

WHITE PAPER

# Pushing out the Efficient Frontier with Bitcoin



**Tom O'Shea, CFA**  
Director of Research & Investment Strategy



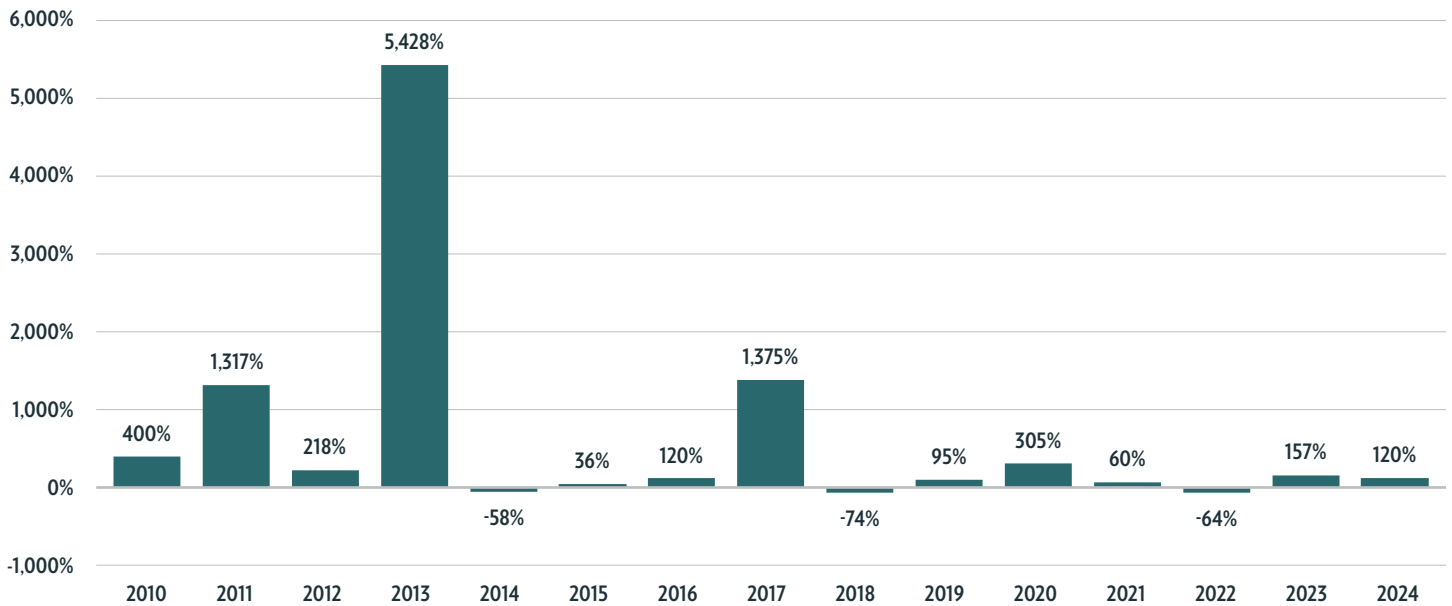
## Pushing out the Efficient Frontier with Bitcoin

Bitcoin, launched in early 2009, revolutionized financial markets by introducing a decentralized medium of exchange and store of value that eliminates intermediary costs. Today, investors can access bitcoin through various channels including cryptocurrency exchanges, brokerage accounts, and a rapidly expanding ETF market that has surpassed \$125 billion in assets. Given bitcoin's historical returns, increasing institutional adoption, and supportive regulatory environment, we anticipate continued growth beyond its current \$2T market capitalization.

### Return Potential

The adoption of bitcoin appears to have been driven largely by its unprecedented returns and investors' fear of missing out (FOMO). Since 2013, bitcoin has delivered calendar year returns as high as -5400% - a performance that would have turned a hypothetical \$18,500 investment into over \$1 million within a single year. This extraordinary return was not an isolated incident; bitcoin achieved returns exceeding 1300% in two other calendar years and delivered triple-digit returns in six additional years. To put this in perspective, an S&P 500 investor would need nearly 37 years at the historical average annual return (since 1949) of -11.6% to match bitcoin's 2013 performance.

CALENDAR YEAR BITCOIN RETURNS

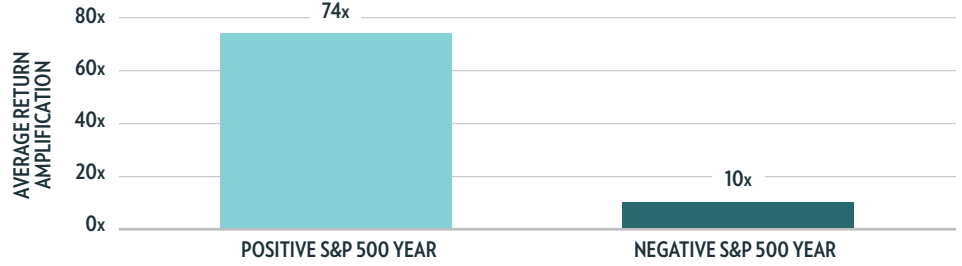


Source: Bloomberg, Innovator. Data from 7/31/2010 - 12/31/2024. Bloomberg Bitcoin Index shown. Past performance is not necessarily indicative of future results. One cannot invest directly into an index.



The S&P 500 appreciated in 13 of the 15 years of bitcoin's existence. With the exception of 2014, bitcoin's return was many multiples higher than the S&P 500 in most positive and negative years. However, the bitcoin multiplier has been much higher in positive returning S&P 500 years. Some strategists believe that wider access to cryptocurrency may erode the extreme price appreciation experienced in the digital asset's early days. Regardless, the cryptocurrency achieved returns exceeding 100% during 2023 and 2024, ~6x and ~5x greater than the S&P 500.

### BITCOIN HAS AMPLIFIED S&P 500 RETURNS IN POSITIVE AND NEGATIVE YEARS



Source: Bloomberg, Innovator. This chart reflects the simple average of Bloomberg Bitcoin Index annual return multiples relative to the S&P 500 Index annual return. Calendar year returns from 7/31/2010 - 12/31/2024. Past performance is not necessarily indicative of future results. One cannot invest directly in an index.

## Volatility Considerations

Modern portfolio theory teaches us that higher expected returns typically require accepting higher risk - a principle particularly evident with bitcoin. The digital asset has experienced booming bull markets, including a +90% surge from late 2024 through early 2025 and a +360% rally following the 2022 tightening cycle. However, these dramatic upswings have been matched by equally dramatic downturns, with investors needing to “hold on for dear life” as the asset loses 50% or more of its value. The crypto winter of 2022 saw bitcoin decline approximately 77% while the S&P 500 fell only 14%.

### US DOLLAR PER BITCOIN

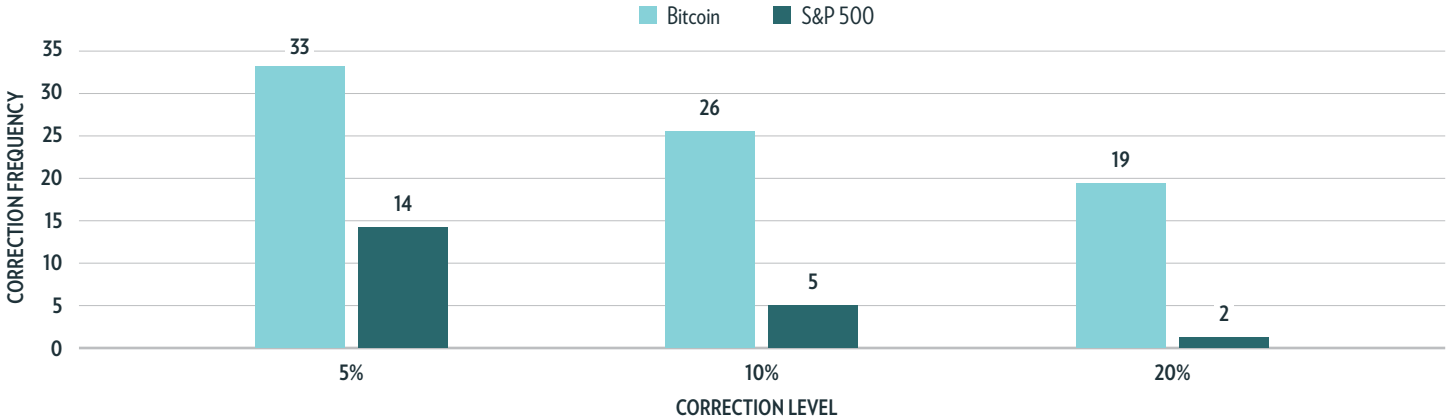


Source: Bloomberg, Innovator. Daily data from 7/18/2010 - 1/31/2025. Historical price action is not necessarily indicative of future results.



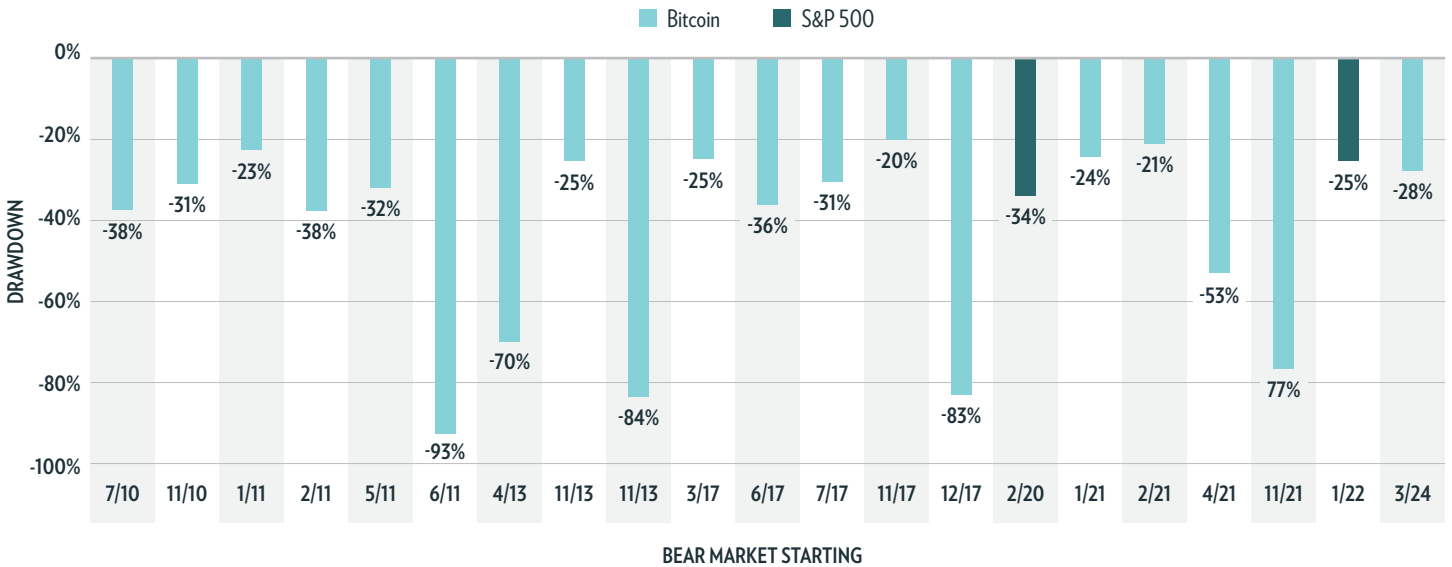
The frequency and magnitude of bitcoin's drawdowns warrant careful consideration. Since its inception, bitcoin has experienced 19 bear markets compared to just two for the S&P 500. Periods between 10% corrections also differ significantly - the S&P 500 historically allows investors about 307 days (median) between the recovery of a correction and the start of a new one, while bitcoin historically allows just 14 days. This heightened volatility profile demands careful portfolio-level analysis when determining allocation sizes.

### BITCOIN CORRECTIONS: MORE FREQUENT AND DEEPER



Source: Bloomberg, Innovator. Data from 7/18/2010 - 12/31/2024. Number of observations associated with 5%, 10%, and 20% corrections shown for the S&P 500 Index and the Bloomberg Bitcoin Index. Past performance is not necessarily indicative of future results. One cannot invest directly into an index.

### S&P 500 AND BITCOIN BEAR MARKETS



Source: Bloomberg, Innovator. Data from 7/18/2010 - 12/31/2024. S&P 500 Index and Bloomberg Bitcoin Index drawdowns shown. Past performance is not necessarily indicative of future results. One cannot invest directly into an index.



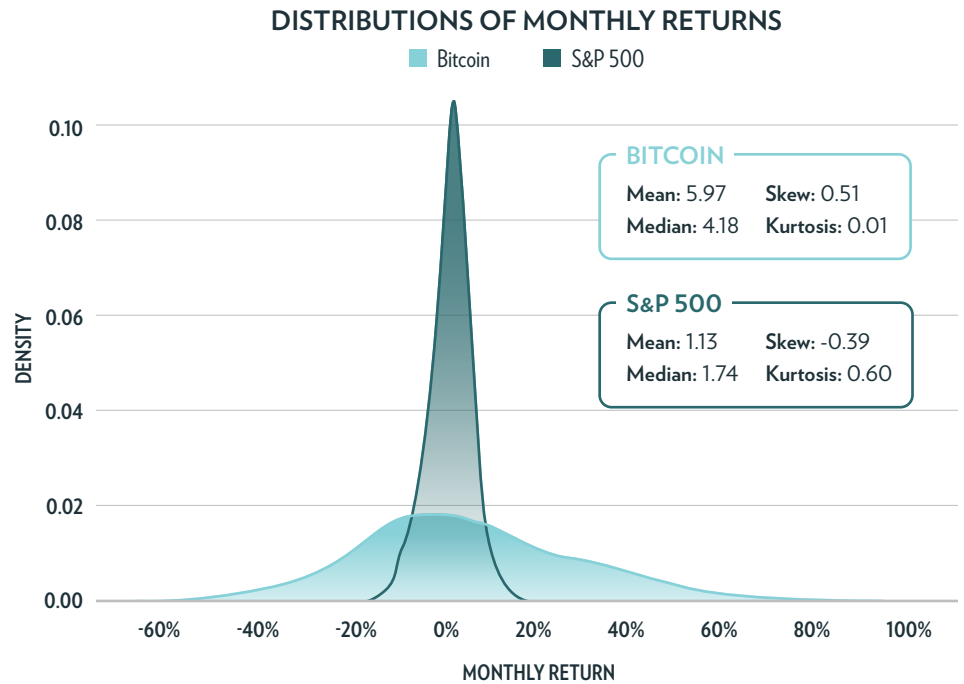
## Portfolio Considerations

When considering adding any asset class to a portfolio, managers should consider several factors: expected return, contribution to volatility, diversification benefits, costs, liquidity, time horizon, etc. A manager should ensure that they are being compensated for all the risks they are taking when they are adding an asset to a portfolio.

## Return Distribution Analysis

Bitcoin's return distribution exhibits distinct characteristics from traditional asset classes. While S&P 500 monthly returns cluster around a 1.1% mean with negative skew (indicating frequent small gains and occasional large losses), bitcoin displays positive skew with a 6.0% mean exceeding its median. This distribution pattern suggests that while most monthly returns hover near the mean, bitcoin periodically delivers exceptional positive outliers dragging the tail of the distribution to the right.

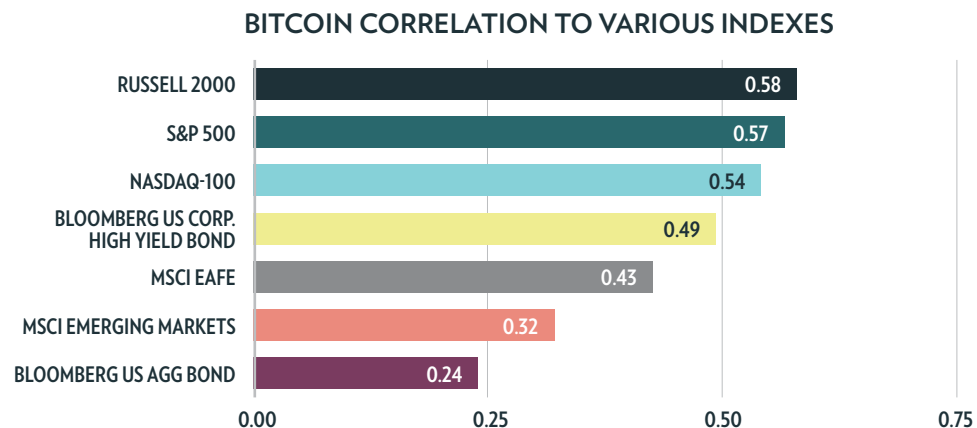
Despite experiencing treacherous drawdowns reaching 40% in the worst month and volatility approximately 3.5 times that of the S&P 500, bitcoin's positive skew has historically compensated investors for this additional risk. This is reflected in higher risk-adjusted returns: 0.93 for bitcoin versus 0.76 for the S&P 500.



Source: Bloomberg, Innovator. Monthly data from 12/31/2013 - 12/31/2024. This chart illustrates the distribution of monthly returns for the Bloomberg Bitcoin Index and the S&P 500 Index. The y-axis shows the quotient of the observations associated with the monthly return noted on the x-axis and the total observations. Past performance is not necessarily indicative of future results. One cannot invest directly in an index.

## Diversification Benefits

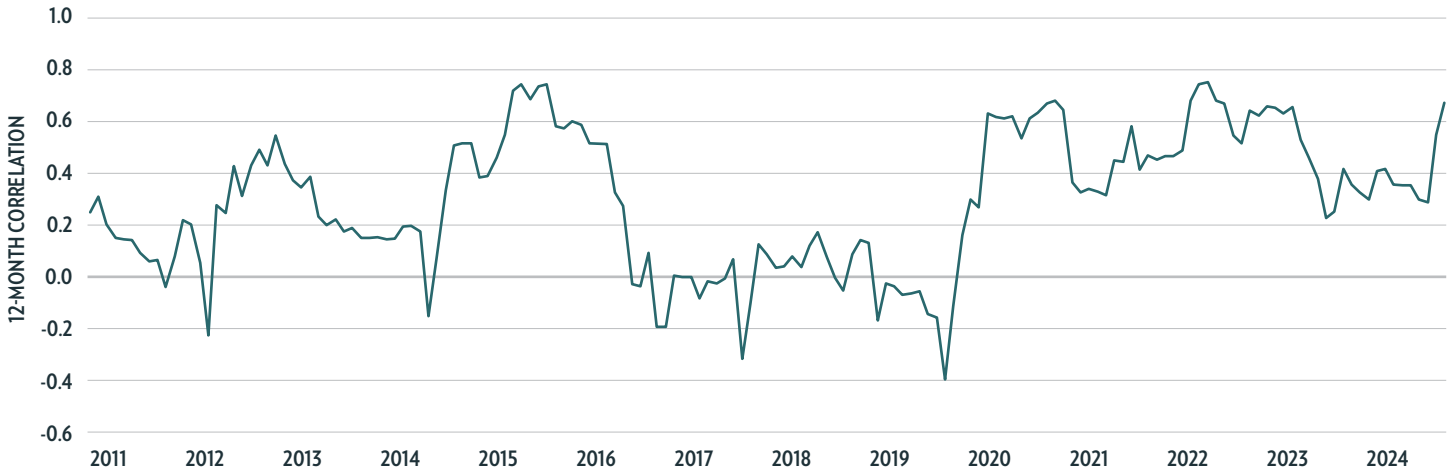
Bitcoin's value as a portfolio diversifier stems from its moderate correlation with traditional asset classes, which has varied across market environments. Over the past five years, bitcoin has shown a moderate positive relationship with U.S. large and small-cap equities. However, this correlation is not static – as global central banks tightened monetary policy to fight inflation in 2022, correlation increased, while it turned negative leading into the COVID-19 pandemic.



Source: Bloomberg, Innovator. Data from 12/31/2019 - 12/31/2024. Correlation to the monthly returns of the Bloomberg Spot Index shown.



## BITCOIN AND S&P 500 TRAILING 12-MONTH CORRELATION



Source: Bloomberg, Innovator. Data from 8/31/2010 – 12/31/2024. Bloomberg Bitcoin Index and S&P 500 Index correlation of monthly returns shown.

## Portfolio Impact Analysis

The optimal bitcoin allocation depends heavily on an investor’s time horizon, risk tolerance, and expectations for future asset class returns. Our analysis examines bitcoin’s portfolio impact at various allocations relative to a 100% S&P 500 portfolio over two distinct periods:

### 2014-2024 Period

The first period examined began following bitcoin’s best year and, in our view, may be more indicative of future returns. The table below highlights the performance experienced by the assets in the portfolio. Over this period bitcoin’s return exceeded the S&P 500 by an annualized 42%, but at the same time, it experienced more than triple its volatility.

### ASSET CLASS PERFORMANCE

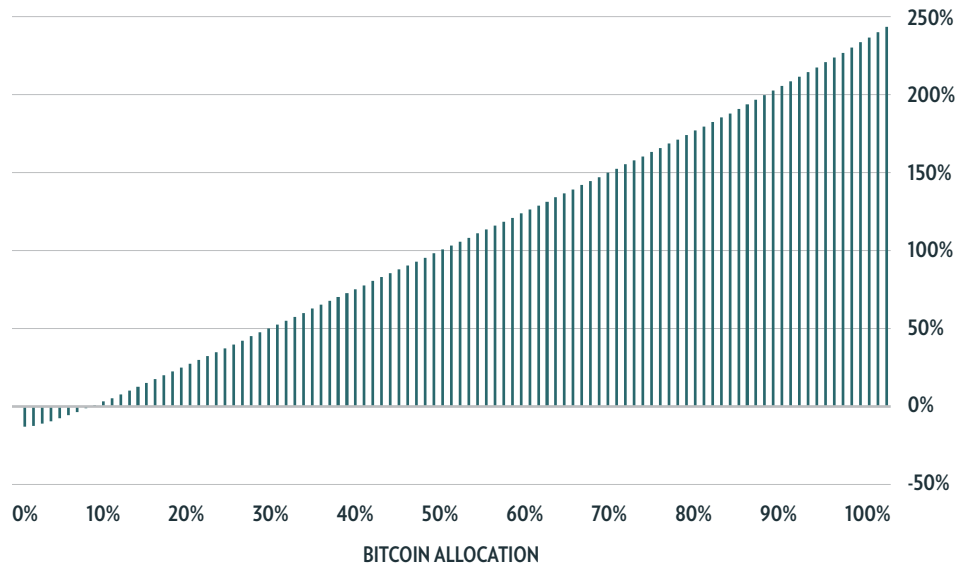
METRIC	BITCOIN	S&P 500
Annualized Return	55.1%	13.1%
Volatility	59.6%	17.3%
Downside Deviation	43.8%	14.3%
Sharpe Ratio	0.88	0.65
Max Drawdown Peak	12/17/17	2/19/20
Max Drawdown Trough	12/14/18	3/23/20
Max Drawdown	-83.4%	-33.8%

Source: Bloomberg, Innovator. Data from 12/31/2013 - 12/31/2024. Bloomberg Bitcoin Index and S&P 500 Index performance shown. Past performance is not necessarily indicative of future results. One cannot invest directly into an index.



When allocating bitcoin to a portfolio in increments of 1%, we quickly realize its diversification impacts. A seemingly insignificant 1% allocation to the cryptocurrency results in a hypothetical portfolio that improves returns by 1.5% annually and minimizes the volatility compared to any other combinations. The illustration below highlights this small allocation leading to the greatest reduction in portfolio volatility. Raising the allocation to 8% manages to create a portfolio with volatility in line with the S&P 500 while increasing the annualized return by over 10%. An investor looking to maximize the portfolio's risk adjusted returns would have had to increase the bitcoin allocation to about 25%. While an investor would have been compensated for the risk in the form of an annual return 24.5% higher than the S&P 500, heightened volatility would have magnified the drawdown to 42.4%.

### PORTFOLIO VOLATILITY CHANGE BY ALLOCATION TO BITCOIN (%)



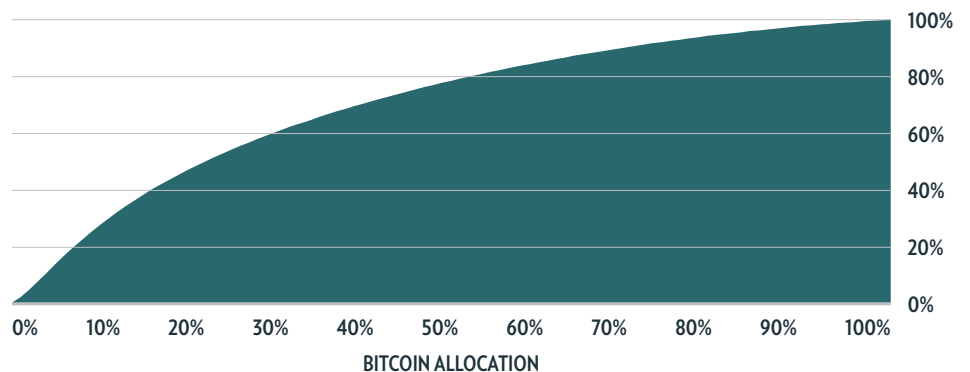
Source: Bloomberg. Daily data from 12/31/2013 - 12/31/2024. Portfolio volatility change associated with the Bloomberg Bitcoin Index is calculated against a portfolio allocation of 100% to the S&P 500 Index.

PORTFOLIO NAME	S&P 500 / BITCOIN	ANNUALIZED RETURN	VOLATILITY	SHARPE	MAX DRAWDOWN
S&P 500	100/0	13.1%	17.3%	0.65	-33.8%
Min Vol	99/1	14.7%	15.1%	0.85	-33.8%
S&P 500 Vol Match	92/8	23.4%	17.1%	1.25	-34.1%
Max Sharpe	75/25	37.6%	24.3%	1.46	-42.4%
Max Return	0/100	55.1%	59.6%	0.88	-83.4%

Source: Bloomberg, Innovator. Data from 12/31/2013 - 12/31/2024. This analysis of hypothetical allocations to the S&P 500 Index and/or the Bloomberg Bitcoin Index is presented for illustrative purposes. Not representative of any actual investment.

Due to bitcoin's extreme volatility relative to most traditional asset classes, investors must understand how the cryptocurrency can drive overall portfolio volatility. A small allocation of 1% in the minimum volatility portfolio has its price movement driven primarily by the S&P 500. However, the S&P 500 volatility match portfolio containing only 8% bitcoin would have experienced a quarter of the portfolio's total volatility from the cryptocurrency. Investors must understand the disproportionate portfolio risk associated with seemingly small allocation changes to bitcoin.

### BITCOIN CONTRIBUTION TO PORTFOLIO RISK BY ALLOCATION (%)



Source: Bloomberg, Innovator. Data from 12/31/2013 - 12/31/2024. The y-axis shows the volatility contribution associated with a hypothetical investment in the Bloomberg Bitcoin Index, at the allocation percentage shown along the x-axis, and the S&P 500 Index.



## 2020-2024 Period

Our portfolio combinations change quite drastically when optimizing over our second time period (2020 – 2024). In the last 5 years, the S&P 500 experienced 2 bear markets driven by Covid-19 and the tightening cycle of 2022. While our annualized return figures remain relatively unchanged, our volatility climbed by 23% due to the concentration of those bear markets. Bitcoin on the other hand saw a slight drop in volatility while the annualized return increased by over 10%.

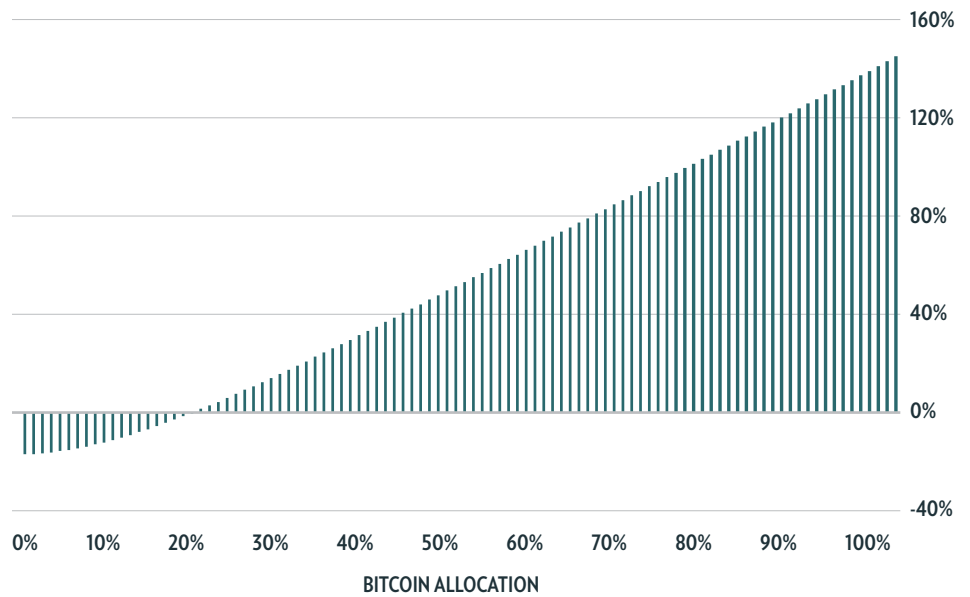
## ASSET CLASS PERFORMANCE

METRIC	BITCOIN	S&P 500
Annualized Return	67.2%	14.5%
Volatility	52.3%	21.3%
Downside Deviation	38.6%	17.4%
Sharpe Ratio	1.21	0.55
Max Drawdown Peak	11/9/21	2/19/20
Max Drawdown Trough	11/21/22	3/23/20
Max Drawdown	-76.9%	-33.8%

Source: Bloomberg, Innovator. Data from 12/31/2019 – 12/31/2024. Bloomberg Bitcoin Index and S&P 500 Index performance shown. Past performance is not necessarily indicative of future results. One cannot invest directly in an index.

The reduction in risk relative to first time frame allows for more flexibility in the percentage of bitcoin allowed into the portfolio, without experiencing as much of the downside. Similar to the first period examined, a 1% allocation to bitcoin in this period achieves the minimum volatility portfolio which increases returns by 0.9% annually and reduces overall volatility by 15%. In the second time frame, an investor would have created the S&P 500 volatility matched portfolio with a 20% allocation to the digital asset. The 20% in bitcoin pushes out the efficient frontier allowing investors to achieve 16% higher returns annually with the same risk as the S&P 500. Finally, an allocation of 45% in bitcoin leads to the best risk-adjusted returns at an enormous 46.3% annual rate. While investors are most compensated for the risk during with this allocation, many investors do not have risk tolerances made of steel to stomach portfolio value cutting in half.

## PORTFOLIO VOLATILITY CHANGE BY ALLOCATION TO BITCOIN (%)



Source: Bloomberg, Innovator. Daily data from 12/31/2019 - 12/31/2024. Portfolio volatility change associated with the Bloomberg Bitcoin Index is calculated against a portfolio allocation of 100% to the S&P 500 Index.



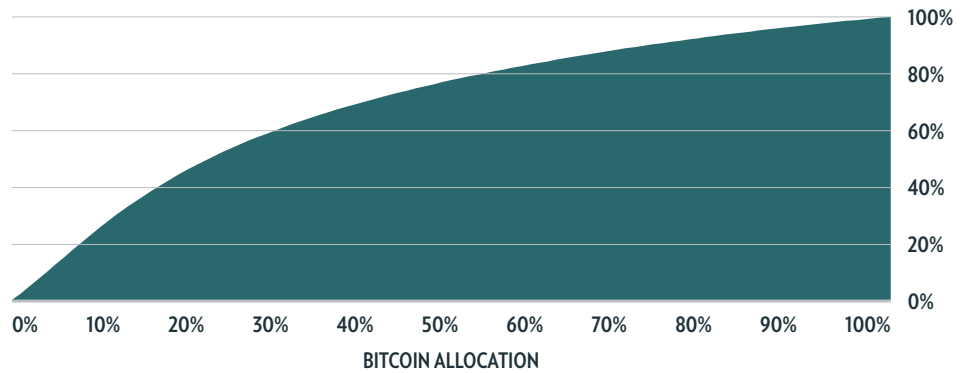


PORTFOLIO NAME	S&P 500 / BITCOIN	ANNUALIZED RETURN	VOLATILITY	SHARPE	MAX DRAWDOWN
S&P 500	100/0	14.5%	21.3%	0.55	-33.8%
Min Vol	99/1	15.4%	17.7%	0.71	-33.8%
S&P 500 Vol Match	80/20	30.5%	21.3%	1.28	-36.9%
Max Sharpe	55/45	46.3%	30.4%	1.41	-51.7%
Max Return	0/100	67.2%	52.3%	1.21	-76.9%

Source: Bloomberg, Innovator. Data from 12/31/2019 – 12/31/2024. This analysis of hypothetical allocations to the S&P 500 Index and/or the Bloomberg Bitcoin Index is presented for illustrative purposes. Not representative of any actual investment. Past performance is not necessarily indicative of future results. One cannot invest directly into an index.

Regardless of time period, small allocations to bitcoin disproportionately drive risk. At an allocation of 20% in the S&P 500 volatility matched portfolio, bitcoin is driving almost half of all portfolio risk. Increasing the allocation to 45% in our Max Sharpe portfolio leads to bitcoin driving almost 75% of portfolio volatility. Most investors seek to maximize risk-adjusted returns in portfolio optimization, but they should not let outsized return potential distract them from their risk constraints.

### BITCOIN CONTRIBUTION TO PORTFOLIO RISK BY ALLOCATION (%)



Source: Bloomberg, Innovator. Data from 12/31/2019 - 12/31/2024. The y-axis shows the volatility contribution associated with a hypothetical investment in the Bloomberg Bitcoin Index, at the allocation percentage shown along the x-axis, and the S&P 500 Index.

## Risk Management Considerations

Historical analysis shows that modest bitcoin allocations may have enhanced historical portfolio outcomes by reducing overall risk while increasing return potential. However, as bitcoin allocations increased beyond 4%, portfolio risk became disproportionately dominated by cryptocurrency volatility. Consequently, larger allocations should be limited to investors with exceptional risk tolerance.

The emergence of risk-managed, derivatives-based strategies has created opportunities for investors to capture bitcoin's upside potential while limiting downside exposure. One approach is to incorporate protective floors while maintaining uncapped upside potential, enabling investors to participate in bitcoin's growth characteristics while moderating its extreme volatility.

While some of these risk-managed strategies operate on annual outcome periods, this time frame may be suboptimal for bitcoin exposure. In some circumstances, rapidly rising bull markets early in the outcome period can lead to reduced protection for the remainder of the annual period. Given the digital asset's notable volatility, quarterly outcome periods may offer several advantages. For example, more frequent rebalancing allow investors to establish a new floor every three months. Historical data supports this approach – bitcoin's value depreciated in 38% of all quarters with just under half of these declining periods exceeding -20%.



### QUARTERLY BITCOIN RETURNS

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Q1	160	14	570	-38	-23	-4	13	-51	11	-9	103	-1	72	67
Q2	1,964	37	7	39	7	60	133	-14	178	41	-41	-59	7	-13
Q3	-68	86	31	-40	-9	-9	67	11	-28	17	26	4	-11	3
Q4	-17	9	488	-19	82	57	237	-44	-13	171	7	-15	57	47

Source: Bloomberg, Innovator. Bloomberg Bitcoin Index data shown. Quarterly data from 12/31/2010 -12/31/2024. Past performance is not necessarily indicative of future results. One cannot invest directly in an index.



By adopting a risk-managed strategy, investors can potentially increase their bitcoin exposure, capitalize on its upside volatility, and maintain greater control over its overall risk impact on the portfolio.

## Conclusion

Bitcoin has demonstrated transformative wealth-generation potential but requires sophisticated risk management to harness effectively. While retail and institutional adoption continues to grow through expanded access channels and regulatory developments, several factors warrant consideration:



Small allocations can significantly impact portfolio outcomes but may drive disproportionate risk



Bitcoin's uncorrelated returns and positive skew may enhance risk-adjusted portfolio returns



Large allocations without proper risk management can severely impact investment objectives



Floor strategies may reduce extreme volatility and still allow for significant upside capture

Investors should carefully evaluate their risk tolerance and capacity when determining bitcoin allocations, particularly given the asset's evolving regulatory landscape and market maturity. While the potential benefits are substantial, they must be weighed against the asset's inherent volatility and the investor's financial goals.



This material contains the current research and opinions of its authors, which are subject to change without notice. This material is not a recommendation to participate in any particular trading strategy. Unless expressly stated to the contrary, the opinions, interpretations, and findings herein do not necessarily represent the views of Innovator Capital Management, LLC ("Innovator") or any of its affiliates.

The hypothetical performance illustrations included in this presentation are for informational purposes only and do not represent the result of any actual account or trading. The indices used within the hypothetical performance illustrations are not directly investable. There is no guarantee that allocations at the stated percentages will result in desired outcomes. Actual investment outcomes will vary and hypothetical performance cannot account for the impact of financial risk in actual trading. Hypothetical performance benefits from a retroactive construction with the benefit of hindsight, all of which can adversely affect actual trading results and performance. This material is intended for financial professionals with the resources to independently analyze hypothetical performance and the financial expertise to understand the risks and limitations of hypothetical performance.

This material is provided for informational purposes only and is made available on an "as is" basis, without representation or warranty. This information is only current as of the date indicated and may be superseded by subsequent market events or for other reasons. Innovator is not providing this information as investment advice. Readers should consult with their investment and tax advisers to obtain investment advice and should not rely upon information published by Innovator or any of its affiliates. Evaluations of market conditions are only current as of the date of publishing, are subject to change without notice, and are not intended to be a forecast of investment outcomes. Innovator specifically disclaims all warranties, express or implied, to the full extent permitted by

applicable law, regarding the accuracy, completeness, or usefulness of this information, including any forecasts or price targets contained herein, and assumes no liability with respect to the consequences of relying on this information for investment or other purposes.

**Investing involves risk, including the loss of principal. Past performance is not indicative of future results. One cannot invest directly into an index. Index performance does not account for fees and expenses.**

Certain information herein contains forward-looking statements such as "will," "may," "should," "expect," "target," "anticipate," or other variations of these statements. Forward-looking statements are based upon assumptions which may not occur, while other conditions not taken into account may occur. Actual events or results may differ materially from those contemplated in such forward-looking statements. References to financial instruments in this material are provided for informational purposes only and do not constitute a recommendation. The forward-looking statements contained herein do not constitute, and should not be relied upon as, investment advice. Such forward-looking statements are not necessarily based upon explicit criteria and assumptions, but rather, represent the opinions of the authors stated herein.

The following marks: Accelerated ETFs<sup>®</sup>, Accelerated Plus ETF<sup>®</sup>, Accelerated Return ETFs<sup>®</sup>, Barrier ETF<sup>™</sup>, Buffer ETF<sup>™</sup>, Defined Income ETF<sup>™</sup>, Defined Outcome Bond ETF<sup>®</sup>, Defined Outcome ETFs<sup>™</sup>, Defined Protection ETF<sup>™</sup>, Define Your Future<sup>®</sup>, Enhanced ETF<sup>™</sup>, Floor ETF<sup>®</sup>, Innovator ETFs<sup>®</sup>, Leading the Defined Outcome ETF Revolution<sup>™</sup>, Managed Buffer ETFs<sup>®</sup>, Managed Outcome ETFs<sup>®</sup>, Stacker ETF<sup>™</sup>, Step-Up<sup>™</sup>, StepUp ETFs<sup>®</sup>, Target Protection ETF<sup>™</sup>, 100% Buffer ETFs<sup>™</sup> and all related names, logos, product and service names, designs, and slogans are the trademarks of Innovator, its affiliates or licensors. Use of these terms is strictly prohibited without proper written authorization.

Copyright © 2025 Innovator Capital Management, LLC. All rights reserved.