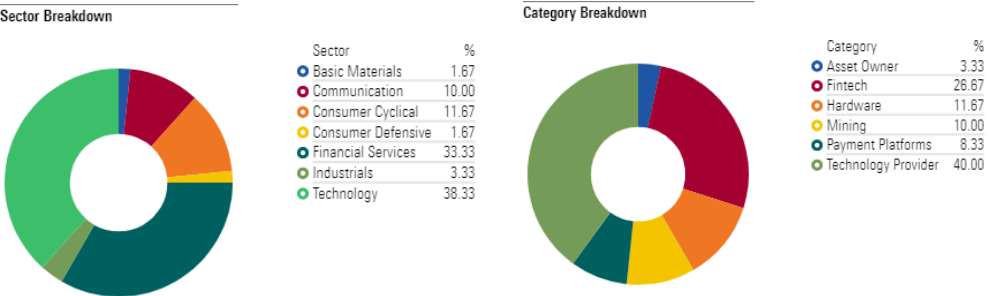


Source: Morningstar Data as of January 31, 2023.

We see that the correlations are high (averaging at 70%) throughout time. This suggests that the basket does indeed move closely with, and therefore mimic, the performance of the benchmark. Evidently, the correlation seems to fall during periods of poor equity market performance as evident in the coronavirus-driven equity market drawdown of March 2020 as well as the more recent inflation-driven drawdowns in 2022.

Exhibit 12 shows the breakdown of these stocks across sectors and categories. Most of these companies belong to either the technology or the financial-services sector. The fintech and technology provider categories make up the bulk of the companies, with the rest being spread across mining, payment platforms, hardware, and asset owners.

Exhibit 12 Sector and Category Breakdown



Source: Morningstar Data as of January 31, 2023.

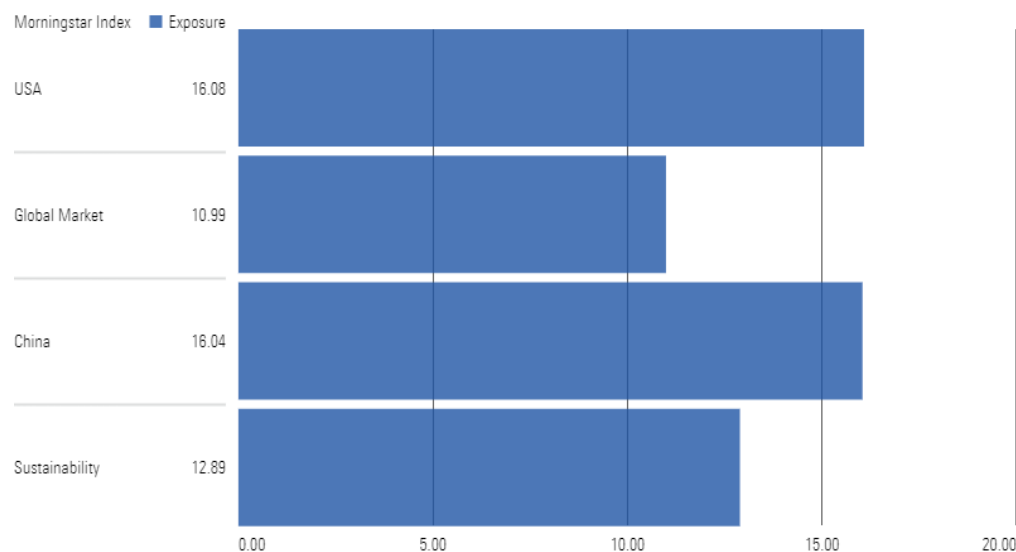
Exhibit 13 demonstrates the comparison of risk level (as measured by the one-year standard deviation of daily returns) of these companies. We bucket the companies into terciles based on their net exposure score to digital assets as calculated in Step 4 of the methodology. It is evident that companies that are classified as having high exposure to digital assets generally have very high volatility. For reference, the annualized standard deviation of the returns of the basket since 2019 is almost 30% against around 20% for the Morningstar Global Markets Index.

Exhibit 13 Exposure vs. Volatility for Exposed Stocks

High Exposure	Volatility	Average Exposure	Volatility	Low Exposure	Volatility
Core Scientific	High	Tesla	High	Swisscom	Low
Marathon Digital Hldgs	High	Meta Platforms	High	DBS Gr Hldgs	Low
Galaxy Digital Hldgs	High	Amazon.com	Medium	Deutsche Boerse	Low
MicroStrategy	High	Alphabet	Medium	Wipro	Low
Silvergate Capital	High	Intel	Medium	WisdomTree	Low
Bitfarms	High	Tencent Holdings	Medium	NTT Data	Low
Coinbase Global	High	Samsung Electronics	Low	Digital Garage	Medium
Hut 8 Mining	High	Citigroup	Low	Rakuten Group	Medium
Riot Platforms	High	Alibaba Group	High	Banco Santander	Medium
Block	High	Cisco	Low	Aker	Medium

Source: Morningstar Data as of January 31, 2023.

Next, we look at the level of exposure of major global Morningstar indexes to tangential exposed digital assets. We then look at the holdings of these Morningstar indexes and calculate a weighted total percentage exposed to tangential digital assets stocks. Exhibit 14 shows the final numbers for the major exposed indexes. The Morningstar US Index and the Morningstar China Index are the most exposed, with a net weighted exposure of around 16%. Morningstar Global Markets Sustainability Index also has a moderate exposure of around 12%, which is slightly more than the exposure of the Morningstar Global Markets Index at around 10%.

Exhibit 14 Morningstar Index Exposure to Digital Assets

Source: Morningstar Data as of January 31, 2023.

The volatility of some such stocks can be very wild, and the performance of these companies themselves can also vary a lot. For instance, as of February 2023, Core Scientific, a leader in high-performance, blockchain infrastructure, has suffered a loss of over 99% in its share price over the last one year and is headed for bankruptcy. On the other hand, IBM, the largest patentholder for blockchain, has a moderately high exposure to the digital space and has gained about 20% over the same period. Such volatility might not be to every investor's liking.

This should entice investors to buy funds that diversify across multiple stocks to reduce the risk of being overexposed to any individual stock. To identify such funds, we start with the holdings of all the 70,000-odd equity funds in the global universe. We then evaluate holdings exposure of each of these funds from the 77 stocks that we believe are exposed to digital assets. To ensure meaningful exposure, we put a threshold on the minimum weight to digital asset equities holdings. The fund should have at least 10 stocks in the portfolio, and a majority of the total allocation should be in the identified 77 stocks.

Once these thresholds are applied, we are left with a list of about 150 funds. Out of these, as of January 2023, we identify 28 funds with intentional and intended exposure to digital assets—that is, funds that are exposed to the digital space because they have explicitly mentioned this in their fund name and the fund strategy is aligned toward this exposure. These are shown in Exhibit 15.

We define *intentionality* by the intention of the fund to invest in digital assets. This could be through either the fund's name or the fund's strategy description. No mention of digital assets exposure reflects that the fund did not intend to invest in digital assets. For instance, almost all the funds in Exhibit 15 (sorted by their assets under management) have one or more of the following words in their fund name or strategy text information: *digital*, *blockchain*, or *crypto*. Moreover, their fund description reflects intent.

For example, the strategy description of VanEck Crypto and Blockchain Innovators UCITS ETF reads: "The VanEck Crypto and Blockchain Innovators UCITS ETF (DAPP) is a UCITS-compliant exchange-traded fund that invests in a portfolio of equity securities with the aim of providing investment returns that closely track the performance of the MVIS Global Digital Assets Equity Index (MVDAPTR). The MVIS Global Digital Assets Equity Index tracks the overall performance of the global digital assets segment or related industries." Intentionality is evident here.

Later in this paper, we will consider cases where there is no intentionality in the fund investment strategy or objective, but the fund has significant exposure to blockchain/crypto. These funds are also part of blockchain theme data that the Morningstar Manager Research team has tagged recently and is available in the Morningstar Direct Platform.

Exhibit 15 Equity Funds With Intentional and High Exposure to Digital Assets

Name	% Holdings exposed	Name	% Holdings exposed
Amplify Transform Data Sharing ETF	76.69	Defiance Digital Revolution ETF	55.89
Siren Nasdaq NextGen Economy ETF	74.20	Grayscale Future of Finance ETF	85.46
Global X Blockchain ETF	99.35	Valkyrie Bitcoin Miners ETF	85.75
Bitwise Crypto Industry Innovators ETF	90.42	Invesco Alerian Galaxy Crypto Econ ETF	78.22
BetaShares Crypto Innovators ETF	96.09	ETC Digital Assets & Blockchain Eq ETF	77.90
VanEck Digital Transformation ETF	100.12	WisdomTree Blockchain UCITS ETF	96.02
VanEck Crypto & Blockchain Inn ETF	99.98	VanEck Digital Assets Mining ETF	98.23
Fidelity Crypto Industry & Digital Pmts	70.46	Vitreo Blockchain BDR NÀvel I FIA	82.87
FT SkyBridge Crypto & Digital Econ ETF	86.63	CI Galaxy Blockchain ETF	91.22
Blockchain Technologies ETF	69.30	Purpose Crypto Opportunities ETF	9.15
Samsung Blockchain Technologies ETF	84.03	FT Skybridge Digital Innovation	95.72
iShares Blockchain Technology ETF	92.21	Viridi Bitcoin Miners ETF	59.47
Schwab Crypto Thematic ETF	59.24	Valkyrie Balance Sheet Opps ETF	61.77
iShares Blockchain and Tech ETF	91.81	Invesco Global Blockchain Equity MF	60.25

Source: Morningstar Data

Interestingly, some of the funds in Exhibit 15 go undetected by the thematic landscape paper³. Funds like Valkyrie Bitcoin Miners ETF, Grayscale Future of Finance ETF, and First Trust Skybridge Digital Innovation in the exhibit above are not flagged by the TRON methodology² as being associated with the blockchain theme (most possibly because of missing text information). In the absence of a holdings-based approach like ARNA, it would have been difficult to identify such funds.

We next extend the holdings analysis to all the funds in our equity universe of more than 70,000 funds. The aim is to find more funds that have a high net allocation to the stocks we have identified. Such funds (excluding the funds in Exhibit 15) would be said to have a high and unintended exposure to digital assets because these funds did not specifically aim to position themselves as investing in the digital space but end up exposed because of their holdings. Exhibit 16 shows a list of the top such unintentionally exposed funds/exchange-traded funds as of January 2023. Given our approach is holdings-based rather than intentionality-based, it is now possible to identify such funds. Additionally, a lot of these funds get exposed to the space because of their exposure to FAANG — Facebook, Apple, Amazon.com, Netflix, Google — stocks. Given that most activities of big tech companies are outside of

the blockchain and crypto space, they can provide stable and diversified return streams with low price volatility. It makes sense to look at the exposure of these funds outside of big tech—that is, ex-FAANG. Accordingly, Exhibit 16 also shows the ex-FAANG crypto-exposed holdings of these funds. It is worth noting that many funds with unintended exposure to blockchain are from the universe of thematic funds.

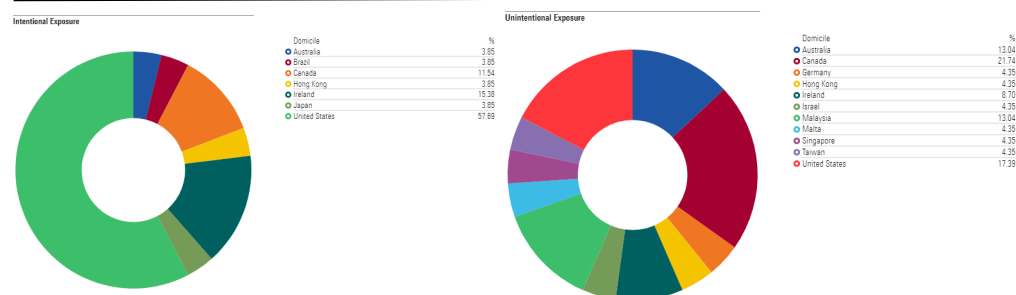
Exhibit 16 Equity Funds With Unintentional and High Exposure to Digital Assets

Fund Name	% Holdings exposed ex-FAANG	Fund Name	% Holdings exposed ex-FAANG
BMO Covered Call Tech ETF	43.39	Taishin SG Gbl AI & Robo Select	31.41
Castlestone FAANG+ UCITS	43.41	FT Cloud Computing	32.51
Horizons Global Metaverse ETF	43.77	Samsung Bbg Gbl Semicondctr	51.48
United Global Growth	12.78	Public e-Carbon Efficient	29.16
Psagot Global Technology Giants	31.50	Putnam Global Technology	34.18
Orca Global Disruption	30.22	Public e-Islamic Innovative Tech	29.77
Holon Photon Fund	42.09	Public Greater China	34.72
Xtrackers AI & Big Data ETF	41.34	AAM Next Gen ESG Strategy	31.73
JHVIT Science & Technology	30.39	FT Technology Select	32.91
Harvest Tech Achievers Gr&Inc	40.10	Global X Metaverse ETF	18.18
MIDAS Global Growth	32.46	Fidelity Total Metaverse ETF	19.30
CI Tech Giants CovCall ETF	39.44	BetaShares Metaverse ETF	10.37

Source: Morningstar Data

Exhibit 17 highlights the global nature of the funds included in our study. While a lot of intentional funds are domiciled in the U.S., unintended exposure is common across global funds.

Exhibit 17 Geographical Breakdown of Funds



Source: Morningstar Data as of January 31, 2023.

We here consider the example of Castlestone FAANG+ UCITS ETF. The investment objective of the fund reads: "The investment objective of the Sub-Fund is to generate capital growth mainly through exposure to the development, advancement, and use of technology. The Sub-Fund will be invested in global technology equities some of which are familiarized by the acronym 'FAANG' defining the most well-known technology equities. Apart from the FAANG equities, the Sub-Fund will also invest in other large technology stocks. Up to 100% of the assets of the Sub-Fund may be invested in equities." However,

even outside of the FAANG companies, the fund has an almost 45% weight to digital-assets-exposed companies. With FAANG companies included, the allocation jumps to about 80%. This is a classic example of a fund with very high unintentional exposure to digital assets.

Next, consider the case of Horizons Global Metaverse ETF. The objective of the fund reads, "The Horizons Global Metaverse Index ETF seeks to replicate, to the extent possible and net of expenses, the performance of an index that seeks to provide exposure to global, publicly listed companies that potentially stand to benefit from the adoption and usage of technologies expected to grow and support the functioning of the metaverse. Currently, the ETF seeks to replicate the performance of the Solactive Global Metaverse Index, net of expenses." While the fund claims to be investing in the metaverse, it unintentionally takes exposure to blockchain and crypto through equity.

Exhibit 18 shows a snippet of the ex-FAANG holdings of the two funds discussed here.

Exhibit 18 Holdings (ex-FAANG) of Two Unintentionally Exposed Funds

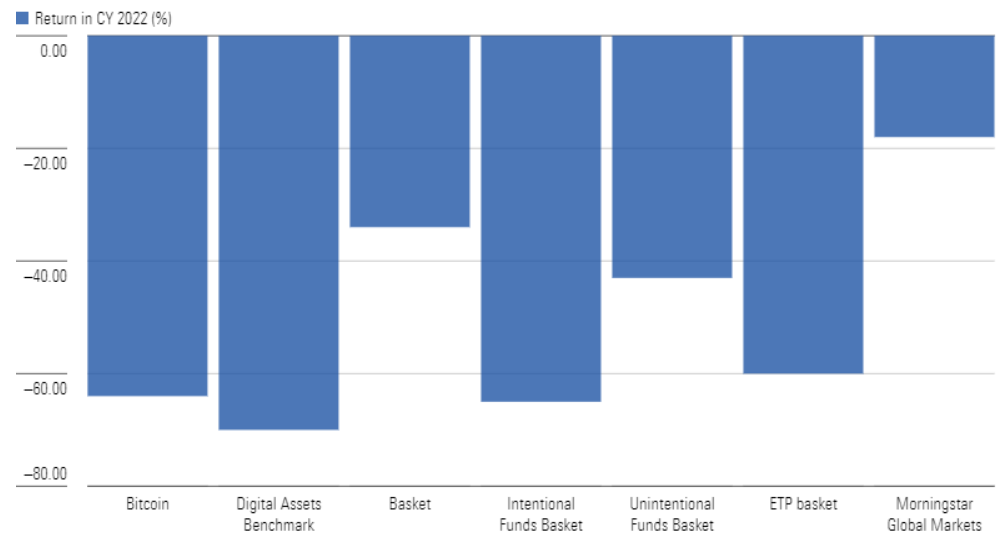
Castlestone FAANG+ UCITS	Holding Weight (%)	Horizons Global Metaverse ETF	Holding Weight (%)
Tesla	4.38	Tencent Holdings	7.87
Visa	2.93	NVIDIA	5.83
Mastercard	2.89	Alibaba Group Holding	5.74
Baidu	2.87	Oracle	4.71
JD.com	2.76	Mastercard	4.65
Alibaba Group Holding	2.74	Visa	4.54
Taiwan Semiconductor	2.67	Advanced Micro Devices	2.36
Samsung Electronics Co	2.54	Intel	2.27
SAP	2.47	PayPal Holdings	1.83
NVIDIA	2.37	JD.com	1.60
Tencent Holdings	2.27	VMware	1.01
Cisco Systems	2.21	SBI Holdings	0.46
Oracle	1.94	Robinhood Markets	0.37
Square	1.43	Coinbase Global	0.33
Intel	0.99		
PayPal Holdings	0.97		
VMware	0.95		

Source: Morningstar Data as of January 31, 2023.

The intentional and unintentional funds are, however, often very volatile themselves. For instance, VanEck Digital Transformation ETF—one of the most digital-assets-exposed ETFs—was launched in April 2021. After losing 43% in 2021 and 85% in 2022, the ETF is up 80% in less than two months of 2023. The annualized volatility of the daily returns is 77%. Likewise, Horizons Metaverse ETF—an unintentionally exposed fund—fell by 38% in 2022 after its launch in November 2021. In the first two months of 2023, however, the fund climbed back up by almost 20%. Most of other funds and ETFs (Exhibits 15 and 16) have experienced similar levels of volatility and extreme return outcomes.

Exhibit 19 compares the performance of various digital-assets-linked approaches as mentioned throughout the paper for calendar-year 2022. All major digital assets have performed very poorly in 2022 and exhibited high volatility. While bitcoin fell by more than 60%, the digital assets benchmark fell by almost 70%. This is in line with our observation that, during bear markets, altcoins tend to perform worse than bitcoin.

Exhibit 19 Performance of Assets in Calendar-Year 2022

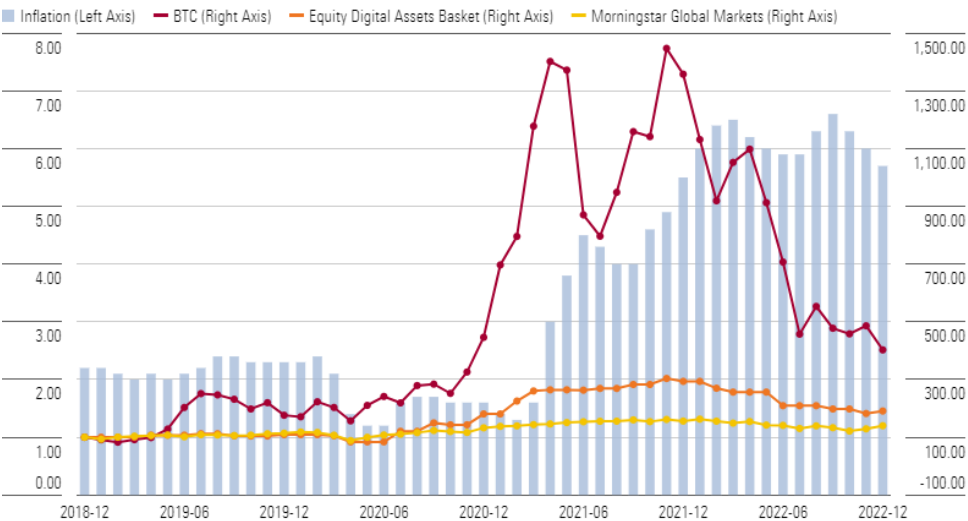


Source: Morningstar Data as of January 31, 2023.

While the Morningstar Global Markets Index fell by just 18%, the equity basket exposed to digital assets fell by almost 35%. ETP/ETN baskets and the intentional and unintentional funds baskets have performed even worse during the same period. While digital assets were traditionally considered a good hedge against equity, they have performed much worse than equity since the second half of 2021. This should raise caution among investors who view this asset class as a hedge against equity.

Moving on, we also test the hypothesis of whether tangential digital asset exposure is a good bet against inflation. To this end, Exhibit 20 plots the U.S. Core Consumer Inflation (as measured by year-over-year change in CPI Core excluding food and fuel) against the performance of bitcoin and the digital assets basket. As shown, while BTC increased with inflation in the first half of 2021, ever since inflation picked up in 2022, digital assets or BTC provided no apparent protection against it.

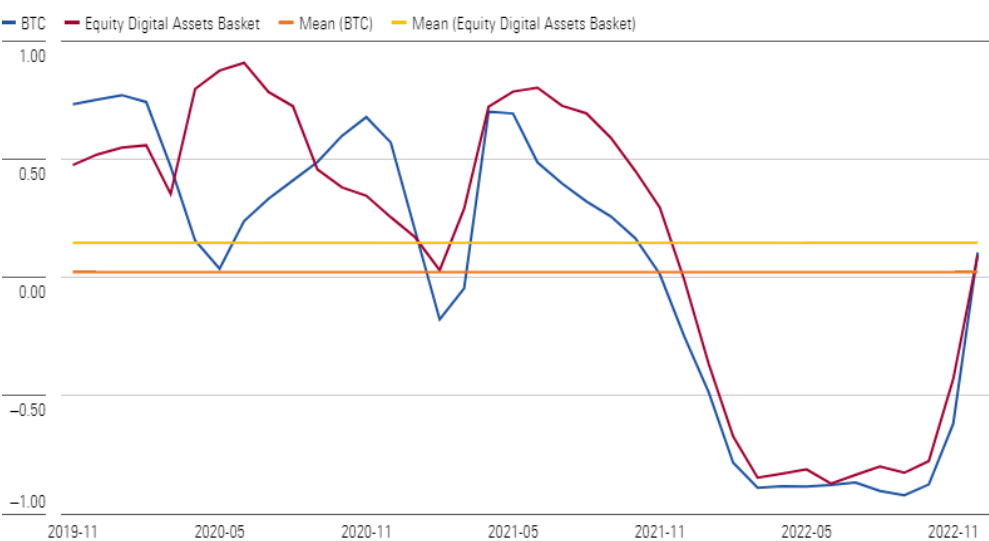
Exhibit 20 U.S. Core Inflation vs. Bitcoin and Digital Assets Basket



Source: St. Louis FED and Morningstar Data

The disconnect becomes even more apparent in Exhibit 21, which shows the correlation of U.S. CPI Core against 12-month yearly returns of BTC and Morningstar Global Markets Index. While the correlation with BTC was fluctuating but positive between 2019 until middle of June 2021, since the second half of 2021 until the end of 2022, correlation was strongly negative. The overall average correlation between CPI inflation and BTC/digital assets is very close to zero, indicating that there is no real hedge that such assets provide against inflation.

Exhibit 21 12-Month Rolling Correlation With U.S. Core Inflation



Source: St. Louis FED and Morningstar Data

Conclusion

In this research, we focused on identifying tangential digital asset exposures within common equities and funds. Tangential exposure is defined as the association of companies based on related business activities such as crypto mining, yield farming, payment solutions, and technology infrastructure, to name a few. As part of this exercise, we first explored our quant-based ARNA methodology, which helps us identify tangential exposures. Once we identified related stocks, we rolled up the results to the fund level to identify intentional and unintentional exposure to digital assets. We also explored the hypothesis that tangential exposure can be a bet against inflation.

We summarize our paper with a caveat that investors should shy away from exposure to digital assets though either direct exposure, ETPs/ETNs, and tangential exposure. Given high volatility and issues with custodians and liquidity, the outcomes of exposure could have a detrimental impact on client portfolios. We also explored funds with unintentional exposure to cryptos. Given our holdings-based approach, exposures otherwise not evident in disclosures have been identified. To this end, investors should consult with their advisors on the types of holdings they specifically wish to avoid. We did not find any evidence that tangential crypto exposure is an effective hedge against inflation.

Our approach is more quantitative than qualitative. Our results could be enhanced with qualitative analysis. Here, we focused on the crypto and blockchain theme and also identified funds from other themes that are exposed to the blockchain theme; later, we wish to expand the framework to other thematic funds that are positioned to capture secular growth patterns but have overlapping exposure to other themes—that is, funds that belong to a certain theme but in fact have exposure across multiple themes.

References

1. Theme Retrieval for Equities—Quantitative Approach for Equity Thematic Exposure Generation
2. Theme Retrieval on Natural Language—Augmenting investment research with natural language processing for thematic funds.
3. Morningstar Global Thematic Funds Landscape 2022

Corrections and Clarifications

In a previous version of this report, [Exhibits 3 and 4 on Page 6](#) had incorrect source lines. The exhibits have been corrected and replaced.

About Morningstar Quantitative Research

Morningstar Quantitative Research is dedicated to developing innovative statistical models and data points, including the Morningstar Quantitative Rating, the Quantitative Equity Ratings, and the Global Risk Model.

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