

Exploring the Role of Cryptocurrencies in Portfolios

A Quantitative Perspective



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Key takeaways

- Bitcoin is not for the faint of heart. Its past strong results do not guarantee future success.
- We calculate that a 1% allocation to Bitcoin increases the portfolio's expected tracking error by the same amount as a 3.5% equity overweight
- Bitcoin has grown to be the most established cryptocurrency by a wide margin, but its volatility is still the major stumbling block for inclusion in portfolios.

There are few asset classes as polarizing as cryptocurrency. Some believe Bitcoin, the original and fastest-growing cryptocurrency, will replace the dollar and appreciate significantly—even after a 61% average annualized return over the last five years.¹ Others think cryptocurrency represents a modern-day version of the 17th century tulip mania.

As a result, many investors are grappling with the question of whether Bitcoin and other cryptocurrencies belong in portfolios.

Rather than opine here on the normative merits of cryptocurrency, we will apply portfolio construction analysis to determine under what conditions and in what size cryptocurrency has a place in a diversified portfolio. While we focus on Bitcoin—the largest and most easily investable of the cryptocurrencies—the same construct could be applied to other cryptocurrencies.

Our analysis concludes that Bitcoin's volatility is a limiting factor for most investors with a moderate risk appetite, and that for this burgeoning asset class to warrant a substantive allocation in a diversified portfolio, a continued decline in realized volatility is necessary.

As the cryptocurrency asset class has matured, its volatility has declined. Cryptocurrencies have become more investable, with more “on ramps” in the form of a broader array of investment vehicles made available to a wider range of investors. The regulatory picture has also become clearer over time. As this process continues, Bitcoin and other cryptocurrencies may begin to exhibit a risk and return profile that make them a more attractive addition to a balanced portfolio.

The broader crypto landscape

The crypto market is always evolving. Bitcoin is the clear leader, with a market capitalization of around \$2 trillion—about six times bigger than that of Ethereum, the next-largest cryptocurrency. Bloomberg currently lists 13 cryptocurrencies with a market cap greater than \$10 billion.²

Although Bitcoin has the most public-market entry points among cryptocurrencies, investing in the smaller ones requires using an exchange or even on-chain transactions. Bitcoin thus enjoys an “established” status in the crypto world, giving it a competitive advantage.

However, while Bitcoin is the clear incumbent among cryptocurrencies as an asset class, other dynamics could pose risks to its continued dominance. Network features such as smart contracts, transaction processing speeds, scalability, security and mining costs/energy requirements vary widely among cryptocurrencies, and the technological landscape is the very definition of dynamic and evolving. It's quite possible that the growth of cryptocurrencies as a group could decelerate. Similarly, Bitcoin could lose its status among cryptocurrencies and other tokens could emerge as the top coins.

One of Bitcoin's original purposes was as a medium of exchange. We would argue that this use has diminished, due to factors such as high price volatility, scalability constraints and the rise of other forms of digital payment. In the cryptocurrency space, stablecoins—i.e., cryptocurrencies pegged to sovereign currencies such as the U.S. dollar and built on faster, lower-cost blockchains—have gained ground as the preferred medium for on-chain transactions. While Bitcoin's role as a medium of exchange has perhaps diminished, it continues to act as a store of value, with stablecoins increasingly fulfilling the transactional function.

Looking at Bitcoin through a portfolio construction lens

The decision to allocate capital to any asset class hinges upon the tradeoff between risk and return. Bitcoin has offered astonishing returns—but also has exhibited considerable volatility. Over the last 10 years, it has returned a cumulative 40,000% (averaging 82% per year). This compares to 187% for the S&P 500 (a respectable 11% per year). Yet over that same period, Bitcoin experienced four drawdowns of more than 50% and two of more than 75%.³

Clearly, investing in Bitcoin has not been for the faint of heart. Even for those with the wherewithal to ride through its volatility, its past strong results do not guarantee future success.

Looking at cryptocurrency quantitatively

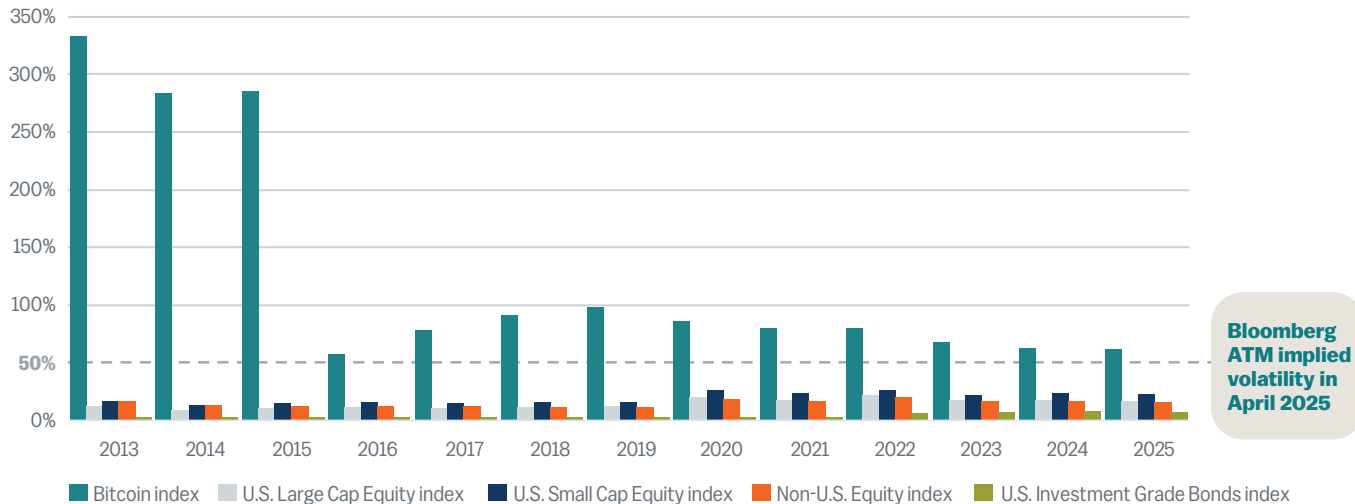
Evaluating risk-adjusted returns for an asset in a portfolio context involves a balance between the returns the asset is expected to deliver and how much risk it introduces to the portfolio.

Given Bitcoin's relatively short history as an asset class, its return stream is difficult to extrapolate. There is considerable debate about the best way to project future returns using fundamental analysis. We use a reverse-engineering approach to determine what it would take from a risk-return standpoint to justify a Bitcoin position in a diversified portfolio. Viewing Bitcoin through a portfolio construction lens allows us to examine both whether return expectations are realistic and the type of risk profile for which Bitcoin may be best suited.

Figure 1

Bitcoin volatility has taken investors on a wild ride

3-year rolling standard deviation and other indices



ATM = at-the-money options.

For a list of indices used for this analysis, please see the Appendix.

Sources: Bloomberg, Wilmington Trust.

Chart shows a 3-year rolling standard deviation for Bitcoin.

Risk: Bitcoin volatility and correlations

Bitcoin, like other cryptocurrencies, has clearly been quite volatile (Figure 1).⁴ While the level of Bitcoin volatility—measured as the annualized standard deviation of historical returns over a rolling three-year window—has decreased, it remains around 60%. By comparison, the Russell 1000 Index (representing the stocks of the 1,000 largest U.S. companies) has a standard deviation of around 15%.⁵ At the time of writing, the implied volatility of at-the-money (ATM) options on Bitcoin futures is approximately 50%.⁶ With volatility at more than three times that of U.S. large-cap equities as measured by standard deviation, Bitcoin still exhibits a high level of risk relative to other asset classes.

Along with volatility, the other major consideration when it comes to the risk of an asset class is how it moves with other asset classes. Measuring co-movement using correlation is one way to look at an asset class's diversification benefit.⁷ For instance, an asset class with low or even negative correlation to another asset can be useful in reducing portfolio volatility even if the asset class itself has relatively high volatility. The correlation of Bitcoin returns with those of other major asset classes has historically been erratic. For many asset classes, correlations to Bitcoin have been low to moderate, particularly over longer time periods (Figure 2). Bitcoin is most strongly correlated with U.S. equities.

Figure 2

Bitcoin's correlation profile could add diversification benefits to a portfolio

Bitcoin correlations vs. major asset classes (monthly returns) through April 2025

	Last 1 Year	Last 3 Years	Since Aug 2010
U.S. Equities	0.67	0.60	0.19
Alternatives	0.43	0.41	0.14
U.S. High Yield Bonds	0.30	0.54	0.18
Real Assets	0.22	0.40	0.14
U.S. Investment Grade Bonds	0.13	0.28	0.08
International Equities	-0.01	0.36	0.13
Average	0.29	0.43	0.14

Sources: Bloomberg, Wilmington Trust. Correlations are calculated using monthly returns. For a list of indices used for this analysis, please see the Appendix. U.S. Equities shows combined data for large- and small-cap equities weighted by market cap.

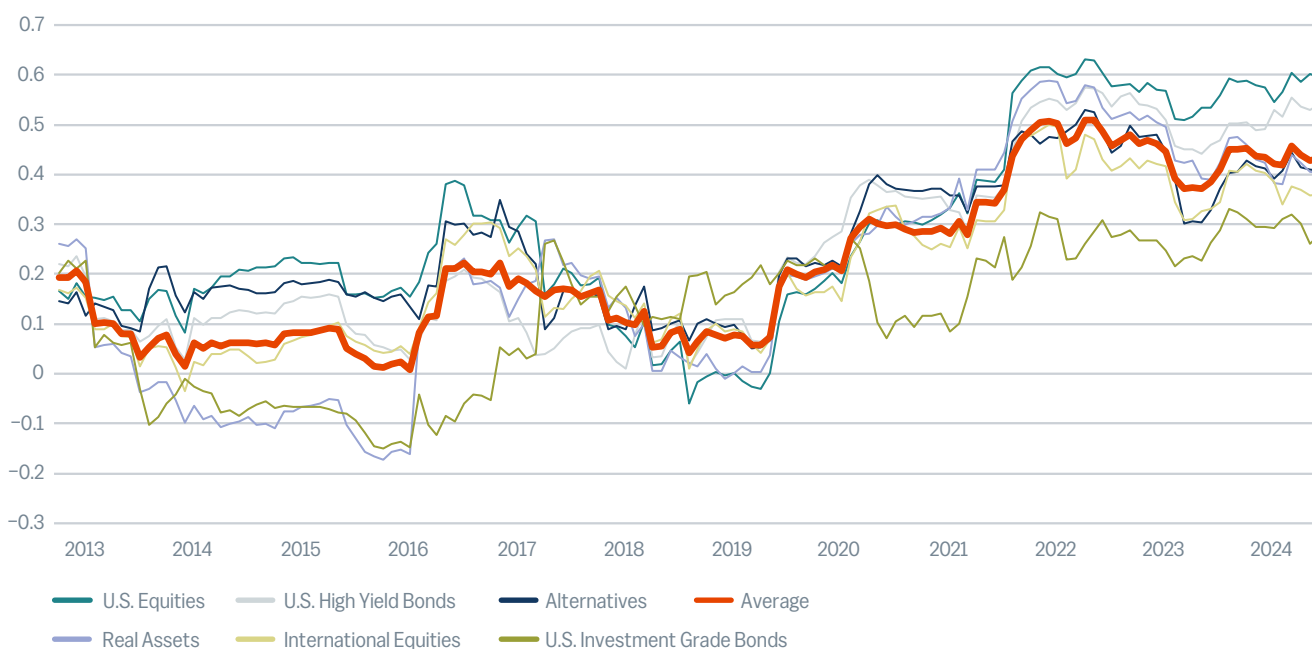
Interestingly, Bitcoin's correlation to equities has increased over the last one- and three-year windows. In fact, its correlation to all major asset classes has steadily increased over time, particularly in the post-COVID period (Figure 3).

This upward trend in correlation is consistent with Bitcoin becoming more of a mainstream asset class. While its historical correlation profile could help diversify a portfolio, Bitcoin's increased co-movement with major asset classes in recent years reduces some of that benefit—even with volatility nearly four times that of U.S. large-cap equities.

Figure 3

Bitcoin's cross-asset correlations are increasing

3-year rolling correlation between Bitcoin and other major asset classes



Sources: Bloomberg, Wilmington Trust. Correlations are calculated using monthly returns. For a list of indices used for this analysis, please see the Appendix.

Figure 4

A 1% allocation to Bitcoin adds the same amount of risk as an estimated 3.5% overweight to equities
Bitcoin and equity tracking error equivalencies

Bitcoin allocation	Tracking error	Estimated equity overweight to match
0.5%	0.4%	2.1%
1.0%	0.7%	3.5%
1.5%	1.0%	4.9%
2.0%	1.3%	6.3%
2.5%	1.6%	7.7%
3.0%	1.9%	9.2%
3.5%	2.2%	10.6%
4.0%	2.5%	12.1%
4.5%	2.8%	13.5%
5.0%	3.1%	15.0%

Table shows the Bitcoin and corresponding equity overweight or underweight required to reach the same expected tracking error.
Sources: Bloomberg, Wilmington Trust.

The equity-risk equivalent of Bitcoin

One last way we can illustrate the risk associated with Bitcoin is to estimate its equivalent equity risk. In other words, we can consider the volatility and correlation characteristics of Bitcoin in terms of the equity overweight (versus a strategic benchmark) required to generate the same increase in portfolio tracking error (Figure 4).⁸

We calculate that adding Bitcoin to the portfolio introduces approximately the same amount of tracking error as a 350% larger equity overweight, which is consistent with our earlier standard deviation comparison. This means that a 1% allocation to Bitcoin increases the portfolio's expected tracking error by the same amount (0.7%) as a 3.5% equity overweight. Similarly, a moderate 3% allocation to Bitcoin is the same as taking a 9.2% overweight to equities. For many investors, that would bump a portfolio into an entirely different risk profile.

Fundamental valuation techniques

There are two broad considerations in assessing whether an asset fits in a portfolio. The first is fundamental valuation and the second is quantitative. While this paper focuses on quantitative portfolio construction techniques, it is worth discussing fundamental valuation techniques as well.

Since Bitcoin does not provide cash flows like stocks and bonds, discounted cash flow analysis—the most fundamental of the fundamental valuation techniques—does not apply. This does not mean that Bitcoin cannot have a place in portfolios, as there are numerous assets, such as many commodities, that do not have cash flows yet play a role in a diversified portfolio.

Some valuation models are specific to the cryptocurrency space. An example is the production cost model, which looks at the cost of mining Bitcoin. This cost is largely determined by electricity prices and has historically provided a longer-term floor on Bitcoin prices, since miners cannot profitably operate below it. Another framework is Metcalfe's Law, which values Bitcoin as a network, with the value proportional to the square of the number of nodes (i.e., users). Finally, on-chain metrics are truly unique to cryptocurrency assets, since they analyze data recorded on the blockchain to estimate valuation, sentiment, and investor behavior.

Another popular technique is the "stock to flow" model, which compares the supply ("stock") of Bitcoin to newly created Bitcoin ("flow"). This concept can also be applied to traditional precious metals such as gold and silver. Finally, there are relative price models comparing Bitcoin to their precious metal counterparts.

Crypto security and custody

The security of cryptocurrency lies in public and private keys. A public security key is shared with others, often in the form of a wallet address and is akin to a phone number or email address. A private key can be thought of as your digital password. Losing it effectively means losing the asset itself. Exposing a private key to others puts your cryptocurrency funds at risk of being stolen. This makes custody of keys incredibly important, whether by an individual or an organization.

Exposure to Bitcoin and other cryptocurrencies is available in a variety of ways. Examples include direct on-chain transactions, transactions on crypto exchanges, futures contracts, and exchange-traded products such as exchange-traded funds (ETFs). These vehicles vary in terms of complexity.

When trading directly on the blockchain and crypto exchanges, one must maintain both public and private security keys. Investors must carefully manage transactions occurring directly on the blockchain, as mistakes such as sending funds to the wrong address or losing a private key can lead to permanent losses. Furthermore, transaction fees and network latency can vary significantly, which can increase the cost and complexity of moving funds on-chain.

Keeping digital assets on crypto exchanges simplifies some of these issues, but counterparty risk and potential security breaches can be serious concerns. The emergence of crypto futures contracts and exchange-traded products such as ETFs transfer the burdens and risks of custody to the product provider. While futures and ETFs still have custody requirements, they are more heavily regulated than crypto exchanges. Futures (and ETFs that hold futures) can experience price divergence from the underlying cryptocurrency.

The Securities and Exchange Commission approved spot ETFs, which directly hold cryptocurrency in early 2024. At the time of writing, the largest Bitcoin ETF is the iShares Bitcoin Trust ETF (IBIT), which has \$65 billion in assets, trades about \$1.8 billion per day and charges a 0.25% management fee.⁹

Finally, trust in blockchain itself is critical: the very structure of the bitcoin ecosystem must be trusted to ensure long-term viability. Bitcoin's value proposition is rooted in trustless, decentralized consensus. Confidence in the security, immutability, and integrity of the blockchain is key. The good news is that the Bitcoin ecosystem, over its roughly 15-year history, has earned credibility. It has never suffered a hack at the protocol level itself and has built-in transparency and auditability (i.e., anyone can inspect and verify a transaction's entire history).

Analyzing expected returns

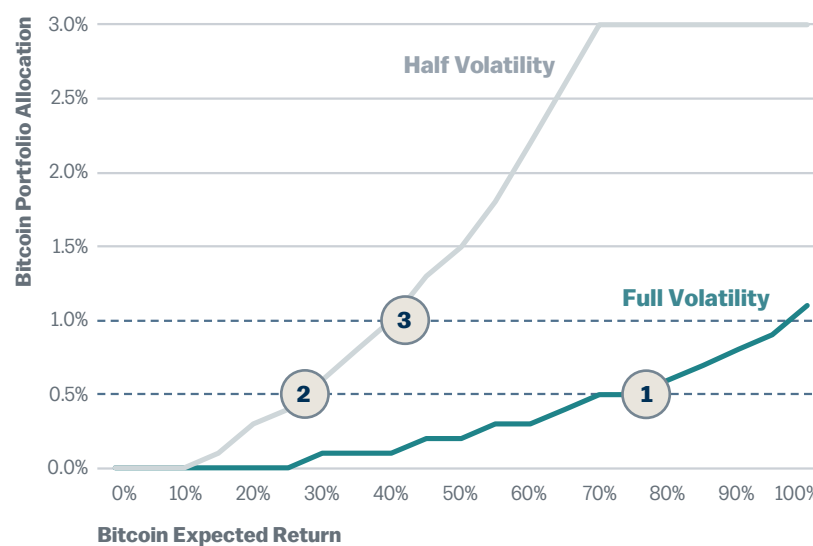
Now that we have explored multiple approaches to gauge the risk of Bitcoin, we can turn to expected return. If expected returns are high enough, they can compensate for the extra risk assumed (depending on an investor's individual risk tolerance, of course).

In this section, we utilize a series of optimizations to calculate Bitcoin's expected return at given levels of volatility, while keeping other assumptions constant.¹⁰ This allows us to solve for an allocation to Bitcoin that maximizes the portfolio's Information Ratio.¹¹ There are different ways to fund an allocation to Bitcoin. We chose to fund Bitcoin proportionally from real assets so that the sum of allocations to real assets and Bitcoin is constant.

Figure 5

Portfolio allocation to Bitcoin may be difficult to justify at current volatility

Bitcoin allocation by expected return and risk



Sources: Bloomberg, Wilmington Trust. Assumes current “full” volatility of 60%, which is the trailing three-year standard deviation, per the earlier analysis. The “half” volatility represents a standard deviation of 32.5%.

Figure 6

Market-implied returns may suggest Bitcoin outperforms U.S. large caps by a factor of five

Black-Litterman implied returns as of April 2025

	Implied Returns
Bitcoin	31.8%
U.S. Small Cap Equity	7.2%
International Emerging Equity	6.2%
International Developed Equity	6.1%
U.S. Large Cap Equity	6.0%
High Yield – Taxable	2.6%
Global ex-USD Bonds	2.3%
U.S. Investment Grade – Taxable	0.9%

Sources: Bloomberg, Wilmington Trust

In Figure 5, we can see that using the current realized volatility (60% standard deviation, teal line), the portfolio optimization requires a nearly 80% annual return (e.g., almost doubling every year) to justify an allocation of 50 basis points to Bitcoin (point 1 on the chart.) However, assumptions are critical, particularly when it comes to Bitcoin's volatility. If we reduce volatility by half, the optimizer allocates 50 basis points at “just” a 25% expected annual return (point 2) and 100 basis points at about 40% expected annual return (point 3).

This shows us just how high Bitcoin's expected returns must be to offset its volatility, even if we assume volatility continues to decrease in coming years. Our return assumptions are comparable to history but could become less attainable as the asset class matures.

The market's expectations for Bitcoin's future returns can be helpful to consider as well. One way to gauge what the market expects for the returns of an asset class is to employ the reverse optimization used in the first step of the Black-Litterman model. This approach suggests a market-implied return of about 32% for Bitcoin—5x greater than that of equities (Figure 6).¹²

If we take these implied returns and refer to our optimization analysis from Figure 5, we see that with a 32% expected return, the optimization would not recommend an allocation to Bitcoin at current volatility levels. Bitcoin has certainly achieved high returns in the past: Annual returns for 2023 and 2024 exceeded 100%. However, extrapolating those types of returns carries significant risk of disappointment. Investing with a margin of safety means allocating to asset classes where there is a greater chance of surprising to the upside. Unless Bitcoin's volatility is significantly reduced, it is hard to find a margin of safety in allocating to Bitcoin.

Bitcoin as a store of value and safety trade

In certain circles, Bitcoin has a reputation as a store of value or hedge against tail risk: in other words, an asset that can retain value in a market drawdown. On their own, the risk characteristics we analyze in this piece would suggest that there is not a very strong case to be made for this. Here, we lay out the major arguments for and against Bitcoin as a store of value/tail-risk hedge.

Scarcity by design. Advocates point out that the supply of Bitcoin is capped at 21 million coins and that it can't be diluted like traditional fiat currency. This engineered scarcity and immunity to dilution makes it a digital analog to physical gold, giving it the same status as a store of value. But the broader crypto market faces the challenge of meta-dilution in that new coins are constantly being introduced and are, in some sense, substitutes for one another. Even if Bitcoin is capped at 21 million coins, a constant influx of new digital assets effectively expands the supply, undermining the argument for absolute scarcity.

Decentralized nature. Bitcoin, like other cryptocurrencies, is decentralized, as the blockchain is a distributed ledger of transactions maintained by a global network of nodes. Transactions are verified independently across nodes using consensus rules so that no single entity or node can alter the ledger or control the currency. In other words, the design of the blockchain obviates the need for a central authority.

On the other hand, many Bitcoin holders do not hold the cryptocurrency directly but, rather, rely on third-party intermediaries such as crypto exchanges, custodial wallets or ETFs. While an individual investor can hold Bitcoin directly, recent developments—particularly the advent of Bitcoin ETFs and the corresponding asset flows—are consistent with a trend toward centralized custody.

Global liquidity and around-the-clock accessibility.

Bitcoin proponents point out that the cryptocurrency trades 24/7 globally and with almost immediate settlement, unlike centralized traditional exchanges. This continuous liquidity allows participants to always access Bitcoin, even in times of turmoil for traditional markets. In practice, however, this liquidity often depends on centralized exchanges, brokers or vehicles that are not active 24/7.

Historically low correlations. Bitcoin supporters also have claimed that it trades independently of traditional assets. They point to instances where the cryptocurrency was stable in value, or even appreciating, when traditional assets such as equities or fiat currencies were under pressure.

As we see in the piece, the correlation between Bitcoin and traditional asset classes has *increased* through time. In fact, as we have demonstrated, Bitcoin behaves similarly to a leveraged bet on equities and, as such, has the characteristics of a risky asset.

One way to measure an asset's ability to hedge tail risk is by looking at its downside capture ratio. This metric shows how an asset has behaved relative to a benchmark during periods when the benchmark declines. Specifically, it indicates what percentage of a benchmark's negative performance is reflected in the asset's performance. A downside capture ratio above 1.0 means that an asset has lost more than the benchmark during downturns. A positive ratio below 1.0 means that the asset has lost less than the benchmark, and a negative ratio means the asset has gained when the benchmark fell.

As we might expect from an asset as volatile as Bitcoin, its downside capture ratio has been volatile through time. Since we are trying to quantify its ability to hedge tail risk, we examine its downside capture ratio during larger drawdowns, specifically periods where the S&P 500 has declined more than 10%.

In Figure 7, we see that during larger S&P 500 drawdowns (i.e., more than 10%), Bitcoin has had a greater than 1.0 downside capture ratio, meaning that it has fallen by a larger magnitude than the S&P 500. Gold, which is widely considered a tail risk hedge, on the other hand, has exhibited close to a zero, or even slightly negative, downside capture ratio during these periods, on average.

Figure 7

Bitcoin and gold returns during S&P 500 drawdowns

Returns in S&P 500 drawdowns exceeding –10.0% sorted by drawdown depth

	S&P500	Bitcoin	Gold
January 29, 2018 – February 8, 2018	–10.1%	–30.5%	–2.5%
July 21, 2015 – February 11, 2016	–13.0%	35.2%	13.0%
February 20, 2025 – April 8, 2025	–18.7%	–20.0%	1.6%
September 21, 2018 – December 24, 2018	–19.4%	–36.3%	5.0%
January 4, 2022 – October 12, 2022	–24.5%	–58.3%	–7.2%
February 20, 2020 – March 23, 2020	–33.8%	–33.3%	–3.6%
Mean	–19.9%	–23.9%	1.1%
Median	–19.1%	–31.9%	–0.4%
Downside capture ratio (Mean)		1.2	–0.1
Downside capture ratio (Median)		1.7	0.0

Sources: Bloomberg, Wilmington Trust. As of date is April 2025. Past performance cannot guarantee future results. Gold: iShares Gold Trust ETF (IAU).

On the sidelines for now, but watching closely

Cryptocurrencies, such as Bitcoin, constitute a young and emerging asset class with many exciting attributes, but also with many of the hallmarks of a speculative fervor. Bitcoin has experienced substantial returns—even relative to its volatility—over the last several years. It has grown to be the most established cryptocurrency by a wide margin, but its volatility is still the major stumbling block for inclusion in portfolios.

Currently, we do not recommend an allocation to Bitcoin or other cryptocurrencies in a diversified portfolio of moderate risk. However, a small allocation may be appropriate for certain risk-seeking investors or those with a penchant for speculation. Despite becoming more of a mainstream asset class, it is important to keep in mind that Bitcoin does continue to act as a turbocharged risk asset.

While we remain on the sidelines in terms of introducing Bitcoin into balanced portfolios, we are watching it and other cryptocurrencies closely. In the future, Bitcoin’s role in a portfolio should depend greatly on its volatility profile and also more generally on its maturity as an asset class. Bitcoin has been on a trajectory of gaining maturity, declining volatility, expanding investor base, and regulatory clarification. If this trend continues, we would anticipate it being an interesting addition to diversified portfolios.

APPENDIX

ENDNOTES

- ¹ Bloomberg Bitcoin Index, as of May 14, 2025.
- ² As of May 14, 2025.
- ³ Bloomberg Bitcoin Index, as of May 14, 2025.
- ⁴ Volatility describes the degree of fluctuation in an asset's returns over time. Standard deviation is the statistical measure used to quantify volatility based on historical data. Implied volatility represents the market's expectation of future price movements as inferred from option prices.
- ⁵ As of December 31, 2024. Sources: Bloomberg, WTIA.
- ⁶ Implied volatility of at-the-money options on the front-month CME Bitcoin contract.
- ⁷ Correlation measures how closely two assets move in tandem. A correlation of one means that their prices move together almost perfectly, while a correlation of minus one means that they move nearly perfectly in opposite directions. A zero correlation indicates that the two assets move independently.
- ⁸ Tracking error is the standard deviation of a portfolio versus its benchmark.
- ⁹ Bloomberg. Data as of May 14, 2025.
- ¹⁰ Covariances are based on longer-term exponentially weighted correlations (equivalent to about six years) and standard deviations (about three years); asset class returns (except for Bitcoin) are based on longer-term annualized returns (about 14 years covering the time span in which we have common returns for all asset-class indexes).
- ¹¹ Information Ratio is defined as expected return over the benchmark divided by expected tracking error.
- ¹² We use the first step of the Black-Litterman model, known as reverse optimization. Instead of assuming that expected returns are known inputs (as in traditional mean-variance optimization) and obtaining the weights of a portfolio, reverse optimization derives the implied excess returns from a given market-cap-weighted portfolio. In other words, instead of finding weights assuming covariance and expected returns, we find expected returns assuming covariance and weights. We also have to choose a baseline level of return for existing asset classes. Here, we assume a 6% return for large cap stocks and the model solves for returns of other asset classes.

Market indexes used for analysis in this document, and corresponding Bloomberg tickers, are as follows:

Bitcoin: Spot Bitcoin/USD exchange rate (XBTUSD).

U.S. equities (large cap): Russell 1000 Total Return Index (RU10INTR).

U.S. equities (small cap): Russell 2000 Total Return Index (RU20INTR).

U.S. equity weights approximately 95% R1K/5% R2K

Alternatives: HFRX Global Hedge Fund Index (HFRXGL).

Real assets: 50% S&P Developed Property USD Total Return Index (SPBMWDUT) / 50% Bloomberg Commodity Index USD Total Return Index (BCOMTR).

International equities: MSCI EAFE USD Total Return Index (NDDUEAFE), MSCI Emerging Markets USD Total Return Index (NDUEEGF). International weights approximately 70% EAFE/30% EM.

U.S. high yield bonds: Bloomberg US Corporate High Yield Bond Total Return Index (LF98TRUU).

U.S. investment-grade bonds: Bloomberg US Aggregate Bond Total Return Index (LBUSTRUU).

Basis point (bps) is a unit of measure used to indicate percentage changes in financial instruments. (1 basis point equals 0.01%.)

Cash: Bloomberg US Treasury Bills Total Return Index (LD20TRUU).

Global non-USD bonds: Bloomberg Global Aggregate Ex-USD Bond Total Return Index (LG38TRUU).

Non-US equities: MSCI All Country World Ex-US Index (NDUEACWZ) USD Total Return Index.

The gold industry can be significantly affected by international monetary and political developments as well as supply and demand for gold and operational costs associated with mining.

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