

Risk Return Performance of Bitcoin and Alternative Investment Assets in Mixed Asset Portfolios in the Years 2018 to 2020

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Abstract

Research background: Since the financial crisis in 2008, numerous other cryptocurrencies have established themselves in the financial industry alongside Bitcoin. Although the validity of the user cases is still lacking, Bitcoin is already being used extensively in the institutional finance sector, among others. Here, the comparison of Bitcoin to other asset classes in mixed portfolio structures must be taken into account. According to the latter, far-reaching areas of investigation emerge by adding Bitcoin in the evaluation of risk-return ratios of mixed portfolio weightings.

Purpose of the article: The objective of this paper is to examine, within the framework of Harry Markowitz's efficiency theory, the impact of including Bitcoin as an investment asset for the risk-return ratios of mixed portfolio structures.

Methods: The statistical analysis is based, among other things, on paired sample tests, where the return and volatility values are tested for significant differences in the selected test values.

Findings & Value added: The statistical investigations show that the introduction of Bitcoin leads to advantageous return structures, but at the same time to significantly increased volatility values of the examined portfolio constellations. Setting a regional focus of the investment assets in the investigations led to a simplified evaluation basis and at the same time offers the scientific space for further investigations.

Keywords: *bitcoin; portfolio; risk return performance*

JEL Classification: *D53; G32; O32; F30; E22*

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1 Introduction

In recent years, especially during periods of global economic downturns such as in 2001, 2008, and 2020, alternative assets showed a significant diversification effect when considering mixed asset portfolios (Candelon et al., 2021). In this context, research papers have already comprehensively addressed the research findings of Markowitz (1952, 1976) and reviewed the importance of portfolio diversification effects. The incorporation of alternative investment assets, such as the classification of cryptocurrencies, has developed new areas of investigation that underlie an interdisciplinary study in comparison to alternative investment assets. Cryptocurrencies are based on the Blockchain technology. It has a wide variety of use cases going as far as smart grids, that automatically buy and sell sustainable electricity between households without the need for an intermediary (Kavousi-Fard et al., 2021). As investment decisions in global portfolio management are increasingly guided by a more intensive focus on returns, the importance of alternative asset classes has come into focus at least since the economic crisis in 2008 (PwC, 2018). In this context, asset classes are influenced by comparable macroeconomic factors due to globalized financial and commodity flows, so that an interdisciplinary linkage has to be considered and novel influencing factors affect the entire global economy (Gerster, 2005). Following this trend, the World Wealth Report by Capgemini and Merrill Lynch projected (2019) that investors increase their share of “alternative” assets by USD 2.7 trillion from USD 11.2 trillion to USD 13.9 trillion between 2017 and 2020 (Capgemini, 2019). Following this finding, the advancing importance of alternative assets, particularly cryptocurrencies, has come to the forefront of global interest and research since the publication of the white paper “Bitcoin: A Peer-to-Peer E-cash System” (Nakamoto, 2008). Hsu et al. (2021), Urquhart & Zhang (2018) and also Jareño et al. (2020) found, that cryptocurrencies can be considered as a safe haven in certain scenarios. Hsu et al. (2021) concluded that cryptocurrencies are an effective risk management tool when diversifying a portfolio. Akhtaruzzaman et al. (2020) confirm that Bitcoin provides an effective hedging mechanism. Also Bhuiyan et al. (2021) and Kang et al. (2020) found that Bitcoin may offer a diversification benefit to an investment portfolio. In the shadow of ever-advancing central bank efforts to digitize the cash-dominated monetary system (Pichler et al., 2020), Bitcoin in particular, and subsequently other cryptocurrencies, have shown significant growth progress. This is due to the many advantages cryptocurrencies offer, such as low transaction costs (Tsang & Yang, 2021). In line with this trend, there are more and more companies, such as Microsoft or Tesla, that have announced transparent support for Bitcoin as an official means of payment (Beigel, 2020). Bitcoin as the market-leading cryptocurrency with a current market share of about 43.9 % (Coinmarketcap, 2021) is continuously taking a more significant position, as mentioned before. Especially due to the growing acceptance and popularity of Bitcoin, the investment value benefits. Nevertheless, research in the field of cryptocurrencies remains scarce and needs to mature according to Corbet et al. (2019). Here, as shown in the research chapters, the comparatively increased fluctuations in returns and volatility are essential to consider (Inci and Lagasse, 2019). Following the global market trend, the World Economic Forum was quick to ascribe cryptocurrencies a far-reaching radius of importance according to the report “Deep Shift Technology Tipping Points and Societal Impact” (World Economic Forum, 2015). This finding was extended by a far-reaching statement as part of the “Great Resets” publications (World Economic Forum, 2021), with an assigned council proclaiming that “Cryptocurrencies have reached a point of inevitability” (World Economic Forum, 2020). This is an observation which will be followed within this publication. Below are the research findings of a scholarly examination of the relevance of Bitcoin and alternative assets when considering mixed asset portfolios.

2 Methods

2.1 Research methodology

The study focuses on the analysis of the risk-return relationship of mixed portfolios. For this purpose, Bitcoin is inserted as an alternative asset class in a mixed portfolio. The aim is to examine whether an improvement of the risk-return structures of the portfolios examined is possible. This fact is measured by three ratios: firstly, the portfolio return comparison, secondly, the portfolio risk comparison and finally, the Sharpe ratio, which takes both aspects into account in a common ratio. The returns are calculated as discrete returns over a period from 2018 to 2020 with the periodicity of one day. These daily returns serve as input for the determination of the portfolio return. The portfolio is constructed in three ways with the different weightings of the individual research values:

1. Equal Weights Portfolio
2. Minimum Variance Portfolio
3. Maximum Return Portfolio

The study values are listed below and are aligned by a broad diversification of the possible mixed asset portfolios.

Table 1. Research data: asset classes.

Name	Mnemonic	Asset class
BTC-USD Index	btcusd	Cryptocurrency
S&P U.S. Treasury Bill Index	billus	Money Market
S&P U.S. Treasury Bond Index	condus	Fixed-income
Dow Jones Equal Weights U.S. Issued Corporate Bonds	corpus	Fixed-income
S&P WCI Gold (ER)	gold	Gold ETF
S&P 100	Sp100	Equity (large cap)
S&P 500	Sp500	Equity (mid cap)
S&P WCI	Wcig	Commodities
Dow Jones U.S. Real Estate Index	Resus	Real Estate
Dow Jones FXCM Dollar Index	usdollar	Currency

Source: own representation

As a result of the selected study values, the price data for the following three research periods were evaluated.

Table 2. Research data: research periods.

1. Research period	January 1 st , 2018 – December 31 st , 2018
2. Research period	January 1 st , 2019 – December 31 st , 2019
3. Research period	January 1 st , 2020 – December 31 st , 2020

Source: own representation

Finally, the study asset Bitcoin was examined with selected study assets for correlations of return-portfolio ratios.

3 Results and Discussion

The mixed-asset portfolios under study have been examined by adding Bitcoin as an alternative investment asset during the three research periods. The individual portfolios are presented below.

Table 3. Research data: mixed-asset portfolio Jan. 1st, 2018 – Dec. 31st, 2018.

Name	Annual return	Annual standard deviation
BTC-USD Index	-72.95 %	69.66 %
S&P U.S. Treasury Bill Index	5.01 %	0.14 %
S&P U.S. Treasury Bond Index	15.17 %	4.76 %
Dow Jones Equal Weights U.S. Issued Corporate Bonds	25.47 %	7.53 %
S&P WCI Gold (ER)	-2.9 %	11.07 %
S&P 100	-7.23 %	21.24 %
S&P 500	-7.6 %	20.4 %
S&P WCI	-16.06 %	23.11 %
Dow Jones U.S. Real Estate Index	-7.41 %	18.38 %
Dow Jones FXCM Dollar Index	3.29 %	4.7 %

Source: own representation

Table 4. Research data: mixed-asset portfolio Jan. 1st, 2019 – Dec. 31st, 2019.

Name	Annual return	Annual standard deviation
BTC-USD Index	94.51 %	57.02 %
S&P U.S. Treasury Bill Index	2.33 %	0.12 %
S&P U.S. Treasury Bond Index	6.02 %	4.33 %
Dow Jones Equal Weights U.S. Issued Corporate Bonds	15.74 %	5.14 %
S&P WCI Gold (ER)	14.69 %	12.45 %
S&P 100	28.98 %	15.3 %
S&P 500	28.71 %	14.9 %
S&P WCI	14.9 %	24.43 %
Dow Jones U.S. Real Estate Index	26.74 %	14.12 %
Dow Jones FXCM Dollar Index	-0.37 %	3.33 %

Source: own representation

Table 5. Research data: mixed-asset portfolio Jan. 1st, 2020 – Dec. 31st, 2020.

Name	Annual return	Annual standard deviation
BTC-USD Index	301.32 %	71.96 %
S&P U.S. Treasury Bill Index	0.72 %	0.15 %
S&P U.S. Treasury Bond Index	6.87 %	6.29 %
Dow Jones Equal Weights U.S. Issued Corporate Bonds	10.35 %	11.09 %
S&P WCI Gold (ER)	22.42 %	24.26 %

S&P 100	149.55 %	137.16 %
S&P 500	15.29 %	41.15 %
S&P WCI	-10.71 %	41.33 %
Dow Jones U.S. Real Estate Index	-7.46 %	49.78 %
Dow Jones FXCM Dollar Index	-4.26 %	5.74 %

Source: own representation

In the comparison of the individual study values, it was possible to determine that consistently increased risk-return performances can be observed when looking at the BTC-USD index. Here, in the further course, the Sharpe Ratio is to be considered, according to which a risk ratio is calculated based on the difference between the excess return of the respective asset compared to the risk-free interest rate and the subsequent division by the empirical standard deviation (Trautman, Dorman, 2018). For this purpose, the study period from January 1st, 2018 to December 31st, 2020 is presented below for the study of mixed asset portfolios with and without the inclusion of Bitcoin.

Table 6. Research data: portfolio including Bitcoin, Jan. 1st, 2018 – Dec. 31st, 2020.

Mixed-asset portfolio: Jan. 1 st , 2018 – Dec. 31 st , 2020 including Bitcoin	Minimum variance	Naïve equal weights	Maximum return
BTC-USD Index	0.15 %	10 %	0.00 %
S&P U.S. Treasury Bill Index	71.75 %	10 %	0.00 %
S&P U.S. Treasury Bond Index	8.97 %	10 %	0.00 %
Dow Jones Equal Weights U.S. Issued Corporate Bonds	2.89 %	10 %	0.00 %
S&P WCI Gold (ER)	0.85 %	10 %	0.00 %
S&P 100	0.03 %	10 %	100 %
S&P 500	0.89 %	10 %	0.00 %
S&P WCI	0.21 %	10 %	0.00 %
Dow Jones U.S. Real Estate Index	0.00 %	10 %	0.00 %
Dow Jones FXCM Dollar Index	14.26 %	10 %	0.00 %
Portfolio return	2.11 %	14.11 %	67.68 %
Portfolio variance	0.01 %	2.21 %	65.35 %
Portfolio volatility	0.73 %	14.86 %	80.84 %
$R_{(f)}$	0.17 %	0.17 %	0.17 %
Sharpe Ratio	2.65	0.94	0.84
Slope	2.89	0.95	0.84

Source: own representation

Table 7. Research data: portfolio excluding Bitcoin, Jan. 1st, 2018 – Dec. 31st, 2020.

Mixed-asset portfolio: Jan. 1 st , 2018 – Dec. 31 st , 2020 including Bitcoin	Minimum variance	Naïve equal weights	Maximum return
S&P U.S. Treasury Bill Index	95.52 %	11.111 %	0.00 %
S&P U.S. Treasury Bond Index	2.36 %	11.111 %	0.00 %

Dow Jones Equal Weights U.S. Issued Corporate Bonds	0.00 %	11.111 %	0.00 %
S&P WCI Gold (ER)	0.03 %	11.111 %	0.00 %
S&P 100	0.00 %	11.111 %	100.0 %
S&P 500	0.18 %	11.111 %	0.00 %
S&P WCI	0.04 %	11.111 %	0.00 %
Dow Jones U.S. Real Estate Index	0.03 %	11.111 %	0.00 %
Dow Jones FXCM Dollar Index	1.85 %	11.111 %	0.00 %
Portfolio return	1.73 %	11.68 %	67.68 %
Portfolio variance	0.00 %	1.96 %	65.35 %
Portfolio volatility	0.18 %	14.01 %	80.84 %
$R_{(t)}$	0.17 %	0.17 %	0.17 %
Sharpe Ratio	8.44	0.82	0.84
Slope	9.38	0.83	0.84

Source: own representation

It can be seen that the inclusion of Bitcoin as an alternative asset in the Naive Equal Weights portfolio improves the portfolio return by 2.43 %, but at the same time increases the portfolio risk by 0.85 %. In the case of the Sharpe ratio, the inclusion of Bitcoin represents an improvement of 0.12. When looking at the individual study periods, the question arises as to the significance of the possible correlations between the study values and Bitcoin. For this purpose, the annual returns of the individual investigation values can be taken into account, after which, when considering the risk-return performance, it is possible to take into account correspondingly positively or negatively correlated investigation values. In the following, four study values are selected for evaluation as excerpts, since these are to show a comparability according to the possible investment significance of Bitcoin as an investment value.

Table 8. Research data: asset classes – SPSS/Correlations of returns.

Name	Mnemonic	Asset class
BTC-USD Index	btcusd	Cryptocurrency
S&P WCI Gold (ER)	gold	Gold ETF
S&P 100	Sp100	Equity (large cap)
Dow Jones FXCM Dollar Index	usdollar	Currency

Source: own representation

To examine the correlations, the software “SPSS”, a program of the IBM company that allows to compare power-intensive statistical investigation values and to set up automated comparison functions by software-supported computations, is used.

Table 9. Research data: Pearson correlation, Sig. (2-tailed) and N Matrix.

		BTC-USD Index	S&P WCI Gold (ER)	S&P 100	Dow Jones FXCM Dollar Index
BTC-USD Index	Pearson correlation	1	0.961**	0.971**	-0.999**

	Sig. (2-tailed)		0.000	0.000	0.000
	N	57	57	57	57
S&P WCI Gold (ER)	Pearson correlation	0.961**	1	0.867**	-0.972**
	Sig. (2-tailed)	0.000		0.000	0.000
	N	57	57	1	57
S&P 100	Pearson correlation	0.971**	0.867**	1	-0.960**
	Sig. (2-tailed)	0.000	0.000		0.000
	N	57	57	57	57
Dow Jones FXCM-Dollar Index	Pearson correlation	-0.999**	-0.972**	-0.960**	1
	Sig. (2-tailed)	0.000	0.000	0.000	
	N	57	57	57	57

Source: own representation

The following is an excerpt of the essential information from the SPSS studies conducted. The strength and direction of the correlation must be taken into account in the calculation (Trautman and Dorman, 2018). Accordingly, when considering the correlation examinations based on the returns, the examination value “BTC-USD index” is highly significantly positively correlated in particular with the alternative examination value “S&P-WCI-Gold-(ER)” with 0.961 as well as with examination value “S&P 100” with 0.971, whereas it is highly significantly negatively correlated with the examination value “Dow-Jones-FXCM-Dollar-Index” with -0.999. Thus, there are corresponding potentials for risk diversification in the context of an investment portfolio with Bitcoin as an alternative investment. The following overview of the investigation results of the previously presented investigation values from Tab. 1, taking into account the admixture of Bitcoin, presents the potentials based on the Sharpe ratio for the overall horizon from 2018 to 2020.

Table 10. Research results 2018-2020: Sharpe ratios of mixed asset portfolios.

Years	Portfolio structure	Portfolio variance	Minimum variance	Naïve equal weights	Maximum return
2018-2020	Including Bitcoin	Sharpe Ratio	2.65	0.94	0.84
2018-2020	Excluding Bitcoin	Sharpe Ratio	8.44	0.82	0.84

Source: own representation

To complete the investigation picture, the investigation values of the individual years from 2018 to 2020 are presented individually below using the Sharpe ratio, so that an individual consideration of the annual results is possible.

Table 11. Individual research results 2018-2020: Sharpe ratios of mixed asset portfolios.

Years	Portfolio structure	Portfolio variance	Minimum variance	Naïve equal weights	Maximum return
2018	Including Bitcoin	Sharpe Ratio	14.99	-0.7	3.36

2018	Excluding Bitcoin	Sharpe Ratio	34.53	0.1	3.36
2019	Including Bitcoin	Sharpe Ratio	5.45	3.02	1.65
2019	Excluding Bitcoin	Sharpe Ratio	15.37	2.7	0.60
2020	Including Bitcoin	Sharpe Ratio	1.47	2.12	1.09
2020	Excluding Bitcoin	Sharpe Ratio	0.95	0.9	1.09

Source: own representation

The listed results show that both portfolio performance and portfolio risk are strongly dependent on market phases. During 2020, for example, the mixed-asset portfolio including bitcoin performed significantly better than without its addition. It would have to be investigated separately whether this effect can be attributed to the influence of the COVID-19 pandemic. In an equally weighted naive equals strategy, the admixture of Bitcoin always makes sense with the exception of 2018. In each of the individual years examined, the mixed-asset portfolio with Bitcoin outperforms the portfolio without Bitcoin.

4 Conclusion

The analyses lead to the conclusion that when considering the risk-return constellations of the mixed-asset portfolios including Bitcoin, a comparable investment to the alternative investment value S&P-WCI-Gold-(ER) and equally to the traditional investment value of shares of the S&P 100 could be presented using the example. Due to the strong negative correlation to the Dow-Jones-FXCM-Dollar-Index, there is sufficient potential for a diversification of the portfolio risk. As a result of this, the possible improvement through the inclusion of Bitcoin as an alternative investment value in mixed-asset portfolios can also be noted when considering the Sharpe ratios.

When looking at the naive equal weights portfolios, a continuous improvement of the Sharpe ratio is noticeable when looking at the annual evaluations. Only in 2018 did the Sharpe ratio turn out worse when looking at the individual values due to the inclusion of Bitcoin. In 2019 and 2020, it turned out more positive due to the inclusion of Bitcoin as an alternative asset. This leads in the whole consideration to the research result that by the admixture of the investigation value “BTC-USD index” in mixed asset portfolios, an improvement of the return-risk constellation comes about. This is shown through the improved Sharpe ratio on the one hand and the highly significant correlation evaluations on the other hand. This scientific elaboration shall serve as an outlook after which the possible importance of Bitcoin as a new asset class was presented in the context of the conducted research.

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