The Impact of COVID-19 on Portfolio Investment: An Empirical Study on Traditional and Innovative Asset Classes

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Abstract: This research examined the impact of the COVID-19 pandemic on different asset classes. The main focus was on traditional assets such as gold and innovative assets such as bitcoin. The time for the study was divided into three: pre-covid, during covid, and post-covid to help effectively determine how the assets classes reacted to the pandemic. The modern portfolio theory was used to help obtain the best asset weights of the portfolio that maximize the hypothetical returns. The Sharpe ratio was used to measure the performance of asset classes in all the three-time periods. The results revealed that Bitcoin was relatively volatile during the experiment time span, whereas the gold ETF was the most stable asset. The portfolios also exhibited different performance to the individual traditional and innovative asset classes. For instance, the portfolio consisting of all traditional assets was more stable throughout the pandemic whereas the innovative assets fluctuated over time. Therefore, investors should consider investing in traditional asset classes such as gold EFT to achieve hedging benefits during health crises.

Keywords: COVID-19, Global equity index, Portfolio investment, Traditional assets, Innovative assets

1 INTRODUCTION

The COVID-19 disease started in China in December 2019 [1]. Since then, the disease morphed into a crisis and was declared a pandemic on March 11, 2020. The outbreak has been unprecedented as it is highly contagious compared to other recent outbreaks [2]. For instance, the COVID-19 pandemic has an infection rate of between 1.5 and 3.5 per infected person, while Ebola has an infection rate of between 1.5 and 2.5 per infected person [2]. The highly contagious nature of the disease led governments across the world to make lockdown decisions. The lockdowns were intended to be a containment measure and were thus strictly imposed to contain the spread of the disease [2]. However, the lockdown measures affected nearly all human activities and practically brought down the global economy to its knees. For instance, the global economy lost between 0.1% and 0.4% in GDP [3].

The pandemic did not spare the financial markets. According to Bradley & Stumpner, the

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pandemic triggered a freefall in stock prices worldwide. For instance, Apple and Amazon shares fell 19% and 7%, respectively, at the begging of the pandemic [4]. The share price declines wiped billions of dollars in value, even as the broader stock markets saw a violent sell-off. The US stock market hit the circuit breaker mechanism four times in ten days in March 2020, a situation that had never happened since Black Monday in 1987. The financial market turbulence adversely affected investors by wiping out their investments and their confidence. For instance, Warren Buffet lost $49.75 billion as the health crisis pummeled his common stock holdings [4]. However, few studies suggest that investors could reduce losses by holding asset portfolios with good risk-resistance ability. For instance, Naeem et al. [1] suggested that holding a fully diversified asset portfolio could have helped reduce investment losses during the COVID-19 pandemic. However, the study suggested that there a no in-depth studies assessing how asset portfolios with good risk-resistance ability could reduce investor losses during a financial crisis [1]. This study is carried to fill the identified gap and contribute to the growth of the existing literature.

This empirical study centers on portfolio construction using different asset classes. The study aims to evaluate and analyze the effect of COVID-19 on world stocks, traditional assets, and innovative assets. It also examines how each asset class affects the overall portfolio risk and return. In achieving these aims, the researcher initially classified different assets into two groups: traditional assets, innovative assets. The traditional asset class comprises gold ETF, SPDR gold shares, and S&P500 index stock, while the innovative asset class is composed of Bitcoin, the fintech index stock, and Global X Fintech ETF. Most authors regard gold as a strong source of security [5]. However, the study uses gold ETF because its relatively lower cost enables more individual investors to enter the market. More importantly, gold ETF has a stronger capacity for hedging and safe haven, and even it may replace gold to avoid potential risk to some extent in the near future [6]. The study uses the S&P500 index to represent the performances of US stocks. The index is widely used by investors and provides good returns at relatively low risks [7]. The Global X FinTech ETF (FINX) is used since they enable investors to access high returns in technological innovations. The EFT delivers access to dozens of companies with high exposure to the fintech industry. Bitcoin and FINX are the index representatives of the companies at the forefront of emerging financial technology. The two assets have not been around during any major financial crisis, and thus their response to the COVID-19 pandemic was unknown before the pandemic. This study examines whether the innovative assets have a good risk-resistance ability that could reduce investor losses during the COVID-19 health crisis.

The study analyses three different portfolios to determine the best portfolio to hold during a crisis. The three portfolios include the pure traditional assets portfolio, pure innovative assets portfolio, and a mixed portfolio of the four assets. The pure traditional asset portfolio is made up of assets that have always been considered a safe haven for investors. However, the asset class performs dismally when compared to the innovative asset class, which is highly risky. The two assets are mixed to form a mixed-asset portfolio that has a moderate risk and return. The Modern Portfolio Theory is adopted to help weigh each asset at the optimal Sharpe ratio of the portfolio and establish the best portfolio to hold before, during, and after a crisis. The study also provides some insights to help investors and policymakers determine how to best respond to financial crises such as the COVID-19 pandemic.

2 LITERATURE REVIEW

Markowitz [8] developed the Modern Portfolio Theory (MPT) to help risk-averse investors structure their portfolios in a way that maximizes expected return based on their risk tolerance and a certain level of market risk. The theory argues that investment's risk and return features should be evaluated based on how they affect the overall asset portfolio's risk and return. It shows that investors should construct a portfolio of several assets that will optimize returns for a given level of risk. The theory assumes that investors are risk-averse and thus will try to construct portfolios that minimize risk while generating the highest possible return. In a practical sense, the theory assumes that investors will invest in multiple assets to reduce risk through diversification. Usually, portfolio performance is evaluated using the Sharpe ratio [9]. The ratio measures the excess returns investors receive for the extra volatility of holding a riskier asset. This study uses the MPT to assist in weighing each asset at the optimal Sharpe ratio of the portfolio and establish the best portfolio to hold during a crisis.

Numerous empirical studies have been conducted to determine the efficiency of different asset classes during financial crises. For instance, Wang, J., and Wang, X. [10] conducted a study to examine the efficiency of different assets during the COVID-19 health crisis. The study used several asset classes such as bitcoin, gold, the S&P 500 index, and the US dollar index. Wang, J., and Wang, X. [10] used the RCMFE algorithm to estimate the efficiency of the four asset classes during the pandemic. The entropy-based measure was developed in 2017 to help researchers ascertain multiscale market efficiency. The findings showed that the COVID-19 health crisis led to a decrease in the efficiencies of all four assets. However, the decrease was however high in the S&P 500 index than in the other assets. The study also showed that bitcoin experienced the least decline in efficiency during the extreme event of the COVID-19 pandemic. This implies that bitcoin could be used as a safe haven during a period of crisis. The results are consistent with Yarovaya et al. [11], who suggested that the bitcoin market is relatively more efficient. Yarovaya et al. [11] showed that the COVID-19 pandemic does not amplify the herding behavior in the cryptocurrency market. The herding behavior is responsible for much of the decreases in efficiency in all major financial markets.

Yousfi et al. [12] evaluated the effects of the COVID-19 crisis on the US stock market. The study assessed the impact of the first two waves on stocks listed on major US markets. The authors compared and analyzed the correlation between the pandemic and different stocks. Findings indicated that the COVID-19 pandemic created uncertainty in the US and Chinese stock markets. The results also showed that stocks performed dismally during the COVID-19 health crisis. This implies that stocks are not good investments during a period of extreme uncertainty. The findings are consistent with Shehzad et al. [13], who showed that stock markets in Italy, Germany, and the US were significantly affected by the COVID-19 pandemic. The researchers compared the effect of COVID-19 in different stock markets in the US, Europe, and Asia. The findings showed that Asian stock markets were less affected by the crisis and could thus have been used to help reduce portfolio risk. The findings imply that the COVID-19 pandemic affects stocks differently depending on the geographical location of the stock market.

Akhtaruzzaman et al. [14] explored the role of gold as a hedge in different phases of the COVID-19 pandemic. The study defines a hedge or safe haven as an asset class that is uncorrelated with another asset class in times of turmoil. The hedging effectiveness of gold is ascertained during

the first two phases of the crisis. Findings suggest that gold was an effective hedge during the first phase of the pandemic. This means that its correlation with the stock market was negative between December 2019 and March 2020. The findings also suggested that the effectiveness of gold as a hedge reduced significantly during the second phase. However, most investors increased their gold portions in their asset portfolios during the second phase, implying that gold was considered a flight-to-safety asset. The findings are supported by Atri et al. and Mensi et al. [15, 16], who suggested that the COVID-19 health crisis positively affected gold prices. In other words, Atri et al. [15] indicated that gold prices are less sensitive to bad news than oil prices or stock prices. This implies that gold is an effective asset for hedging against the uncertainty created by health or financial crises. Mensi et al. [16] also evaluated and analyzed the impact of COVID-19 on gold and oil prices. The authors established that gold is more efficient as a safe haven during a downward trend. Salisu et al. [17] also confirm that gold is a safe haven for investors. The study indicated that gold offers better-hedging opportunities than stocks and other precious metals. The findings explain why gold was in high demand during the first quarter of 2020.

Mariana et al. [18] explored the relevance of bitcoin and Ethereum during the COVID-19 pandemic. The study sought to determine whether the two innovative assets could be used as safe havens during a health crisis. The authors tested both Ethereum and bitcoin and showed that they are suitable as short-term hedging strategies. This implies that investors can include bitcoin and Ethereum into their portfolios to reduce risk during a crisis. This is because both bitcoin and Ethereum have negative correlations with stocks. However, the study suggested that the two cryptocurrencies are highly volatile and should not be used as long-term save havens. The findings are supported by Umar et al. [19], who suggested that bitcoin is a safe haven during a period of increased uncertainty. However, the study suggested that the effectiveness of bitcoin as a safe haven tends to change over time. This means that bitcoin may not provide hedging opportunities to investors in the long term. Investors should thus include bitcoin in their portfolios only when the asset is positively correlated with uncertainty [19].

Chemkha et al. [20] investigated the hedging properties of gold and bitcoin during the COVID-19 health crisis. The authors used the asymmetric DCC research model to effectively ascertain the effect of the pandemic on the two assets. The findings indicated that both gold and bitcoin are effective in minimizing portfolio risks during crises. Chemkha et al. [20] also suggested that gold is a weak safe haven while bitcoin is highly volatile. This means that the usefulness of gold and bitcoin in hedging is limited. The findings are consistent with Huang et al. [21], who showed that bitcoin could offer diversification benefits to investors. The study by Huang et al. [21] uses the VAR method to show that bitcoin has hedging properties within and across borders. This means that the asset can be used to provide diversification benefits within and outside of the US. The role of bitcoin is, however, indicated to be altered outside of the US market.

Le et al. [22] compared traditional and innovative assets during COVID-19 pandemic. The investigative study sought to ascertain the spillover effects among different asset classes. The study utilized data for the period between June 2019 and August 2020 to ascertain the hedging properties of different assets. Findings suggested that gold and the US dollar are more effective safe havens than innovative assets such as bitcoin. The innovative technology assets were represented by bitcoin and other financial technology indexes but were more volatile during the COVID-19 pandemic. However, the findings are inconsistent with Goodell & Goutte [23], whose evidence indicated that bitcoin is a safe haven as its correlation with COVID-19

uncertainty is positive. In other words, Goodell & Goutte [23] established that bitcoin prices increased during the COVID-19 pandemic. However, the findings are supported by Ozturk & Cavdar [24], who showed that the COVID-19 pandemic adversely affected all asset classes. The two authors used the ARMA-GARCH model to assess the influence of the pandemic on the prices of bitcoin, oil, gold, and exchange rates. The findings suggested that the COVID-19 pandemic caused price shocks in all four asset classes.

Kumar [25] conducted an investigative study to test the safe haven hypothesis. The study was interested in determining whether gold and bitcoin are negatively correlated with equity markets (as proxied by NSE50, DJIA, SSE, and CAC40). It used two different multivariate volatility models to test the hedging properties of bitcoin and gold. Findings indicated that gold and bitcoin have significant hedging properties against the volatility of stock markets. This means that bitcoin and gold could be used to reduce risk in a portfolio that contains equity stocks. However, the findings suggested that the hedging properties of the two assets were compromised during the COVID-19 pandemic [25]. In other words, the COVID-19 pandemic reduced the effectiveness of gold and bitcoin as safe-havens. Demir et al. [26] supported the findings by showing that cryptocurrencies have a positive but weaker hedging role during pandemics. The authors suggested that the correlation between COVID reported cases started as negative before turning positive as the pandemic progressed. Overall, this review shows that previous studies provide mixed results and that the current study is needed to conclusive empirical results.

3 METHODOLOGY

3.1 Overall Explanation

The data analysis of this research paper is based on the Modern Portfolio Theory (MPT) by Harry Markowitz [8]. The optimal proportion of each asset in the portfolio is determined by first calculating the expected return of the portfolio:

$$E(R_p) = \sum_{1}^{n} w_i E(R_i) \quad (1)$$

Whereby:

R_p is the portfolio return.

R_i is the asset return,

and w is the weight of each asset.

It is crucial to use a matrix-multiplication method to calculate the optimal return when computing multiple asset portfolios, using the formula as follows [27]:

$$E(R_p) = W^T R \quad (2)$$

$$= [w_1 \dots w_n] \begin{bmatrix} E(R_1) \\ \dots \\ E(R_n) \end{bmatrix}$$

Where W^T represents the transposed vector of weights and R represents the vector of

The variance of a two-asset portfolio is calculated as:

$$\sigma^2{}_p = w_x^2\sigma_x^2 + w_y^2\sigma_y^2 + 2w_x w_y cov(r_x, r_y) \quad (3)$$

Which can be generalized as below:

$$\sigma^2{}_p = \sum_{i=1}^{n}\sum_{j=1}^{n} w_i w_j \rho_{ij} \quad (4)$$

For a multiple asset portfolio, this further develops into:

$$\sigma^2{}_p = W^T S(W) \quad (5)$$

$$\sigma^2{}_p = \left[[w_1 \dots w_n] \begin{bmatrix} \sigma_{11} & \cdots & \sigma_{1n} \\ \vdots & \ddots & \vdots \\ \sigma_{n1} & \cdots & \sigma_{nn} \end{bmatrix} \begin{bmatrix} w_1 \\ \dots \\ w_n \end{bmatrix} \right]$$

Where $S(W)$ is the covariance matrix of the assets.

3.2 Efficient Frontier

The points on the efficient frontier correspond to the portfolios that have the minimum volatility for a specific expected return. Therefore, the efficient frontier can be calculated by solving the following optimization problem for different values of expected return.

$$\begin{aligned} \min_{\mathbf{w}} \quad & w^T \sum w \\ \text{s.t.} \quad & \mu^T w = \mu_t \\ & \sum_{j=1}^{n} w_j = 1 \\ & w_j \geq 0, j = 1, .., N \end{aligned} \quad (6)$$

Where μ_t represents the targeted portfolio return of the investor. By varying μ_t from a minimum return to a maximum return, it can obtain a series of the corresponding minimum risk portfolios. The efficient frontier is then displayed by plotting those portfolios in the volatility-return plane.

The optimal mix of weights of the assets in portfolios creates a mix along the efficient frontier that is tangent to the capital allocation line (CAL). This brings the largest slope (i.e., largest Sharpe ratio), which is the optimal portfolio.

3.3 Sharpe Ratio Maximization

The Sharpe ratio is applied to calculate each asset class's optimal weights that give the minimum variance. The maximum Sharpe Ratio portfolio can be found by solving the following optimization problem. The objective is to maximize the Sharpe Ratio of each asset portfolio. The constraints of the weights are positive and sum to 1.

$$\boldsymbol{S_p = \frac{E(r_p) - r_f}{\sigma_p}} \quad (7)$$

$$\begin{aligned} \underset{\mathbf{w}}{\text{maximize}} \quad & \frac{\mu^T w - r_f}{(w^T \sum w)^{\frac{1}{2}}} \\ \text{s.t.} \quad & \sum_{j=1}^{n} w_j = 1 \\ & w_j \geq 0, j = 1, .., N \end{aligned}$$

Where w refers to the set of weights for the portfolio assets, Σ is the covariance matrix of the assets, μ is the expected asset returns, and r_f is the risk-free rate. This research paper uses the sample mean of historical returns as the expected returns and the sample covariance matrix as the expected covariance matrix. The annual T-bill rate of 7% is used as the risk-free rate.

A major difficulty with the above formulation is that the objective function is not convex, and this presents a problem for some solvers which only accept convex optimization problems. However, under a reasonable assumption, it can be reduced to a standard convex quadratic program as follows.

$$\begin{aligned} \underset{\mathbf{w}}{\text{minimize}} \quad & y^T \sum y \\ \text{s.t.} \quad & (\mu^T w - r_f)^T y = 1 \\ & \sum_{j=1}^{N} y_j = \kappa, \qquad (8) \\ & \kappa \geq 0, \\ & w_j = \frac{y_j}{\kappa}, j = 1, .., N \end{aligned}$$

Where y refers to the set of unscaled weights, κ is the scaling factor, and the other symbols are the same as above. The assumption is that there exists a vector x satisfying the above constraints such that

$$\mu^T x - r_r > 0 \qquad (9)$$

This assumption is generally true because it expects the universe of assets to get a higher return than the risk-free rate. However, in some extreme conditions, some assets have returns lower than the risk-free rate. In this analysis, the innovative assets all have negative returns during the COVID-19 period, which requires to take care of such cases separately. 1-year T-bill rate of 7% is used as the risk-free rate throughout the calculations.

4 DATA ANALYSIS

4.1 Time Period Selection

The study chose three time periods to effectively investigate the impact of the pandemic on different financial markets. In order to study the impact of the COVID-19 on the financial market, this paper chooses three time spans including before, during and after the COVID-19. Since January 5th, 2020, WHO issued its first Disease Outbreak News report and officially declared the coronavirus disease crisis [28]. This research centers on this date as the time node,

tracing back 6 months prior to the discovery of the virus, **from July 4th, 2019 to January 4th, 2020** as the pre- COVID-19 period. The pandemic period, when the effects of the pandemic were extreme, is considered as during period to occur between **January 6, 2020, and December 31, 2020**. The pandemic is yet to end, but most countries have eased their lockdown measures. This implies that the effects of the pandemic are not as severe as they were during the lockdown. Besides, since January 1, 2021, countries have opened up their borders to travelers and international trade. Therefore, this paper considers the period between **January 1, 2021, and August 19, 2021**, as the "post-COVID-19" to help examine how the portfolios performed when the economy is healing and rebounding while the effects of the pandemic weakened.

4.2 Respective Performance of Four Assets

Figure 1 shows the annualized return of the assets, Gold, S&P 500 index, Global X FinTech ETF, and Bitcoin, in the three selected three time periods. The daily adjusted close price of the four assets is used for the following calculations. All the original data are downloaded from Yahoo Finance [29]. We can see that each asset performance varies very differently in the examined time periods. The gold prices have positive returns before and during the pandemic but have negative returns after the pandemic. Conversely, the S&P 500 index and FinTech ETF both have decent performance in all three periods. The performance of Bitcoin illustrates a different pattern. It has a negative return before the COVID-19 but bouncing back to very high returns during and after the COVID-19.

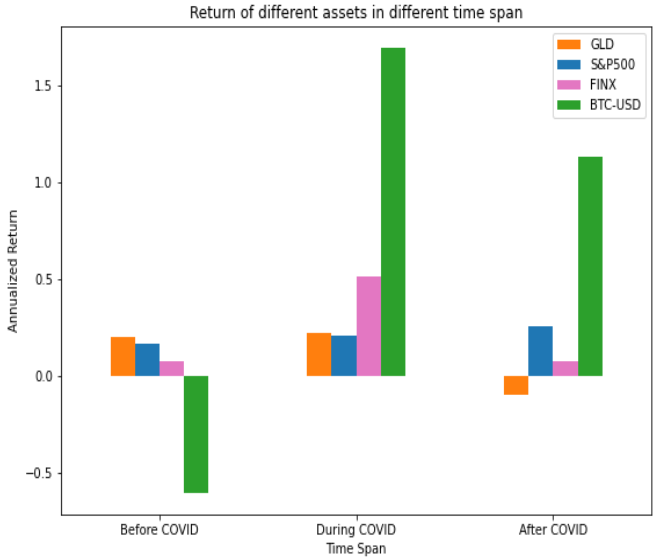

Figure.1 - The annualized return of different assets

This paper also examines the volatility patterns of different assets. Figure 2 shows the volatility of the four assets during different time spans. It can be observed that Bitcoin is the most volatile asset in all three time periods. In addition, the volatility of all assets increased significantly during the COVID-19. For example, the volatility of the S&P 500 index has increased from 10% to about 40%. After the pandemic, it returns back to a normal value under 20%. The

FinTech ETF is the second risky asset among these four assets. The S&P 500 index and the gold have similar volatility before and after the pandemic, but S&P 500 is more volatile during the crisis.

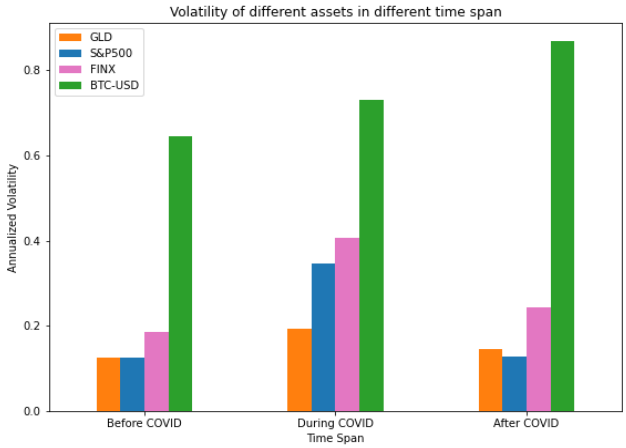

Figure.2 - Annualized volatility of different assets

In addition, the correlations between the four assets are displayed in Figure 3, where some interesting observations can be seen. First of all, the correlations are significantly higher during the crisis than during the pre-crisis period. These findings can be explained by a lack of liquidity in the financial market during the crisis. This also means that it is difficult to hedge the market risk by investing in diversified assets when a "black swan" event happens. Cash might be the best option in such conditions.

Gold and Bitcoin have smaller correlations with other assets among all the four assets, which indicates that they are good choices to hedge risk. However, the graphs indicate that both assets have higher correlations after the COVID-19 than before. The correlation between S&P 500 index and gold prices is 0.25 now, whereas it was -0.37 before the COVID-19. This change indicates that the financial assets now are mostly driven by some common factors, such as the interest rate, inflation, and the process of economic recovery. Besides, Bitcoin is now less correlated with the traditional market than Gold. It possibly implies that hedging with Bitcoin could be a potential alternative to Gold.

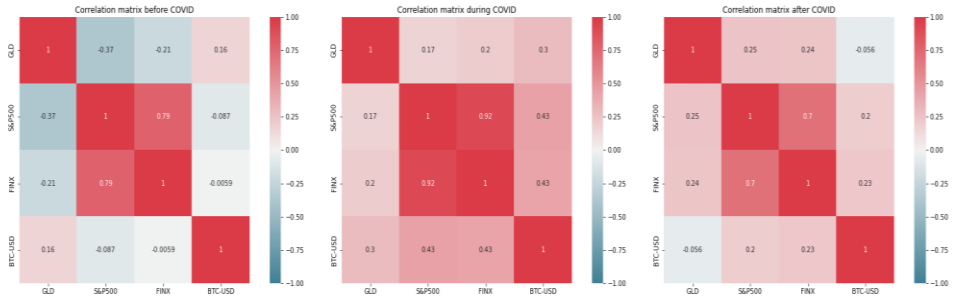

Figure.3 - Correlation matrix during different periods

4.3 Portfolio Performance

The efficient frontiers of three portfolios, pure traditional assets (Gold and S&P 500), pure innovative assets (Fintech ETF and Bitcoin), and mixed portfolio (these four assets in total), in the three-time spans, are calculated using the methodology explained above. The nine frontiers are combined in Figure 4. Stars mark the positions of maximum Sharpe ratio portfolios in the plot. Some frontiers do not show a standard shape because the assets may have negative returns during a certain period. In some cases, the optimal portfolio is at one end of the frontier, suggesting that people should invest all the money into one asset.

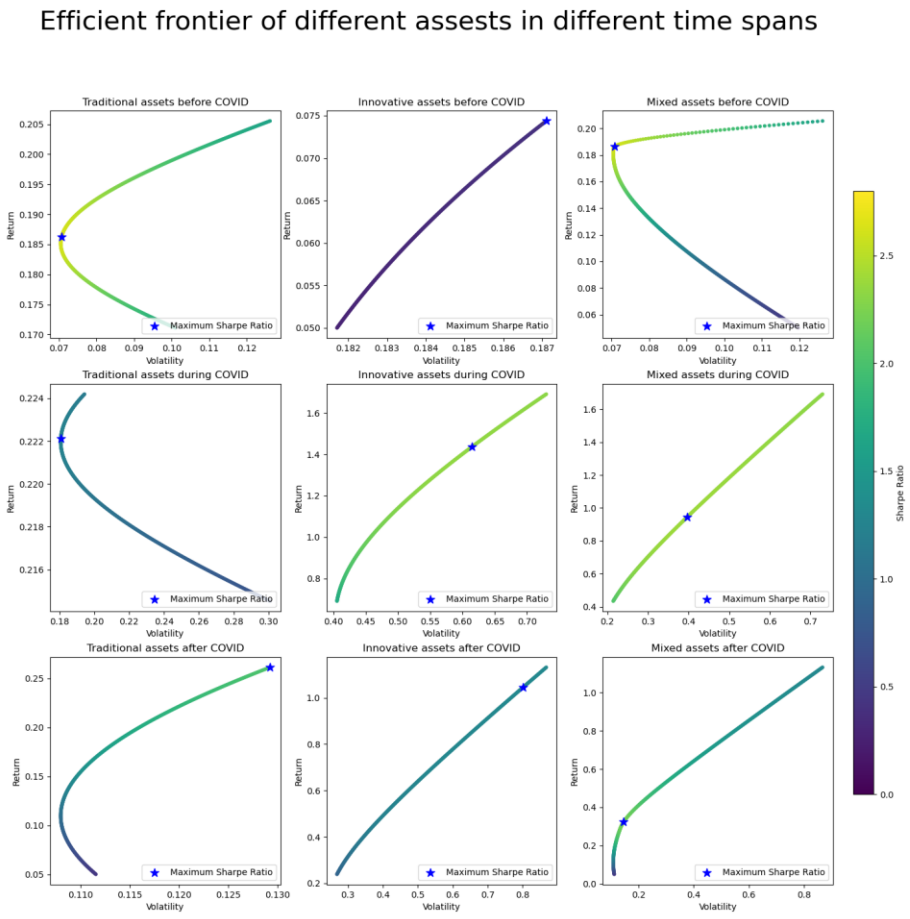

Figure.4 - Efficient frontiers of the nine portfolios

Under the nine settings, the weights of the maximum Sharpe ratio portfolio can be solved respectively. The chosen solver is cvxpy in python. The optimal weights are shown in Table 1. Because of the limited number assets, some portfolios contain only one asset. For example, Bitcoin had been showing negative returns 6 months before the pandemic, therefore, the portfolio of innovative assets has only one investment in FINX in before COVID-19 period.

Table.1 - Portfolio weights

Period	Assets	GLD	S&P500	FINX	BTC-USD
Before COVID	Traditional	0.5225	0.4775	-	-
Before COVID	Innovative	-	-	1.0	0.0
Before COVID	Mixed	0.5225	0.4775	0.0	0.0
During COVID	Traditional	0.8177	0.1823	-	-
During COVID	Innovative	-	-	0.2155	0.7845
During COVID	Mixed	0.416	0.0	0.1171	0.4669
After COVID	Traditional	0.0	1.0	-	-
After COVID	Innovative	-	-	0.0814	0.9186
After COVID	Mixed	0.0	0.929	0.0	0.071

This paper further examines and compares the performance of the nine portfolios in Figure 5-7. The three plots show the return, risk, and Sharpe ratio of the nine portfolios, respectively. Traditional assets present higher returns than innovative assets before the COVID-19 but lower returns during and after the COVID-19. The innovative assets have higher volatility all the time. For the Sharpe ratio, traditional assets are higher before and after the COVID-19, but the innovative assets are higher during the COVID-19. Another finding is that before the COVID-19, the mixed optimal portfolios do not contain innovative assets because the traditional assets have better returns and lower risk. However, things have changed during the pandemic. The optimal mixed portfolio now has some weights in the FinTech ETF or Bitcoin because of its good performance. And the mixed portfolio indeed has a higher Sharpe ratio than the portfolio only with traditional assets, revealing that people would pay more attention to the innovative assets and the opportunities in them.

Figure.5 - Portfolio returns

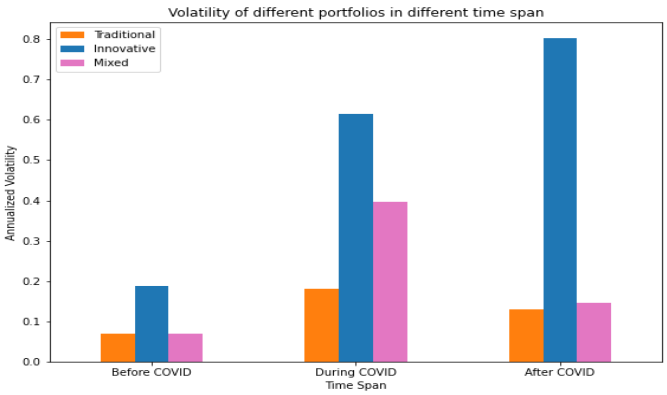

Figure.6 - Portfolio volatility

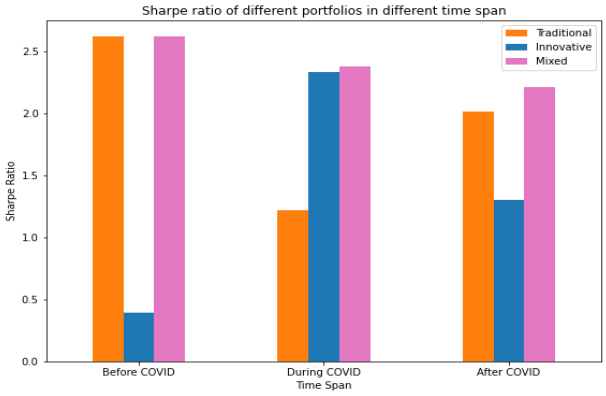

Figure.7 - Portfolio Sharpe Ratio

4.4 Limitations and Improvements

The study provides reliable evidence into the effect of the covid-19 pandemic on financial markets. However, some limitations still exist in the study. First, the calculation throughout the paper does not rebalance the stock and does not apply the rolling method – which potentially leads to some errors and residuals. Second, the MPT model also has some drawbacks: for example, it develops the ideas based on the assumption that portfolio returns follow Normal distribution, but in reality, the distribution might be skewed. Another factor that was not taken into consideration is the level of risk aversion of individual investors. Therefore, future studies should consider including risk aversion in their models.

$$S_p = \frac{E(r_p) - r_f}{A\sigma_p} \quad (10)$$

The separation property states that the allocation between risk-free assets and the portfolio asset should also consider the level of risk aversion. Some future analysis on individual investment needs to be done in the future.

5 CONCLUSION

In the final analysis, Modern Portfolio theory advocates evaluating investments according to how each asset varies and contributes to the overall risk and return of the portfolio, rather than looking at the risk and return of each asset individually. From a series of data analyses, it concludes that each asset class and its corresponding portfolios: The higher the return, the riskier the assets will be. S&P 500 index and Gold ETF have been stable assets to invest in since their volatility did not significantly change during the pandemic. In contrast, innovative assets (such as the Fintch index and Bitcoin) are much more sensitive to the external environment, in which they experienced a tremendous change in both returns and variance, a better performance than the traditional ones during the pandemic. This could possibly mean that cryptocurrency and Fintech are promising industries, but the role of traditional assets' hedging property is nonnegligible as the combined portfolio gives the best performance and the highest Sharpe ratio. It is crucial to diversify investment portfolios because every asset is indispensable and has its own functions.

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