

Analysis of the hedge functions of Bitcoin, Gold, and their Portfolios - Based on global events

Kelan Gao *

Department of Finance, School of Economics and Management, Wuhan University, Wuhan, Hubei Province, China

Corresponding author: 2020311051273@whu.edu.cn

Abstract. The global current situation continues to be turbulent. International crises like the Covid-19 epidemic and the continuing Russian-Ukrainian war have thrown the global economy for a loop. As a result, global economic policy uncertainty has spiked due to the resulting spike in energy prices and economic disruptions. During the outbreak of Covid-19, prices of bitcoin (BTC) have moved higher, but its hedging effect is weakening. Also, combined with rising global inflation expectations and the constant rate hikes by central banks against inflation, bitcoin's hedging effectiveness is waning due to its strong correlation with equities. Furthermore, with the outbreak of the Russian-Ukrainian war, the price of gold continued to rise, and the relationship between gold and the global financial market decreased, confirming gold's diversification ability in a crisis. Simultaneously, the link between gold and bitcoin has weakened marginally. Ultimately, preliminary evidence suggests that gold and bitcoin can be used as complements, rather than substitutes, for diversification purposes during a crisis. This article will construct a portfolio about bitcoin and gold, and examine how individual gold and bitcoin and this portfolio performed as hedging assets throughout the Covid-19 pandemic and the Russian-Ukrainian war.

Keywords: Portfolio Theory; Hedging assets; Gold-Bitcoin.

1. Introduction

In times of global outbreaks, the development direction of the world economy can deviate greatly from expectations. The Covid-19 epidemic and the Russian-Ukrainian war have both destabilized the whole planet in past few years. They jeopardized not just lives, but also the global financial balance in only a few months. As a result, many investors began to search the market for appropriate assets to secure the stability of their asset values.

Gold is considered a universal hedging asset because of the metal's actual value itself. Gold demonstrated remarkable safe-haven attributes throughout the 2008 financial crisis [1]. In the United States and the United Kingdom, gold is viewed as a hedge against higher inflation. Furthermore, gold retains its value even when stock market indexes fall. Varieties of studies have demonstrated gold's effectiveness as a hedge asset in several industries [2].

After the financial crisis in 2008, the concept of digital currency started to appear in the public in the background of expansionary monetary policies adopted by all central banks. After the bankruptcy of Lehman Brothers in 2009, Bitcoin was initially presented. This cryptocurrency managed to attract the attention of investors and institutions due to the deteriorating confidence in financial institutions. Bitcoin is equally as scarce, durable, and global as gold. The unincreasing supply ensures that they are stable in value. At the same time, as a metal asset that exists in nature, gold can move around the world without being restricted by any country or company. Bitcoin can move with the internet. The commonality between Bitcoin and gold makes Bitcoin “digital gold”.

Gold's relatively secure capabilities have been studied for a long period. In the European and American financial markets, gold is indeed a narrow hedge asset for equity markets. According to research on the gold-currency relationship, gold may be used to hedge against US dollar risk for long period [3]. Gold can also be used as a hedge against Asian currencies outside of China. Other researchers argue that gold is a poorer hedge against specific assets and that the hedging impact is less substantial [4-6]. Under normal market conditions, the US dollar is a better hedging asset than gold, and gold may only be an effective hedging mechanism during a financial crisis [7].

It has been hotly debated whether bitcoin can be utilized as an insurance asset. Some scholars believe that when the market receives negative shocks, bitcoin is an ideal choice for hedging investors, and its hedging attribute is between gold and the US dollar [8]. Furthermore, bitcoin has been demonstrated to be a safe harbor for stock indexes in bitcoin-friendly economies. [9], which can play a weak hedging role in the stock market. Similarly, other researchers argue that bitcoin is not a suitable hedging asset, has a poor connection with traditional assets, and is best used for diversification [10]. It cannot be used as a hedge asset for the world's major asset type [11]. Therefore, bitcoin is only suitable for investors who expect high returns to include in their portfolios [12]. Some scholars have studied the risk and high return of bitcoin [13] indirectly confirming that bitcoin is not suitable as a hedging tool.

The economic impact of global events on financial markets has always been a hotly debated topic. It's acknowledged that there have been studies that have analyzed Bitcoin and gold, which makes Bitcoin and gold in competition for the most useful hedge asset. So why not build a portfolio of gold and Bitcoin that maximizes their common advantages while avoiding each other's shortcomings as safe haven assets?

This article will conduct a study on the potential of Bitcoin, gold, and the portfolio in hedging market uncertainty, particularly during the Covid-19 and the Russian-Ukrainian war, using portfolio theory to design optimum gold-bitcoin portfolios. The rest of the paper is structured as follows. Section 2 describes the prior data processing and introduces the technique. Section 3 constructs an asset portfolio and evaluates the empirical outcomes. Section 4 concludes.

2. Methods and Data

2.1 Methods: Markowitz's Portfolio Theory

When analyzing asset portfolios, Markowitz first used the marginal analysis principle in 1959 [14]. Investor preferences are precisely mathematically described, and the mean and variance of portfolio return are employed as unbiased estimates of portfolio return and risk. The ideal asset allocation mean-variance model is established:

$$\begin{aligned} \text{Min} \quad & \sigma^2(r_p) = \sum \sum x_i x_j \text{Cov}(r_i, r_j) r_p = \sum x_i r_i \\ \text{St.} \quad & \sum x_i = 1 \text{ (Short selling allowed)} \\ & \text{or } \sum x_i = 1, x_i \geq 0 \text{ (Short selling is not allowed)} \end{aligned} \quad (1)$$

In this model, r_p stands for the portfolio return, r_i for the i^{th} asset return, x_i and x_j for the asset i and j investing proportions, and $\sigma^2(r_p)$ for the portfolio variance. The covariance between the two assets is expressed as $\text{Cov}(r_i, r_j)$. According to the aforementioned equation, the percentage of investments in X_i securities may be resolved by creating a Lagrange objective function such that the risk $\sigma^2(r_p)$ of the portfolio is reduced under certain circumstances, subject to limitations and a desired return for the portfolio.

According to Markowitz's portfolio theory, the risk of an asset is defined by its variance or standard deviation, the risk price of an asset in a portfolio is determined by its covariance, and assets are valued according to their level of risk. The viable solution set of the model is a boundary curve concave to the origin, and the top half of the curve is referred to as the efficient boundary, as shown in Figure 1 by using the standard deviation and the anticipated value of portfolio earnings as the x-axis and y-axis.

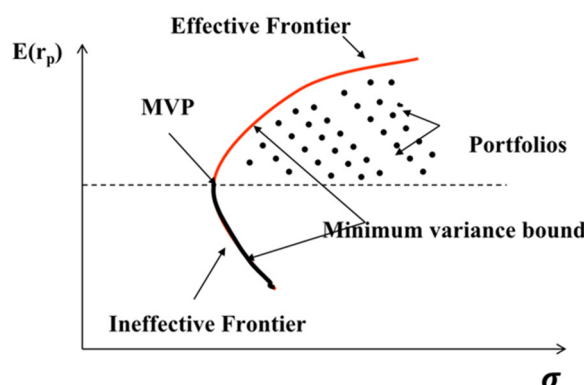


Fig. 1 Effective Frontier
(Photo credit: Original)

According to the effective frontier graph, the return increases as risk increases and decreases as risk decreases. The economic significance is that investors can determine expected returns in advance, and then the proportion of assets for each investor can be calculated to minimize risk. Subsequently, with the introduction of risk-free assets, capital can be freely allocated between risk-free and risky assets. For the new portfolio, the Capital Market Line (CML) shows how return and risk are linearly related.

$$E(r_M) = r_f + \frac{[E(r_p) - r_f]}{\sigma_p} \sigma_M \quad (2)$$

r_f stands for the return of risk-free assets in this function. The capital market portfolio's anticipated return, $E(r_M)$ is calculated after risk-free assets are included. σ_M is the market portfolio's exposure. The Sharpe ratio is another name for the slope of CML $[E(r_p) - r_f]/\sigma_p$. The Sharpe ratio's size reveals how much excess return may be expected for every unit of risk assumed by hazardous assets. The risk compensation is higher and the portfolio is more cost-effective the higher the Sharpe ratio. When the slope of the capital allocation line is tangent to the effective frontier, the Sharpe ratio of a portfolio is maximized. As shown in Figure 2, the tangent point is the optimal capital allocation point on the portfolio's effective frontier, and the capital market is efficient and finds equilibrium. At this stage, the most appropriate portfolio can be determined.

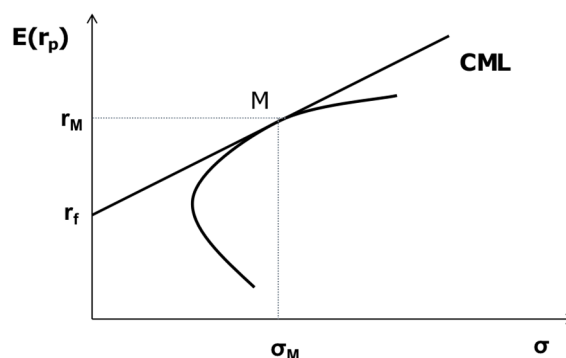


Fig. 2 Capital Market Line
(Photo credit: Original)

2.2 Data Analysis

In the empirical section, market indexes and currencies have been chosen to analyze with gold and bitcoin. The data is collected from cn.investing.com. NDX, US500 (United States), STOXX 50 (Europe), and UK100 (United Kingdom) are chosen for market indexes analysis. EUR (Euro), JPY (Japanese Yen), and GBP (Pound) are chosen for currency analysis. All values are in US dollars. The

overall time horizon is from June 1, 2019, to November 10, 2022. The Covid-19 is from January 25, 2020, to April 1, 2021. The Russian-Ukrainian war is from February 24, 2022, to November 10, 2022. Figure 3 depicts the daily price change for all assets, with the x-axis representing the date and the y-axis representing closing prices. The red box shows the Covid-19 time interval and the green box shows the Russian-Ukrainian wartime interval.



Fig. 3 Daily Price for Bitcoin, gold, indices, and exchange rates
(Photo credit: Original)

2.2.1 The Covid-19 Period

When Covid-19 first started to spread, prices for all assets have fallen dramatically, especially in market indexes, suggesting that Covid-19 caused a global financial market downturn [15]. Gold benefited from a stable distribution. Bitcoin experienced a gaping decline. These results demonstrate that bitcoin, rather than being a hedge asset, can enhance portfolio volatility. Nevertheless, following this decline, all assets rose sharply. Bitcoin's price soared even higher.

Table 1 shows a summary statistical test of the above asset returns. Bitcoin always has the maximum return and the greatest risk. According to Baur and his partners, this dramatic increase is due to the increased requirement from institutional stockholders caused by the rise of Bitcoin.

The correlation coefficient matrix for these assets is presented in Table 2. Before the Covid-19 era, the correlation between bitcoin or gold and individual market returns was negative, suggesting that in stable periods, it is possible to use gold and bitcoin as hedging assets, to hedge the risk of holding the assets. During Covid-19, the correlation coefficient between bitcoin and gold becomes negative. Also, the correlation between several market indexes is positive, which indicates that global financial markets have become more interconnected. However, the relationship between bitcoin and currencies is negative, whereas the relationship between gold and currencies is positive, indicating that one can use bitcoin to hedge against currency depreciation. As a result, Bitcoin and gold may provide some hedging properties.

Table 1. Summary statistics tests for daily returns (Some tests have been removed) (Covid-19)

before Covid-19									
	BTC	GOLD	NDX	US500	STOXX	UK100	EUR	GBP	JPY
MEAN	20.12131	1.76811	14.88958	2.81343	1.40514	-1.52530	-0.00002	-0.00007	0.00005
STD.dev	0.916	0.0083	0.0087	0.105	0.128	0.099	0.0033	0.006	0.0061
ARCH(10)	799.08***	128.79***	587.98***	129.88***	106.99***	265.79***	107.87***	107.45***	67.95***
J-B test	890.01†	487.03†	522.38†	347.36†	218.61†	320.26†	352.48†	856.10†	580.10†
Q2(10)	445.65c	196.63c	1050.14***	206.51***	202.101***	349.75***	169.60***	139.76***	85.985***
during Covid-19									
MEAN	152.15397	0.41455	12.08286	3.07078	2.82063	2.64028	0.00009	0.00032	-0.00013
STD.dev	0.05	0.0102	0.0208	0.0198	0.0156	0.019	0.0054	0.0081	0.0049
ARCH(10)	5.9863*	2.9956*	98.973***	32.874***	78.934***	67.987***	32.837***	31.912***	47.984***
J-B test	145.98†	187.37†	102.91†	185.68†	106.31†	365.47†	384.26†	136.63†	139.32†
Q2(10)	54.877***	27.878***	167.982***	26.883***	134.612***	51.923***	78.913***	90.885***	87.928***

Note: This table summarizes the daily return statistics for various assets. J-B is the Jarque-Berra test for normality, and $Q^2(10)$ is the Ljung-Box statistic for serial correlation in daily returns. ARCH (10) is the heteroskedasticity test. Pre-Covid-19 period is from June 1, 2019 to January 25, 2020. The Covid-19 pandemic is from January 25, 2020 to April 1, 2021.

† Normality is rejected at 5% significance level.

*** Null hypothesis is rejected at 1% confidence level.

** Null hypothesis is rejected at 5% confidence level.

* Null hypothesis is rejected at 10% confidence level.

Table 2. Matrix of correlation coefficients. (Covid-19)

before Covid-19									
	BTC	GOLD	NDX	US500	STOXX	UK100	EUR	GBP	JPY
BTC	1.00000								
GOLD	0.03123	1.00000							
NDX	0.01080	-0.13601	1.00000						
US500	0.01693	-0.15461	0.96292	1.00000					
STOXX	-0.02046	-0.09581	0.05029	0.04592	1.00000				
UK100	0.04918	-0.20735	-0.05132	-0.03732	0.08877	1.00000			
EUR	-0.05759	0.25906	-0.18180	-0.18325	-0.25512	-0.06573	1.00000		
GBP	-0.08585	0.23827	0.00836	0.00690	-0.04598	-0.13782	0.57786	1.00000	
JPY	-0.05629	0.30750	-0.22754	-0.21154	-0.29803	-0.10284	0.58145	0.36399	1.00000
during Covid-19									
	BTC	GOLD	NDX	US500	STOXX	UK100	EUR	GBP	JPY
BTC	1.00000								
GOLD	-0.04479	1.00000							
NDX	0.00786	-0.03894	1.00000						
US500	-0.00940	-0.04939	0.87593	1.00000					
STOXX	-0.03750	0.01799	0.02934	0.02496	1.00000				
UK100	0.02222	-0.03366	0.06828	0.04288	0.05701	1.00000			
EUR	-0.04141	0.47062	0.01922	0.00450	-0.00340	0.05708	1.00000		
GBP	-0.01834	0.33255	0.02250	0.03205	0.06983	0.06107	0.58982	1.00000	
JPY	0.00642	0.29602	0.06632	0.02415	0.05298	-0.07224	0.13885	0.12261	1.00000

2.2.2 The Russian-Ukrainian War Period

As in the study of the Covid-19 period, the earnings of gold and bitcoin during the Russian-Ukrainian War period with the same market indexes and currency exchange rates are compared. At the beginning of the Russian-Ukrainian war, a short and sharp rise in the price of gold can be discovered, but then a long period where it gradually fell back, as other assets. This shows that the war had a huge side effect on the global financial markets, and led to an increase in the instability of economic conditions around the world.

The summary statistical results of the returns during this period are as Table 3. The average returns are all negative, so it is obvious that it is very difficult to get a return on any kind of asset during this period. At the same time, the war also brought fluctuations in asset prices, making currency exchange rates fluctuate tremendously. However, it is undeniable that in times of war, both gold and Bitcoin have the possibility of transferring large amounts of money across borders. Meanwhile, bitcoin is easier to hide, thus offering partial protection against the possibility of a financial market decline.

After analyzing the correlation matrix during this period in Table 4, The assets are related in a beneficial way that can be found. Also, gold has a strong correlation with each asset, and similarly,

bitcoin has a significant correlation. Based on the increased uncertainty that war brings to the world economic environment, and the high correlation of gold and bitcoin with market indexes and currencies, to hedge the extremely high risk of losing investors can't invest in gold and bitcoin during the Russian-Ukrainian war because they simply can't give investors a better return performance.

Table 3. Summary statistics tests for daily returns. (Some tests have been removed)
(Russian-Ukrainian War)

	BTC	GOLD	NDX	US500	STOXX	UK100	EUR	GBP	JPY
MEAN	-39.46792	-0.26908	-11.13623	-1.57595	-1.06720	1.26754	-0.00045	-0.00058	-0.00063
STD.dev	2.9658	3.0837	1.1382	2.02316	1.0924	1.073	9.0189	8.0182	9.1294
ARCH (10)	4.394*	3.2342*	93.983***	38.374***	98.384***	72.389***	42.384***	34.231***	31.234***
J-B test	123.4513†	331.4323†	921.9132†	387.3868†	109.3943†	7381.3982†	29.3984†	12.3821†	123.9821†
Q2(10)	28.3982***	29.3872***	37.2817***	39.3817***	28.3817***	49.3871***	83.4871***	83.4811***	47.1487***

Note: This table summarizes the daily return statistics for various assets. J-B is the Jarque-Berra test for normality, and $Q^2(10)$ is the Ljung-Box statistic for serial correlation in daily returns. ARCH (10) is the heteroskedasticity test. Russian-Ukrainian War is from February 24, 2022 to November 10, 2022.

† Normality is rejected at 5% significance level.

*** Null hypothesis is rejected at 1% confidence level.

** Null hypothesis is rejected at 5% confidence level.

* Null hypothesis is rejected at 10% confidence level.

Table 4. Matrix of correlation coefficients. (Russian-Ukrainian War)

	BTC	GOLD	NDX	US500	STOXX	UK100	EUR	GBP	JPY
BTC	1								
GOLD	0.01437861	1							
NDX	0.03829804	0.18024384	1						
US500	0.0314861	0.19408522	0.95923927	1					
STOXX	0.07685235	0.1973871	0.06755266	0.11493433	1				
UK100	-0.0294083	0.14867266	0.09081093	0.14026488	0.10427867	1			
EUR	0.0300296	0.35157593	0.16916304	0.19617517	0.19770708	0.09552952	1		
GBP	0.04951856	0.38878253	0.2491276	0.29131765	0.27627042	0.06609751	0.74799974	1	
JPY	0.05579669	0.42190924	0.19266298	0.22894981	0.08922277	-0.0638864	0.37564496	0.40328321	1

3. Results

3.1 Data Analysis

3.1.1 Introduction of risk-free rate of return

Table 5 illustrates the theory of bank deposits in America from 2019 to 2022 based on available data. Assuming that the interest rate for bank deposits is the risk-free asset's return rate therefore the risk-free rate in the capital market, which was $R_f = (0.90\% + 1.50\%)/2 = 1.20\%$ during the Covid-19 epidemic, and $R_f = 2.7\%$ during the Russian-Ukrainian war.

Table 5. Average annual interest rate on USD deposits

Year	2019	2020	2021	2022
Interest Rate	2.10%	0.90%	1.50%	2.70%

3.1.2 Basic data calculation

Given the high cost of shorting assets in the market, analyzing a portfolio that is short-sale restricted is more appropriate with the general investment situation. Table 8 shows the investment proportion of gold and bitcoin in the portfolio after the relevant data processing. The portfolio constructed using the weights at the maximum Sharpe ratio will have the most optimal portfolio point on the effective frontier, according to Markowitz's asset portfolio theory.

Based on previous data, the mean, standard deviation, and variance of the returns of gold and bitcoin during Covid-19 and the Russo-Ukrainian War were determined by calculating using

previously collected data. Tables 6 and 7 show the results. Meanwhile, the period volatilities of gold and bitcoin returns are shown in Figure 4 and Figure 5.

Table 6. Statistical results of gold and bitcoin returns (Covid-19)

	BTC	GOLD
MEAN	0.52%	0.11%
STD	4.24%	1.30%
VAR	0.18%	0.02%

Table 7. Statistical results of gold and bitcoin returns (Russian-Ukrainian War)

	BTC	GOLD
MEAN	-0.22%	-0.04%
STD	3.61%	0.99%
VAR	0.13%	0.01%

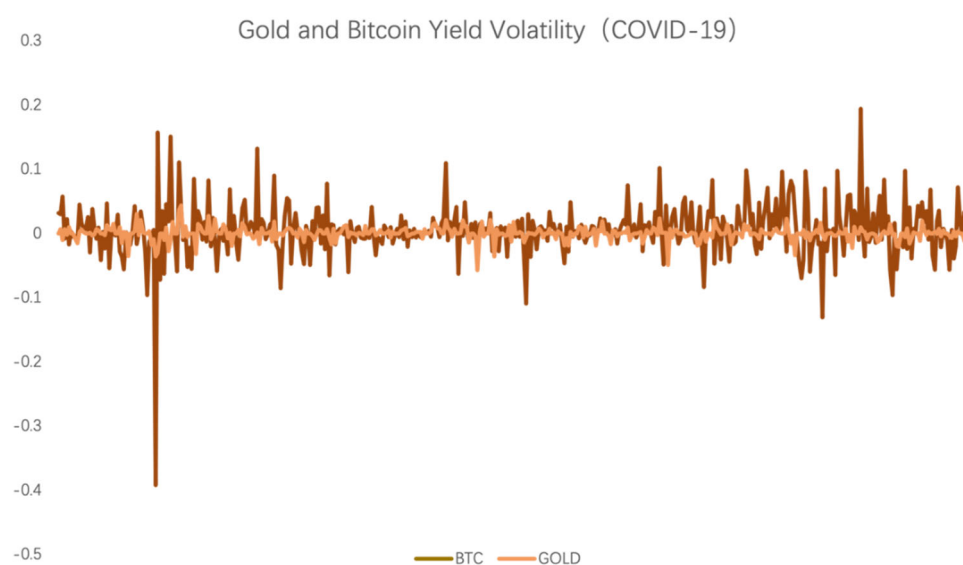


Fig. 4 Gold and BTC Yield Volatility (Covid-19)
(Photo credit: Original)

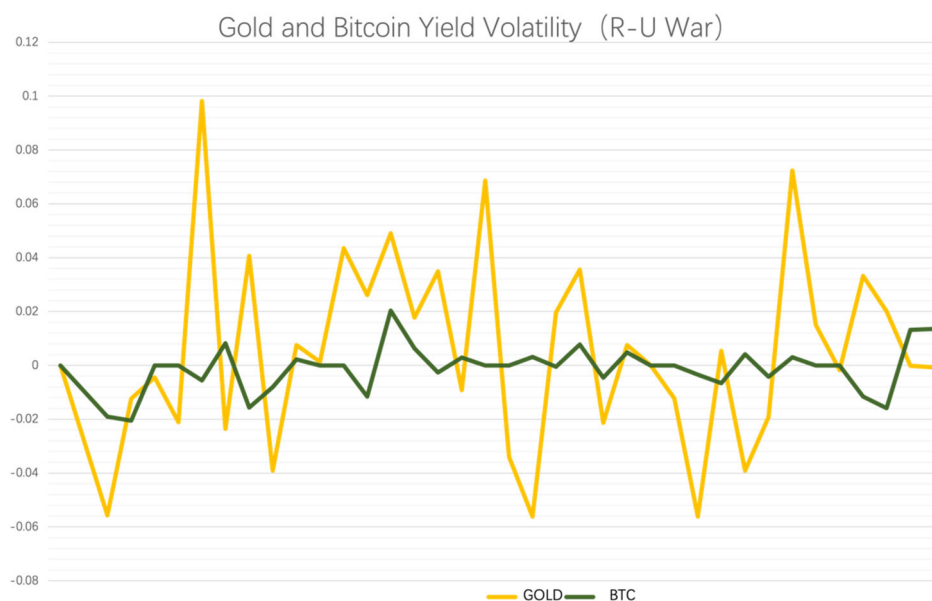


Fig. 5 Gold and BTC Yield Volatility (Russian-Ukrainian War)
(Photo credit: Original)

To further obtain the optimal portfolio weights and effective frontier curves, all possible asset portfolio weights for gold and bitcoin are combined based on different correlation coefficients to form the opportunity set, as shown in Figure 6.

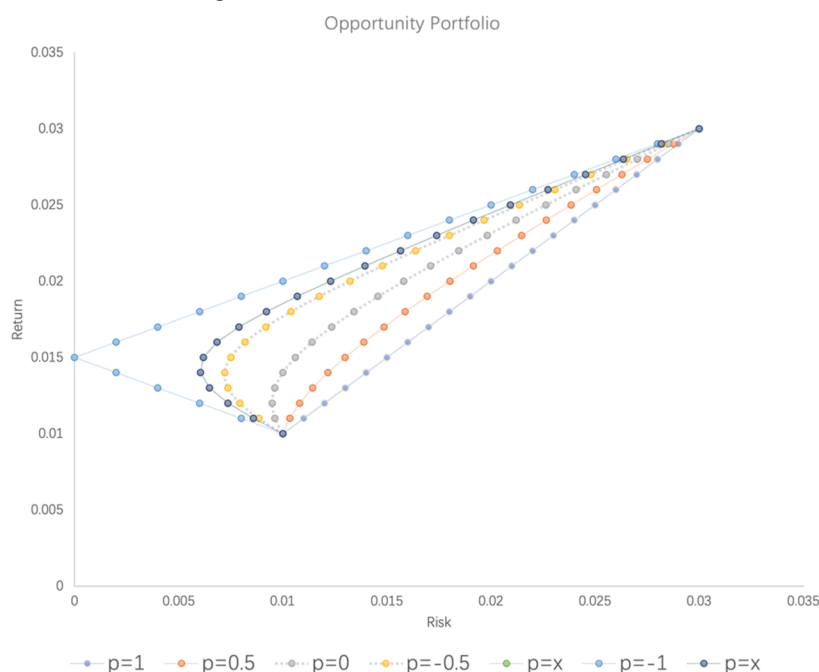


Fig. 6 Opportunity Set of BTC and GOLD (Covid-19)
(Photo credit: Original)



Fig. 7 Opportunity Set of BTC and GOLD (Russian-Ukrainian War)
(Photo credit: Original)

By compiling the results calculated above, Markowitz's portfolio theory is used to allocate the asset portfolio and calculate to derive the following effective frontiers and their optimal solutions. Figures 8 and 9 illustrate the effective frontiers during the Covid-19 era and the Russian-Ukrainian War period.



Fig. 8 Portfolio Effective Frontier (Covid-19)
(Photo credit: Original)



Fig. 9 Portfolio Effective Frontier (Russian-Ukrainian War)
(Photo credit: Original)

After collation, the best proportion for investing in bitcoin and gold for the Covid-19 era and the Russian-Ukrainian war era to use investments in these two assets for hedging purposes can be obtained. The results of asset weights are shown in table 8.

Table 8. Optimal asset investment weights

	BTC	GOLD
Covid-19	72.36%	27.64%
Russian-Ukrainian War	34.87%	65.13%

3.2 Empirical results

In the previous section, a portfolio of bitcoin and gold for the Covid-19 era and the Russian-Ukrainian war era based on Markowitz's portfolio theory was built. The following section will analyze whether this portfolio performs better than gold and bitcoin in these two periods.

The results are shown in Figures 10 and 11, which illustrate that the volatility of the portfolio has improved compared to the volatility of bitcoin and gold. This means that although the asset portfolio

cannot have a huge return, the investor is guaranteed to have a good return and won't have to face too much risk, which ensures the safety of the investor's assets.

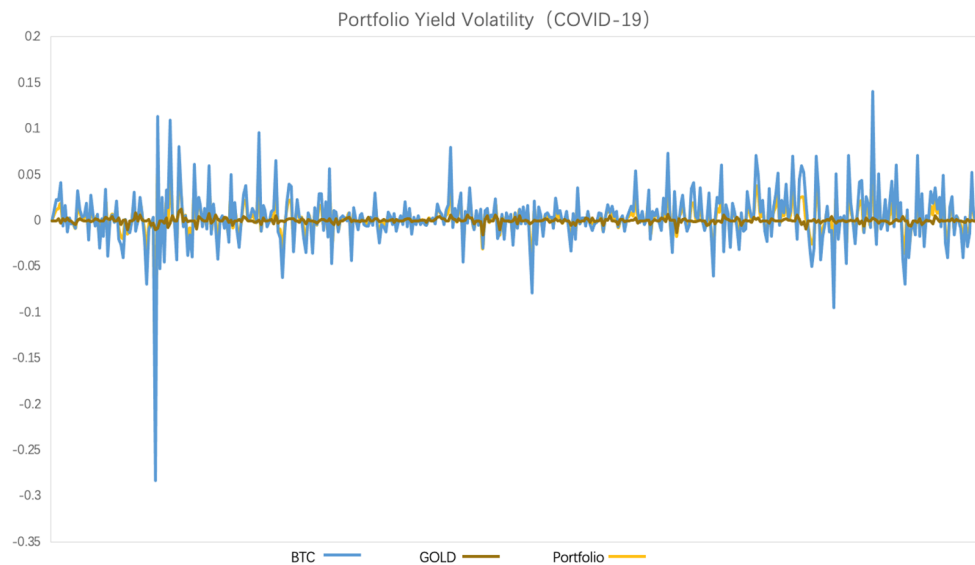


Fig. 10 Portfolio Yield Volatility (Covid-19)
(Photo credit: Original)

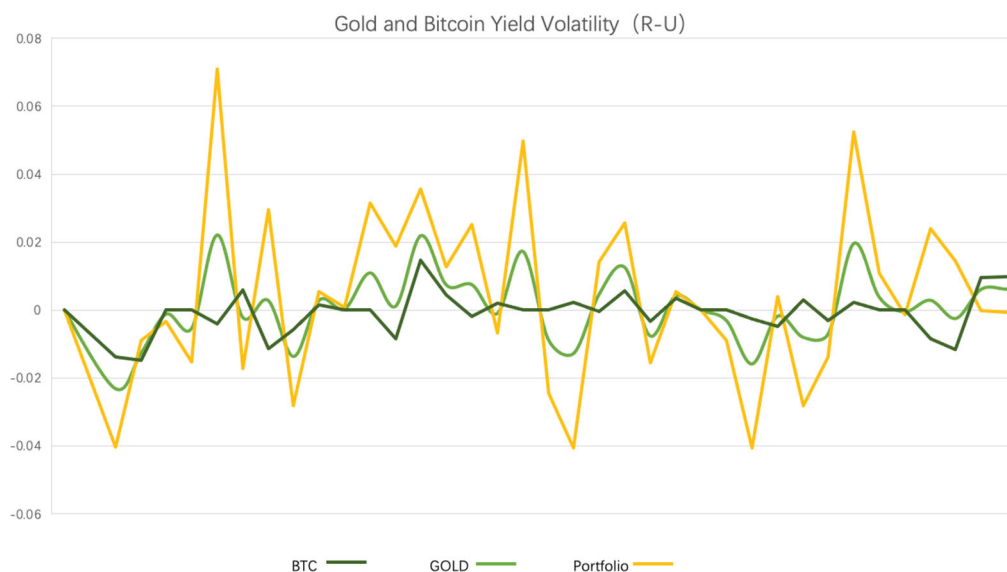


Fig. 11 Portfolio Yield Volatility (Russian-Ukrainian War)
(Photo credit: Original)

The next comparison of trends with bitcoin, gold, and several market indexes shows that the portfolio was able to outperform the market indexes, during both Covid-19 and the Russian-Ukrainian war. This shows that the portfolio can effectively hedge the risk from market shocks and fully play its role as a safe-haven asset.

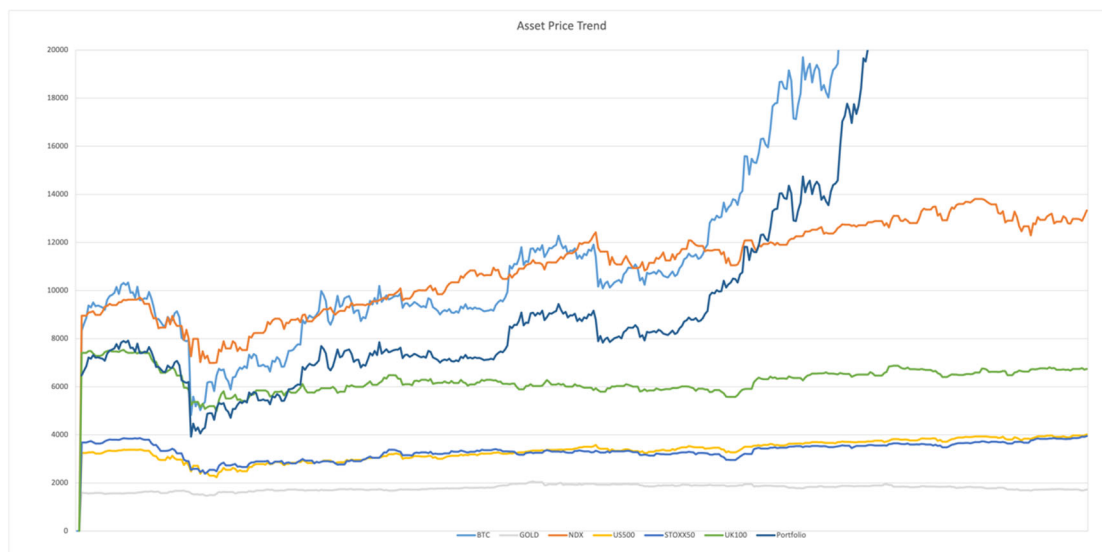


Fig. 12 Asset Price Trend (Covid-19)
(Photo credit: Original)

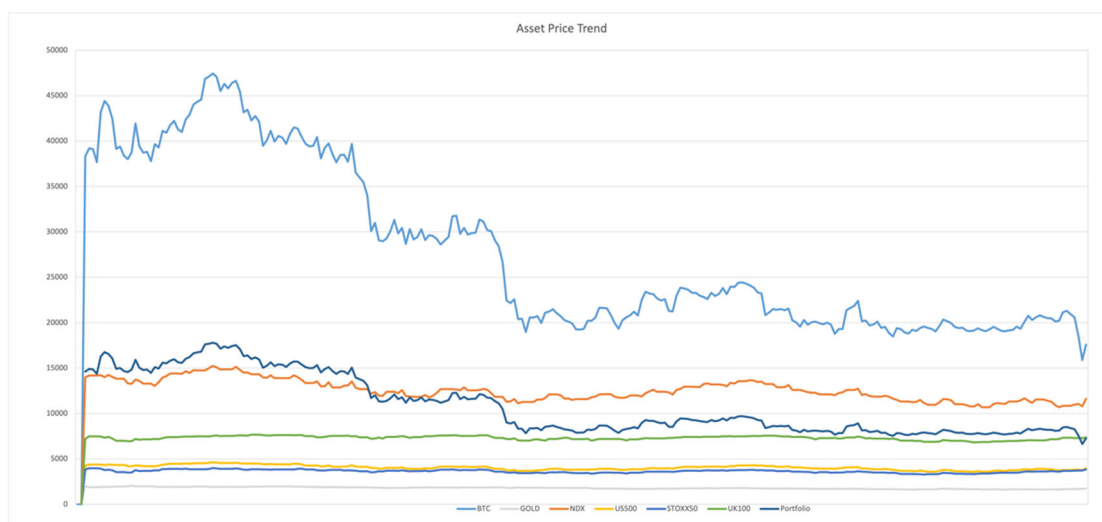


Fig. 13 Asset Price Trend (Russian-Ukrainian War)
(Photo credit: Original)

In addition, the mean and variance of the returns are shown in Tables 9 and 10. The portfolio not only cushions the return volatility of the risky assets but also improves the overall return profile of the low-yielding assets. This was more pronounced during the Russian-Ukrainian war, which transform the original situation of negative average returns for both assets into a positive average return.

Table 9. Means and standard deviations of gold, bitcoin and portfolio returns (Covid-19)

	BTC	GOLD	Portfolio
MEAN	0.52%	0.11%	0.40%
STD	4.24%	1.30%	3.09%

Table 10. Means and standard deviations of gold, bitcoin and portfolio returns (Russian-Ukrainian War)

	BTC	GOLD	Portfolio
MEAN	-0.22%	-0.04%	0.08%
STD	3.61%	0.99%	1.02%

Therefore, building a portfolio is a good way to improve on the original asset deficit. In the process of building asset portfolios for gold and bitcoin, the portfolio for both bitcoin and gold can not only bring out their hedging functions but also circumvent the shortcomings of these two assets themselves. This may be able to provide good protection for investors' assets in the event of a large-scale crisis.

4. Conclusion

Some global events in recent years have severely affected the growth of international financial markets, causing investors to lose confidence in future benefits. Therefore, people need to explore alternative investment options that can counteract this situation. Our article analyzes bitcoin's and gold's diversification capabilities. Even when used as hedge assets, bitcoin and gold were found to have numerous flaws. Therefore, it is thought that constructing a portfolio of bitcoin and gold assets alleviates their respective shortcomings while fully utilizing their functions as hedging assets.

Gold and Bitcoin are first analyzed against market indexes (NDX, US500, STOXX50, and UK100), and currencies (Euro the Japanese yen, and Pound). A correlation analysis of gold and bitcoin and the above market indexes and currencies provides evidence that both gold and bitcoin were able to maintain their role as weak hedge assets during the Covid-19 era. However, both gold and bitcoin underperformed in yield during the Russian-Ukrainian war, making it difficult to bear the burden of a long-term hedge asset due to the continued increase in uncertainty in capital markets during global events. While these findings provide policymakers, regulatory agencies, and stockholders with beneficial information to assist them to avoid damage in times of great unpredictability, they are not supposed to be accepted as fact.

The portfolio theory proposed by Markowitz states that decreases unsystematic risk and the portfolio's valuation is decided by the standard deviation of the risky assets. Therefore, based on Markowitz's portfolio theory, a portfolio of gold and bitcoin is constructed. It is possible to estimate the average return and variation of the portfolio objectively using the mean and variance of the returns. The Sharpe ratio may be used to determine the ideal risky asset weights for the portfolio under certain risk-return equilibrium, which leads to the capital market line and thus the asset weights. The performance of bitcoin, gold, and portfolio illustrates that the portfolio was able to outperform almost all assets, indicating that investing in the portfolio can mitigate market risks and get higher profits in a shorter time frame. Consequently, investing in a portfolio to diversify risk is an effective investment strategy.

However, the Markowitz portfolio model has strict assumptions. Actual portfolio return average and volatility deviate from computed statistics. There are some problems in forming a portfolio in this article. Firstly, the number of assets used in the construction is small, and the backtesting results are subject to a certain degree of chance. Besides, the evaluation indexes are not rich enough, so the advantages of the portfolio are not obvious.

The analysis can be expanded in the following studies, which try to include assets with different returns and risks, study their diversification potential, and find out whether the construction of a new portfolio can provide better performance. So that investors can make investment decisions and effectively hedge risks.

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