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The Case for Crypto in an Institutional Portfolio

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I. Executive Summary

This paper revisits the case for adding cryptoassets to a diversified portfolio of stocks and bonds by updating the data used in a paper with the same name published in May 2020.[1] We consider the impact that different allocations to cryptoassets would have had on a Traditional Portfolio consisting of 60% equities and 40% bonds under a myriad of different market regimes.

The findings continue to be remarkable.

The paper shows that crypto would have contributed positively to a diversified portfolio's cumulative and risk-adjusted returns in 100% of three-year periods, 97% of two-year periods, and 77% of one-year periods since 2014, assuming quarterly rebalancing.

In addition, the size of that positive impact has been significant: Assuming quarterly rebalancing, a 2.5% allocation to crypto would have boosted the median three-year cumulative return of a traditional 60% equity/40% bond portfolio by 13.30 percentage points.[2]

Counterintuitively, crypto has positively impacted portfolios even over periods in which crypto's price has declined. For example, an investor who initiated an allocation to crypto at the precise top of the 2017 bull market on December 16, 2017, would have seen that allocation begin to contribute positively to the portfolio by June 17, 2019, despite crypto still being down 52.02% at that time. This remarkable result is driven by the fact that crypto has low correlations with other asset classes and daily liquidity, allowing investors to capitalize on the volatility-harvesting opportunity that non-correlated assets offer.[3]

The paper builds on a significant existing literature examining crypto's influence on portfolio returns. One criticism of prior papers, however, is that the authors cherry-pick specific time periods, rebalancing strategies, or allocations to highlight positive results. The question that lingers in the back of many potential investors' minds is: "But what if I didn't allocate exactly this way?"

This paper aims to address this type of question by being comprehensive in all possible aspects. Specifically, it shows how key portfolio metrics would have fared considering:

- Extensive price data, considering prices from January 1, 2014, all the way through June 30, 2021;
- All available time periods, using rolling period analyses to examine every possible one-, two-, and three-year holding period within that history;
- A range of potential crypto allocations, from 0% to 10% of the portfolio; and
- Multiple rebalancing frequencies, including monthly, quarterly, annual, and no rebalancing.

There is, of course, no guarantee that the relationships between a crypto allocation and the key portfolio performance metrics identified in this report will persist going forward, but the paper shows that cryptoassets continue to be an extremely consistent enhancer of diversified portfolios.

1 "The Case for Crypto in an Institutional Portfolio," published in May 2020 and available at https://s3.amazonaws.com/static.bitwiseinvestments.com/Research/Bitwise-The-Case-For-Crypto-In-An-Institutional-Portfolio.pdf
2 We examine other rebalancing strategies, holding periods, and allocation sizes in the body of the paper.
3 See, for instance, Paul Bouchey, Vassilii Nemtchinov, Alex Paulsen and David M. Stein, "Volatility Harvesting: Why Does Diversifying And Rebalancing Create Portfolio Growth?" *The Journal of Wealth Management* 15, no. 2 (Fall 2012).

II. Methodology

This paper examines the impact of adding a cryptoasset allocation to a traditional, diversified portfolio of stocks and bonds (the "Traditional Portfolio").

The Traditional Portfolio features a 60% allocation to the Vanguard Total World Stock ETF (VT) and a 40% allocation to the Vanguard Total Bond Market ETF (BND). VT holds a market-cap-weighted portfolio of global stocks covering 98% of the world's market capitalization, while BND holds a market-value-weighted portfolio representing all taxable, investment-grade U.S. bonds. This paper uses the total return track record of these funds, assuming all dividends are reinvested.

Bitcoin is used as a proxy for cryptoassets in general, not only because it is the largest and most developed cryptoasset but also because, as the first cryptoasset, it has a longer price history that allows for more comprehensive simulations. The returns of bitcoin are gross of any fees, and therefore might not replicate exactly the experience of actual investors. On the other hand, the study uses bitcoin's price return and does not add in the value of hard forks or airdrops. In practice, an investor allocating to bitcoin could have achieved a higher total return by capturing the value of those distributions over the study period.

The paper focuses on the period between January 1, 2014, and June 30, 2021, therefore removing the first 3.5 years of bitcoin's returns. The decision to remove these years was made in an effort to better represent the modern experience of professional asset allocators in the U.S. It should be noted that including this earlier period would only have strengthened the findings of this paper,[4] as bitcoin's returns during this period were exceptionally strong: Bitcoin returned 506% from July 17, 2010, through December 31, 2010; 1,474% in 2011; 186% in 2012; and 5,537% in 2013, for a cumulative return over the roughly 3.5-year period of 1,537,795%.

Importantly, the paper takes advantage of both point-in-time and rolling analyses. For these, instead of looking at arbitrary start and end dates, we fix a certain holding period window (e.g. three years, two years, or one year) and analyze all possible holding periods of that length. We find rolling period analyses useful because they eliminate concerns about cherry-picking specific time periods, and because they provide a fuller view of the frequency and magnitude of the impact a crypto allocation can have on a portfolio under different market regimes.

Aside from cumulative and annualized returns, this analysis also delves into key portfolio performance metrics like Sharpe ratios,[5] standard deviations, and maximum drawdowns.

Pricing data used throughout this study was sourced from IEX Cloud for traditional assets and from Bitwise Asset Management's internal database for bitcoin.[6] All returns are calculated daily and normalized for official market trading days. This means that bitcoin returns over weekends or market holidays are accounted for in the following official market trading session.

4 Past performance does not guarantee future results.
5 This paper uses a risk-free rate of 1.45% per year to calculate the Sharpe ratio. This was the 10-year Treasury yield at the cutoff date of our analysis (June 30, 2021) as per https://home.treasury.gov/policy-issues/financing-the-government/interest-rate-statistics.
6 Bitwise Asset Management calculates bitcoin reference prices daily by averaging the prices from select exchanges. Prices were collected at midnight UTC before July 31, 2018 and at 4pm ET thereafter.

III. The Impact of Adding Crypto to a 60/40 Traditional Portfolio

HOW ADDING BITCOIN TO A TRADITIONAL PORTFOLIO WOULD HAVE IMPACTED RETURNS

We begin this study with a classic 60/40 Traditional Portfolio, initially without a crypto allocation. From the start of our primary study period on January 1, 2014 until June 30, 2021, this portfolio returned 74.72%, which translates to an annualized return of 7.75% per year.

As the chart and the table below show, a modest allocation to crypto would have significantly improved these returns.

For example, adding a 2.5% crypto allocation with quarterly rebalancing would have improved the cumulative return of the portfolio from 74.72% to 112.73%.[7] Importantly, this result would have been achieved without significantly changing either the portfolio's volatility (10.43% with crypto, 10.19% without) or its maximum drawdowns (21.80% with crypto, 21.07% without).

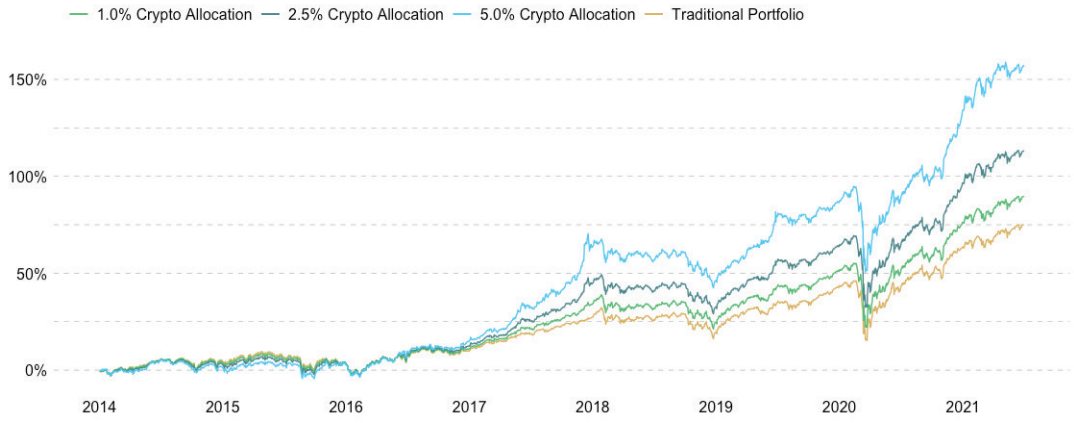
The portfolio's Sharpe ratio, which measures excess returns per unit of risk, would have improved by a whopping 42.31%.

Naturally, crypto's portfolio impact would have scaled with the size of the allocation: A 5% allocation to crypto would have boosted the cumulative return of the portfolio to 156.46%, more than doubling the total return of the Traditional Portfolio. That is a remarkable impact considering the relatively small size of the allocation.

A 2.5% allocation to crypto would have improved the return of a diversified portfolio by 38.01 percentage points between January 1, 2014, and June 30, 2020.

CUMULATIVE RETURNS – TRADITIONAL PORTFOLIO WITH AND WITHOUT QUARTERLY-REBALANCED CRYPTO ALLOCATIONS

Period between January 1, 2014 and June 30, 2021



Source: Bitwise Asset Management with data from IEX Cloud

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7 We examine the impact of other rebalancing frequencies — as well as strategies that involve no rebalancing — later in the paper. As that analysis shows, more frequent rebalancing strategies generally have two impacts: 1) reducing the positive impact on cumulative returns from adding crypto to a portfolio; and 2) reducing the impact on the portfolio's volatility. In other words, the more frequent the rebalancing, the lower the risk — and the lower the reward.

PORTFOLIO PERFORMANCE METRICS

Period between January 1, 2014 and June 30, 2021 (assuming quarterly rebalancing)

PORTFOLIO	CUMULATIVE RETURN	ANNUALIZED RETURN	ANNUALIZED VOLATILITY	SHARPE RATIO	MAXIMUM DRAWDOWN
Traditional Portfolio	74.72%	7.75%	10.19%	0.609	21.07%
Traditional Portfolio + 1.0% crypto	89.26%	8.90%	10.21%	0.719	21.32%
Traditional Portfolio + 2.5% crypto	112.73%	10.62%	10.43%	0.867	21.80%
Traditional Portfolio + 5.0% crypto	156.46%	13.42%	11.18%	1.055	22.76%

Source: Bitwise Asset Management with data from IEX Cloud

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It is fair to note that the price of bitcoin rose sharply during this period, from $755 at the start of 2014 to $34,759 on June 30, 2021.

As a result, a natural follow-up question is: What occurred during other potential holding periods?

GENERALIZING CRYPTO'S PORTFOLIO IMPACT THROUGH ROLLING ANALYSES

While studies that focus on a single point in time are illustrative, looking at rolling return periods gives a fuller understanding of the impact of a crypto allocation on the Traditional Portfolio.

For the rolling period analyses, we fix a certain holding period window (e.g., three years, two years, or one year) and analyze all possible holding periods of that length. This allows us to consider thousands of potential holding periods that investors may have experienced, rather than individual isolated periods.

First, we will examine the impact of a 2.5% allocation to crypto on a Traditional Portfolio over three-year rolling periods, using a quarterly rebalancing frequency. Later, we will analyze the impact of different allocation sizes, holding periods, and rebalancing frequencies.

The results of this analysis show that crypto would have contributed positively to the cumulative three-year return of a Traditional Portfolio for every possible start date in its history.

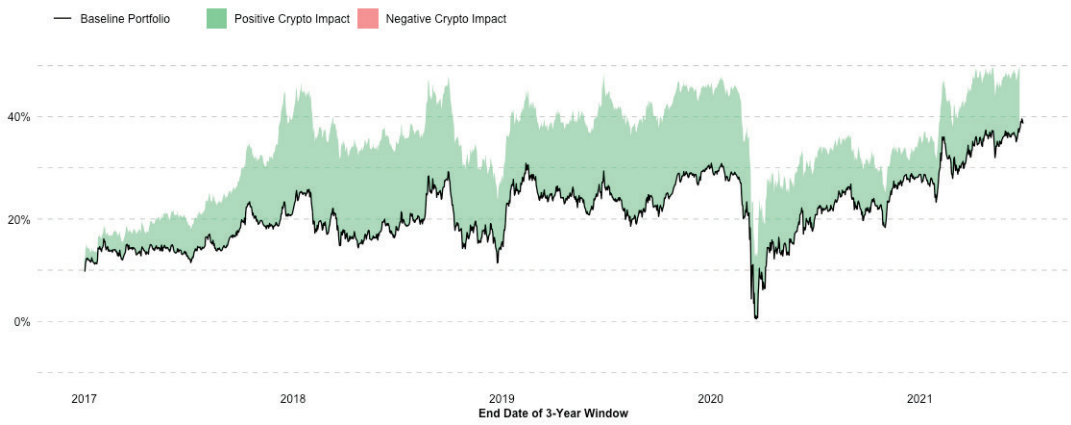
The chart below depicts the impact of such allocation. The x-axis of the chart begins on January 1, 2017. The first data point on the leftmost side of the chart shows the results for the three years ending January 1, 2017. The last data point on the right side of the chart captures the returns for the three-year period ending June 30, 2021. The other data points represent all three-year windows between these two.

The black line represents the three-year rolling returns of the Traditional Portfolio, while the green shade shows the positive contribution a crypto allocation would have added. (A red shade would indicate a negative contribution from crypto, but there are no three-year periods where adding crypto to a portfolio has contributed negatively to the return of the Traditional Portfolio, and therefore no red shading on this chart.)

Adding a crypto allocation has increased the cumulative three-year return of a Traditional Portfolio for every possible window between January 1, 2014 and June 30, 2021

CONTRIBUTION OF A 2.5% QUARTERLY-REBALANCED CRYPTO ALLOCATION TO A 60/40 PORTFOLIO

Three-year rolling cumulative return for the periods between January 1, 2014 and June 30, 2021



Source: Bitwise Asset Management with data from IEX Cloud

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The scale of the impact is remarkable.

While the size of the impact ebbs and flows throughout the study period, the median contribution of a 2.5% allocation to crypto on the three-year return of a Traditional Portfolio during this period was an impressive 13.30 percentage points, producing a median three-year return of 34.70%.

Over the full time period studied, covering 1,642 three-year windows, the smallest contribution was 1.84 percentage points and the largest contribution was 22.30 percentage points.

The median contribution of a crypto allocation to the three-year returns of a diversified portfolio between January 1, 2014 and June 30, 2021 was 13.30 percentage points.

CONTRIBUTION OF A 2.5% CRYPTO ALLOCATION TO A TRADITIONAL PORTFOLIO

Three-year rolling cumulative return for the periods between January 1, 2014 and June 30, 2021

Maximum Contribution	22.30 pp
Median Contribution	13.30 pp
Minimum Contribution	1.84 pp
Frequency of Positive Contributions	100.00%
Frequency of Negative Contributions	0.00%

Source: Bitwise Asset Management with data from IEX Cloud

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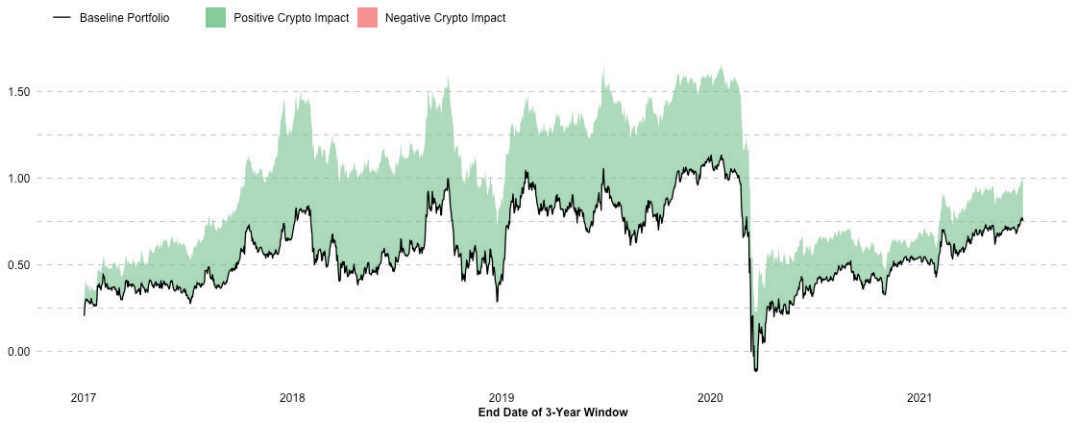
Just as with cumulative returns, a crypto allocation had a positive impact on the Traditional Portfolio's accumulated Sharpe ratio for every possible three-year window in this study. The chart below shows the improvement to a Traditional Portfolio's Sharpe ratio over rolling three-year windows. In this case, the median result boosts the Sharpe ratio by 0.51 points. The worst three-year period boosts the Sharpe ratio by "only" 0.07, while the best three-year period boosts the Sharpe ratio by 0.74. This means that the small increase in annualized volatility that crypto adds to the Traditional Portfolio was more than compensated for by its excess returns.

CONTRIBUTION OF A 2.5% QUARTERLY-REBALANCED CRYPTO ALLOCATION TO A 60/40 PORTFOLIO

Three-year rolling Sharpe ratio for the periods between January 1, 2014 and June 30, 2021



Source: Bitwise Asset Management with data from IEX Cloud

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Adding crypto to a portfolio would also have significantly boosted its risk-adjusted returns, as measured by the Sharpe ratio.

EXAMINING WORST-CASE SCENARIOS: ALLOCATING TO CRYPTO AT THE "WRONG TIME"

As strong as the findings are regarding the typical experience, a natural follow-up question is: What happens in the worst-case scenario?

One concern that investors express is what happens if they buy crypto at exactly the wrong time.

Bitcoin had four drawdowns of over 50% throughout our study period, with peak-to-trough pullbacks between 50.23% and 83.62%, as shown below.

BITCOIN MAJOR PRICE CORRECTIONS (OVER 50%) SINCE 2014

	CORRECTION START DATE (LOCAL PEAK)	BITCOIN PRICE ON START DATE	CORRECTION END DATE (LOCAL BOTTOM)	BITCOIN PRICE ON END DATE	LOCAL PEAK-TO-TROUGH BITCOIN RETURN	DAYS FOR BITCOIN TO RECOVER TO PREVIOUS HIGH
Correction #1	6-Jan-14	$919.30	14-Jan-15	$173.08	-81.17%	1,086 days
Correction #2	16-Dec-17	$19,396.53	14-Dec-18	$3,177.43	-83.62%	1,080 days
Correction #3	26-Jun-19	$13,827.07	16-Mar-20	$4,962.38	-64.11%	494 days
Correction #4	15-Apr-21	$63,485.01	26-Jun-21	$31,598.86	-50.23%	N/A

Source: Bitwise Asset Management with data from IEX Cloud

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To evaluate the impact of a "worst-case" starting date, we examined the returns of an investor who made an initial allocation to crypto at the start of each of these four corrections, still using a 2.5% allocation with quarterly rebalancing.

The following table below highlights the results. The data show that there are moments where allocating to crypto can have a negative impact on overall returns, but that the impact is modest: The worst-case peak-to-trough portfolio impact in these four examples ranged from -1.27% to -3.23%.

Additionally, in each complete example, the crypto allocation achieved a positive contribution to the diversified portfolio before the price of bitcoin fully recovered to its previous all-time high, often by a wide margin. For instance, in the December 2017-December 2018 correction (Correction #2), it took 1,080 days for bitcoin to recover its previous all-time high, but a bitcoin allocation began contributing positively to the Traditional Portfolio after just 548 days. And in Correction #1, the portfolio impact was positive within the first year.

This asymmetric recovery is driven by crypto's unique return profile, which combines significant volatility and a lack of correlation with other assets. As discussed in "Volatility Harvesting: Why Does Diversifying And Rebalancing Create Portfolio Growth" (Bouchey et al.), applying a disciplined rebalancing strategy to a volatile, non-correlated asset often yields positive portfolio impacts.[8]

CONTRIBUTION OF A 2.5% CRYPTO ALLOCATION TO A TRADITIONAL PORTFOLIO

Three-year rolling cumulative return for the periods between January 1, 2014 and June 30, 2021

	1-YEAR PORTFOLIO IMPACT	2-YEAR PORTFOLIO IMPACT	3-YEAR PORTFOLIO IMPACT	WORST-CASE PORTFOLIO CONTRIBUTION	DAYS FOR BITCOIN TO RECOVER TO PREVIOUS HIGH	DAYS FOR BITCOIN PORTFOLIO CONTRIBUTION TO TURN POSITIVE
Correction #1	1.68%	2.37%	14.39%	-2.90%	1,086 days	877 days
Correction #2	-7.19%	12.90%	32.87%	-3.23%	1,080 days	548 days
Correction #3	4.82%	37.53%	N/A	-1.36%	494 days	316 days
Correction #4	N/A	N/A	N/A	-1.27%	N/A	N/A

Source: Bitwise Asset Management with data from IEX Cloud

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Zooming out, the long-term impact of allocating to crypto even with a worst-case starting point has been strongly positive. The following charts compare the returns of a Traditional Portfolio and a crypto-enhanced portfolio using these four "worst case" start points and running through the end of the study on June 30, 2021.

8 Paul Bouchey, Vassilii Nemtchinov, Alex Paulsen and David M. Stein, "Volatility Harvesting: Why Does Diversifying And Rebalancing Create Portfolio Growth?" The Journal of Wealth Management 15, no. 2 (Fall 2012).

CUMULATIVE RETURNS SINCE CORRECTION #1 – TRADITIONAL PORTFOLIO WITH AND WITHOUT A QUARTERLY-REBALANCED 2.5% CRYPTO ALLOCATION

Period between January 6, 2014 and June 30, 2021

Source: Bitwise Asset Management with data from IEX Cloud

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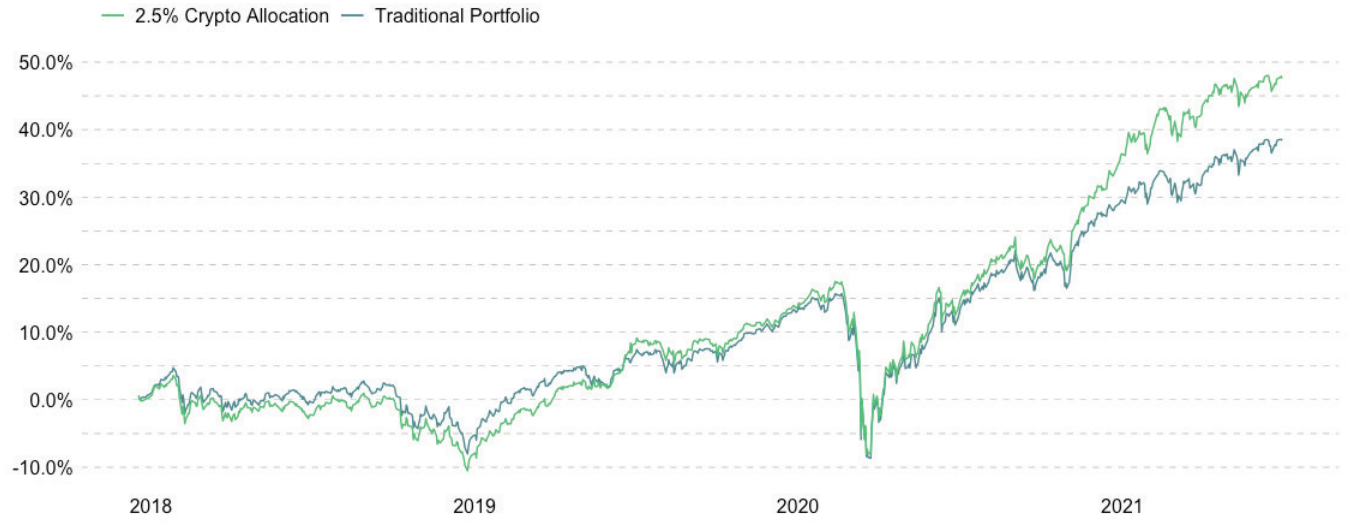
CUMULATIVE RETURNS SINCE CORRECTION #2 – TRADITIONAL PORTFOLIO WITH AND WITHOUT A QUARTERLY-REBALANCED 2.5% CRYPTO ALLOCATION

Period between December 16, 2017 and June 30, 2021



Source: Bitwise Asset Management with data from IEX Cloud

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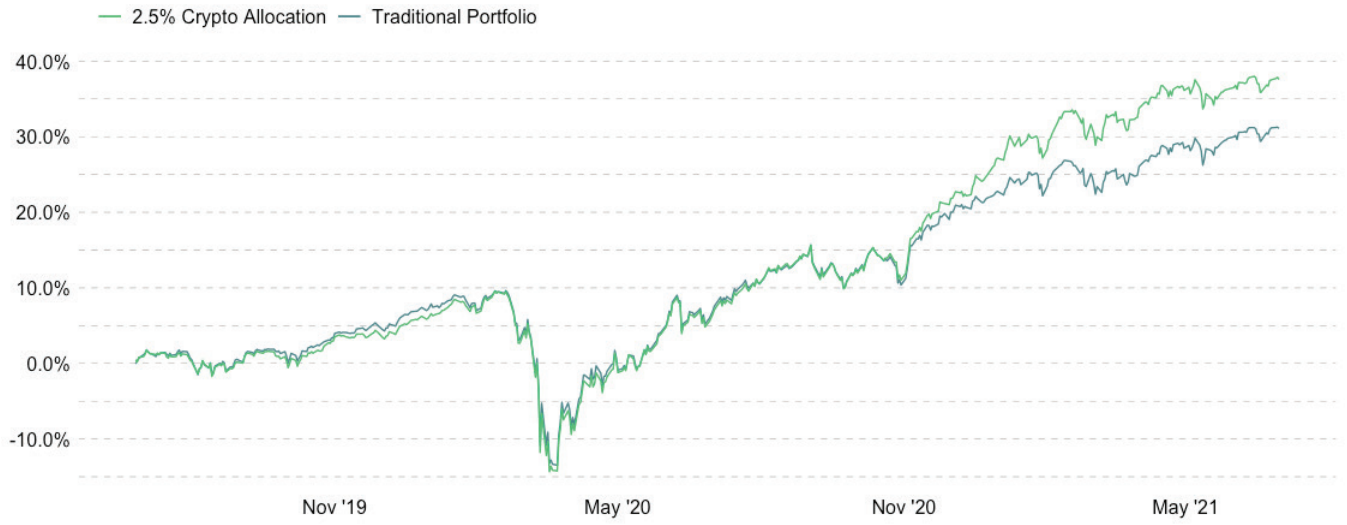
CUMULATIVE RETURNS SINCE CORRECTION #3 – TRADITIONAL PORTFOLIO WITH AND WITHOUT A QUARTERLY-REBALANCED 2.5% CRYPTO ALLOCATION

Period between June 26, 2019 and June 30, 2021



Source: Bitwise Asset Management with data from IEX Cloud

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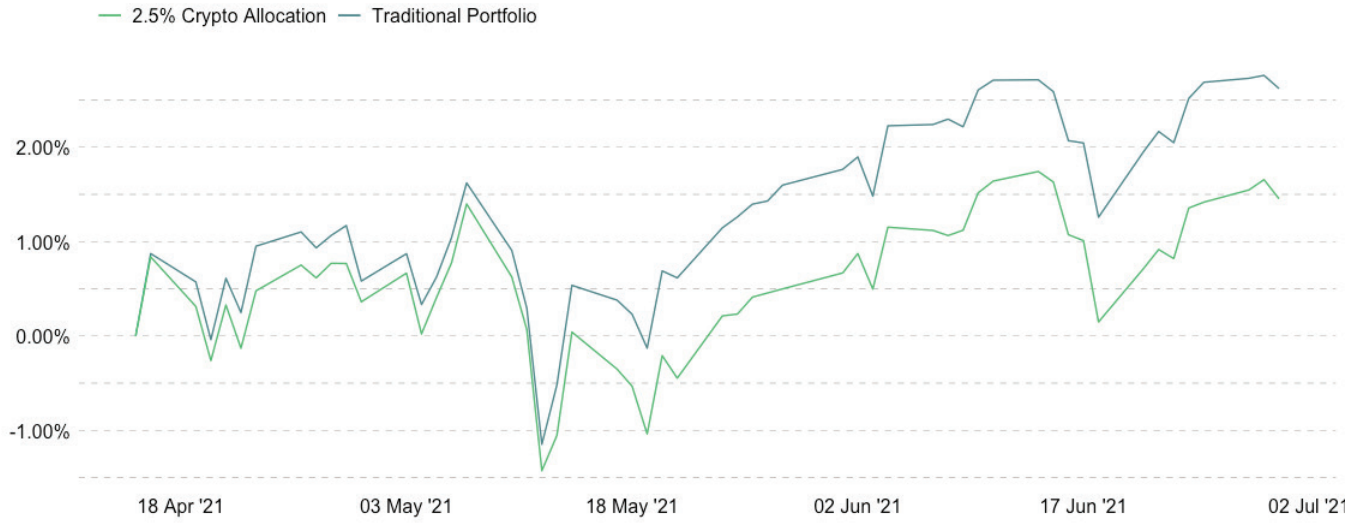
CUMULATIVE RETURNS SINCE CORRECTION #4 – TRADITIONAL PORTFOLIO WITH AND WITHOUT A QUARTERLY-REBALANCED 2.5% CRYPTO ALLOCATION

Period between April 15, 2021 and June 30, 2021



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In each of the first three corrections, investors who allocated to crypto at these "worst-case" moments are now comfortably ahead of investors who eschewed crypto altogether. The fourth correction is very recent, and the jury is still out on whether the pattern seen in the three earlier corrections will hold.

IV. The Three Key Questions When Allocating to Crypto

Investors allocating to crypto need to think about their time frames, rebalancing strategies, and position sizes. As a result, we will address the following questions based on the historical record:

- What is the impact of different time frames on the overall portfolio results?
- What difference does rebalancing make for a crypto allocation?
- How does position size impact key overall portfolio metrics?

We have evaluated each of these questions separately to gauge the sensitivity of key portfolio metrics to various holding periods, rebalancing strategies, and allocation sizes.

QUESTION 1:
WHAT IS THE IMPACT OF DIFFERENT TIME FRAMES ON THE OVERALL PORTFOLIO RESULTS?

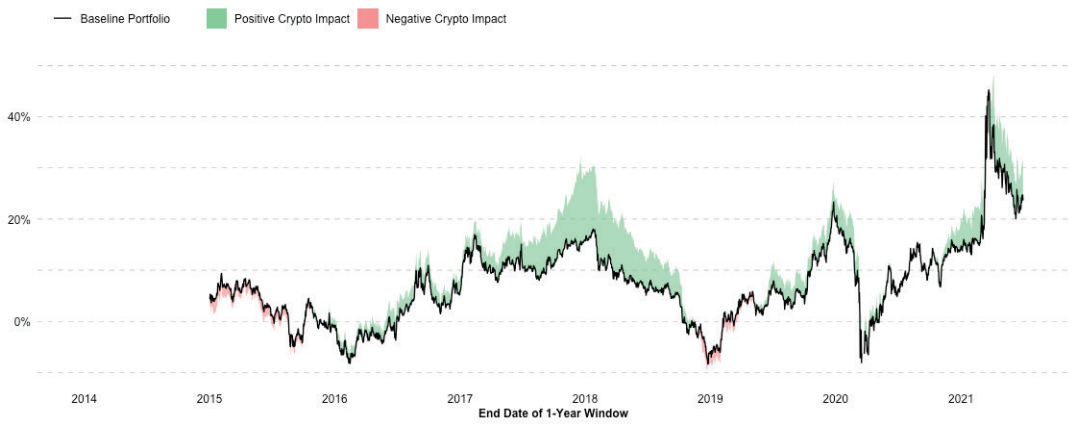
To examine the most appropriate holding period, we reran the rolling return and Sharpe ratio exercise for holding periods varying from one to three years, using a 2.5% crypto allocation and quarterly rebalancing as the base case.

As discussed earlier, this analysis shows that crypto's generally positive contribution to a portfolio's returns remains strong over all time periods studied. Specifically, crypto had a positive impact on three-year returns 100% of the time, on two-year returns 97% of the time, and on one-year returns 77% of the time.

The charts below show that impact, with data since 2014:

CONTRIBUTION OF A 2.5% QUARTERLY-REBALANCED CRYPTO ALLOCATION TO A 60/40 PORTFOLIO

One-year rolling cumulative return for the periods between January 1, 2014 and June 30, 2021



Source: Bitwise Asset Management with data from IEX Cloud

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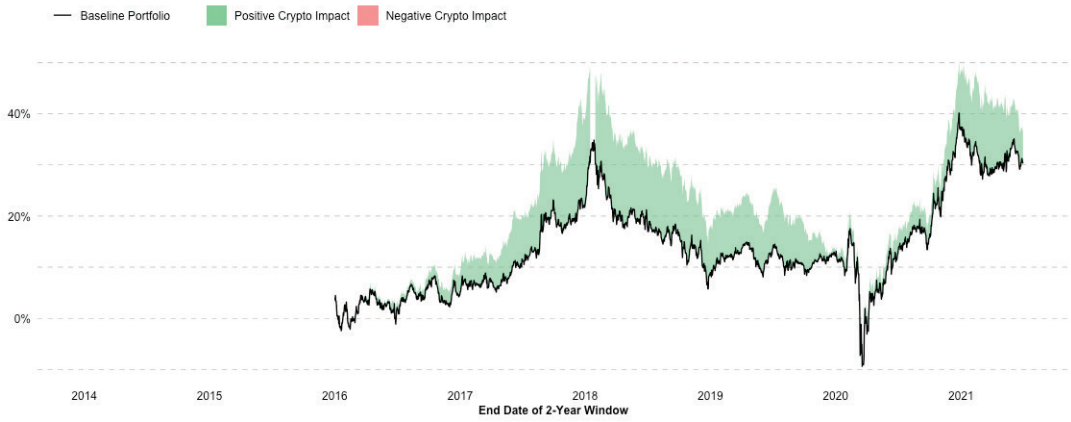
CONTRIBUTION OF A 2.5% QUARTERLY-REBALANCED CRYPTO ALLOCATION TO A 60/40 PORTFOLIO

Two-year rolling cumulative return for the periods between January 1, 2014 and June 30, 2021



Source: Bitwise Asset Management with data from IEX Cloud

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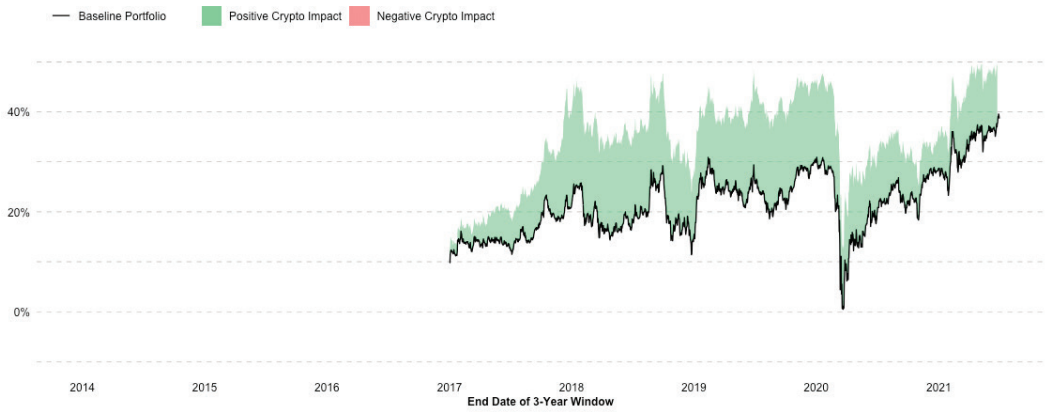
CONTRIBUTION OF A 2.5% QUARTERLY-REBALANCED CRYPTO ALLOCATION TO A 60/40 PORTFOLIO

Three-year rolling cumulative return for the periods between January 1, 2014 and June 30, 2021



Source: Bitwise Asset Management with data from IEX Cloud

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As the holding period of a crypto allocation extends to two years and beyond, the frequency of positive contributions quickly approaches 100%.

It is worth noting that, even in the one-year study where negative contributions occur, the impact is asymmetrically positive: The median positive contribution to cumulative returns was 3.55 percentage points, while the median negative contribution was only -1.61 percentage points. This asymmetric skew persists at the most extreme outcomes: The best-case contribution was 16.67 percentage points, while the worst-case contribution was -2.98 percentage points.[9]

9 As this statistic points out, one negative impact of rebalancing is that you can lose more than your original investment. In this worst-case one-year period, for instance, the portfolio impact is -3.0%, despite the 2.5% initial allocation, because the rebalancing discipline forced the portfolio to "average down" into the position.

CONTRIBUTION OF A 2.5% QUARTERLY-REBALANCED CRYPTO ALLOCATION TO A TRADITIONAL PORTFOLIO

Rolling portfolio metrics for the periods between January 1, 2014 and June 30, 2021

HOLDING PERIOD	MAXIMUM	MEDIAN	MINIMUM	WIN RATE	LOSS RATE
1 Year	16.67 pp	3.01 pp	-2.98 pp	77.33%	22.67%
2 Years	20.23 pp	8.24 pp	-0.64 pp	97.31%	2.69%
3 Years	22.30 pp	13.30 pp	1.84 pp	100.00%	0.00%

Source: Bitwise Asset Management with data from IEX Cloud

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QUESTION 2: WHAT DIFFERENCE DOES REBALANCING MAKE FOR A CRYPTO ALLOCATION?

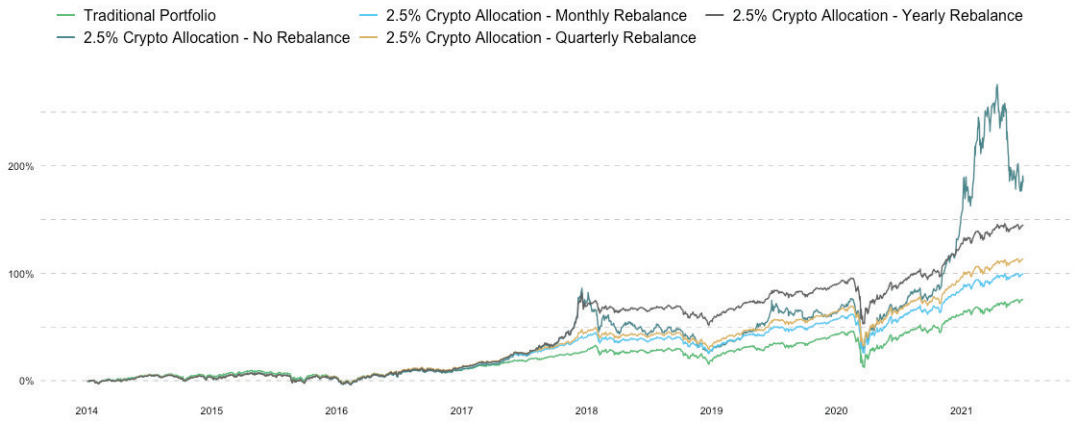
The decision about how frequently to rebalance a portfolio carries extra weight when dealing with an asset with crypto's historical level of upside volatility. Absent rebalancing, even a small allocation to crypto can grow to dominate a portfolio's risk/return characteristics.

Below we compare the cumulative and risk-adjusted returns of a Traditional Portfolio enhanced with a crypto allocation under four different rebalancing strategies: no rebalancing, monthly, quarterly, and annual rebalancing.

The chart and table below highlight the substantial impact that a rebalancing strategy can have on crypto's impact on a portfolio. As might be expected with a highly volatile but historically upwardly biased asset, lower rebalancing frequencies generally lead to higher volatility, higher cumulative returns, and significantly higher maximum drawdowns. Conversely, more frequent rebalancing strategies dampen both the volatility and return impact.

IMPACT OF DIFFERENT REBALANCING STRATEGIES ON 2.5% CRYPTO ALLOCATIONS

Period between January 1, 2014 and June 30, 2021



Source: Bitwise Asset Management with data from IEX Cloud

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More frequent rebalancing strategies would have reduced the portfolio's volatility and drawdowns. Less frequent rebalancing strategies would have generated stronger returns.

PORTFOLIO PERFORMANCE METRICS

Period between January 1, 2014 and June 30, 2021

PORTFOLIO	CUMULATIVE RETURN	ANNUALIZED RETURN	ANNUALIZED VOLATILITY	SHARPE RATIO	MAXIMUM DRAWDOWN
Traditional Portfolio (no rebalancing)	75.13%	7.78%	10.71%	0.583	23.08%
2.5% crypto allocation (no rebalancing)	184.88%	15.02%	17.71%	0.755	32.52%
2.5% crypto allocation (yearly rebalancing)	144.12%	12.67%	11.11%	0.995	21.80%
2.5% crypto allocation (quarterly rebalancing)	112.73%	10.62%	10.43%	0.867	21.80%
2.5% crypto allocation (monthly rebalancing)	99.07%	9.64%	10.41%	0.776	22.31%

Source: Bitwise Asset Management with data from IEX Cloud

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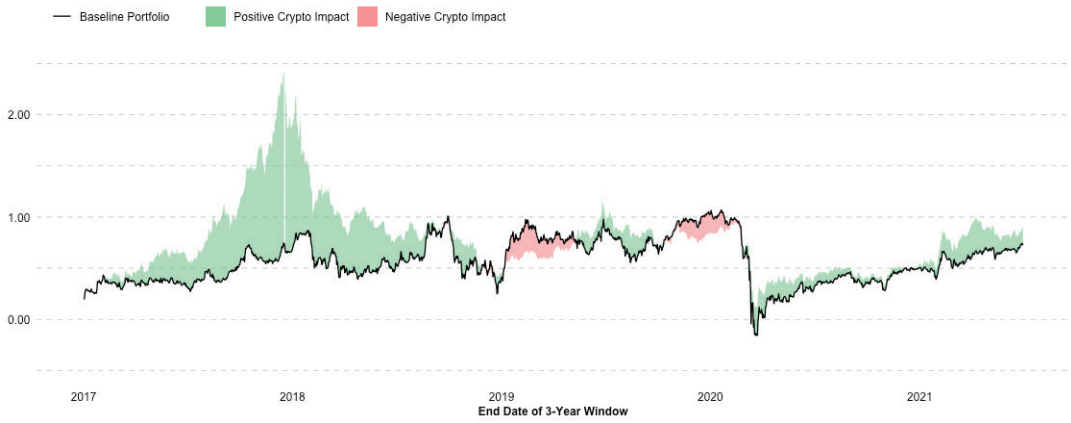
There is a clear relationship between cumulative returns and volatility. Adding crypto to a portfolio and not rebalancing led to a massive jump in portfolio volatility (from 10.71% to 17.71%), and a dramatic uptick in maximum drawdown (from 23.08% to 32.52%).

The primary takeaway from this analysis is that adding any rebalancing strategy — monthly, quarterly, or annually — dramatically lowers the volatility impact. This has led to substantially higher Sharpe ratios for strategies with rebalancing in place. Investors can determine the most appropriate rebalancing strategy depending on their volatility tolerance and practical limitations.

The charts below use rolling-period analysis to better visualize the impact that rebalancing has on portfolio outcomes. It shows, for instance, that the contribution of a crypto allocation to the Traditional Portfolio's Sharpe ratio is positive 75% of the time when not rebalanced, versus 100% with any sort of rebalancing. Also, the median portfolio contribution is significantly lower for the non-rebalanced portfolio versus its rebalanced peers.

NO REBALANCING – CONTRIBUTION OF 2.5% CRYPTO ALLOCATION TO A 60/40 PORTFOLIO

Three-year rolling Sharpe ratio (period between January 1, 2014 and June 30, 2021)



Source: Bitwise Asset Management with data from IEX Cloud

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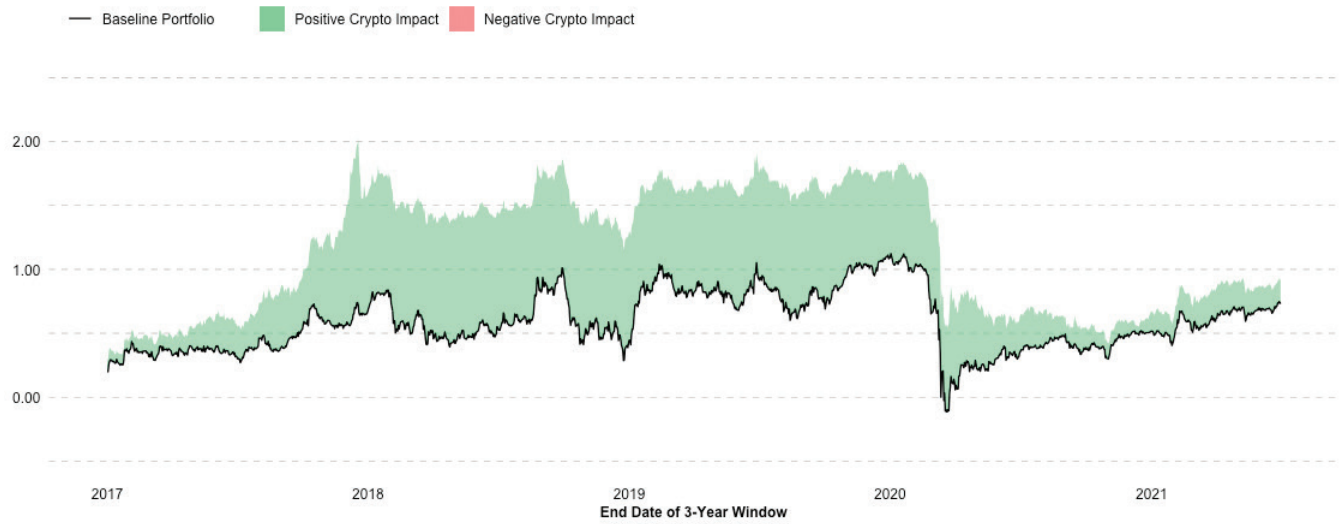
YEARLY REBALANCING – CONTRIBUTION OF 2.5% CRYPTO ALLOCATION TO A 60/40 PORTFOLIO

Three-year rolling Sharpe ratio (period between January 1, 2014 and June 30, 2021)



Source: Bitwise Asset Management with data from IEX Cloud

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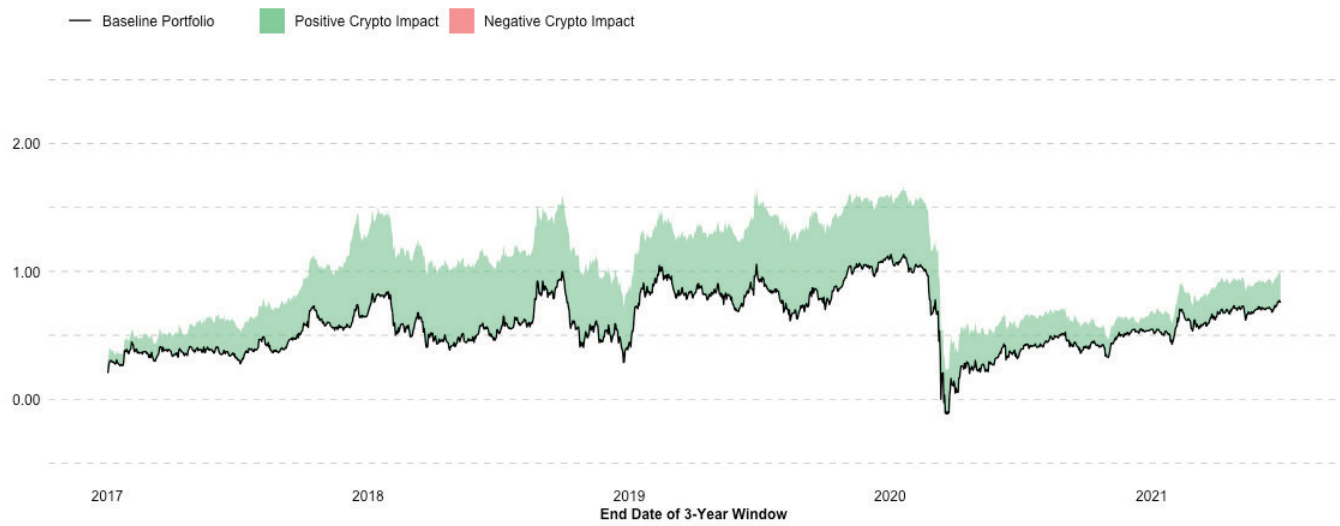
QUARTERLY REBALANCING – CONTRIBUTION OF 2.5% CRYPTO ALLOCATION TO A 60/40 PORTFOLIO

Three-year rolling Sharpe ratio (period between January 1, 2014 and June 30, 2021)



Source: Bitwise Asset Management with data from IEX Cloud

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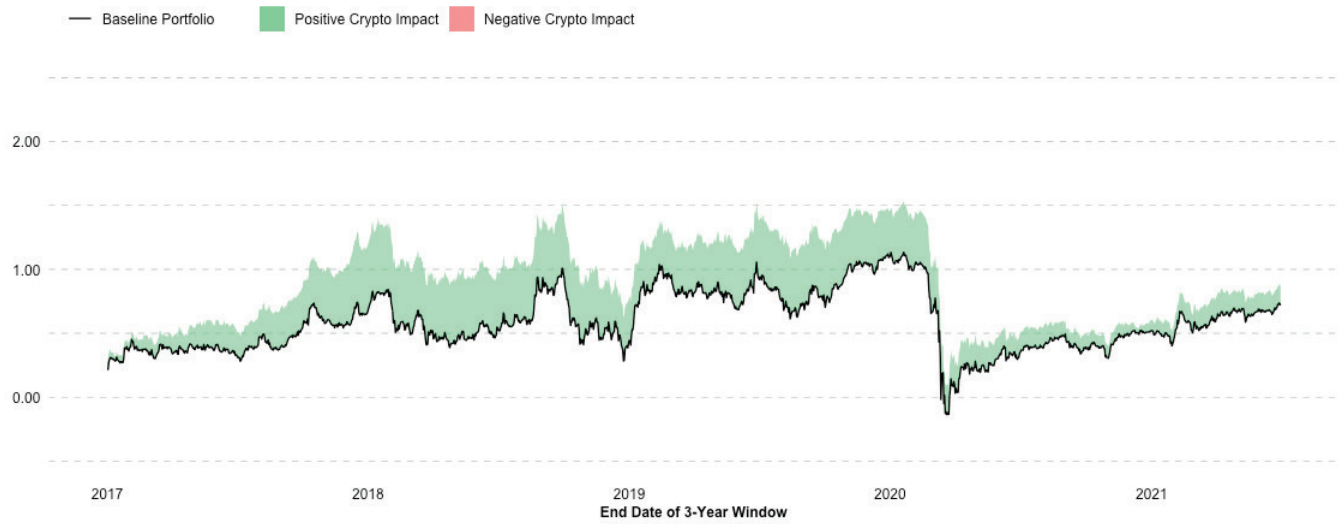
MONTHLY REBALANCING – CONTRIBUTION OF 2.5% CRYPTO ALLOCATION TO A 60/40 PORTFOLIO

Three-year rolling Sharpe ratio (period between January 1, 2014 and June 30, 2021)



Source: Bitwise Asset Management with data from IEX Cloud

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QUESTION 3:
HOW DOES POSITION SIZE IMPACT KEY OVERALL PORTFOLIO METRICS?

Perhaps the most important question when allocating to crypto is: How does position size impact the portfolio's overall performance? The four figures below answer that question.

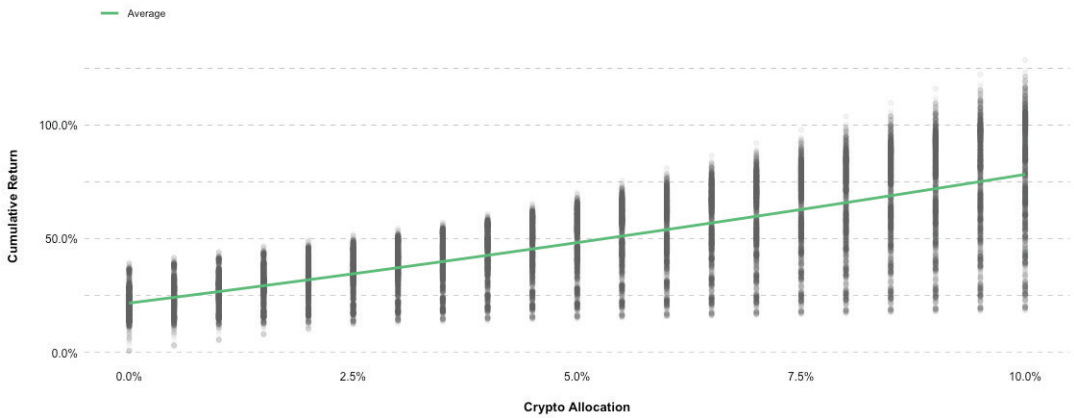
The figures show the impact that allocating between 0% and 10% of a portfolio to crypto would have had over a three-year period on cumulative return, standard deviation, Sharpe ratio, and maximum drawdown, respectively.

The figures are informationally dense and bear explanation.

On each figure, the x-axis represents the amount of crypto added to the portfolio, from 0% (on the far left) to 10% (on the far right), increasing in 0.50% increments. The y-axis represents the portfolio performance metric being studied. For instance, in the figure below, the y-axis represents the cumulative return of the portfolio over a three-year time period.

THREE-YEAR ROLLING CUMULATIVE RETURN BY CRYPTO ALLOCATION

Period from January 1, 2014 to June 30, 2021 (assuming quarterly rebalancing)



Source: Bitwise Asset Management with data from IEX Cloud

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The vertical gray lines are composed of a series of dots. Each dot represents the result for a single three-year period given the crypto allocation indicated by the x-axis. So, for instance, the dots in the leftmost line represent the various three-year returns experienced by portfolios with a 0% allocation to crypto; the second column represents the returns experienced by portfolios with a 0.5% allocation to crypto; and so on. There are 1,642 dots in each vertical line, representing all possible three-year holding periods during our study window of January 1, 2014 through June 30, 2021.

The green line highlights the average result.

The cumulative return figure on its own tells a clear story: The more crypto the better. As the green line shows, there is nearly a linear relationship between the amount of crypto added to the portfolio and the cumulative return.

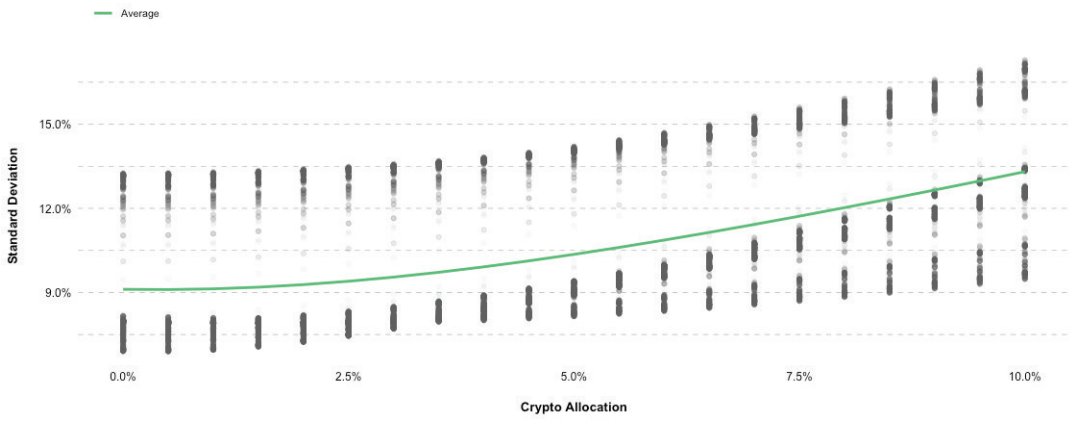
This return, however, comes with the potential drawback of added volatility.

The following figure shows the impact of higher crypto allocations on standard deviation, a common measure of portfolio volatility. Clearly, as the crypto allocation increases, the portfolio's volatility does as well.

Interestingly, however, the relationship here is not linear; the green line has a distinctive swoosh-like shape. This suggests that small allocations to crypto — roughly between 0.5% and 3.0% — have a minimal impact on portfolio volatility, but that the impact increases quickly as the size of the allocation goes up.

THREE-YEAR ROLLING STANDARD DEVIATION BY CRYPTO ALLOCATION

Period from January 1, 2014 to June 30, 2021 (assuming quarterly rebalancing)



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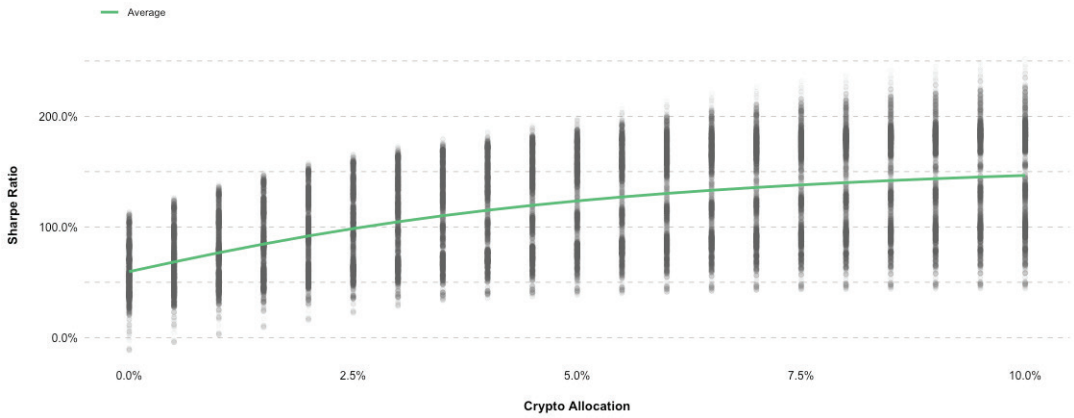
Above approximately a 3% allocation, adding crypto to a portfolio meaningfully increases the portfolio's volatility.

The next figure combines the previous two by examining Sharpe ratios. Like the standard deviation figure, this one has a distinct shape, rising sharply at first and then flattening out as the size of the portfolio allocation increases.

The right way to interpret the chart below is that adding crypto to a portfolio tends to increase risk-adjusted returns, but that the incremental benefit of adding more crypto to a portfolio diminishes once allocations go beyond the 3-4% range.

THREE-YEAR ROLLING SHARPE RATIO BY CRYPTO ALLOCATION

Period from January 1, 2014 to June 30, 2021 (assuming quarterly rebalancing)



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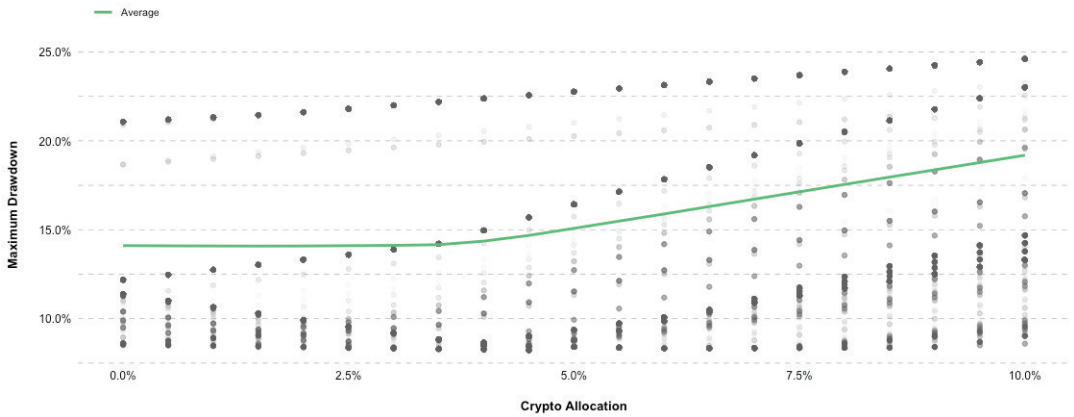
The final chart is the most telling of the four; it looks at the impact that different allocations to crypto had on a portfolio's maximum drawdown.

The shape of the green line's curve here is notable. It shows that adding crypto to a portfolio has, on average, held steady a portfolio's maximum drawdown over three-year periods for allocations between 0.5-3.5%. This fact may surprise some observers, as crypto itself is very volatile. Crypto's returns, however, are not typically correlated with stocks or bonds, which can help cushion the portfolio against stock and bond pullbacks.

Things change above a 3.5% crypto allocation, however, and become increasingly meaningful above 5.0%. At these higher levels, the crypto allocation itself becomes a driver of maximum drawdowns.

THREE-YEAR ROLLING MAXIMUM DRAWDOWN BY CRYPTO ALLOCATION

Period from January 1, 2014 to June 30, 2021 (assuming quarterly rebalancing)



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The most crucial portfolio metric for investors to consider when sizing a crypto allocation has been maximum drawdown.

The table below summarizes the impact of different crypto allocations on all four of the key portfolio metrics over the three-year period studied.

KEY PORTFOLIO METRICS BY CRYPTO ALLOCATION

Three-year rolling analysis from January 1, 2014 to June 30, 2021 (assuming quarterly rebalancing)

CRYPTO ALLOCATION	CUMULATIVE RETURN			SHARPE RATIO			STANDARD DEVIATION (VOLATILITY)			MAXIMUM DRAWDOWN		
	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.
0.00% (Traditional Portfolio)	0.49%	20.11%	30.93%	-0.115	0.637	1.133	6.91%	7.65%	11.60%	8.51%	11.43%	21.07%
1.00%	5.31%	25.53%	37.54%	0.026	0.839	1.386	6.95%	7.65%	11.66%	8.44%	11.31%	21.32%
2.00%	10.07%	31.11%	44.69%	0.157	1.017	1.581	7.23%	7.81%	11.85%	8.37%	11.19%	21.61%
3.00%	12.84%	36.87%	52.74%	0.280	1.166	1.731	7.70%	8.09%	12.17%	8.29%	11.09%	22.00%
4.00%	13.83%	42.80%	61.07%	0.357	1.286	1.859	8.00%	8.48%	12.60%	8.22%	11.28%	22.38%
5.00%	14.80%	48.90%	70.90%	0.386	1.381	1.987	8.14%	8.96%	13.12%	8.42%	12.13%	22.76%
6.00%	15.76%	55.18%	81.39%	0.412	1.455	2.138	8.33%	9.50%	13.70%	8.32%	13.10%	23.13%
7.00%	16.57%	61.65%	92.38%	0.427	1.513	2.263	8.56%	10.10%	14.35%	8.34%	14.11%	23.51%
8.00%	17.19%	68.29%	103.89%	0.435	1.560	2.364	8.83%	10.73%	15.03%	8.36%	15.11%	23.88%
9.00%	17.80%	75.12%	115.96%	0.439	1.597	2.449	9.13%	11.39%	15.76%	8.41%	16.11%	24.24%
10.00%	18.39%	82.14%	128.73%	0.442	1.627	2.519	9.47%	12.08%	16.51%	8.59%	17.11%	24.61%

Source: Bitwise Asset Management with data from IEX Cloud

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V. Conclusion

This study showed that adding cryptoassets to a diversified portfolio of stocks and bonds would have consistently and significantly increased both the cumulative and risk-adjusted returns of that portfolio over all three-year periods and most two-year and one-year periods since the asset class has existed, assuming a rebalancing strategy is in place.

This positive impact endures even in periods in which cryptoasset prices fell. For instance, investors who first allocated to crypto at its all-time closing high on December 16, 2017, would have broken even by June 17, 2019, when the price was still down 52.02% from its previous high. The ability to enhance portfolio returns with cryptoasset allocations even during difficult markets has been driven by crypto's unique combination of high volatility, low correlations, and liquidity, which allow for volatility harvesting through disciplined rebalancing strategies.

In an effort to offer a more comprehensive view, this paper also analyzes the impact of adding cryptoassets to a diversified portfolio through rolling holding periods instead of the typical arbitrary start and end dates. Both the magnitude and the consistency of crypto's contributions are remarkable.

Achieving this benefit does not require much: a reasonable time frame, a disciplined rebalancing strategy, and a well-thought-out position size. These are individual decisions for each investor, but we note some interesting historical patterns:

- **Time Frame:**
  As holding periods increase above two years, the historical record of positive contributions has approached 100%. Cryptoassets are a volatile asset class that have experienced significant drawdowns in their history. They may experience more in the future. Still, allocating to cryptoassets has improved a portfolio's cumulative and risk-adjusted returns in 100% of three-year periods, 97% of two-year periods, and 77% of one-year periods since 2014.

- **Rebalancing Discipline:**
  Adding an asset with a significant degree of volatility in a portfolio makes rebalancing more critical than otherwise. Generally, a quarterly rebalancing strategy has delivered a healthy balance between capturing crypto's asymmetric upside returns while keeping drawdowns under control.

- **Position Sizing:**
  Maximum drawdowns are probably the main limiting factor for investors to have in mind when deciding how much crypto to add to their portfolio. Although increasing crypto allocations tends to increase a diversified portfolio's cumulative returns and Sharpe ratio, the story is somewhat different with regard to maximum drawdowns. A rule of thumb is: Allocations below 5% have tended to have a minimal impact on maximum drawdowns; above 5%, however, the allocations become significant.

The overarching message from the data in this study is clear: Crypto has had a uniquely valuable role to play in enhancing the risk-adjusted returns of a Traditional Portfolio of stocks and bonds. Investment advisors can add immense value by helping their clients structure and manage allocations to this important new asset class.

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