



## **Bitcoin and Ethereum: A Decade of Risk/Return Analysis**

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### **ABSTRACT**

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This study evaluates the risk/return analysis of two cryptocurrencies, Bitcoin and Ethereum, since their inceptions. CMBI Bitcoin and CMBI Ethereum indices are compared to ten traditional asset classes: gold, Global stocks, developed country stocks, emerging market stocks, commodities, energy, U.S. bonds, global bonds, U.S. real estate, and global real estate. Results show that both cryptocurrencies had very high risk, absolute returns, and risk-adjusted returns compared to traditional asset classes. While both Bitcoin and Ethereum had very high cumulative returns and, thereby, generated much more wealth, both also had very high monthly downside deviations when compared to the traditional asset classes. Overall, results show cryptocurrencies to be extremely high risk, high reward investment alternatives.

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Key words: Cryptocurrency, risk-adjusted performance, drawdown

JEL classifications: G2, G11, G15

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## 1. Introduction

As of September 13, 2024, the global cryptocurrency market had a total market cap of \$2.1 trillion. On that date, Bitcoin and Ethereum had market caps of \$1.188 billion and \$438.128 billion, respectively. The global cryptocurrency market had a total market cap of \$2.1 Trillion on the same day (<https://coinmarketcap.com/>).

Bitcoin, the world's first cryptocurrency, was launched in 2009 to act as an alternate currency or medium of exchange and store of value. Bitcoin is a peer-to-peer payment network for online transactions. The digital currency is not administered by any central authority, and there is no middleman or broker between the sender/buyer and receiver/seller as there are with traditional payment systems such as PayPal. The Bitcoin transaction network consists of computers across the world running open-source software containing the protocol for administering Bitcoin network transactions. To utilize the network, users need a Bitcoin address that can be generated using the open-source software. Alternatively, many users establish accounts with one or more Bitcoin providers and store Bitcoins at addresses provided through those accounts (<https://www.perkinscoie.com/images/content/1/4/v2/14394/Bitcoin-Primer.pdf>).

Ethereum, introduced in Vitalik Buterin's 2013 whitepaper and launched in 2015, aimed to create a universal blockchain-based application platform. Ethereum incorporated a Turing complete language making it possible to express all practical computations in smart contracts (Tikhomirov, 2017). Meshcheryakov and Ivanov (2020) detail a major difference between Ethereum and Bitcoin. Bitcoin is simply a medium of exchange similar to the U.S. dollar or any other tangible currency. Ethereum uses new and more secure technology and protocols to facilitate smart contracts that allow for faster and safer automatic contract execution when certain predefined requirements are met. The Ethereum platform provides functionality that allows the use of Ether as payment, while Bitcoin does not provide this functionality.

In addition to serving as a medium of exchange, cryptocurrencies have become a popular investment alternative. Corbet, et al. (2018b) assert that Bitcoin is a speculative asset. Corbett, et al. (2018a) examined pricing bubbles in Bitcoin and Ethereum and found that Bitcoin was almost certainly in a bubble. Baeck & Elbeck (2015) and Cheah & Fry (2015) also concluded that the Bitcoin market is speculative. Cheah & Fry (2015) determined that the fundamental price of Bitcoin is zero. The market for Bitcoin does not satisfy the efficient market hypothesis (Nadarajah & Chu, 2017). While the market for Bitcoin is currently inefficient, it may be moving toward market efficiency (Urquhart, 2016). Liu (2019) found that diversification among different cryptocurrencies does not improve investment results. These studies affirm the risk associated with investment in cryptocurrency.

Research is mixed with respect to the ability of investors to mitigate the risk associated with cryptocurrency. Bitcoin's daily exchange rates have zero correlation with widely used currencies or with gold making it very difficult for investors to hedge associated risk (Yermack, 2014). Pal & Mitra (2019) examine the possibility of hedging Bitcoin with other assets and find that gold provides the best hedging alternative.

While the risk from investment in cryptocurrency is difficult to hedge, there is potential for cryptocurrency to function as a hedge. Dyrberg (2016) found that Bitcoin has some of the same hedging abilities as gold and can be used to hedge market specific risk. Meshcheryakov & Ivanov (2020) also concluded that Ethereum is an effective hedge against the U.S. stock and gold markets. Chen, et al. (2020), however, showed that Bitcoin failed to act as a safe haven during the COVID-19 pandemic.

The purpose of this study is to evaluate the historical risk/return for Bitcoin and Ethereum. The risk/return of the cryptocurrencies are compared to gold and nine other traditional assets. The analysis should be beneficial for investors in determining the amount and allocation of cryptocurrencies in an investment portfolio.

## 2. Methodology and Results

This study measures absolute- and risk-adjusted returns of Bitcoin and Ethereum based on CMBI Bitcoin and CMBI Ethereum indices. The CMBI Single Assets Indices are available from the Bloomberg Terminal and provide publicly available and investable benchmarks that reliably and accurately track the price of a single cryptocurrency, including Bitcoin and Ethereum, through sourcing market prices from numerous global liquidity venues. The indices are designed to accurately reflect the performance of the global market, be easily tradable, and be readily accessible to market participants. The indices reflect the returns an investor would expect by purchasing all of the assets at the corresponding weights for each index. Index prices are quoted in real time, and assets are rebalanced on the first business day of every month to account for the inflation rate of each asset, changes in market pricing, changes in network activity, and the addition or deletion of index constituents. The CMBI Bitcoin Total Return index started on July 19, 2010, and the CMBI Ethereum Total Return index started on August 10, 2015.

## 3. Returns Performance of Bitcoin and Ethereum

The absolute- and risk-adjusted returns of Bitcoin and Ethereum are compared to ten different asset classes. Those asset classes are- gold, Global stocks, developed country stocks, emerging market stocks, commodities, energy, U.S bonds, global bonds, U.S. real estate, and global real estate. Table 1 shows the specific indices for each asset group. Monthly returns beginning August 2010 were downloaded from Bloomberg Terminal for each asset group index.

**Table 1 Indices Used for Measuring Returns**

Asset class	Index
Bitcoin	CMBI Bitcoin TR USD
Ethereum	CMBI Ethereum TR USD
Gold	Bloomberg Sub Gold USD
Global stocks	S&P Global BMI TR USD
Developed market stocks	S&P Developed BMI TR USD
Emerging market stocks	S&P Emerging BMI TR USD
Commodities	Bloomberg Commodity USD
Energy	Bloomberg Sub Energy USD
U.S. bonds	BBgBarc U.S. Agg Bond TR USD
Global bonds	BBgBarc Global Aggregate TR USD
U.S. real estate	DJ U.S. Real Estate TR USD
Global real estate	DJ Global World Real Estate TR USD

Correlations between returns Bitcoin and the ten asset groups and Ethereum and the ten asset groups are shown in Tables 2a and 2b, respectively. Bitcoin had the highest correlation with developed country stocks (0.18) and Global stocks (0.17) while having the lowest correlation with gold (0.02). Ethereum had the highest correlation with global bonds (0.25) and the lowest correlation with energy (-0.03).

**Table 2a Correlation Between Bitcoin and Other Asset Classes August 2010 – August 2024**

	Bitcoin	Gold	Glob stocks	Devel mark stocks	Emerg mark stocks	Comm	Energy	U.S. bonds	Global bonds	U.S. real estate	Global real estate
Bitcoin	1.00										
Gold	0.02	1.00									
Global stocks	0.17	0.19	1.00								
Developed market stocks	0.18	0.17	0.99	1.00							
Emerging market stocks	0.07	0.32	0.83	0.79	1.00						
Commodities	0.09	0.35	0.53	0.52	0.55	1.00					
Energy	0.07	-0.00	0.42	0.42	0.38	0.83	1.00				
U.S. bonds	0.08	0.35	0.29	0.29	0.26	-0.07	-0.22	1.00			
Global bonds	0.14	0.52	0.52	0.50	0.54	0.23	-0.12	0.84	1.00		
U.S. real estate	0.11	0.20	0.76	0.77	0.59	0.34	0.22	0.52	0.58	1.00	
Global real estate	0.12	0.27	0.86	0.85	0.78	0.46	0.30	0.49	0.65	0.94	1.00

**Table 2b Correlation Between Ethereum, Bitcoin, and Other Asset Classes September 2015 – August 2024**

	Ether	Gold	Glob stocks	Devel Mark stocks	Emerg Mark stocks	Comm	Energy	U.S. bonds	Global bonds	U.S. real estate	Global Real estate
Ethereum	1.00										
Gold	0.24	1.00									
Global stocks	0.21	0.17	1.00								
Developed market stocks	0.20	0.15	0.99	1.00							
Emerging market stocks	0.18	0.29	0.81	0.77	1.00						
Commodities	0.06	0.16	0.47	0.46	0.47	1.00					
Energy	-0.03	-0.18	0.39	0.39	0.33	0.87	1.00				
U.S. bonds	0.17	0.44	0.42	0.41	0.38	-0.06	-0.21	1.00			
Global bonds	0.25	0.59	0.54	0.52	0.56	0.11	-0.11	0.91	1.00		
U.S. real estate	0.14	0.20	0.81	0.81	0.61	0.36	0.28	0.56	0.59	1.00	
Global real estate	0.19	0.26	0.87	0.86	0.75	0.42	0.31	0.57	0.66	0.96	1.00

Tables 3a and 3b, respectively, show the monthly return for Bitcoin and Ethereum compared to the other asset classes. Bitcoin had a much higher return, measured as both mean (15.50%) and median (5.76%) monthly returns, compared to all other asset classes. Bitcoin was also very volatile over the time period examined as evidenced by the much greater standard deviation in the monthly returns relative to the other asset classes. As the Ethereum index was introduced much later in mid-August 2015, the monthly correlation for Ethereum with other asset classes was calculated since September 2015. Ethereum had higher average monthly returns, but lower median returns compared to Bitcoin. However, Ethereum had much higher returns compared to other asset classes. Ethereum also had much higher risk compared to Bitcoin and other asset classes over the period measured.

**Table 3a Monthly Returns for Bitcoin and Other Asset Classes August 2010 – August 2024**

	Mean	Median	Standard Deviation
Bitcoin	15.50%	5.76%	55.90%
Gold	0.48	0.25	4.44
Global stocks	0.91	1.30	4.26
Developed market stocks	0.96	1.42	4.29
Emerging market stocks	0.45	0.74	4.89
Commodities	-0.01	0.05	4.17
Energy	-0.42	0.13	7.84
U.S. bonds	0.19	0.12	1.27
Global bonds	0.10	0.15	1.69
U.S. real estate	0.82	1.02	4.85
Global real estate	0.61	0.86	4.58

**Table 3b Monthly Returns for Ethereum and Other Asset Classes September 2015 – August 2024**

	Mean	Median	Standard Deviation
Ethereum	14.59%	1.85%	46.86%
Bitcoin	7.66	5.61	22.71
Gold	0.73	0.30	3.85
Global stocks	0.94	1.56	4.41
Developed market stocks	0.99	1.47	4.52
Emerging market stocks	0.67	1.03	4.68
Commodities	0.28	0.07	3.94
Energy	0.01	1.52	8.54
U.S. bonds	0.15	0.04	1.47
Global bonds	0.09	0.18	1.88
U.S. real estate	0.75	1.00	5.17
Global real estate	0.51	0.84	4.75

#### 4. Risk-Adjusted Returns Performance of Bitcoin and Ethereum

An investment with higher risk would be expected to generate higher returns, particularly over the time periods examined in this study (fourteen years for Bitcoin and nine years for Ethereum). The high returns for the cryptocurrencies could be a result of the high risk of those investments. To control the differences in risk between cryptocurrencies and the other asset classes, this study also examines risk-adjusted returns using the Sharpe Ratio, the Sortino Ratio, and the Omega Ratio.

The Sharpe Ratio (1966) evaluates how well an investment compensates its investor for each unit of risk they incur. The higher the Sharpe ratio, the better is the performance of the investment. The Sharpe ratio is calculated as:

$$\text{Sharpe Ratio} = \frac{(R_p - R_f)}{\sigma_p}$$

Where  $R_p$  denotes the monthly returns on the portfolio,  $R_f$  is the monthly risk-free rate and  $\sigma_p$  is the standard deviation of monthly portfolio returns.

The Sortino ratio (1991) differentiates between good and bad volatility in the Sharpe ratio. The differentiation of upward and downward volatility allows the calculation of the risk-adjusted return to provide a performance measure of an investment without penalizing it for positive returns. Similar to the Sharpe ratio, the higher the Sortino ratio, the better is the performance of a portfolio. The Sortino Ratio is calculated as:

$$\text{Sortino Ratio} = \frac{(R_p - R_f)}{\sigma_d}$$

Where  $R_p$  and  $R_f$  are described as above and  $\sigma_d$  is the standard deviation of portfolio's negative returns.

Introduced by Shadwick and Keating (2002), the Omega ratio is a way of measuring the performance of financial assets based on the level of returns they offer in return for the risk of investing in them. The Omega ratio is the ratio of weighted gains to weighted losses. The measure divides expected returns into two parts – gains and losses or returns above the expected rate (the upside) and those below it (the downside). Therefore, in simple terms, consider omega as the ratio of upside returns (good) relative to downside returns (bad). While the Sharpe Ratio covers only the first two moments of return distribution (means and variance), Omega ratio covers all moments of return distribution. Thus, the Omega ratio is a measure of asset performance that gives the investor the information the Sharpe ratio discards. The Omega ratio is calculated as:

$$\Omega = \frac{\int_r^b (1 - F(x)) dx}{\int_a^r F(x) dx}$$

Where  $F(x)$  is the cumulative probability distribution (i.e. the probability that a return will be less than  $x$ ),  $r$  is a threshold value selected by the investor and  $a, b$  are the investment intervals. It is effectively equal to the probability weighted gains divided by the probability weighted losses after a threshold.

Tables 4a and 4b present the risk-adjusted returns for Bitcoin and Ethereum, respectively. Bitcoin had a much higher Sharpe Ratio compared to all other asset classes over the entire period of the analysis. Bitcoin had much higher risk-adjusted return when measured by the Sortino and Omega ratios than all the other asset classes. Sortino Ratio adjusts for downside risk indicating that Bitcoin provided better downside protection compared to other the other asset classes. Results for Ethereum, shown in Table 4b, were like Bitcoin.

**Table 4a Risk Adjusted Performance for Bitcoin and Other Asset Classes August 2010 – August 2024**

	Sharpe Ratio	Sortino Ratio	Omega Ratio
Bitcoin	0.28	1.33	3.55
Gold	0.09	0.14	1.25
Global stocks	0.19	0.29	1.65
Developed market stocks	0.20	0.32	1.69
Emerging market stocks	0.07	0.11	1.21
Commodities	-0.02	-0.03	0.94
Energy	-0.06	-0.08	0.84
U.S. bonds	0.08	0.11	1.24
Global bonds	0.01	0.01	1.02
U.S. real estate	0.15	0.23	1.48
Global real estate	0.11	0.16	1.35

**Table 4b Risk Adjusted Performance for Ethereum and Other Asset Classes September 2015 – August 2024**

	Sharpe Ratio	Sortino Ratio	Omega Ratio
Ethereum	0.31	0.97	2.76
Bitcoin	0.33	0.72	2.39
Gold	0.15	0.26	1.48
Global stocks	0.18	0.27	1.60
Developed market stocks	0.19	0.28	1.62
Emerging market stocks	0.11	0.17	1.34
Commodities	0.04	0.05	1.10
Energy	-0.01	-0.02	0.96
U.S. bonds	0.004	0.006	1.01
Global bonds	-0.03	-0.04	0.93
U.S. real estate	0.12	0.17	1.36
Global real estate	0.08	0.11	1.24

## 5. Portfolio Returns Performance of Bitcoin and Ethereum

Following Kanuri (2016), Kanuri & McLeod (2016), Kanuri, et al. (2018) and Kanuri (2020), this study also constructs a Cumulative Wealth Index (CWI) for the two cryptocurrencies and each asset category. The CWI measures the outcome of investing \$1 in each category at the beginning of August 2010 and September 2015, for Bitcoin and Ethereum, respectively, presuming reinvestment of dividends. Tables 5a and 5b present the cumulative returns and CWI for Bitcoin and Ethereum as well as the other asset classes. Bitcoin had massive cumulative returns of 108,794,302.23% over the period analyzed. A \$1 investment in the CMBI Bitcoin index in August 2010 would have returned \$1,087,944.02 at the end of August 2024. All of the other traditional asset classes generated much less wealth compared to the Bitcoin index. Similarly, Ethereum had returns of 207,837.09%. A \$1 investment in the Ethereum index would have yielded \$2,079.37 from September 2015 to August 2024. Overall, both the cryptocurrencies had much higher returns and generated much more wealth compared to the other asset classes over the time periods analyzed.

**Table 5a Cumulative Wealth Index for Bitcoin and Other Asset Classes August 2010 – August 2024**

	Cumulative returns	CWI
Bitcoin	108,794,302.23%	\$1,087,944.02
Gold	89.69	1.90
Global stocks	294.39	3.94
Developed market stocks	334.48	4.34
Emerging market stocks	75.80	1.76
Commodities	-15.21	0.85
Energy	-71.43	0.29
U.S. bonds	35.89	1.36
Global bonds	16.28	1.16
U.S. real estate	228.34	3.28
Global real estate	131.98	2.32



**Table 5b Cumulative Wealth Index for Ethereum and Other Asset Classes September 2015 – August 2024**

	Cumulative returns	CWI
Ethereum	207,837.09%	\$2,079.37
Bitcoin	27,161.95	\$272.62
Gold	103.69	2.04
Global stocks	149.86	2.50
Developed market stocks	159.48	2.59
Emerging market stocks	83.36	1.83
Commodities	24.79	1.25
Energy	-32.86	0.67
U.S. bonds	15.85	1.16
Global bonds	8.15	1.08
U.S. real estate	94.08	1.94
Global real estate	53.51	1.54

Downside deviation measures the potential loss that may arise from risk as measured against a minimum acceptable return by isolating the negative portion of the volatility. A high downside deviation represents a greater risk of negative returns. This study examines the downside deviation for cryptocurrencies and the other asset classes.

Tables 6a and 6b show the downside deviation as percentages, for Bitcoin and Ethereum and the other asset classes. Both cryptocurrencies had downside deviations that were substantially higher than the other traditional asset classes.

**Table 6a Maximum Drawdown and Monthly Downside Deviation for Bitcoin and Other Asset Classes August 2010 – August 2024**

	Downside Deviation
Bitcoin	11.62%
Gold	2.86
Global stocks	2.77
Developed market stocks	2.77
Emerging market stocks	3.32
Commodities	3.12
Energy	6.13
U.S. bonds	0.89
Global bonds	1.25
U.S. real estate	3.24
Global real estate	3.20

**Table 6b Maximum Drawdown and Monthly Downside Deviation for Ethereum and Other Asset Classes September 2015 – August 2024**

	Downside Deviation
Ethereum	14.85%
Bitcoin	10.41
Gold	2.24
Global stocks	2.93
Developed market stocks	2.98
Emerging market stocks	3.07
Commodities	2.82
Energy	6.49
U.S. bonds	1.06
Global bonds	1.40
U.S. real estate	3.54
Global real estate	3.39

This study also investigates the benefits of adding Bitcoin and Ethereum to a simple stock/bond portfolio. The average portfolio of a pension fund is diversified as 60% stocks and 40% bonds [Brinson *et al.*, 1986; Ambachtsheer, 1987; Chaves *et al.*, 2011]. We use a 60% global stock and 40% global bond portfolio for the typical retirement portfolio. Damianov and El Sayed (2020) find that Bitcoin's optimal weight in portfolios maximizing Sharpe and Sortino ratios are on the magnitude of 10% to 20%. Table 7a shows results for a 60/40 Global stocks / Global bonds portfolio, a 50/40/10 Global stocks / Global bonds / Bitcoin portfolio, and a 50/30/20 Global stocks / Global bonds / Bitcoin portfolio. Similarly, Table 7b shows results for portfolios including Ethereum in combination with Global stocks and Global bonds.

**Table 7a Diversification Benefits of Bitcoin in a 60/40 Global Stock/Global Bond Portfolio  
From August 2010 – August 2024**

	Mean Monthly Returns	Median Monthly Returns	Std. Dev.	Sharpe Ratio	Sortino Ratio	Omega Ratio
60% Global stocks / 40% Global bonds	0.58%	0.80%	2.96%	0.17	0.26	1.55
50% Global stocks / 40% Global bonds / 10% Bitcoin	2.04	1.55	6.54	0.30	0.85	2.80
50% Global stocks / 30% Global bonds / 20% Bitcoin	3.58	1.87	11.86	0.29	1.11	3.23

**Table 7b Diversification Benefits of Ethereum in a 60/40 Global Stock/Global Bond Portfolio  
From September 2015 – August 2024**

	Mean Monthly Returns	Median Monthly Returns	Std. Dev.	Sharpe Ratio	Sortino Ratio	Omega Ratio
60% Global stocks / 40% Global bonds	0.61%	0.90%	3.13%	0.15	0.22	1.48
50% Global stocks / 40% Global bonds / 10% Ethereum	1.97	1.27	5.94	0.31	0.68	2.36
50% Global stocks / 30% Global bonds / 20% Ethereum	3.42	1.30	10.27	0.32	0.85	2.62

Not surprisingly, risk-adjusted performance goes up when cryptocurrencies are added to the portfolios. Among the three portfolio options examined, the Sharpe, Sortino, and Omega ratios are all maximized when the portfolios are rebalanced to include 20% cryptocurrencies, with the Bitcoin portfolios slightly outperforming the Ethereum portfolio.

## 6. Conclusion

This study performs risk/return analyses for both Bitcoin and Ethereum since their inception and compares cryptocurrencies to ten traditional asset classes. Results show that both cryptocurrencies had much higher risk as well as absolute- and risk-adjusted returns over the time examined as compared to the other asset classes. Both Bitcoin and Ethereum also had much higher cumulative returns and generated much more wealth when compared to the other asset classes. The cryptocurrencies had very high monthly downside deviations. Consistent with prior research, the overall analysis shows that Bitcoin and Ethereum are very high-risk investments as compared to

traditional asset classes. While both cryptocurrencies have generated enormous returns since their inception, they also exhibit a great deal of volatility. Given that, perhaps the concern expressed in prior research about a cryptocurrency bubble should be taken into consideration by investors planning to add cryptocurrencies to their portfolios. Nevertheless, cryptocurrencies do show potential for increasing the risk-adjusted returns of traditional pension portfolios.

This study examines the performance of just two cryptocurrencies: Bitcoin and Ethereum. According to coinbase ([www.coinbase.com](http://www.coinbase.com)), there are currently over 16,500 digital assets, with over 250 those being tradeable. Prices and returns on the various cryptocurrencies vary tremendously. Future research could expand the scope of this study to examine additional cryptocurrencies. Further, this study performs an *ex post* analysis to examine the performance of Bitcoin and Ethereum since their inceptions. An *ex ante* analysis of the various cryptocurrencies that identifies factors contributing to risk and returns and, therefore, helped guide investment decisions would also obviously be beneficial for future research.

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