

# Portfolio Management Series #1

## Diversification Benefits with Bitcoin

How does Bitcoin fit into multi-asset portfolios?

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Binance Research - July 25th 2019

### KEY TAKEAWAYS

- For 10 years, Bitcoin (BTC) has been an **extremely volatile asset**, exhibiting large drawdowns following some of the largest price rallies recorded in history.
- Despite its volatility, **Bitcoin has not exhibited a significant correlation** with other traditional asset classes such as commodities, equities or fixed-income products since its creation in 2009.
- From a trading perspective, Bitcoin is one of **the most liquid assets on the planet** with consistently **low spreads** (median spread less than 2-3bp), **high volumes** and **price efficiency** as trading venues are continuously being arbitrated.
- Binance Research simulated different Bitcoin allocation techniques in existing diversified multi-asset portfolios. **All simulated portfolios which included Bitcoin** exhibited overall **better risk-return profiles than traditional multi-asset class portfolios**. These results show that Bitcoin provides active diversification benefits for all investors worldwide, following multi-asset strategies.
- With the creation of **institutional-focused solutions for custody and other new investment vehicles**, Bitcoin has become an essential **alternative asset to be included** in multi-asset portfolios **for its diversification properties**.

# 1. Bitcoin: a volatile diversifier

In this section, some fundamental metrics such as volatility and calendar returns about Bitcoin are calculated, correlations with other asset classes are investigated and the liquidity profile of Bitcoin as a financial asset is also discussed.

## 1.1 A volatile asset

Without surprise, Bitcoin exhibited extremely large price changes across the years as its price moved from less than 1 USD to as high as USD 20,000.

**Table 1 - Calendar returns of Bitcoin (BTC) in US dollars<sup>1</sup>**

CALENDAR YEAR	ANNUAL RETURN	EOY DRAWDOWNS
2011	1,317%	-86%
2012	218%	-54%
2013	5,428%	-34%
2014	-58%	-72%
2015	36%	-62%
2016	120%	-16%
2017	1,403%	-23%
2018	-74%	-80%
Q2 2019	<b>232%</b>	-35%

*Source: Binance Research, Bloomberg*

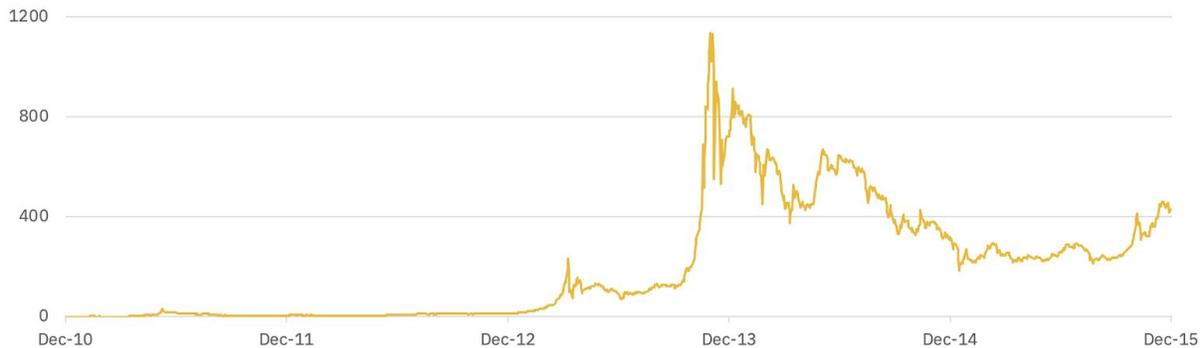
*Calendar drawdowns were calculated using closing Bitcoin prices on EOY previous business days.*

In the table above, **hard forks** resulting in new chains<sup>2</sup> were purposely **excluded** in the computation, but these new coins could have provided **non-negligible** sources of **positive extra-return for passive investors**.

<sup>1</sup> Sources: until 2013 - Bitwise, from 2014 - CoinMarketcap with calculations performed by Binance Research.

<sup>2</sup> <https://bitcoinmagazine.com/articles/infographic-map-bitcoin-forks>

**Chart 1 - Price of Bitcoin in USD (2010-2015)**



*Source: Binance Research, Bloomberg*

Bitcoin price exhibited wild fluctuations between its first reference price on an exchange and December 2015 with a peak in the price above 1,000 USD.

Following MtGox's bankruptcy, Bitcoin price declined to reach a bottom of around 300 USD in 2015. Despite these fluctuations, Bitcoin's hashrate reached 1 exahash/sec for the first time in December 2015, signaling a very strong interest by miners.

**Chart 2 - Price of Bitcoin in USD (2016-2019) with major two forks**



*Source: Binance Research, Bloomberg*

While the price of Bitcoin remained around USD 1,000-2,000 until early 2017, the second half of 2017 saw Bitcoin reaching new highs with a sharp increase in late 2017 to reach an all-time high **slightly below USD 20,000**. After that, its price collapsed to **USD 3,500** in late 2018.

Since the beginning of 2019, Bitcoin price has rebounded to price levels **near USD 10,000**.

From August 2017 to early 2018, Bitcoin's blockchain split several times (i.e. hard fork), resulting in two coins, running on two separate blockchains.

Notably, **Bitcoin Cash (BCH)** was forked on August 1st 2017 due to a community disagreement regarding the maximum block size. It is one of the hard-forks that would have generated a potentially large source of additional return.

To that regard, new coins created from contentious hard-forks are similar to special dividends in the traditional equities industry. For simplicity purposes, proceeds from forks will be excluded from the portfolio analysis, which may lead to a **small negative bias** in the results in the next sections.

Exhibiting these large movements, Bitcoin price volatility is certainly worth taking a closer look at. In the chart below, Bitcoin volatility is computed using the [close-to-close volatility](#).

**Chart 3 - Rolling 90-day annualized volatility**



Source: *Binance Research*

In spite of its high value, **Bitcoin's price volatility has been decreasing** since the genesis block. While this report does not intend to cover in-depth explanations about the volatility of Bitcoin, it can be explained by a few main reasons<sup>3</sup> such as:

- **Nascency of Bitcoin as an asset class along with blockchain as a “new technology”:** owing to its relatively short history, Bitcoin (along with other cryptocurrencies) is fairly new and as its value started at a null value, it has since exhibited wild price movements, leading to high volatility.
- **Past lack of liquidity and credible trading venues:** until recently, there was a lack of main go-to exchanges. Most of the early exchanges ran into trouble (e.g. MtGox, BTCC) and until recently, most of the services were solely retail-driven.
- **Extremely high retail presence** where investors rotate their positions frequently, etc.<sup>4</sup>

As the cryptoasset industry matures, as reflected in new institutional-focused product offerings, such as Fidelity Digital (for custody), ETFs and the creation of new mutual funds, the volatility of Bitcoin may further decrease.

<sup>3</sup> <https://www.luno.com/blog/en/post/bitcoin-price-volatility>

<sup>4</sup> See our report about Cryptoasset cycles: <https://info.binance.com/en/research/marketresearch/cryptoasset-cycles.html>

## 1.2 Low correlation with other asset classes

**Correlation analysis** is a fundamental tool for investors looking to achieve **portfolio diversification** (see section 2.1 for an in-depth discussion).

If the returns of two assets exhibit a positive correlation, it implies that the two assets tend to move in the same direction, and therefore share similar risks. On the other hand, a negative correlation between the returns of two assets indicates that the two assets move in opposite directions, and it is thus possible to use one asset as a hedge against the other.

As a result, assets with low correlations are generally good diversifiers in a portfolio whereas assets with negative correlations serve as a portfolio hedge.

Bitcoin correlation was calculated with returns different asset market indices, representing different asset classes or sub-segment of asset classes.

**Table 2 - Overview of the major commodity, equity and fixed-income indices**

Asset	Ticker (Bloomberg)	Description
S&P 500 Index	SPX	American stock market index based on the market capitalization of 500 large companies having common stock listed on the NYSE, NASDAQ, or the Cboe BZX Exchange.
Russell 2000 Index	RTY	American stock market index based on the market capitalization of the lowest 2,000 companies of the Russell 3000, proxying the performance of small-cap to mid-cap company shares.
NASDAQ Composite	CCMP	American stock market index of common stocks and similar securities listed on the NASDAQ stock market.
Bloomberg Barclays Global Aggregate Index (in USD)	LEGATRUU	Index representing the performance of government, government-related and corporate bonds, as well as asset-backed, mortgage-backed and commercial mortgage-backed securities from both developed and emerging markets issuers.
Bloomberg Barclays US Aggregate Index (in USD)	LBSTRUU	Index measuring the investment grade, U.S. dollar-denominated, fixed-rate taxable bond market. This includes Treasuries, government-related and corporate securities, mortgage-backed securities, asset-backed securities and collateralized mortgage-backed securities.
Oil	CL1	Crude Oil Futures price traded on the NYMEX.
Gold	GC1	Gold Futures prices traded on the COMEX.

Silver	SI1	Silver Futures prices traded on the COMEX.
Bloomberg Commodity Index Total Return	BCOMTR	Broadly diversified commodity price index. It tracks the prices of futures contracts on physical commodities on the commodity markets.
TOPIX Index (in JPY)	TPX	Japanese stock market index based on the market capitalization of all domestic companies listed on the “First Section” of the Tokyo Stock Exchange.
Hang Seng Index (in HKD)	HSI	Hong Kong free float-adjusted market-capitalization-weighted stock-market index in Hong Kong, including the largest 50 companies listed on the Hong Kong Stock Exchange.
EuroStoxx 50 Index (in EUR)	SX5E	European free-float market-capitalization-weighted stock-market index of the largest 50 European stocks in the Eurozone.
FTSE 100 Index (in GBP)	UKX	British market-value weighted stock-market index of the largest 100 British stocks listed on the London Stock Exchange.

Correlations between Bitcoin and the above indices were computed using prices changes over two different time lengths: one year and three years (see charts 4 and 5).

**Chart 4 - Three-year weekly return correlations among asset classes**

	BTC	SPX	RTY	LEGATRUU	LBUSTRUU	CCMP	CL1	GC1	SI1	BCOMTR	TPX	HSI	UKX	SX5E
BTC	1.00													
SPX	0.00	1.00												
RTY	0.01	0.90	1.00											
LEGATRUU	0.12	-0.19	-0.14	1.00										
LBUSTRUU	-0.05	-0.31	-0.29	0.74	1.00									
CCMP	-0.02	0.96	0.92	-0.12	-0.20	1.00								
CL1	0.12	0.52	0.49	0.08	-0.03	0.56	1.00							
GC1	0.06	-0.14	-0.07	0.67	0.41	-0.09	0.17	1.00						
SI1	-0.05	-0.03	0.02	0.51	0.35	0.04	0.24	0.80	1.00					
BCOMTR	0.12	0.37	0.29	-0.06	-0.15	0.33	0.71	0.16	0.18	1.00				
TPX	0.09	0.68	0.61	-0.08	-0.29	0.65	0.41	0.02	0.12	0.47	1.00			
HSI	0.04	0.47	0.52	0.03	-0.15	0.53	0.31	0.18	0.28	0.35	0.65	1.00		
UKX	0.16	0.73	0.71	-0.02	-0.29	0.71	0.45	0.04	0.20	0.30	0.70	0.68	1.00	
SX5E	0.22	0.72	0.68	0.04	-0.28	0.69	0.51	0.08	0.16	0.37	0.64	0.63	0.89	1.00

Source: Binance Research, Bloomberg

**Chart 5 - One-year weekly return correlations among asset classes**

	BTC	SPX	RTY	LEGATRUU	LBUSTRUU	CCMP	CL1	GC1	SI1	BCOMTR	TPX	HSI	UKX	SX5E
BTC	1.00													
SPX	0.06	1.00												
RTY	0.03	0.88	1.00											
LEGATRUU	0.11	-0.17	-0.22	1.00										
LBUSTRUU	0.05	-0.18	-0.23	0.76	1.00									
CCMP	0.04	0.94	0.88	-0.16	-0.13	1.00								
CL1	0.04	0.29	0.26	-0.02	-0.09	0.25	1.00							
GC1	0.07	-0.20	-0.22	0.70	0.50	-0.19	0.02	1.00						
SI1	0.06	0.03	0.02	0.53	0.42	0.03	0.13	0.80	1.00					
BCOMTR	0.07	0.29	0.25	0.12	-0.02	0.22	0.74	0.24	0.39	1.00				
TPX	0.08	0.55	0.46	0.04	-0.01	0.51	0.26	-0.04	0.15	0.33	1.00			
HSI	-0.03	0.55	0.52	0.07	-0.03	0.55	0.30	0.03	0.21	0.39	0.69	1.00		
UKX	0.06	0.67	0.64	0.06	-0.06	0.61	0.39	0.00	0.23	0.46	0.62	0.70	1.00	
SX5E	0.10	0.66	0.59	0.01	-0.12	0.61	0.31	-0.11	0.11	0.33	0.65	0.65	0.84	1.00

Source: Binance Research, Bloomberg

Bitcoin **did not** exhibit any significant **correlation** with other asset classes, with a median correlation coefficient with other asset classes **below 0.10**. Irrespective of the study period, Bitcoin remains **uncorrelated** with all other non-crypto financial instruments<sup>5</sup> and asset classes. As illustrated in the two charts above, Bitcoin (as an asset class) has the lowest correlation closest to other asset classes.

The next subsection will study whether Bitcoin is investable for large investment companies from a liquidity perspective.

### 1.3 A liquid asset with high volumes and low spreads

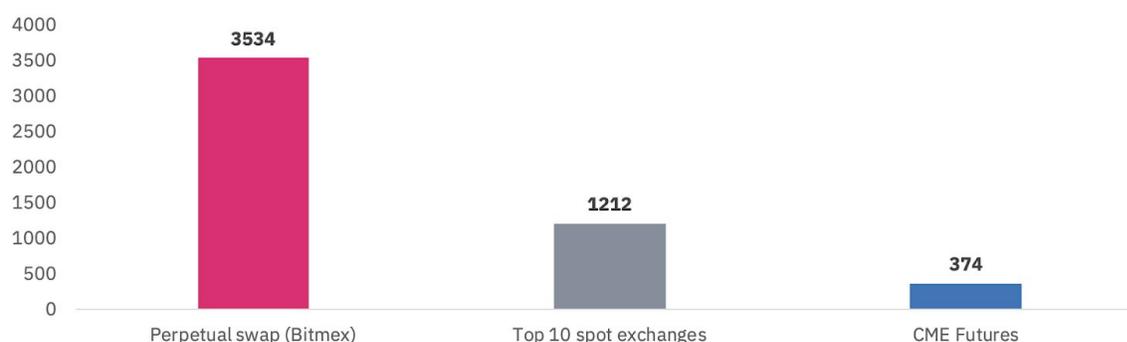
As of 2019, the total Bitcoin volume is spread across different exchange platforms, with spot and derivatives contracts being actively used.

While Bitcoin’s trading volume is split across spot and CME markets, Bitmex’s perpetual swap contract represents one of the largest sources of liquidity for Bitcoin trading and will be the reference index in the following chart and analysis.

<sup>5</sup> Our past reports about correlations within the crypto-industry indicated that Bitcoin remains highly correlated with large marketcap cryptoassets such as Ethereum or Litecoin.

- (1) 2019 Q2 Crypto-Correlations Review  
<https://info.binance.com/en/research/marketresearch/correlations-q2-2019.html>
- (2) Are Cryptoassets Highly Correlated?  
<https://info.binance.com/en/research/marketresearch/crypto-correlations.html>

**Chart 6 - 24-hour Bitcoin trading exchange volumes (USD million) as of July 24th 2019**



Sources<sup>6</sup>: Binance Research, Bitmex, Bitwise, CME

While Bitmex’s [perpetual swap](#) volume represents the most traded pair for BTC trading, this result is “amplified” by the use of leverage, which currently allows up to 100 times more exposure to the underlying BTC<sup>7</sup>.

Spot exchange platforms also have extremely high volumes with more than USD 1.2 billion (as of July 24th 2019) being traded daily on the largest 10 spot platforms. Among them, Binance stands as the most liquid exchange for Bitcoin spot trading, with daily volume above **USD 450 million**. Coinbase Pro and Kraken also exhibit high volumes for BTCUSD trading pairs, with daily volumes above USD 200 million respectively, as of July 24th 2019.

**Table 3 - Comparison of spread and volume on BTC main pairs across 24/7 exchanges**

Platform: Product	24-hour estimated median spread (July 24th)	24-h daily volume (July 24th)
Bitmex: XBTUSD Perpetual Swap	<0.01%	3.54 billion
Binance: BTCUSDT Spot	<0.02%	458 million
Kraken: BTCUSD Spot	<0.05%	204 million
Coinbase Pro: BTCUSD Spot	<0.01%	202 million
Bitfinex: BTCUSDT Spot	<0.02%	133 million

On the other hand, CME Bitcoin futures also represent a significant component with around **USD 374 million**, as of July 24th 2019, of the trading volume. In June, it exhibited an even larger total volume in June **with average daily volumes above USD 500 million**, outpassing all other individual spot exchange platforms<sup>8</sup>.

<sup>6</sup> Top 10 spot exchanges from Bitwise methodology are Binance, Coinbase, Kraken, Bitfinex, Bitstamp, Bitflyer, Gemini, itBit, Bittrex. <https://www.bitcointradevolume.com/>

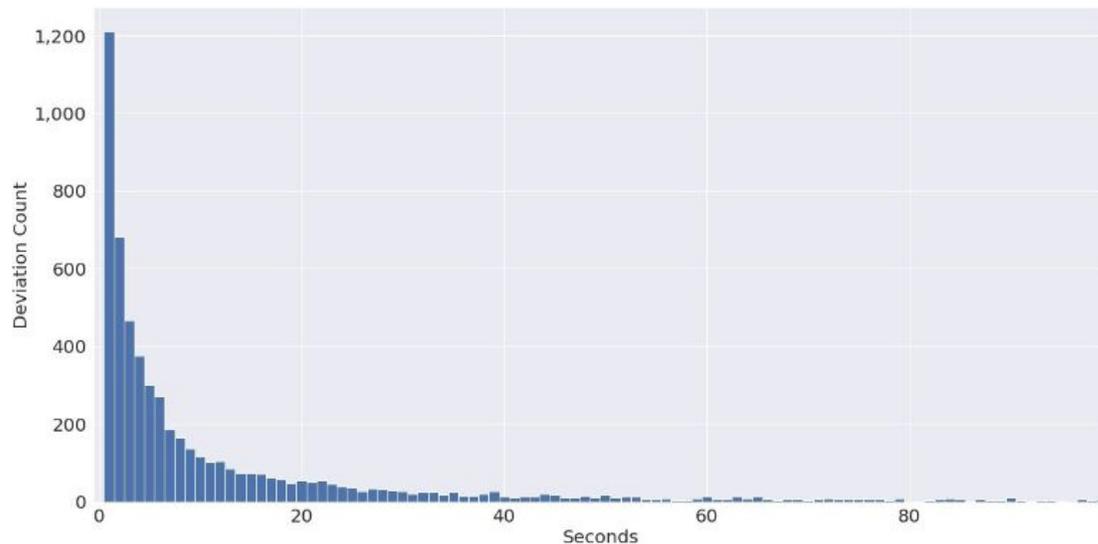
<sup>7</sup> However, the average leverage on Bitmex is much lower.

<sup>8</sup> <https://www.coindesk.com/may-was-best-month-for-cme-bitcoin-futures-volume-since-2017>

Eventually, other investment vehicles<sup>9</sup> and OTC trading desks<sup>10</sup> have become quite significant in the Bitcoin and digital asset industry.

With several very liquid venues for Bitcoin trading with small spreads and high volumes, price differences across exchanges are also quickly arbitrated. Based on a recent Bitwise research paper<sup>11</sup>, **more than 50%** of price differences above 1% are arbitrated within **5 seconds**, and **90%** of these differences are arbitrated **within 35 seconds**.

**Chart from Bitwise: Histogram of duration of 1% price deviations from consolidated price across all exchanges**



Source: [Bitwise](#)

In its research report, Bitwise additionally found that CME Bitcoin futures prices are also extremely efficient with average price deviations with spot exchange prices below 0.25% since the second half of 2018<sup>12</sup>.

In conclusion, Bitcoin has become an extremely liquid asset with **high trading volumes**, **efficient price mechanisms** across trading venues along with **extremely narrow spreads**, making it investable for large investors. With the development of institution-focused solutions for custodianship<sup>13</sup>, **Bitcoin has become an essential alternative asset to include in diversified portfolios.**

<sup>9</sup> Grayscale Investment Trust or CoinShares Bitcoin Tracker One are examples.

<sup>10</sup> <https://bitcoinist.com/bitcoin-otc-trading-volume-accumulating/>

<sup>11</sup> Bitwise Asset Management (Matthew Hougan, Hong Kim, Micah Lerner). Economic and Non-Economic Trading In Bitcoin: Exploring the Real Spot Market For The World's First Digital Commodity (2019). <https://www.sec.gov/comments/sr-nysearca-2019-01/srnysearca201901-5574233-185408.pdf>

<sup>12</sup> Bitwise: Page 79, figure 35.

<sup>13</sup> e.g. Fidelity Digital Assets. <https://www.fidelitydigitalassets.com/overview>

The next section will discuss modern portfolio theory along with the methodology used for backtesting the inclusion of Bitcoin into diversified multi-asset portfolios in the third section of this report.

## 2. Portfolio management: theory and simulations

In this section, diversification and modern portfolio theory are discussed. Afterward, the general methodology for the backtests is explained in-depth along with some justifications behind it.

### 2.1 Modern portfolio theory

In modern portfolio management, [diversification](#) is defined as:

*“Diversification is a risk management strategy that mixes a wide variety of investments within a portfolio. The rationale behind this technique is that a portfolio constructed of different kinds of assets will, on average, yield higher long-term returns and lower the risk of any individual holding or security.”*

Similarly, [Binance Academy](#) diversification is defined as:

*“Diversification is the allocation of capital to different financial instruments within and across asset classes. The main goal is to reduce the risks that may arise from holding a single asset class, such as a stock, bond, commodity, or cryptocurrency.”*

As discussed in the previous section, one of the core concepts is related to **the correlation between financial assets**<sup>14</sup>. If two assets are not correlated (i.e. correlation coefficient is close to 0), these assets provide diversification benefits when included in a portfolio.

As **Bitcoin** is found to be **uncorrelated to all other non-crypto asset classes**, it should theoretically be a good addition to a multi-asset portfolio.

Multi-asset portfolios typically cover a wide range of asset classes, including equities, bonds, cash and alternative investments such as property and infrastructure. A wider range of investable type of assets provides a greater degree of diversification than is possible when investing in a single asset class. The next section will discuss the general methodology for backtesting the inclusion of Bitcoin into multi-asset portfolios.

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<sup>14</sup> See our report about Q2 2019 correlations of large cryptoassets.  
<https://info.binance.com/en/research/marketresearch/correlations-q2-2019.html>

## 2.2 General methodology

Throughout this paper, the methodology works as follows:

- First of all, the largest traditional investment management companies are analyzed and the **top 2 largest companies** by assets under management (AUM) are considered.
- Each of these two asset management companies is then analyzed to determine what their largest Exchange Traded Fund (ETF), following a multi-asset strategy<sup>15</sup>, is.
- Each ETF is used to proxy the non-crypto multi-asset allocation, and eventually, Bitcoin (BTC) is “incorporated” into these funds following two methods:
  - **Time-Based Rebalancing** consists of a portfolio rebalancing at fixed, pre-defined intervals. For instance, Bitcoin’s weight is re-allocated at the end of each month with different levels of exposure such as 1% and 5%.
  - **Dynamic Boundary Rebalancing** (also called “**Tolerance-Based Rebalancing**”), refers to the rebalancing of a portfolio whenever the effective portfolio weight of Bitcoin in the portfolio would be either:
    - Below a specific threshold (e.g. if the portfolio weight of BTC is < 2.5%)
    - Above a specific threshold (e.g. if the portfolio weight of BTC is > 7.5%)
- Each of these methods is also backtested with different parameters and have been mentioned in the next section.
- Bitcoin transaction fees are included and include both the existing spread and median transaction fee on large exchanges. For practical reasons, slippage is not considered for this analysis but may be a key factor to consider for very large investors. Transaction fees are set at 0.10% for Bitcoin and at 0.15% for both ETFs.
- Both methods represent rebalancing among two assets where each event represents either:
  - (1) a purchase of the ETF and a sale of BTC
  - (2) a sale the ETF and a purchase of BTC.

**Table 4 - Relevant ETFs selected for this analysis**

Asset Management Company	ETF Name	Allocation
BlackRock	<a href="#">iShares Morningstar Multi-Asset Income ETF</a>	60% bonds, 20% stocks, and 20% alternative income sources
Vanguard Asset Management	<a href="#">VPGDX   Managed Payout Fund</a>	55% stocks, 20% bonds, and 25% alternative and other sources

For both ETFs, all the **distributed payouts are reinvested immediately** in order to calculate performance accordingly.

<sup>15</sup> i.e. diversified strategy across different asset classes like equities, commodities and fixed-income instruments.

Please note that there may be some extremely minor price differences owing to the differences between NAV prices and market prices, as an ETF sometimes trades at a discount/premium, along with different calculation methods.

In the next section, results from the backtests are discussed along with the choice of the hyperparameters for each method.

## 3. Results and interpretation

In this section, the results of both Time-Based and the Dynamic Boundary rebalancing approaches are analyzed, discussed and interpreted.

### 3.1 Time-Based Rebalancing

For the purpose of this analysis, Bitcoin is allocated with different target weights into a diversified multi-asset portfolio.

While these parameters were chosen arbitrarily, they are in line with the sentiment of: *“add a little bit of Bitcoin for its large upside potential without too much downside risk to the overall portfolio”*.

Regarding the hyperparameters of this analysis:

- Bitcoin’s weight of 1% or 5% is allocated to both of these portfolios (i.e. four model portfolios).
- Model portfolios are rebalanced on **the last business day of every month** such that Bitcoin’s weight in the portfolio is respectively equal to the target weight on the rebalancing fee.
- The target study period ranges from **December 31st 2015 to June 30th 2019** which represents a period of 3 years and six months. It covers three different stages of the Bitcoin market, an increase in price, a sharp decrease in price, along with a period where Bitcoin remains flat.

**Table 5 - Aggregated results for monthly rebalanced portfolios**

Portfolio	Total Return (%)	Annualized Return (%)	Annualized Volatility (%)	Max Drawdown (%)
<b>BlackRock Multi-Asset Income</b>	27.86%	7.29%	5.63%	-6.98%
<i>Customized With Bitcoin 1%</i>	33.70%	8.67%	5.63%	-7.59%
<i>Customized With Bitcoin 5%</i>	59.31%	14.26%	6.69%	-12.22%
<b>Vanguard Managed Payout Fund</b>	26.03%	6.85%	7.00%	-11.61%
<i>Customized With Bitcoin 1%</i>	31.81%	8.23%	6.97%	-12.09%
<i>Customized With Bitcoin 5%</i>	57.17%	13.82%	7.78%	-14.04%

Including Bitcoin in all of these portfolios would have generated a **better risk-return profile** than portfolios without Bitcoin.

Specifically, a target allocation of 1% to Bitcoin rebalanced monthly would have generated an additional return of **5-6% over the 3.5 year study period, i.e. an extra annualized return of nearly 1.5%**.

On the other hand, a target weight of 5% for Bitcoin would have increased the volatility of the fund by around +1% annualized and led to significantly higher maximum drawdowns. However total returns over the period **would have been much higher** with +59.3% and +57.2%, versus ex-Bitcoin total returns of respectively +27.86% and +26.03%.

These are **significant extra-positive returns** over each ETF of respectively +34.19% (+7.53% annualized) and +33.42% (+7.44% annualized).

**Chart 7 - Monthly rebalancing results with BlackRock Multi-Asset Income (Base = 1000)**



**Chart 8 - Monthly rebalancing results with Vanguard Managed Payout Fund (Base = 1000)**



**Table 6 - Calendar returns for monthly rebalanced portfolios**

Portfolio	2016	2017	2018	Q2 2019
<b>BlackRock Multi-Asset Income</b>	9.83%	10.95%	-4.78%	10.19%
<i>with 1% BTC</i>	10.72%	14.63%	-5.69%	11.70%
<i>with 5% BTC</i>	14.33%	30.40%	-9.32%	17.84%
<b>Vanguard Managed Payout Fund</b>	7.55%	13.28%	-5.65%	9.63%
<i>with 1% BTC</i>	8.45%	17.01%	-6.54%	11.14%
<i>with 5% BTC</i>	12.09%	32.93%	-10.07%	17.29%

With the exception of the year 2018, all portfolios with Bitcoin, using a monthly rebalancing approach, exhibited better returns than without.

In 2018, the loss was magnified by the frequency of rebalancing. As Bitcoin was re-allocated every month with more BTC being purchased every month, it led to a magnified loss (-6.54% instead of -5.65% and -5.69% instead of -4.78%), nearly equal to the target allocation of 1%. Less frequent rebalancing events, such as quarterly, would reduce potential magnitude effects that inherently linked to the high frequency of these events.

Unsurprisingly, owning Bitcoin in a portfolio over 2017 led to **greater returns with an alpha-generated return by nearly 4% with only a 1% allocation of Bitcoin**. On the other hand, Bitcoin with a 1% target allocation only led to additional marginal negative returns inferior to -1% over 2018, while the price of Bitcoin lost 80% of its value from its peak (see table 1).

## 3.2 Dynamic Boundary Rebalancing

Dynamic boundary rebalancing can be defined as: “whenever the weight of an asset in the portfolio reaches above/below a specific threshold at the end of the day, its allocation is rebalanced to its target weight”.

Regarding the hyperparameters of this analysis:

- Bitcoin’s weight of 1% or 5% is allocated to both of these portfolios (i.e. four model portfolios) at each rebalancing date.
- Model portfolios are rebalanced **only if at the closing day:**
  - For 1% Bitcoin target weight: if BTC’s portfolio weight goes below 0.50% or above 1.50%.
  - For 5% Bitcoin target weight: if BTC’s portfolio weight goes below 2.50% or above 7.50%.
- The target study period ranges from **December 31st 2015 to June 30th 2019** which represents 3.5 years, in line with the previous subsection.

**Table 7 - Aggregated results for dynamic boundary rebalanced portfolios**

Portfolio	Total Return (%)	Annualized Return (%)	Annualized Volatility (%)	Max Drawdown (%)
<b>BlackRock Multi-Asset Income</b>	27.86%	7.29%	5.63%	-6.98%
<i>With Bitcoin 0.5% - 1.5 %</i>	33.99%	8.74%	5.63%	-7.52%
<i>With Bitcoin 2.5% - 7.5 %</i>	62.05%	14.82%	6.57%	-10.28%
<b>Vanguard Managed Payout Fund</b>	26.03%	6.85%	7.00%	-11.61%
<i>With Bitcoin 0.5% - 1.5%</i>	32.10%	8.30%	6.97%	-12.05%
<i>With Bitcoin 2.5% - 7.5 %</i>	59.45%	14.29%	7.68%	-13.82%

Similarly to the previous subsection, dynamically rebalanced portfolios exhibited better risk-return profiles when Bitcoin was included into the two respective ETFs than without its inclusion.

Once again, the inclusion of Bitcoin in these multi-asset portfolios led to larger maximum drawdowns with increasing absolute values based on how large was the target allocation of Bitcoin. On the other hand, Bitcoin inclusion brought larger total returns, increasing in line with how large was the dedicated Bitcoin allocation in the portfolio.

**Chart 9 - Dynamic allocation results with BlackRock Multi-Asset Income (Base = 1000)**



**Chart 10 - Dynamic allocation results with Vanguard Managed Payout Fund (Base = 1000)**



**Table 8 - Calendar returns for dynamically rebalanced portfolios**

Portfolio	2016	2017	2018	Q2 2019
<b>BlackRock Multi-Asset Income</b>	9.83%	10.95%	-4.78%	10.19%
<i>with 1% BTC</i>	10.78%	14.68%	-5.63%	11.77%
<i>with 5% BTC</i>	14.61%	31.35%	-7.92%	16.91%
<b>Vanguard Managed Payout Fund</b>	7.55%	13.28%	-5.65%	9.63%
<i>with 1% BTC</i>	8.49%	17.12%	-6.45%	11.13%
<i>with 5% BTC</i>	12.28%	33.81%	-9.58%	17.37%

Once again, **all portfolios with Bitcoin exhibited better returns** than without, in all sub-periods with the exception of the year 2018.

Regarding rebalancings, all of these dynamic portfolios triggered rebalancing just 11 or 12 times over this 3.5-year section. In comparison, monthly rebalanced portfolios changed their allocations every month, resulting in 42 rebalancing events over the same period.

As each rebalancing incurs transaction fees, it may be judicious to prevent too frequent rebalancing events. Yet, a quarterly rebalancing approach could also serve as a potential solution to reduce transaction fees. An alternative approach could be to quarterly rebalance the Bitcoin allocation while also set up caps and floors on the effective weight to trigger rebalancings. Despite having larger maximum drawdowns, portfolios rebalanced based on dynamic weight boundaries **had similar (or even lower) volatility profiles with higher average returns.**

The next subsection will discuss some of the key findings from this analysis along with some of the key limits that need to be considered.

### 3.3 Key findings and limitations

As Bitcoin is uncorrelated to all other traditional asset classes, its inclusion in multi-asset portfolios leads to improved risk/return profiles for these simulated portfolios. While it also leads to greater maximum drawdowns, this increase is quite marginal compared to the added positive returns over the study period.

However, some of the important limitations of this analysis must be considered, such as:

- **Slippage and taxation costs.** While transaction fees were included in this analysis, neither taxation nor slippage costs were considered for this analysis. For large investors, slippage should be considered for a more accurate representation of the expected past performance. Furthermore, taxation may potentially impact realized returns at rebalancing events and could vary greatly depending on the taxation jurisdiction applying to every single investor (or investment management company). However, Bitcoin is a very liquid asset (see section 1.3) and slippage is almost nonexistent for most of the retail and small-medium institutional investors.
- **Calendar days and price sources.** This analysis relied on calendar days, using an aggregated price source among Bitcoin spot exchanges. Furthermore, there may be small discrepancies in the reported performance from ETF providers themselves versus actual performance owing to the use of different calculation methods and other small changes such as different calendar days or the use of market data (versus NAV returns + income distribution versus including the reinvestments).
- **Study period.** Owing to its relatively short history, Bitcoin has a short price history. Specifically, some of the high growth periods may not be replicated in the future and past performance should not be considered as a proxy for expected future returns. However, if Bitcoin (and other cryptocurrencies) remains uncorrelated to other asset classes, the diversification benefits should remain in the future.

Other reports in the Portfolio Management Series will include different allocation periods & more complex methodologies including the addition of other cryptoassets (e.g. Ethereum and XRP) in these simulations.

## 4. Conclusion

In this first report about portfolio management series, Bitcoin represents its own asset class as it exhibited a null correlation with all other traditional asset classes like equities, fixed-income and commodities.

As part of a multi-asset portfolio, Bitcoin provides **diversification benefits** for investors, irrespective of their preferred asset classes. In spite of its high (yet decreasing) volatility, a simple allocation to Bitcoin in a diversified portfolio consistently leads to improved risk/return profile for both retail and institutional investors, in line with modern portfolio and diversification theories.

While Bitcoin slippage and taxation rates were not discussed in this report, the popularity of OTC desks<sup>16</sup> and futures contracts have increased as alternative methods to trade Bitcoin in large volumes, making it **possible for institutions to quickly build significant positions of cryptoassets**. Large volumes across large exchanges, along with efficient prices and low spreads also provide relief to potential investors.

Furthermore, **new product offerings for Bitcoin** are being introduced to all investors:

- Physically delivered futures contracts (e.g. LedgerX, Bakkt)
- ETF providers trying to approve their products by the SEC in the US (e.g. Bitwise)
- Dedicated custodian solutions (e.g. Fidelity Digital Assets)

These new products will help in answering most of the existing concerns from traditional investors, such as technology and custodian risks. As a result, these launches could elevate Bitcoin's status from being an intriguing risky asset class to an investable asset for most traditional asset managers with an appetite for Bitcoin's unique diversification properties.

Despite the simplicity of the strategies described in this report, they all provided overall positive results from a risk/return perspective; hence, there is a reason to believe that more complex strategies should provide even more room for additional positive contribution owing to the inclusion of Bitcoin into portfolios.

While Bitcoin can be considered as the flagship in the new asset class of **cryptocurrencies and digital assets**, other large market cap assets (e.g. Ethereum, XRP) will be included in future reports with more **complex portfolio allocation strategies**, such as mean-variance strategies, **both within the cryptoasset industry and across other asset classes**.

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<sup>16</sup> For instance, someone can purchase USDC/PAX with their bank account. Then he/she can head over to the Binance OTC trading desk to purchase BTC in block trades.

Telegram: [@BinanceOTC](https://t.me/BinanceOTC)

Mail: [tradingdesk1@binance.com](mailto:tradingdesk1@binance.com)

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