Impact of Covid-19 on Portfolio Selection Based on Case Study of Pharmaceutical, High Technology and Expression Industry

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Abstract. The spread of Covid-19 has an impact on humans in both physical and economic ways. The pandemic resulting from coronavirus changes the financial world a lot. Numerous sectors experienced dramatic changes in its market environment. The stock market is also largely affected by pandemic. It is worth to explore the impact of Covid-19 on portfolio selections. Three different sectors (pharmaceutical, high technology and expression) were chosen in this paper for building portfolios. The data includes the performance of the stock of three firms ((Shenzhen Kangtai Biological Products Co., Ltd, iFLYTEK co. LTD. and Shunfeng Express) from January 1, 2018, to December 31, 2021. Due to the influence of the Covid-19, this paper seperates the date into two periods. Before and after, the analysis has been done on the change in weight and marginal contribution of risk by the influence of Covid-19. The portfolio is built based on the Markowitz model. The research result shows that coronavirus has a negative effect on return and risk. The portfolio after Covid-19 has a drop in return combined with a drop in risk, which might be due to the decrease in the rate of return of major assets and the increase in diversification of assets.

Keywords- Covid-19; portfolio; pharmaceutica industry; high-tech company; expression industry

1 INTRODUCTION

2020 is a year of misfortune and opportunity. The Coronavirus pandemic has brought turbulence to the capital markets. However, it also gave opportunities for some markets to rise. This paper mainly studies the influence of Coronavirus on the selected industries, using the Markowitz model, creating portfolios and observing the ratio transformation before and after portfolio.

Literature suggests that epidemic has influences on investors behavior and affects stock price. The tourism industry is negatively impacted by the avian influenza outbreak in 1998 Hong Kong [1]. The stock price of the hotel industry in Tai Wan experienced a sharp decline due to the influence of SARS [2].

The current outbreak of infections with SARS-CoV-2 is termed Coronavirus Disease 2019 (COVID-19) by the World Health Organization (WHO) [3,4]. The coronavirus pandemic is now

influencing the whole world in both physical and economic ways. The global stock market has experienced a large decline. Around 30% of wealth disappear in the stock market within 100 days. The spread of the virus increases people's panic and deteriorates the situation [5]. The world GDP will decrease by 3% in 2020 according to the estimate of the International Monetary Fund (IMF) and the world trade will decrease by 32% estimated by World Trade Organization (WTO) [6].

There is evidence that human-to-human transmission has occurred among close contacts since the middle of December 2019 [7]. As a result, Wuhan has been put on lock-down. The origin of coronavirus, the live animal market, has been suspended. Trains and flights out of the city have been cancelled and people were asked to stay at home. Public gatherings have been restricted and long term bus services have been suspended [8]. Due to the lock-down resulting from coronavirus, China's economic growth and multiple industries were being affected. China's economic growth is projected to fall to 5.6% this year, the International Monetary Fund (IMF) projected that policy investment and tax policies to implement $3.3 trillion and contributes further $4.5 trillion [9].

Specific to regions, the Covid-19 outbreak has a negative effect on the stock price of companies with a commitment to corporate socially responsible (CSR) in both abnormal return and cumulated abnormal return in Tai Wan [10]. Specific to different industries, transportation, mining, electricity & heating, and environment industries have been adversely impacted by the pandemic. In contrast, manufacturing, information technology, education and healthcare industries have been resilient to the pandemic [6].

However, there is limited research focusing on the influence of coronavirus on portfolio combination. Research has studied coronavirus-related news (CRNs) and shows CRNs has a positive effect on medical portfolios in China [11]. Research related to portfolio diversity in the Covid-19 period indicates that the weight of cryptocurrencies decrease during this period due to the varies in hedging effectiveness [12].

This paper mainly discusses the influence of coronavirus on the portfolio combination of three stocks (Shenzhen Kangtai Biological Products Co. Ltd (Kangtai), iFLYTEK co. LTD. (iFLYTEK) and Shunfeng Express (Shunfeng)) covering three different sectors (pharmaceutical, high technology and expression). The result shows that the weighted average of the pharmaceutical company drops while that of the high-tech company and expression company increase. The risk and return of the portfolio drop slightly after the influence of coronavirus. This drop may be due to the increase in diversification of the portfolio. Because before coronavirus, the rate of return of the high-tech company is negative and the portfolio does not include this company.

2 DATA

Due to the Corona Virus outbreak, the financial market was in great turbulence. This paper chooses three head companies from three different sectors that changed greatly due to the Covid situation. In particular, they are Kangtai, iFLYTEK and Shunfeng, from January 1, 2018 to December 31, 2021, covering the pharmaceutical, internet and high-tech retail industry.

Kangtai is one the largest pharmaceutical company that focuses on the invention and production of human vaccines. It was listed at the Shenzhen Stock Exchange in 2017 and it is the first listed enterprise in South China. During the Covid-19 situation, the vaccine Kangtai independently developed was approved for use in May 2021, which also resulted in a rise in its stock price. iFLYTEK is a high-tech company specializing in artificial intelligence. It was listed on the Shenzhen Stock Exchange in 2008. Shunfeng is a comprehensive express company in China. It provides clients with logistics services and also warehousing management, sale forecast, big data analysis and other package solutions. It was listed on the Shenzhen Stock Exchange in 2017. The stock price of them from January 2018 to December 2021 is shown in Figure 1 and the average stock return is shown in Table 1.
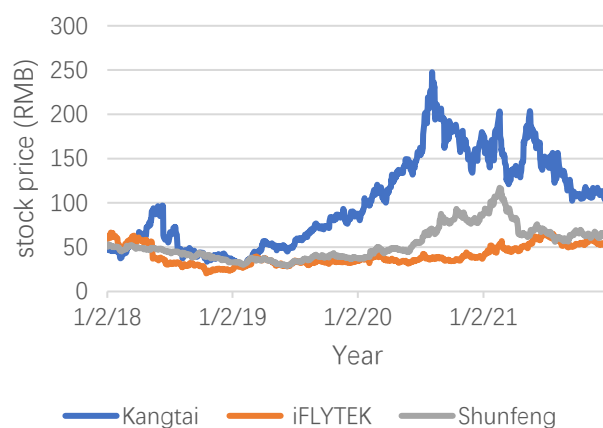

Figure 1. Stock price of three companies from Jan. 2018 to Dec. 2021.

Table 1. Average Returns for assets

Stock	Return(%)
Kangtai	0.182
iFLYTEK	0.032
Shunfeng	0.055

The distribution of logarithmic returns on stocks is shown as Figure 2, indicating that the data have the characteristic of leptokurtosis and fat tails. This is the classic characteristic of the distribution of return of financial assets.
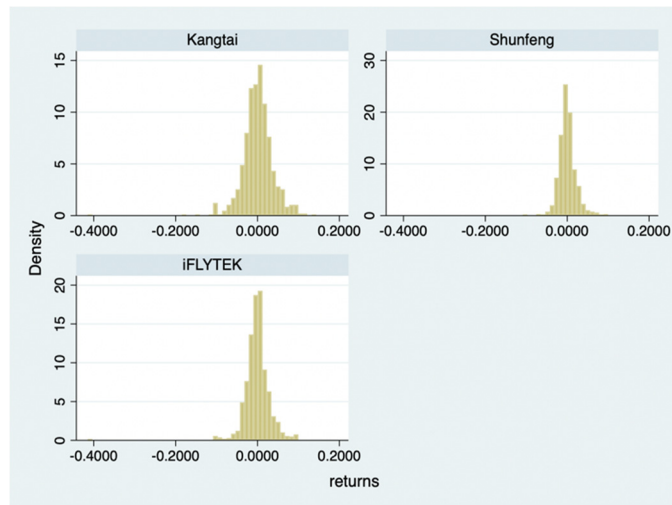
Figure 2. The distribution of logarithmic returns on stocks.

By using logarithmic returns on stocks, the data can be stable without changing the correlation between them and the yield rate can be observed directly. In addition, logarithmic returns help to reduce the heteroscedasticity and collinearity of data, which benefits the calculation.

As a result, the stock trend relation can be observed by standardizing the initial stock price as 100 and using logarithmic return. It is shown in Figure 3.
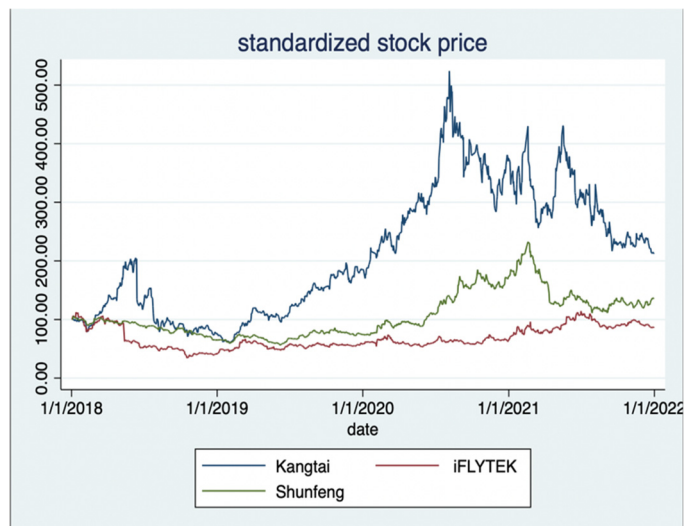

Figure 3. Standardized stock price for three assets.

The graph shows that the moving trends between stocks are different. By finding the covariance between stock prices, this difference can be testified. Table 2 shows that the covariances are all around 0.001, which is very small, indicating that the moving trends between stocks are different. Table 3 shows that the correlation between the return of three assets is very small, which are all around 0.2 to 0.3. This low correlation between stocks provides a basis for the following model distribution.

Table 2. Covariance Between assets

	Kangtai	**iFLYTEK**	**Shunfeng**
Kangtai	0.001459		
iFLYTEK	0.000232	0.000939	
Shunfeng	0.000201	0.000181	0.000458

Table 3. Correlation Between assets

	Kangtai	**iFLYTEK**	**Shunfeng**
Kangtai	1.000		
iFLYTEK	0.253	1.000	
Shunfeng	0.303	0.295	1.000

Diversification means spreading a portfolio over many investments to avoid excessive exposure to any one source of risk [13]. Investors can take benefits from diversification by investing in assets that have low correlation. This is because since the stocks have low correlation, while facing the same market threat, the stocks will have different reactions and the risk can be reduced. The risk that can be reduced is called diversifiable risk.

Due to covid, this paper separates the whole sample into two periods. The first period is the period before covid, which is January 1, 2018, to January 20, 2020. The second period is the period after covid, which is January 20, 2020, to December 31, 2021. This paper chooses January 20, 2020, as the starting time of the Coronavirus pandemic. This is the day when the head of the National Health Commission Nanshan Zhong first announced on CCTV that human-to-human transmission of Coronavirus has occurred. After January 20, Hunan province launched a second-level emergency response on January 22, then Wuhan city locked sown on January 23.

3 MODEL

The classical Markowitz model is used during diversifying the risk of investment. Harry Markowitz first proposes this model in Portfolio Selection [14]. In the model, investors hold a portfolio with a predetermined proportion of capital in a single investment period. The model obtains the optimal risks and returns by optimizing the portfolio. In the three assets model, the portfolio return is shown below.

Portfolio return $= w_{Kangtai} * r_{kangtai} + w_{iFLYTEK} * r_{iFLYTEK} + w_{Shunfeng} * r_{Shunfeng}$ (1)

where $w_{Kangtai}$ is weighted of Kangtai in the portfolio, $w_{iFLYTEK}$ weighted of iFLYTEK in the portfolio, $w_{Shunfeng}$ is weighted of Shunfeng in the portfolio; $r_{kangtai}$ is the stock return of Kangtai, $r_{iFLYTEK}$ is the stock return of iFLYTEK, $r_{Shunfeng}$ is the stock return of Shunfeng.

Portfolio risk $= \sigma^2 = w_{Kangtai}^2 * \sigma_{Kangtai}^2 + w_{iFLYTEK}^2 * \sigma_{iFLYTEK}^2 + w_{Shunfeng}^2 * \sigma_{Shunfeng}^2 + 2 * w_{Kangtai} * w_{iFLYTEK} * \sigma_{Kangtai\&iFLYTEK} + 2 * w_{Kangtai} * w_{Shunfeng} * \sigma_{Kangtai\&iShunfeng} + 2 * w_{Shunfeng} * w_{iFLYTEK} * \sigma_{Shunfeng\&iFLYTEK}$ (2)

Where $w_{Kangtai}^2$ is the variance of the return of Kangtai and same for that of iFLYTEK and Shunfeng, and $\sigma_{Kangtai\&iFLYTEK}$ is the covariance of Kangtai and iFLYTEK and same for $\sigma_{Kangtai\&iShunfeng}$ and $\sigma_{Shunfeng\&iFLYTEK}$. Covariance is a statistical measure of the directional relationship between two asset prices.

As the number of assets in the portfolio increases, the portfolio's risk falls, but the falls would not reach zero, which indicates that there is no perfect investment with no risk in reality. If the expected return is given, the portfolio that minimizes risk is called the mean-variance frontier portfolio, or the portfolio frontier.

As the efficient frontier shows, the best one among all the portfolio combinations is called the tangency portfolio. The tradeoff between risk and return is most efficient at tangency portfolio, where the curve's tangent is located. The most effective portfolio, known as the tangency portfolio, is the intersection point of the Capital Market Line (CML) and the efficient frontier [15]. Investors will try to manage their portfolio to fit the asset weight at this point, to get the best relatively investment option.

Our research chose three different companies in different markets, constructed a portfolio based on these three companies, analyzed the portfolio's risk and return using Markowitz Model, and found out how coronavirus impacts the tangent portfolio.

4 RESULT

This section shows the change in asset allocation before and after coronavirus influence. Using formula (1), the average rate of return of three companies before and after the pandemic are calculated and listed by Table4.

Table 4. Average rate of return of assets

Stock	Before pandemic	After pandemic	Whole period
Kangtai	0.00283	0.00075	0.00182
iFLYTEK	-0.00047	0.00115	0.00032
Shunfeng	-0.00046	0.00162	0.00055

Surprisingly, the average rate of return of Kangtai drops from 0.28% to 0.075%. This is different from what people normally think. The reason for the decrease may due to the large fluctuation of Kangtai's stock price. Although it experienced an increase in overall stock price, the rate of return decreased. Also, this may be due to the lack of data. The existing data after the pandemic is still limited and there is only one year after the start of Covid-19. For the second after pandemic group, only one-year data is observed compared to the two years data before the pandemic. This limited data might create bias during the calculation and result in the drop in Kangtai's rate of return. The average rate of return of iFLYTEK increased from -0.047% to 0.115%. This may be due to people starting to work at home and the demand for intelligent speaking starting to increase. As a result, the rate of return of high-tech company increase. The average rate of return of Shungfeng also increases, from -0.046% to 0.162%. This might be because people start to self-isolation and the shopping way changed from in-store to online, leading to the boom in the express industry.

To begin the analysis, this paper starts from the whole period. By creating the efficient frontier for three assets from 2018 to 2021 using Stata, the weight for each asset in the portfolio can be observed.

Table 5. The weight and contributuion to risk of the tangent portfolio with a risk-free rate of 0 for whole period

Stock	Weight	Contribution to risk
Kangtai	0.6727	0.0346
iFLYTEK	0.0000	0.0078
SHunfeng	0.3273	0.0106

Table 5 has shown that if investors consider the performance of three assets from 2018 to 2021, they should be allocated around 67.27% of their assets to Kangtai and 32.73% of them to Shunfeng. In this case, a tangent portfolio that has 0.140665% of return and 2.673067% of risk can be created

By separating the return before and after the coronavirus, this paper creates two new portfolios that have different risks and return. Table 6 shows the weighted vector of the Tangent Portfolio with a risk-free rate of 0 for period before and after influence of pandemic.

Table 6. The weight and contributuion to risk of the tangent portfolio with a risk-free rate of 0 before and after pandemic

Stock	Before pandemic	After pandemic
Kangtai	0.6727	0.0346
iFLYTEK	0.0000	0.0078
SHunfeng	0.3273	0.0106

Table 6 has shown that if investors consider the performance of three assets before covid, they should allocate around 99.07% of their assets to Kangtai and 0.93% of them to Shunfeng. By

contrast, if investors consider the performance of three assets after covid, investors should allocate around 3.047% of their assets to Kangtai, 69.80% of them to Shunfeng and 27.16% of them to iFLYTEK. The weight of Kangtai drops significantly. This may be due to the drop in the rate of return of it. The weight of iFLYTEK and Shunfeng increases, resulting from the increase in the rate of return.

Table 7.   The marginal contribution to risk of the portfolio

Stock	Before pandemic	After pandemic
Kangtai	0.0345	0.0109
iFLYTEK	0.0080	0.0167
SHunfeng	0.0054	0.0236

Using formula (2), the marginal contribution of risk of the assets in the tangent portfolio before and after coronavirus influence is calculated and listed in Table 7. Before the Covid-19 situation, Kangtai is the stock that contributes to risk the most. A 1 unit risk increase in Kangtai will lead to a 0.0345 unit increase in the portfolio risk. After the Covid-19 situation, the marginal contribution to risk has been averaged out. The marginal contribution to risk of Kangtai drops. It is mainly due to the decrease in the weight of Kangtai in the portfolio. The marginal contribution to risk of Shunfeng experienced a sharp increase, from 0.0054 to 0.0236. This may be due to the increase in the weight of Shunfeng in the portfolio.

Table 8.   Portfolio risk and return for three period

Stock	Before pandemic	After pandemic	Whole period
Return (%)	0.2807	0.1468	0.1407
Risk (%)	3.4238	2.1309	2.6731

Table 8 shows the portfolio return and risk before and after the Covid-19 situation. The portfolio return decreases from 0.2807% to 0.1468% due to the influence of coronavirus on these markets. However, this decrease in return is combined with a decrease in risk from 3.42% to 2.13%. This decrease in risk may be due to the additional stock iFLYTEK added leading to the increase in diversification of the portfolio.

5 CONCLUSION

The outbreak of the Covid-19 pandemic has significant influence on the world financial market. This paper selects data from three different sectors (pharmaceutical, high technology and expression) from 2018 to 2021 and exploring the influence of Covid-19 on these sectors. According to the effect of Covid-19 pandemic, the time period is separated into three parts: before pandemic, after pandemic, and the whole period. The portfolio contribution is based on the Markowitz model. The research result shows that coronavirus has a negative effect on portfolio return and a positive effect on portfolio risk. The portfolio after pandemic has a lower return (0.1468%) and a lower risk (2.13%), which might be due to the decrease in the rate of return of major assets and the increase in diversification of assets. This paper investigates the impact of Covid-19 on portfolio combination, highlighting the likely reason leading to the

decrease in the rate of return of the pharmaceutical company, providing assistance for people who want to explore this field.

One of the main limitations is the limited data. Compared to the various data before coronavirus, the data after it is still limited because it is only two years after the start of the virus. The influence of coronavirus still needs some time to spread and be discovered.

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