

Can Portfolio Investment Outperform Individual Stocks in Internet Content and Information Industry in Hong Kong Stock Market?

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ABSTRACT

The rapid growth of the internet industry makes the internet content information industry in the Hong Kong stock market a popular and appealing investment target. However, investing in this industry cannot guarantee an ideal outcome. This research tests the volatility of portfolios in the internet content and information industry. It obtains mean standard deviation and Sharpe ratio to evaluate the performance of portfolios in this industry. The result indicates that portfolio investment can provide better performance with short selling constraints than individual stocks do. Without short selling constraints, portfolio investment cannot provide a higher return but can still provide better outcomes with lower risk and a higher Sharpe ratio. This suggests that investors should always practice portfolio investment in the internet content and information industry in the Hong Kong stock market when short selling is available. When short selling is not available, risk-averse investors should always consider portfolio investment.

Keywords: Portfolio investment, Hong Kong stock market, the Internet industry

1. INTRODUCTION

As Internet technology develops, internet content and information infiltrate into people's daily lives and become an indispensable part of society. As a result, investors have been more interested in investing in the internet content and information industry during recent years. Hong Kong stock market, which had HK\$3.7 trillion total market capitalization in 2019 and HK\$4.7 trillion total market capitalization in 2020 [1], has become one of the most popular stock markets among investors, and the internet content and information industry is an attractive one with Tencent, Baidu, NetEase, etc. included. However, even though the Internet content and information industry are booming, stocks under this industry cannot guarantee high returns and low risk. During the past two years, especially under the COVID-19 pandemic, which dramatically affects the global financial market [2], internet content and information industry stocks have experienced frustrations.

Let's take Tencent as an example. Although it is the most popular and valuable stock in the Internet content and information industry, its stock price continuously decreased from February 2020. Under this circumstance, poor investment skills can easily lead to loss. Alhenawi

and Elkhali argue that households with financial knowledge can still have poor financial planning skills [3]. Some other preceding studies also indicate that portfolio investment can significantly reduce the risk [4, 5]. Therefore, investors must find an alternative way of investment to obtain an ideal return with acceptable risk. Portfolio investment, a method of diversifying investment into different stocks, is a choice in this situation. According to Alex, a balanced asset allocation enables investors to generate profit during different economic environments regardless of the success of future condition forecasting [6]. The purpose of this research is to examine whether portfolio investment can have better performance than individual stocks. To achieve this goal, two methods are used. First, a volatility test is done to check if portfolio investment can provide stable and low-risk outcomes regardless of weights assigned to stocks in portfolios. Second, 3 types of portfolios with the size of 3, 4, and 5 are created under each of two situations: with and without short selling. After comparing portfolios' performance with individual stocks' performance, whether portfolio investment has better performance in the Hong Kong stock market's

Internet content and information industry can be verified. The result can contribute as an instruction of investment in the Internet content and information industry.

The rest of this paper is structured as follows. In Section 2, data and methodology are described. In Section 3, the empirical results are illustrated. In Section 4, the conclusion is made, the whole paper is summarized, and the limitations are pointed out.

2. DATA AND METHODOLOGY

2.1. Data

This research uses data from Yahoo finance. There is a total of 14 stocks belong to the internet content & information industry, and 9 stocks that have 2-year historical data available from 2019/09/01 to 2021/08/01 is collected. From the original data, variables Date and Adjusted close value are selected to do the research. The reason to choose Adjusted close value rather than choose Close value is the Close value is just the cash of the last transaction price at the end of the day. In contrast, adjusted close value, which considers other factors like the new stock offering from corporations, reflects the stock's close value more accurately.

In addition to two variables of the original data, a new variable, "Return is created using the equation below to compare the performances of individual stocks and portfolios.

$$Return = \frac{Adj_t - Adj_{t-1}}{Adj_{t-1}} \quad (1)$$

In Equation (1), Adj_t and Adj_{t-1} denote the adjusted close values of two months in a row. The Variable Return is the monthly stock value change in percentage. With this variable, statistics such as mean, standard deviation, and Sharpe ratio that are used to evaluate the performance of a stock or a portfolio can be measured.

2.2. Methodology

The purpose of this research is to examine if portfolios can have better performance than an individual stock in the internet content & information industry of the Hong Kong stock market. To achieve this goal, 4 indicators: mean return, the standard deviation of return, Sharpe ratio, and volatility are selected to compare the performances of individual stocks and portfolios. To ensure that the result covers more cases, 3 portfolios by respectively 3, 4, and 5 stocks randomly selected from the 9 internet content & information industry stocks are created. The process is divided into two parts. The First part is the volatility test which tests if adding stocks into portfolios can make portfolios more stable. The second part is the portfolio creation and statistics comparison that create portfolios and compares statistics (mean, standard deviation, and Sharpe ratio) of portfolios and individual

stocks. Considering the availability of short selling and the effect of short selling on asset price like overvaluation [7, 8], all the research processes are done twice: one with portfolios that use short selling and another with portfolios that do not use short selling.

2.2.1. Volatility Test

Before assigning weight to stocks in portfolios, an overall volatility test is conducted to check if adding stocks to a portfolio can reduce the standard deviation and make standard deviation hold at a similar level regardless of the weight. This result can verify that portfolios are more stable than individual stocks overall.

To do this test, an empty portfolio is created first. Then shuffle the 9 stocks, and add them into the portfolio and calculate the standard deviation of the portfolio one by one until the last one is in. Lastly, by making a scatterplot of the standard deviation of the portfolio by the number of stocks in the portfolio, the value and trend of standard deviation can be observed.

2.2.2. Portfolio Creation and Statistics Comparison

Previous studies have developed many methods to measure portfolio performance. The Mean-Variance approach [9] and Sharpe ratio [10] were proposed to evaluate the tradeoff between return and risk. In this study, variance is replaced by standard deviation because standard deviation has the same unit as the original value. To evaluate the performance of portfolios, 3 portfolios with respectively 3, 4, and 5 stocks contained are created for each situation (with and without short selling). Then, the criteria: mean, standard deviation and Sharpe ratio of portfolios are calculated. The mean represents the expected return of a portfolio, which evaluates how profitable a portfolio is. The standard deviation represents the dispersion of returns. The higher the standard deviation a portfolio has, the riskier the portfolio is. The Sharpe ratio evaluates the overall performance of a portfolio. It represents the increase in return for an additional unit of risk. A Higher Sharpe ratio indicates better overall performance. It is calculated with the equation below.

$$S = \frac{R}{\sigma} \quad (2)$$

In Equation (2), the S denotes the Sharpe ratio, the R denotes the return, and the σ denotes the standard deviation. After obtaining the mean, standard deviation and Sharpe ratio of portfolios, they are used to compare with the counterpart of individual stocks to check whether portfolios perform better.

3. EMPIRICAL RESULTS

3.1. Stability of Portfolios

The volatility test is the test of the risk level of portfolios. This test indicates if portfolios can

significantly reduce risk compared to individual stocks and continuously provide returns at a specific level. To do this, the standard deviation of by the number of stocks in a portfolio is calculated, plotted, and compared with 9 individual stocks. The result is shown in Figure 1.

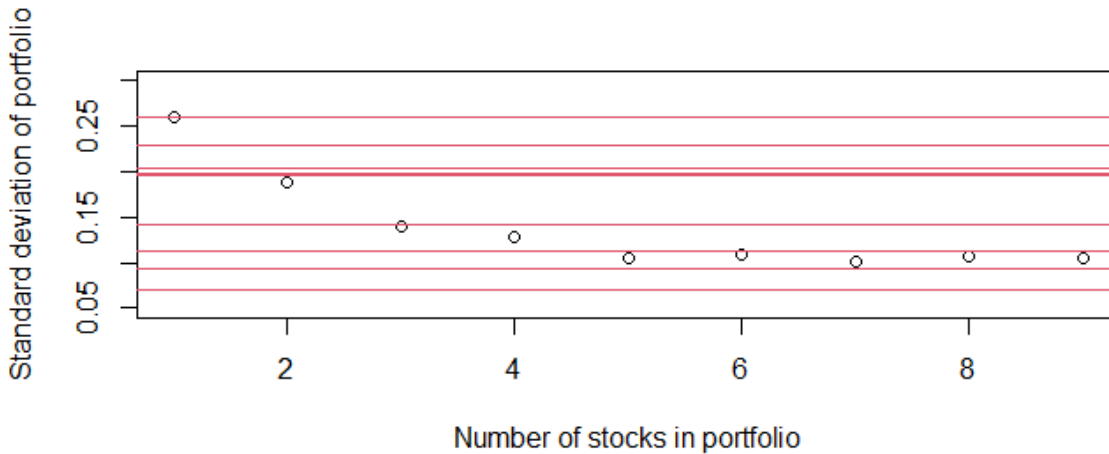


Figure 1. The plot of standard deviation by the number of stocks in the portfolio. *Notes:* Each black point represents the standard deviation of its corresponding number of stocks in the portfolio. Each red line in the plot represents the standard deviation of one stock.

In Figure 1, the standard deviation of the portfolio keeps decreasing and then maintains around 0.10 after the 5th stock is added. This figure illustrates that when a portfolio size grows, the portfolio can provide a more stable and lower standard deviation outcome. This makes portfolio investment always a reliable choice. Additionally, compared to the individual stock, the standard deviation of the portfolio is lower than 7 out of 9 stocks. Although the standard deviation of the portfolio cannot outperform all the stocks, it is still better than an individual stock most of the time. This result suggests that investing in a portfolio with an appropriate size can efficiently reduce the risk. Therefore, risk-averse investors can obtain safer outcomes with portfolio investment.

3.2. Portfolio's Performance by Statistics

From investors' perspectives, return, risk level, and Sharpe ratio is what they are interested in. Therefore, mean return, the standard deviation of return, and the Sharpe ratio are three important portfolio performance indicators. To obtain these statistics, each portfolio is

randomly assigned a weight in a specific range depends on the availability of short selling with a total weight equals 1. After assigning weights, a table with many portfolios inside can be created, and the statistics of each portfolio are calculated. To cover more situations, 3 portfolios with respectively 3, 4, and 5 stocks included are created, which allow the observation of portfolio performance under different sizes. These 5 stocks are Tencent Holdings Limited (HK.0700), Hypebeast Limited (HK.0150), Tian Ge Interactive Holdings Limited (HK.1980), China Literature Limited (HK.0772), and Inke Limited (HK.3700). In the figures and tables of the rest paper, these 5 stocks are denoted by numbers 1 to 5, respectively. In addition, short selling is an ideal situation and not always be possible for some investors. The above processes are being done twice for two different cases of short selling availability.

3.2.1. Performance of Portfolio with Short Selling

Short selling means investors sell shares they own. Utilizing short selling, more possible portfolios can be made.

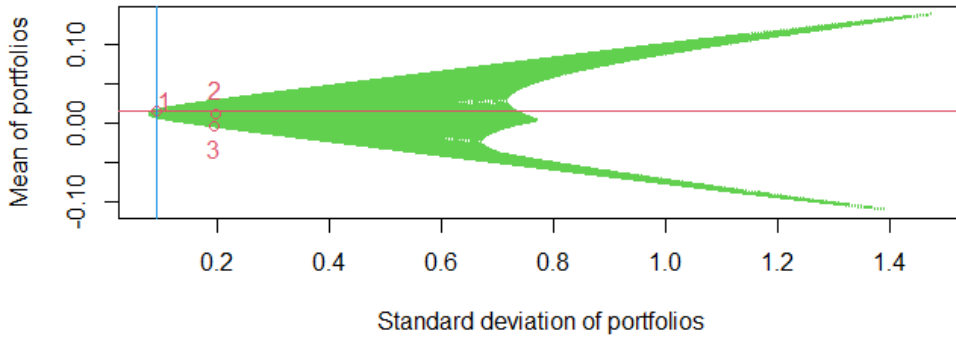


Figure 2. The plot of the portfolio means by the portfolio standard deviation of the 3-stock portfolio. *Notes:* Each green point represents one portfolio. Each red point represents a stock. The red line represents the mean of the individual stock, which has the highest mean among the three individual stocks. The blue line represents the standard deviation of the individual stock, which has the lowest standard deviation.

Figure 2 shows many green points above the red line and on the left of the blue line. This indicates that portfolios exist with returns higher than any of the individual stocks and portfolios lower than any of the individual stocks both exist.

Table 1. Statistics of 3-stock portfolio and individual stocks.

Asset	Weight 1	Weight 2	Weight 3	Mean	Sd.	Sharpe ratio
Highest mean portfolio	4.0000	4.0000	-8.0000	0.1388	1.4740	0.0942
Lowest sd portfolio	0.7671	0.0361	0.1698	0.0117	0.0818	0.1431
Highest Sharpe ratio portfolio	0.9639	0.0924	-0.0563	0.0164	0.0970	0.1693
Stock 1	1	0	0	0.0156	0.0020	0.1665
Stock 2	0	1	0	0.0126	0.1970	0.0638
Stock 3	0	0	1	-0.0037	0.1968	-0.0189

Notes: Weight 1-3 denote the weight of stock 1-3, Sd. denotes standard deviation

Table 1 contains the detailed statistics of the 3-stock portfolios and comparison to the individual stocks. Portfolio 4*stock 1 + 4* stock 2 - 8* stock 3 has a mean return of 0.1388, higher than any of the individual stocks. The portfolio 0.7671* stock 1 + 0.0361* stock 2 +

0.1698* stock 3 has a standard deviation of 0.0818, which is lower than any one of the individual stocks. The portfolio 0.9639*stock1 + 0.0361* stock 2 - 0.0563* stock 3 has a Sharpe ratio of 0.1693, which is higher than any of the individual stocks.

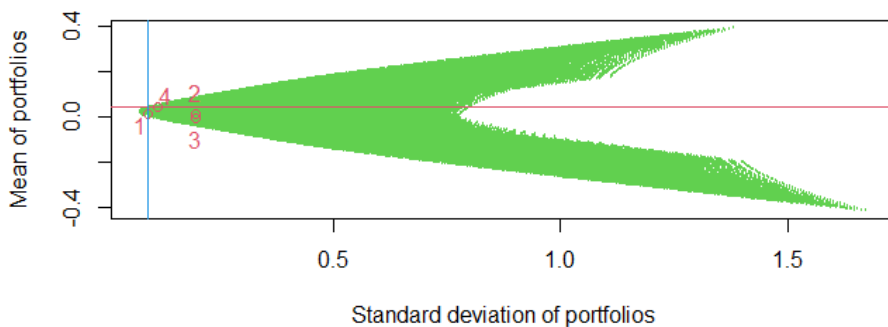


Figure 3. The plot of the portfolio mean by the portfolio standard deviation of the 4-stock portfolio. *Notes:* Each

green point represents one portfolio. Each red points represent a stock. The red line represents the mean of the individual stock, which has the highest mean among the three individual stocks. The blue line represents the standard deviation of the individual stock, which has the lowest standard deviation.

Figure 3 also shows portfolios with higher returns or lower standard deviation than any of the individual stocks.

Table 2. Statistics of 4-stock portfolio and individual stocks.

Asset	Weight 1	Weight 2	Weight 3	Weight 4	Mean	Sd.	Sharp ratio
Highest mean portfolio	-3.0000	-3.0000	-3.0000	9.0000	0.3941	1.3820	0.2852
Lowest sd portfolio	0.4286	-0.1429	0.2857	0.4286	0.0239	0.0767	0.3113
Highest Sharpe ratio portfolio	-0.2857	-0.1429	0.1429	1.2857	0.0533	0.1201	0.4441
Stock 1	1	0	0	0	0.0156	0.0938	0.1665
Stock 2	0	1	0	0	0.0126	0.1970	0.0638
Stock 3	0	0	1	0	-0.0037	0.1968	-0.0189
Stock 4	0	0	0	1	0.0468	0.1136	0.4115

In Table 2, The portfolio $-3 \times \text{stock 1} - 3 \times \text{stock 2} - 3 \times \text{stock 3} + 9 \times \text{stock 4}$ has a mean return of 0.3941, higher than any of the individual stocks. The portfolio $-3 \times \text{stock 1} - 3 \times \text{stock 2} - 3 \times \text{stock 3} + 9 \times \text{stock 4}$ has a standard deviation of 0.0767, which is lower than any one of the

individual stocks. The portfolio $-0.2857 \times \text{stock 1} - 0.1429 \times \text{stock 2} + 0.1429 \times \text{stock 3} + 1.2857 \times \text{stock 4}$ has a Sharpe ratio of 0.4441, which is higher than any of the individual stocks.

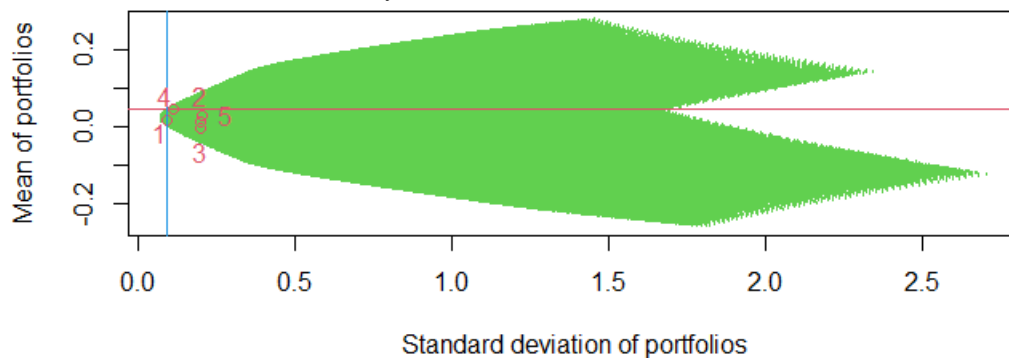


Figure 4. The plot of the portfolio mean by the portfolio standard deviation of the 5-stock portfolio. *Notes:* Each green point represents one portfolio. The red point 1 represents stock 0700.HK. The red point 2 represents stock 0150.HK. The red point 3 represents stock 1980.HK. The red point 4 represents stock 0772.HK. The red point 5 represents stock 3700.HK. The red line represents the mean of the individual stock, which has the highest mean among the three individual stocks. The blue line represents the standard deviation of the individual stock, which has the lowest standard deviation.

Figure 4 has a similar result as of the previous two. Portfolios have a higher mean and lower standard deviation.

Table 3. Statistics of 5-stock portfolio and individual stocks.

Asset	Weight 1	Weight 2	Weight 3	Weight 4	Weight 5	Mean	Sd.	Sharp ratio
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Highest mean portfolio	-3	-3	-3	4	5	0.2777	1.4611	0.1901
Lowest sd portfolio	0.4286	0	0.2857	0.4286	-0.1429	0.0218	0.0753	0.2888
Highest Sharpe ratio portfolio	-0.2857	-0.1429	0.1429	1.2857	0	0.0533	0.1201	0.4441
Stock 1	1	0	0	0	0	0.0156	0.0938	0.1665
Stock 2	0	1	0	0	0	0.0126	0.1970	0.0638
Stock 3	0	0	1	0	0	-0.0037	0.1968	-0.0189
Stock 4	0	0	0	1	0	0.0468	0.1136	0.4115
Stock 5	0	0	0	0	1	0.0274	0.2042	0.1340

In Table 3, The portfolio $-3 \times \text{stock 1} - 3 \times \text{stock 2} - 3 \times \text{stock 3} + 4 \times \text{stock 4} + 5 \times \text{stock 5}$ has mean return of 0.2777 which is higher than any of the individual stocks. The portfolio $0.4286 \times \text{stock 1} + 0.2867 \times \text{stock 3} + 0.4286 \times \text{stock 4} - 0.1429 \times \text{stock 5}$ has standard deviation of 0.0753 which is lower than any one of the individual stocks. The portfolio $-0.2857 \times \text{stock 1} - 0.1429 \times \text{stock 2} + 0.1429 \times \text{stock 3} + 1.2857 \times \text{stock 4}$ has Sharpe ratio of 0.4441 which is higher than any of the individual stocks.

In summary, all three portfolios with short selling can have a higher return, lower standard deviation, and higher

Sharpe ratio than individual stocks. The results suggest that if it is possible for investors to short sell, portfolio investment with appropriate weight can always outperform individual stocks.

3.1.2. Performance of portfolio without short selling

Although short selling enables a portfolio to provide good outcomes, it is not available for every investor. Therefore, the previous processes in 3.1.1 are repeated to test the portfolios without short selling.

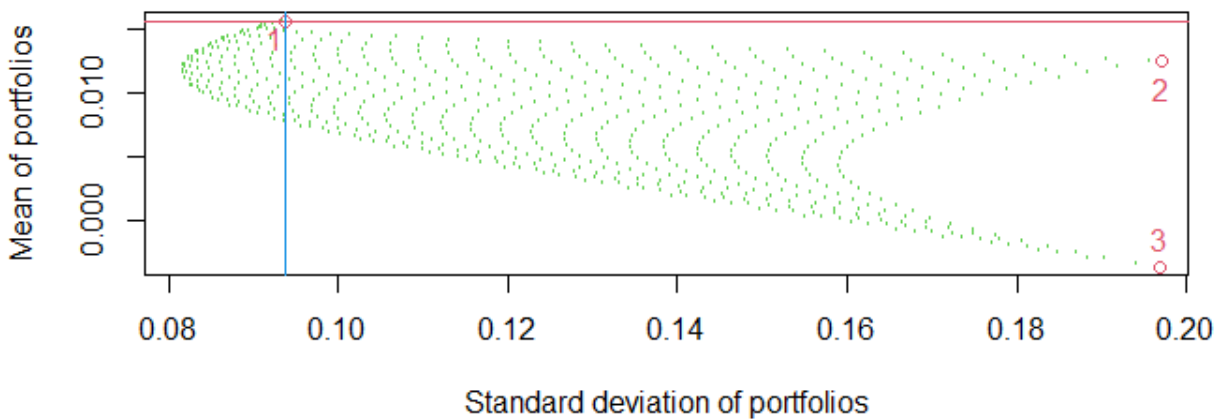


Figure 5. The plot of portfolio mean by the portfolio standard deviation of 3-stock portfolio without short selling. Notes: Each green point represents one portfolio. Each red points represent a stock. The red line represents the mean of the individual stock, which has the highest mean among the three individual stocks. The blue line represents the standard deviation of the individual stock, which has the lowest standard deviation.

When short selling is not allowed, the result is different from the result of the portfolio with short selling. The most obvious difference is no portfolio has a mean return higher than the stock with the highest mean return. Figure 5 shows many green points on the left of the blue line, but no green point is above the red line.

Table 4. Statistics of 3-stock portfolio without short selling and individual stocks.

Asset	Weight 1	Weight 2	Weight 3	Mean	Sd.	Sharp ratio
Highest mean portfolio	0.9920	0.0080	0	0.0156	0.0934	0.1669
Lowest sd portfolio	0.7671	0.0361	0.1698	0.0117	0.0818	0.1431
Highest Sharpe ratio portfolio	0.9357	0.0643	0	0.0154	0.0915	0.1686
Stock 1	1	0	0	0.0156	0.0938	0.1665
Stock 2	0	1	0	0.0126	0.1970	0.0638
Stock 3	0	0	1	-0.0037	0.1968	-0.0189

In Table 4, the portfolio $0.9920 \times \text{stock 1} + 0.0080 \times \text{stock 2}$ has a mean return of 0.0156, lower than the mean of stock 1. The portfolio $0.7671 \times \text{stock 1} + 0.0361 \times \text{stock 2} + 0.1698 \times \text{stock 3}$ has a standard deviation of 0.0818,

which is lower than any one of the individual stocks. The portfolio $0.9357 \times \text{stock 1} + 0.0643 \times \text{stock 2}$ has a Sharpe ratio of 0.1693, which is higher than any of the individual stocks.

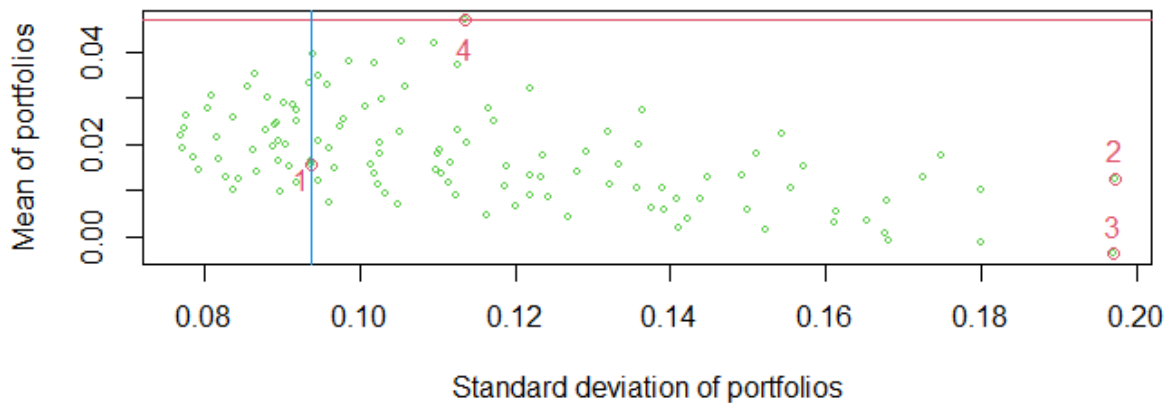


Figure 6. The plot of portfolio mean by the portfolio standard deviation of 4-stock portfolio without short selling. Each green point represents one portfolio. Each red points represent a stock. The red line represents the mean of the individual stock, which has the highest mean among the three individual stocks. The blue line represents the standard deviation of the individual stock, which has the lowest standard deviation.

Table 5. Statistics of 4-stock portfolio without short selling and individual stocks.

Asset	Weight 1	Weight 2	Weight 3	Weight 4	Mean	Sd.	Sharp ratio
Highest mean portfolio	0	0	0	1	0.0468	0.1136	0.4115
Lowest sd portfolio	0.5714	0	0.1429	0.2857	0.0218	0.0770	0.2825
Highest Sharpe ratio portfolio	0	0	0.1429	0.8571	0.0395	0.0940	0.4208
Stock 1	1	0	0	0	0.0156	0.0938	0.1665

Stock 2	0	1	0	0	0.0126	0.1970	0.0638
Stock 3	0	0	1	0	-0.0037	0.1968	-0.0189
Stock 4	0	0	0	1	0.0468	0.1136	0.4115

In Table 5, portfolio 1*stock 4 has to mean the return of 0.0468, which is lower than the mean return of stock 1. The portfolio 0.5714* stock 1 + 0.1249* stock 3+0.2857* stock 4 has a standard deviation of 0.0770, which is lower

than any one of the individual stocks. The portfolio 0.8571* stock 4 has a Sharpe ratio of 0.4208, which is higher than any of the individual stocks.

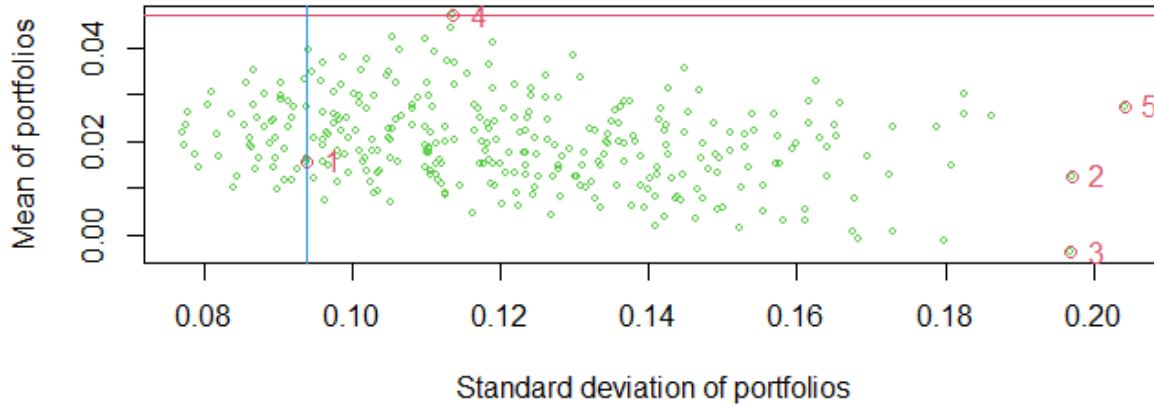


Figure 7. The plot of the portfolio mean by the portfolio standard deviation of the 5-stock portfolio. *Notes:* Each green point represents one portfolio. Each red points represent a stock. The red line represents the mean of the individual stock, which has the highest mean among the three individual stocks. The blue line represents the standard deviation of the individual stock, which has the lowest standard deviation.

In Figure 7, the stock 0772.HK has the highest mean return, and many portfolios have a standard deviation lower than any of the individual stocks.

Table 6. Statistics of 5-stock portfolio without short selling and individual stocks.

Asset	Weight 1	Weight 2	Weight 3	Weight 4	Weight 5	Mean	Sd.	Sharp ratio
Highest mean portfolio	0	0	0	1	0	0.0468	0.1136	0.4115
Lowest sd portfolio	0.5174	0	0.1429	0.2857	0.0540	0.0468	0.1136	0.4115
Highest Sharpe ratio portfolio	0	0	0.1429	0.8571	0	0.0395	0.0940	0.4208
Stock 1	1	0	0	0	0	0.0156	0.0938	0.1665
Stock 2	0	1	0	0	0	0.0126	0.1970	0.0638
Stock 3	0	0	1	0	0	-0.0037	0.1968	-0.0189
Stock 4	0	0	0	1	0	0.0468	0.1136	0.4115
Stock 5	0	0	0	0	1	0.0274	0.2042	0.1340

In Table 6, portfolio 1*stock 4 has a mean return of 0.0468, the same as the highest one of the 5 stocks. The

portfolio $0.5174 * \text{stock 1} + 0.1429 * \text{stock 3} + 0.2857 * \text{stock 4} + 0.0540 * \text{stock 5}$ has standard deviation of 0.1136 which is lower than any one of the individual stocks. The portfolio $0.1429 * \text{stock 3} + 0.8571 * \text{stock 4}$ has a Sharpe ratio of 0.4208 which is higher than any of the individual stocks.

In summary, when short selling is not available, the portfolio cannot have a higher return than the highest mean of individual stocks. However, portfolio investment is still able to provide a lower standard deviation and higher Sharpe ratio. Investors who seek low risk or additional high returns per unit of risk can still invest in portfolios.

4. CONCLUSION

This paper examines the performance of portfolios in the internet content and information industry of the Hong Kong stock market using two methods. The first method is continuously adding a stock to a portfolio to verify if portfolios can provide low-risk outcomes and maintain that level. The result of this method proves that this assumption is true. The second method obtains the portfolio's mean return, standard deviation, and Sharpe ratio and compares them with individual stocks to check which one has better performance. The results suggest that portfolio investment can outperform individual stocks in terms of mean return, standard deviation, and Sharpe ratio when short selling is available. When short selling is not available, portfolio investment can only outperform individual stocks in terms of standard deviation. Overall, portfolio investment can have better performance than individual stocks in the Hong Kong stock market's internet content and information industry and thus be a reliable and profitable choice of investors.

This research has some limitations. First, it is only an overall research. Situations of every investor cannot be covered which makes the conclusion less instructive to individual investors. Second, this research just evaluates the portfolio performance using past data, and it cannot predict the performance in the future.

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