ERASMUS UNIVERSITY ROTTERDAM

ERASMUS SCHOOL OF ECONOMICS

BSc International Bachelor Economics and Business Economics

Can Bitcoin Offer Diversification Benefits?

A perspective on the COVID-19 pandemic and the China ban on cryptocurrencies.

Author: S.G. Morsink

Student number: 528440

Thesis supervisor: Dr. J.J.G. Lemmen

Second reader: Dr. R. de Bliek

Finish date: June, 2022

PREFACE AND ACKNOWLEDGEMENTS

Since last year, Bitcoin has drawn my attention as an investment option. During the first years after the coin was founded, I could hardly understand its value and was amazed by the prices it reached. I was more interested in traditional assets and therefore had not much attention for cryptocurrencies. However, during the past year I have read books and articles, watched YouTube videos and listened to numerous amounts of podcasts about cryptocurrencies and Bitcoin. Here, I got a glimpse of how mature the asset already has become. Therefore, I wanted to observe whether Bitcoin can already be of use in the portfolios of professional and institutional investors.

My gratitude goes to J.J.G. Lemmen who has guided me in writing this thesis and was always available for consult. I would also like to thank my family and friends for their support when writing this thesis.

ABSTRACT

Bitcoin has gained much in value in the past years. Therefore, it has drawn the attention of many new investors who consider the cryptocurrency for portfolio diversification. This research considered how Bitcoin performed before and after the COVID-19 pandemic and the China ban on cryptocurrencies. This is done by using Markowitz (1952) mean-variance portfolio theory with daily price data on Bitcoin, S&P500, gold and Treasury Yield 30 Years. Furthermore, it is considered how large institutions and organizations view Bitcoin and cryptocurrencies. Based on the results it can be concluded that Bitcoin performed equal to the portfolios without the coin before and during the pandemic and China ban.

Keywords: Markowitz, Bitcoin, COVID-19, Portfolio theory

JEL Classification: G11

TABLE OF CONTENTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1 Introduction

The increasing popularity of cryptocurrencies, and especially Bitcoin, among investors raises the question *whether Bitcoin has diversification benefits to traditional investment portfolios?* This paper tries to answer the question whether traditional investors should invest in Bitcoin to safely diversify their portfolio. As the cryptocurrency already exists for multiple years and has reached significant value, it may become an investment product for professional investors. Figure 1 shows that most Bitcoin trades at Coinbase are already from institutional investors.

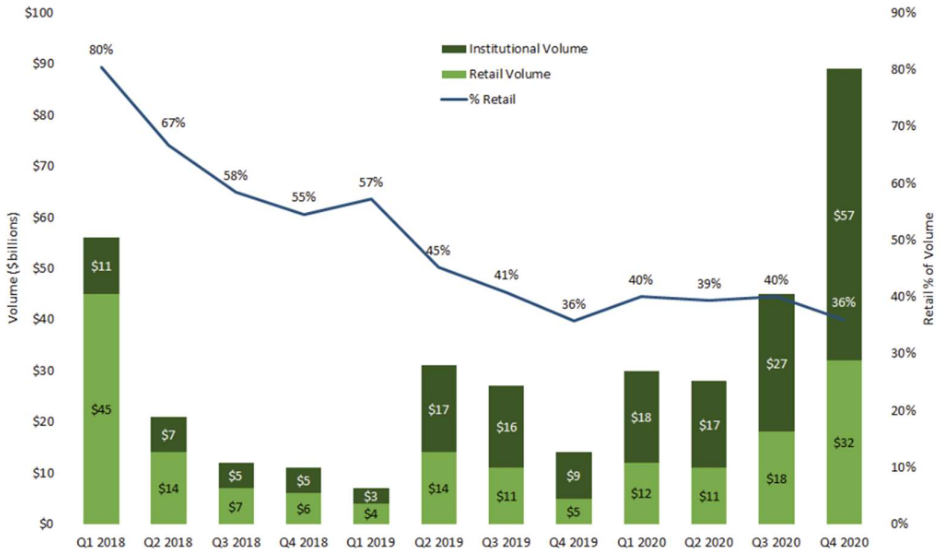

Figure 1. Trading volumes of retail and institutional investors at Coinbase, 2018-2020.

Adapted source: Voell, 2021.

However, Bitcoin is highly volatile. This may be a hurdle for many institutional investors. Furthermore, it is hard to value. It is a legitimate question whether Bitcoin or other cryptocurrencies have intrinsic value. This is shown by former Federal Reserve Chairman Alan Greenspan. Greenspan said "You really have to stretch your imagination to infer what the intrinsic value of Bitcoin is. I haven't been able to do it. Maybe someone else can." (Kearns, 2013). There are no cash flows or dividends that can be discounted, it is therefore hard to value Bitcoin using traditional valuation methods. Nevertheless, much academic research has focused on whether Bitcoin has diversification benefits in a traditional investment portfolio. This research contributes to earlier research by examining the effects that the COVID-19 period, and the China ban on cryptocurrencies have on Bitcoin as potential diversification option for investors.

Chapter 2 will briefly summarize earlier academic research on Bitcoin and whether it has diversification benefits. Chapter 2 also derives the hypotheses. The data that is going to be used to perform all qualitative research is explained in Chapter 3. The fourth Chapter will explain which methodology is used to answer the research question. The results of the research will be presented in Chapter 5. The conclusion of this research will be given in Chapter 6.

CHAPTER 2 Literature Review

Bitcoin was founded in 2008 when Satoshi Nakamoto released a paper called 'Bitcoin: A Peer-to-Peer Electronic Cash System.' Nakamoto described Bitcoin as a form of electronic cash which could be transferred online without a financial institution. Since then, the cryptocurrency has gained a lot of value and is currently worth around 20671 dollars (CoinMarketCap, 2022). This means that, over the years, investing in the coin would have been highly lucrative. Many academic literature has been written on Bitcoin and whether it may have diversification benefits for investors. This section tries to briefly summarize what previous findings are about the subject.

Vejačka (2014) started to research the fundamentals of cryptocurrencies. The study showed that Bitcoin is far more volatile compared to traditional assets like the S&P500 and gold and that this brings extreme risks for traders. Vejačka does highlight that cryptocurrencies have an advantage over other commodities because they are digital and thus more portable. However, the digital character makes it useless in a non-digital environment.

Brière, Oosterlinck and Szafarz (2015) show that Bitcoin has a low correlation compared to traditional and alternative investments. Furthermore, they find that Bitcoin offers diversification benefits. The research mentions that it will be interesting to observe whether the low correlation of Bitcoin compared to other assets will hold in the long run. According to the paper, correlations increase during times of crises, implying that there are no diversification benefits in times when they are needed. This makes it relevant for this research to give a clear view of the effects that the pandemic will have on Bitcoin and whether it still has diversification benefits in times of such as crises.

Akhtaruzzaman, Sensoy and Corbet (2019) used econometric tools to examine the effects of Bitcoin on portfolio diversification. The research makes use of a VARMA DCC-GARCH model and concludes lower conditional correlations between Bitcoin and traditional assets.

Klein, Thu and Walther (2018) have tried to compare Bitcoin to gold and show whether it can be just like gold: a safe haven and a store of value in times of crises. They also apply econometric methods to observe correlations between different assets. The results they find contradict the findings of other research discussed in this chapter. From their point of view, Bitcoin correlates differently compared to gold, and is no safe haven. They even conclude that Bitcoin has a positive correlation with downward markets.

The research of Platanakis and Urquhart (2019) also addresses the question whether investors should make use of Bitcoin. The authors have researched whether adding Bitcoin to a portfolio of stocks and bonds gives benefits to investors based on eight different portfolio construction techniques. Platanakis and Urquhart find that adding Bitcoin increases portfolio return and the Sharpe, Omega and Sortino

ratios. The results that the authors give are optimistic for everyone that invests in crypto. However, the paper does mention that results are based on historic outcomes and never really are good predictors for the future. Again, this makes it relevant to observe how the inclusion of Bitcoin will affect a portfolio during times of crises like the COVID-19 pandemic and the China ban on crypto.

Ghabri, Guesmi and Zantour (2021) have researched whether Bitcoin can be used to reduce liquidity risk. They compared Bitcoin to the MSCI index, gold, oil and real estate. Using multivariate GARCH models, they concluded that Bitcoin has the potential to reduce liquidity risk.

Applying the mean-variance framework to determine optimal portfolio weights for cryptocurrencies is not new. Brauneis and Mestel (2019) used the Markowitz mean-variance method to make a portfolio consisting only of some of the largest cryptocurrencies. Based on daily date, they have made a portfolio out of the 500 most highly capitalized currencies. The outcome showed that a portfolio of different cryptocurrencies has a higher Sharpe ratio compared to only holding a single cryptocurrency.

Some literature has also been written about how Bitcoin performed during the COVID-19 pandemic. Conlon and McGee (2020) tried to answer the question whether Bitcoin was a safe haven during the pandemic by comparing the cryptocurrency to the S&P500. They found out that during the pandemic, Bitcoin was not a safe haven.

Mariana, Ekaputra and Husodo (2021) also tried to answer the question whether Bitcoin and Ethereum could be a safe-haven for stocks during the COVID-19 outbreak. They had different findings compared to Conlon and McGee. According to their research, both Bitcoin and Ethereum are safe-havens for stocks.

Another research that focuses on the impact of the pandemic on Bitcoin as diversifier is the one of Huang, Duan and Mishra (2021). This study focused on potential diversification benefits of Bitcoin compared to stocks and bonds for five economies. Based on the results of the study, Bitcoin can be a diversifier to stocks and bonds for all five different economies.

It becomes clear from previous literature that Bitcoin can be, in most of the cases, an option for investors to diversify their portfolio risk. The cryptocurrency has a low correlation compared to other traditional financial assets and has exceptional returns. On the contrary, there are some drawbacks. Bitcoin is relatively new and performances in the past are not always good predictors for the future. It is highly relevant to see how the cryptocurrency behaves during hectic times or during crises. The first hypothesis of this research will be the following: *Bitcoin has still diversification benefits after the COVID-19 outbreak*. Proves the coin itself to be a safe haven during difficult times? Or did investors sell their Bitcoin out of fear for the pandemic?

One of the largest countries in the world, China, made all transactions with cryptocurrencies illegal in September 2021 (BBC, 2021). This obviously had an impact on the price of Bitcoin, it went down with $2000 after the announcement. The second hypothesis of this research: *Bitcoin has still diversification benefits after the China ban on cryptocurrencies.*

As mentioned earlier, Bitcoin is a relatively new asset. Many countries and governments still need to decide how to regulate cryptocurrencies. Investors that are potentially going to add Bitcoin to their portfolio should also take current developments regarding to cryptocurrencies into account. For example, will more countries follow China and forbid the coins like Bitcoin? The third hypothesis of this research is: *Bitcoin is not seen as a threat by Central Banks and leading organizations.*

Table 1 will highlight the most important findings of all research that is covered in this chapter. For every research it will be stated what the methodology is and what the results of the research are.

Table 1: Meta table describing important literature.

Author(s) (Publication year)	**Time period**	**Region**	**Method**	**Results**
Vejačka	2010-2014	Global	Volatility of Bitcoin and Litecoin is compared to other traditional assets	Volatility of Bitcoin and Litecoin is far higher than of other assets
Brière, Oosterlinck and Szafarz (2015)	2010-2013	US	Spanning tests	Bitcoin offers diversification benefits
Klein, Thu and Walther (2018)	2011-2018	Global	BEKK-GARCH	Bitcoin correlates positive with market movements
Akhtaruzzaman, Sensoy and Corbet (2019)	2011-2018	Global	VARMA DCC-GARCH	Bitcoin offers lower dynamic conditional correlations
Brauneis & Mestel (2019)	2015-2017	Global	Markowitz mean-variance	Combining cryptocurrencies in a portfolio gives the lowest variance portfolio
Conlon and McGee (2020)	2019-2020	US	Two-moment VaR to measure risk	Bitcoin moves in the same direction as S&P500. Therefore not a safe haven
Platanakis and Urquhart (2020)	2011-2018	US	Multiple portfolio optimization techniques. Among these techniques is also the framework of Markowitz (1952)	Bitcoin improves the risk-adjusted returns of portfolios
Mariana, Ekaputra and Husodo (2021)	2019-2020	US	DCC-GARCH to observe dynamic correlations. Also an OLS is used	Bitcoin and Ethereum can be both safe-havens for stocks
Huang, Duan, Mishra (2021).	2019-2020	Australia, Canada, Europe, U.K. and U.S.	Bayesian PVAR is used to observe interaction and heterogeneity between economies	Bitcoin can be a diversifier to stocks and bonds for all economies

CHAPTER 3 Data

Daily price data of Bitcoin, S&P500, gold and the Treasury Yield 30 Years (here after: Treasury Yield) between March 11, 2018 and March 29, 2022 will be used. All the data has been retrieved from Yahoo Finance!. Note, whereas most financial markets are closed on holidays and weekends, Bitcoin is traded every day, 24 hours per day. Therefore, Bitcoin price data on weekends and holidays is not considered to make it align with the data of the other assets. The returns are calculated by taking the natural logarithm of the closing price with respected to the closing price on the day before. This is illustrated with the following formula:

$$Ri = \log \frac{P,t}{P,t-1}$$

Ri illustrates the daily return of asset *i* where *P,t* is the adjusted closing price on day t of asset *i* and *P,t-1* is the adjusted closing price on the day before t of asset *i*.

To calculate the Sharpe ratios, the 2-year and 1-year U.S. Treasury rates are used as measure for the risk-free rate. The 2-year rate is 2.612% and the 1-year rate is 2.010%. These are retrieved from MarketWatch on May 23, 2022. The 2-year rate is used for the COVID portfolios and the 1-year rate is used for the China portfolios.

Tables 2, 3, 4, 5 and 6 will give an overview of the descriptive statistics of the returns of Bitcoin, the S&P500, gold and the Treasury Yield.

Table 2. Descriptive statistics of the daily returns of Bitcoin, S&P500, gold and Treasury Yield between March 12, 2018 and March 29, 2022.

	Mean	**Median**	**Std. Dev.**	**Minimum**	**Maximum**	**Skewness**	**Kurtosis**
Bitcoin	0.16	0.14	4.57	-46.47	20.30	-0.99	12.08
S&P500	0.05	0.10	1.35	-12.77	8.97	-0.97	17.28
Gold	0.04	0.05	0.98	-5.11	5.95	-0.27	5.58
Treasury Yield	-0.02	-0.03	2.86	-25.98	26.31	-0.46	23.87

Note. Mean, Median, Std. Dev., Minimum and Maximum are in percentages.

Table 3. Descriptive statistics of the daily returns of Bitcoin, S&P500, gold and Treasury Yield between March 12, 2018 and March 10, 2020.

	Mean	Median	Std. Dev.	Minimum	Maximum	Skewness	Kurtosis
Bitcoin	-0.03	-0.03	4.21	-15.90	20.30	0.03	3.17
S&P500	0.01	0.07	1.08	-7.90	4.84	-0.89	8.91
Gold	0.05	0.04	0.74	-4.74	3.53	-0.23	5.24
Treasury Yield	-0.19	-0.16	2.53	-25.98	26.31	-1.87	64.25

Note. Mean, Median, Std. Dev., Minimum and Maximum are in percentages.

Table 4. Descriptive statistics of the daily returns of Bitcoin, S&P500, gold and Treasury Yield between March 12, 2020 and March 09, 2022.

	Mean	Median	Std. Dev.	Minimum	Maximum	Skewness	Kurtosis
Bitcoin	0.33	0.30	4.94	-46.47	19.15	-1.64	16.57
S&P500	0.09	0.15	1.56	-12.77	8.97	-0.96	17.17
Gold	0.04	0.10	1.16	-5.11	5.78	-0.28	4.25
Treasury Yield	0.11	0.13	3.13	-15.14	18.16	0.22	5.86

Note. Mean, Median, Std. Dev., Minimum and Maximum are in percentages.

Table 5. Descriptive statistics of the daily returns of Bitcoin, S&P500, gold and Treasury Yield between March 24, 2021 and September 23, 2021.

	Mean	Median	Std. Dev.	Minimum	Maximum	Skewness	Kurtosis
Bitcoin	-0.15	0.10	4.96	-14.81	10.95	-0.48	0.66
S&P500	0.10	0.12	0.68	-2.17	1.65	-0.27	0.54
Gold	0.01	0.04	0.90	-4.72	1.76	-1.39	5.75
Treasury Yield	-0.16	-0.05	1.90	-6.20	3.87	-0.33	0.36

Note. Mean, Median, Std. Dev., Minimum and Maximum are in percentages.

Table 6. Descriptive statistics of the daily returns of Bitcoin, S&P500, gold and Treasury Yield between September 27, 2021 and March 29, 2022.

	Mean	Median	Std. Dev.	Minimum	Maximum	Skewness	Kurtosis
Bitcoin	0.08	-0.20	3.86	-10.96	11.06	0.30	0.62
S&P500	0.03	0.09	1.14	-3.00	2.54	-0.15	-0.27
Gold	0.07	0.11	0.95	-2.69	2.29	-0.23	0.39
Treasury Yield	0.19	0.13	2.55	-7.49	5.95	-0.19	-0.05

Note. Mean, Median, Std. Dev., Minimum and Maximum are in percentages.

CHAPTER 4 Method

The fist hypothesis that is going to be tested is the following: *Bitcoin has still diversification benefits after the COVID-19 outbreak.* To do this, a Markowitz (1952) mean-variance framework is used to calculate optimal portfolio weights that will minimize the variance of each portfolio that will be considered in this research. In this research, short selling is not allowed. One portfolio will include the S&P500, Treasury Yield and gold, whereas the other portfolio will also have these assets, but also includes Bitcoin.

For both portfolios, it will be considered how they performed before the outbreak of COVID-19, and the period during the pandemic. It is of importance to observe whether Bitcoin shows diversification benefits before the pandemic, and whether the pandemic changed this or not. This will perfectly show the impacts of such an event on Bitcoin as potential diversification asset. The pre-pandemic period considers daily returns between March 12, 2018 and March 10, 2020. The World Health Organization (WHO) declared on March 11, 2020 that the COVID-19 outbreak was officially a pandemic (WHO, 2020). So, the pandemic period starts on March 12, 2020 and ends on the March 9, 2022. A two-year timespan for both portfolios has been chosen as this is the maximum that could be considered, where the length of days is equal for both time periods. The following formulas were used to calculate portfolio returns and variances.

$$Portfolio\ return\ (Rp) = \sum_{i=1}^{N} Wi\ E(Ri)$$

where Wi is the portfolio weight of asset i and $E(Ri)$ is the expected return of an asset i. The portfolio variance for the portfolios is calculated as follows:

$$Portfolio\ variance = \sum_{i=1}^{N} Wi^2\ Var(Ri) + \sum_{i=1}^{N} 2\ Wi\ Wj\ Covar(Ri, Rj)$$

where $Var(Ri)$ is the variance of the returns of asset i and $Covar(Ri, Rj)$ is the covariance between the returns of assets i and j.

A Sharpe ratio will be calculated for both portfolios to compare the performance of the portfolios. This is calculated with the following formula:

$$Sharpe\ ratio = \frac{Rp - Rf}{\sigma}$$

where Rp represents the portfolio return, Rf the risk-free rate and σ the portfolio standard deviation.

The portfolio which has a statistically significant higher ratio, will have the preference. To test this, a Jobson Korkie (1981) test, which is corrected by Memmel (2003), will be used to test the Sharpe ratios.

$$Z = \frac{SRh - SRl}{\sqrt{V}}$$

where Z is the test-statistic, SRh is the portfolio with the higher Sharpe ratio and SRl the portfolio with the lower Sharpe ratio and V is the asymptotic variance.

$$V = \frac{1}{T}[2 - 2\rho 12 + \frac{1}{2}(SRh^2 SRl^2 - 2\, SRh\, SRl\, \rho 12^2)$$

where T is the amount of returns, and $\rho 12$ the correlation between the two portfolios. The following hypothesis will be tested:

$$H0: SRh = SRl$$

$$H1: SRh > SRl$$

$H0$ is rejected at a 5% significance level if the Z-score is larger than 1.645.

Bitcoin has still diversification benefits after the China ban on cryptocurrencies, is the second hypothesis of this research. It has practically the same method as the first hypothesis but it shifts the attention to a cryptocurrency specific crisis. Again, a portfolio will be built with the Markowitz (1952) framework. Here, we want to see which portfolios perform the best before the ban and after the ban. Because the China ban is very recent, September 24, 2021, both portfolios only track returns during a period of approximately 6 months. The first period of returns starts on March 23, 2021 and lasts until the ban. The second period of returns starts on September 27, 2021 and lasts until March 29, 2022.

As mentioned earlier, *Bitcoin is not seen as a threat by Central Banks and large organizations*, is the third and last hypothesis of this study. This is more of a qualitative hypothesis compared to the more quantitative first two hypotheses. Also, the method will be very different compared to the first two. Literature and articles on current developments of cryptocurrencies and Bitcoin will be analyzed to answer this question. The current views of important economists and political figures will also be taken into account. Main focus here is to inform investors about what is currently happening and what the sentiment of institutions is towards Bitcoin and cryptocurrencies. For example, do central banks view Bitcoin as a danger to their potential future digital currencies? If so, China might not be the last country to forbid cryptocurrencies. Hence, this will be crucial information which investors need to take into account before potentially accepting Bitcoin in their portfolios.

CHAPTER 5 Results

5.1 The effects of the pandemic on Bitcoin

The first hypothesis is that Bitcoin still has diversification benefits after the COVID-19 outbreak. Tables 7 and 8 show the correlations between the S&P500, gold, Treasury Yield and Bitcoin before the pandemic, and during the pandemic.

Table 7. Correlations between the S&P500, gold, Treasury Yield and Bitcoin during the two years before the pandemic.

	S&P500	**Gold**	**Treasury Yield**	**Bitcoin**
S&P500	1			
Gold	-0.15	1		
Treasury Yield	0.48	-0.27	1	
Bitcoin	0.00	0.13	0.07	1

Table 8. Correlations between the S&P500, gold, Treasury Yield and Bitcoin during the two years of pandemic.

	S&P500	**Gold**	**Treasury Yield**	**Bitcoin**
S&P500	1			
Gold	0.17	1		
Treasury Yield	0.32	-0.22	1	
Bitcoin	0.38	0.19	0.02	1

Based on the tables above, Bitcoin does not show much correlation with the other assets. However, during the COVID-19 pandemic, the cryptocurrency starts to show some correlation with respect to the S&P500 and gold. Table 9 highlights the portfolio weights of the assets in the four different portfolios based on the mean-variance analysis.

Table 9. Portfolio weights of the different portfolios.

	Without Bitcoin before pandemic (portfolio 1)	**With Bitcoin before pandemic (portfolio 2)**	**Without Bitcoin during pandemic (portfolio 3)**	**Without Bitcoin before pandemic (portfolio 4)**
S&P500	30.23%	29.82%	32.47%	31.59%
Gold	64.05%	62.80%	59.43%	57.34%
Treasury Yield	5.53%	5.42%	8.10%	7.90%
Bitcoin	-	1.96%	-	3.17%

Pre-COVID, Bitcoin gets a small percentage to the portfolio. During the pandemic, things slightly change. Bitcoin gets a stake of 3.17% in the portfolio in which it is considered. Gold has the largest position in all portfolios, where the S&P500 follows at a second place. Table 10 shows the performances of the four different portfolios.

Table 10. Annualized performances of portfolios before and during the pandemic.

	Portfolio 1	**Portfolio 2**	**Portfolio 3**	**Portfolio 4**
Expected portfolio return	7.47%	7.08%	23.20%	25.21%
Portfolio variance	1.29%	1.27%	2.90%	2.82%
Sharpe ratio	0.43%	0.40%	1.21%	1.35%

Table 11. Z-scores for the Memmel (2003) Sharpe ratio test for the portfolios before and during the pandemic.

Test	**Z-score**
Portfolio 1 > Portfolio 2	0.02
Portfolio 4 > Portfolio 3	0.07

The portfolios before the COVID-19 pandemic both show similar characteristics with respect to return and variance, where the portfolio without Bitcoin has a higher expected return and variance. Hence, it is not surprising to observe an almost equal Sharpe ratio for both portfolios, were the ratio for the portfolio without Bitcoin is slightly higher. To observe whether the Sharpe ratio of the portfolio is statistically higher, the Jobson Korkie test is used. From table 11 it becomes clear that the Z-score is 0.02. As this is smaller than 1.645, it cannot be statistically concluded that the portfolio without Bitcoin has a higher Sharpe ratio. Hence, the portfolio with Bitcoin performed equal to the portfolio without the asset. During the pandemic, the portfolio with Bitcoin had a higher Sharpe ratio and expected return, whereas the portfolio without Bitcoin performed better in terms of variance. It is tested whether the Sharpe ratio of the portfolio with Bitcoin is statistically higher compared to the portfolio without Bitcoin. Again, the resulting 0.07 is smaller than 1.645 which means that the null hypothesis of equal Sharpe ratios cannot be rejected. Thus, both portfolios performed the same. Because the Bitcoin portfolios did not perform worse or better compared to the non-Bitcoin portfolios, it can be used as diversifier. But it does not show clear benefits compared to a regular portfolio.

5.2 The effects of the China ban on cryptocurrencies on Bitcoin

According to the second hypothesis, Bitcoin has still diversification benefits after the China ban on cryptocurrencies. First, tables 12 and 13 will highlight the correlations, before and after the ban, between all the different assets.

Table 12. Correlations between the S&P500, gold, Treasury Yield and Bitcoin during the 6 months before the China ban.

	S&P500	**Gold**	**Treasury Yield**	**Bitcoin**
S&P500	1			
Gold	0.21	1		
Treasury Yield	0.17	-0.17	1	
Bitcoin	0.27	-0.05	-0.08	1

Table 13. Correlations between the S&P500, gold, Treasury Yield and Bitcoin during the 6 months after the ban.

	S&P500	**Gold**	**Treasury Yield**	**Bitcoin**
S&P500	1			
Gold	-0.29	1		
Treasury Yield	0.23	-0.21	1	
Bitcoin	0.41	0.04	0.13	1

Tables 12 and 13 show that Bitcoin and the S&P500 show light correlations. The cryptocurrency shows almost no correlation with respect to the other assets. From table 14 the different portfolio weights can be observed.

Table 14. Portfolio weights of both portfolios during the 6 months prior to the China ban on cryptocurrencies.

Portfolio weights	**Without Bitcoin, before ban (portfolio 5)**	**With Bitcoin, before ban (portfolio 6)**	**Without Bitcoin, after ban (portfolio 7)**	**With Bitcoin, after ban (portfolio 8)**
S&P500	58.61%	57.96%	38.10%	36.87%
Gold	33.78%	33.41%	54.32%	52.58%
Treasury Yield	7.61%	7.53%	7.58%	7.34%
Bitcoin	-	1.10%	-	3.21%

Based on the pre-ban analysis, Bitcoin gets allocated 1.10% in the portfolio where the coin is considered. After the ban, based on the mean-variance analysis, the coin gets 3.21% allocated in the portfolio. Table 15 gives an insight into the performances of the four different portfolios, whereas table 16 shows the Z-scores of the Sharpe ratio tests that have been performed.

Table 15. Annualized performance of portfolios before and after the China ban.

	Portfolio 5	**Portfolio 6**	**Portfolio 7**	**Portfolio 8**
Expected portfolio return	18.52	17.69%	23.11%	23.31%
Portfolio variance	0.99%	0.98%	1.79%	1.73%
Sharpe ratio	1.66%	1.58%	1.58%	1.62%

Table 16. Z-scores for the Memmel (2003) Sharpe ratio test for the portfolios before and after the China ban.

Test	**Z-score**
Portfolio 5 > Portfolio 6	0.03
Portfolio 8 > Portfolio 7	0.02

Before the ban, the portfolios with and without Bitcoin performed almost equal, where the portfolio without Bitcoin has a better Sharpe ratio but a higher variance. Therefore, it is tested whether the Sharpe ratio of the portfolio without Bitcoin is statistically higher compared to the Sharpe ratio of the portfolio with Bitcoin. The resulting Z-score of 0.03 is lower than 1.546 which means that it cannot be statistically concluded that the portfolio without Bitcoin has a higher Sharpe ratio. Hence, the portfolios performed equal with respect to risk versus return. After the ban, the portfolio with Bitcoin has a slightly better return, variance and Sharpe ratio. Again, the Z-score is rejected as 0.02 is lower than the critical value. This means that both portfolios also performed equal after the ban. It means that a portfolio with Bitcoin did not perform worse or better and the China ban on cryptocurrencies did not change this. Furthermore, it cannot be concluded that a portfolio with Bitcoin shows clear benefits compared to a portfolio without the cryptocurrency.

5.3 How do large institutions view Bitcoin?

So far, we have only considered how Bitcoin performed in the past and whether it has proven itself as a mature diversification option for a professional portfolio. Because it is a relatively new technology and it is still in adoption, some important fundamental developments should be taken into account. Last year, in June 2021, the country El Salvador issued a law which made Bitcoin legal tender in the country (PwC, 2021). You can imagine that if more countries would follow and adopt Bitcoin, huge gains can be made by investing in the coin. On the contrary, there are many institutional forces that have objections to Bitcoin and this might be a risk to investors. For example, the IMF asked El Salvador to stop using Bitcoin as legal tender (BBC, 2022). These are some serious threats that investors should take into account.

It becomes clear that more governments and institutions do not want to adopt Bitcoin and other cryptocurrencies. The China ban on cryptocurrencies, which is mentioned earlier in this paper, is a good example of this. In a recent interview, the president of the European Central Bank, Christine Lagarde called cryptocurrencies worthless (Browne, 2022). She mentioned that cryptocurrencies are not based on anything and there is no underlying asset. Besides, the ECB is currently considering introducing a central bank digital currency (DNB, 2022). Such a digital euro could become a competitor for Bitcoin.

Although the skepticism towards the cryptocurrency, it is unlikely that the European Union will ban the digital coin. In 2020, the European Union published the Digital Finance Strategy (Zetzsche et al., 2021). Part of this strategy are the plans of the regulation on Markets in Crypto-Assets (MiCA). This means that new legislation and other rules will enter the market, which brokers and potentially also investors have to adhere to. The new legislation will also aim to help protect consumers and investors of risks that come along with cryptocurrencies (Deloitte, 2021). It also needs to help bring more stability into crypto markets and prevent criminal use of cryptocurrencies.

Joe Biden, the president of the United States, has very recently signed an order for the U.S. government to analyze potential risks and benefits of cryptocurrencies (Browne, 2022). Biden asked to focus on areas that the European Union also wants to address with their MiCA legislation. The order also called for ways to make the U.S. more competitive in the field of digital asset technologies. This might be good news for crypto investors as it implies that the U.S. government is taking cryptocurrencies, and thus Bitcoin, serious. The order also asked to examine the potentials of a digital dollar. Again, this is also something the European Union is considering, and it still needs to be determined how this will coexist alongside cryptocurrencies.

In 2020, Christine Lagarde talked about the rise of stablecoins (Lagarde, 2020). Stablecoins have become popular because they are pegged to fiat currency, which should bring price certainty to investors. However, Lagarde already mentioned the risks that these stablecoins bring. For example, if an issuer of a stablecoin can't guarantee the fixed price, a run could occur. Something like this happened back in May, when the coin LUNA and its stablecoin plummet (Ostroff, 2022). This also had an effect on the price of Bitcoin, and thus its volatility. Events like these show that the cryptocurrency market is still not mature and brings risks to investors. It is therefore a good development that policymakers are preparing legislation to protect investors and consumers.

A study performed in 2021 by Fidelity Digital Assets gave positive signals for cryptocurrency adoption among institutional investors (Neureuter, 2021). The study surveyed 1100 professional investors around the world. Out of the respondents, 52% already invested in digital assets, whereas 70% had a neutral-to-positive perception to digital assets. There are also some drawbacks regarding the adoption of digital assets according to the study. It mentioned that 54% of investors surveyed found price volatility one of the largest hurdles for investing in digital assets.

The third hypothesis that Bitcoin is not seen as threat by Central Banks and large institutions can be answered positively based on previous findings. Although many institutions recognize risks that come along with cryptos and Bitcoin, they do not wish to ban them. It is the focus to bring in new legislation that will bring standards into the markets and decrease financial risks. The U.S. even see blockchain and the technology that it brings as a chance, rather than a threat.

Chapter 6 CONCLUSION

This paper answers the question whether Bitcoin has diversification benefits for traditional investment portfolios. Three hypotheses have been researched that help answering the main research question. Hypothesis one stated that Bitcoin still has diversification benefits after the COVID-19 outbreak. Based on the results of the mean-variance analysis before and after the pandemic, both portfolios that include Bitcoin performed equal to the ones without Bitcoin. It can be concluded that Bitcoin is a diversification option for investors, but it does not show clear benefits. Furthermore, the pandemic did not change the role of Bitcoin as diversifier. The second hypothesis is that Bitcoin still has diversification benefits after the China ban on cryptocurrencies. Portfolios before and after the China ban show similar results compared to the results of the first hypothesis. The portfolios with Bitcoin performed equally well compared to the traditional portfolios. This implies that, again, Bitcoin can be used as diversifier, but it does not make the portfolio perform better or worse. The third hypothesis is that Bitcoin is not seen as a threat by Central Banks and large institutions. Although there are many Bitcoin critics and some countries have forbidden cryptocurrencies, the European Union and the U.S. want to regulate cryptocurrencies. The European Union is very close to integrating the MiCA legislation which should bring more stability and safety to European crypto markets. Developments like these are hopeful for Bitcoin investors as it may pave the way for a more professional crypto market which could attract even more professional investors.

Based on the results it can be concluded that Bitcoin does not show clear diversification benefits to traditional investment portfolios. This differs compared to the papers by Mariana, Ekaputra and Husodo (2021) and Huang, Duan and Mishra (2021). Both papers conclude that Bitcoin was a safe haven during the COVID-19 pandemic. It is interesting to see that major shocks to the market, like the pandemic and China ban on cryptocurrencies, do not have much impact on the role of Bitcoin as diversifier. Also, legislation for cryptomarkets could help Bitcoin to become a reliable financial asset. Furthermore, some portfolios that included Bitcoin in this research, did already show lower absolute terms of variance and higher expected returns compared to portfolios without the coin. Therefore, this research sees positive signals for Bitcoin to show serious diversification benefits to investors.

Limitations to this research are the lack of presence of data. As the pandemic and the China ban are very recent, there is only about 2 years and 6 months of data, respectively, available. It still needs to be shown whether the conclusions drawn hold when comparing the assets long term. Furthermore, only daily data is considered in this research. Conclusions could change when intra-day data is being used.

REFERENCES

Akhtaruzzaman, Sensoy & Corbet. (2019). The influence of Bitcoin on portfolio diversification and design. *International Review of Financial Analysis, 63*, 431-437.

BBC. (2021). *China declares all crypto-currency transactions illegal*. Retrieved from https://www.bbc.com/news/technology-58678907

BBC. (2022). *IMF urges El Salvador to remove Bitcoin as legal tender*. Retrieved from https://www.bbc.com/news/world-latin-america-60135552

Benninga, S. (2006). *Principles of Finance with Excel*. Oxford University Press Inc.

Brauneis, A., & Mestel, R. (2019). Cryptocurrency-portfolios in a mean-variance framework. *Finance Research Letters, 28*, 259-264.

Brière, M., Oosterlinck, K., & Szafarz, A. (2015). Virtual Currency, tangible return: Portfolio diversification with bitcoin. *Journal of Asset Management, 16*(6), 365-373.

Browne. (2022). *Biden just put out an executive order on cryptocurrencies- here's everything that's in it*. Retrieved from https://www.cnbc.com/2022/03/09/heres-whats-in-bidens-executive-order-on-crypto.html

Browne. (2022). *Christine Lagarde says crypto is worth nothing*. Retrieved from https://www.cnbc.com/2022/05/23/ecb-chief-christine-lagarde-crypto-is-worth-nothing.html#:~:text=European%20Central%20Bank%20President%20Christine%20Lagarde%20thinks%20cryptocurrencies%20aren't,on%20nothing%2C%E2%80%9D%20she%20added.

CoinMarketCap. (2022). *Bitcoin*. Retrieved from https://coinmarketcap.com/currencies/bitcoin/

Conlon, T., & McGee, R. (2020). Safe Haven or Risky Hazard? Bitcoin during the Covid-19 Bear Market, *Finance Research Letters*, *35*, 101554.

Deloitte. (2021). *Digital Finance: European Parliament adopts MiCA Regulation, paving the way for an innovation-friendly crypto regulation*. Retrieved from https://www2.deloitte.com/lu/en/pages/financial-services/articles/digital-finance-european-parliament-adopts-mica-regulation-innovation-friendly-crypto-regulation.html

DNB. *Digital Euro: what, why and how?* Retrieved from https://www.dnb.nl/en/innovations-in-payments-and-banking/digital-euro-what-why-and-how/

Ghabri, Y., Guesmi, K., & Zantour, A. (2021). Bitcoin and liquidity risk diversification. *Finance Research Letters*, *40*, 1-8.

Huang, Y., Duan, K., & Mishra, T. (2021). Is Bitcoin really more than a diversifier? A pre-and post-COVID-19 analysis. *Finance Research Letters*, 43, 102016.

Kearns, J. (2013). *Greenspan Says Bitcoin Bubble Without Intrinsic Currency Value*. Retrieved from https://www.bloomberg.com/news/articles/2013-12-04/greenspan-says-bitcoin-a-bubble-without-intrinsic-currency-value

Klein, T., Thu, H.P., & Walther, T. (2018). Bitcoin is not the New Gold- A comparison of volatility, correlation, and portfolio performance. *International Review of Financial Analysis, 59*, 105-116.

Lagarde, C. (2020). *The future of money-innovating while retaining trust*. Retrieved from https://www.ecb.europa.eu/press/inter/date/2020/html/ecb.in201130~ce64cb35a3.en.html

MarketWatch. (2022). *U.S. 1 Year Treasury Bill*. Retrieved from https://www.marketwatch.com/investing/bond/tmubmusd01y?countrycode=bx

MarketWatch. (2022). *U.S. 2 Year Treasury Note*. Retrieved from https://www.marketwatch.com/investing/bond/tmubmusd02y?countrycode=bx

Mariana C.D., Ekaputra, I.A., & Husodo, Z.A. (2021). Are Bitcoin and Ethereum safe-havens for stocks during the COVID-19 pandemic? *Finance Research Letters, 38, 101798.*

Memmel, C. (2003). Performance Hypothesis Testing with the Sharpe Ratio. *Finance Letters*, *1*, 21-23

Nakamoto, S. (2008). Bitcoin: A Peer-to-Peer Electronic Cash System. Retrieved from https://bitcoin.org/bitcoin.pdf

Neureuter, J. (2021). THE INSTITUTIONAL INVESTOR DIGITAL ASSETS STUDY. Retrieved from https://www.fidelitydigitalassets.com/sites/default/files/documents/2021-digital-asset-study.pdf

Ostroff, C. (2022). *Why Did Cryptocurrencies TerraUSD and Luna Unravel? Stablecoin Price Crash Explained*. Retrieved from https://www.wsj.com/articles/why-did-cryptocurrencies-terrausd-and-luna-unravel-stablecoin-price-crash-explained-11652462779

Platanakis, E., and Urquhart, A. (2020). Should investors include Bitcoin in their portfolios? A portfolio theory approach. *British Accounting Review, 52*(4), 100837.

PwC. (2021). *El Salvador's law: a meaningful test for Bitcoin*. Retrieved from https://www.pwc.com/gx/en/financial-services/pdf/el-salvadors-law-a-meaningful-test-for-bitcoin.pdf

Vejačka, M. (2014). Basic aspects of cryptocurrencies. *Journal of Economy, Business and Financing, 2*(2), 75-83.

Voell, Z. (2021). *Coinbase Institutional, Retail Trading Volume Grew at Equal Rates in 2020*. Retrieved from https://www.coindesk.com/markets/2021/02/25/coinbase-institutional-retail-trading-volume-grew-at-equal-rates-in-2020/

WHO. (2020). *WHO Director-Genera's opening remarks at the media briefing on COVID-19- 11 March 2020*. Retrieved from https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020

Yahoo!Finance. (2022). *Bitcoin USD (BTC-USD)*. Retrieved from https://finance.yahoo.com/quote/BTC-USD/history?p=BTC-USD

Yahoo!Finance. (2022). *Treasury Yield 30 Years (^TYX)*. Retrieved from https://finance.yahoo.com/quote/%5ETYX/history?p=%5ETYX

Yahoo!Finance. (2022). *Gold Aug 22 (GC=F)*. Retrieved from https://finance.yahoo.com/quote/GC%3DF/history?p=GC%3DF

Yahoo!Finance. (2022). *S&P500 (^GSPC)*. Retrieved from https://finance.yahoo.com/quote/%5EGSPC/history?p=%5EGSPC

Zetzsche, D.A., Annunziata, F., Arner D.W., & Buckley, R.P. (2021). The Markets in Crypto-Assets regulation (MiCA) and the EU digital finance strategy. *Capital Markets Law Journal*, *16*(2), 203-225.