Portfolio Shading up - A Portfolio composed by NVDA, NVO, KO AND C Using Efficient Frontier and Mean Variance Analysis

Zijiao Liang*

Shenzhen College of International Education, Shenzhen, China

*Corresponding author: S20156.Liang@scie.stu.com.cn

Abstract. This article illustrates that since last century investment becomes more and more popular as a way for people to save or spend money, but during the recovery of the pandemic, how we could make a suitable investment. This article, it demonstrates how to make an optimal portfolio with high return and low risk, with the introduction of the Variance and Mean model and efficient frontier, accompanied with the aid of Excel functions, and let it helps to get the solution best fitted in our expectations. The companies we chose for this portfolio are NVDA, KO, C and NVO, which are outstanding firms from four different industries. And another method of shading up the portfolio is also mentioned in this article, Potter's five force analysis and ESG analysis and rating scale, in a way that could increase the practical usefulness and validity in the reality of our portfolio. And these measures are also expected to be used in the future portfolio shading up.

Keywords: Mean-Variance analysis; Efficient Frontier; Risk; Return.

1. Introduction

Investment lately has been a popular choice for ‘spare money’, giving to the fund manager, making a real estate speculation, or buying stocks or treasury, are all examples of investing. However, even as Peter Lynch said in the book ‘one up on all street’: “My advice for next decade, Keep on the lookout for tomorrow’s big baggers. You are likely to find one.” [1], the book was first published in 1989, and we could learn from the latest news, not only ‘the next decade’, but the following decades, there are still ten baggers for us to find. However, the influence of the covid-19 and it has put a great impact on the economy, example as inflation, it is noted, occurred in equity prices, with stock markets soaring as investors borrow money at near-zero interest rates and find few attractive investment opportunities other than equities [2]. So that in the recovery stage of the economy, how could we invest more safely and wisely.

In this article, we will discuss stock investment, which always leads to a term --- portfolio. Risk and return would be the eternal measure of a good portfolio, all the clients and their managers want to find the best portfolio with the lowest risk but highest return, as they may find from their experiences and first-hand news. But how can we as amateurish investors, make a good portfolio? To achieve this, we decide to introduce models to help to build up the portfolio, and among those famous analyzing models like the fama-french three-factor model, SWOT, or PEST, we choose Mean-Variance analysis and Efficient Frontier to help our study, not only because these two measures are easier to learn and get data, but also it tends to be a purely statistical analysis, which could answer a specific value, that gives us a very objective and trustworthy result.

2. Data

2.1 Basic information

2.1.1 NVIDIA Corporation

The companies that we take to consider in our portfolio are the leading companies within four different fields, which are NVIDIA corporation from the technology industry, Coca-cola company for food staples area, Citigroup among financial stocks and in pharmaceuticals and medical market Novo nordisk is chosen to represent. And the basic information for these four companies is as follows, and due to the serious impact of the pandemic and force majeure like the rise of US interest rate, we choose to use the data from February 1st 2019 to June 1st 2021.

NVIDIA is a pioneered firm mainly working on artificial intelligence, advanced software, producing chips, and motherboard manufacturing, formed by Jensen Huang in 1993, and it's keeping developing the 'metaverse' that aims to transform the world's largest industries and profoundly impact society [3].

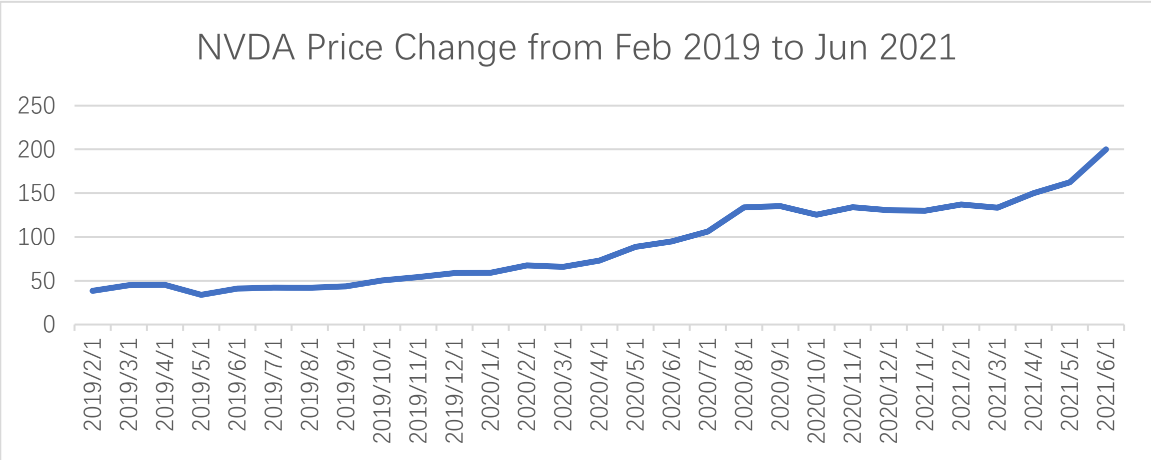

Figure 1. NVDA Price

According to figure 1, the average return of NVDA from Feb 2019 to Jun 2021 is 7%, which is quite high among all the four stocks that have been chosen. And as we could see from the line graph above, from the start of 2019 till the third season of 2020, the stock has experienced a smooth increase, from about 50 dollars per share to nearly 100 dollars per share. And encounter a relatively stable phase in the following 6 months, a sudden increase in April 2021, and reached a peak that touched 200 dollars per share in June.

2.1.2 Novo Nordisk

Novo Nordisk is a global healthcare company, founded in 1923, headquartered just outside Copenhagen, Denmark.[4] mainly products are treatments for diabetes, and serious chronic diseases such as obesity and rare blood and rare endocrine diseases. With the aim of defeating diabetes, the company has kept developing its technology and has supplied 50% of the global consumption of insulin.

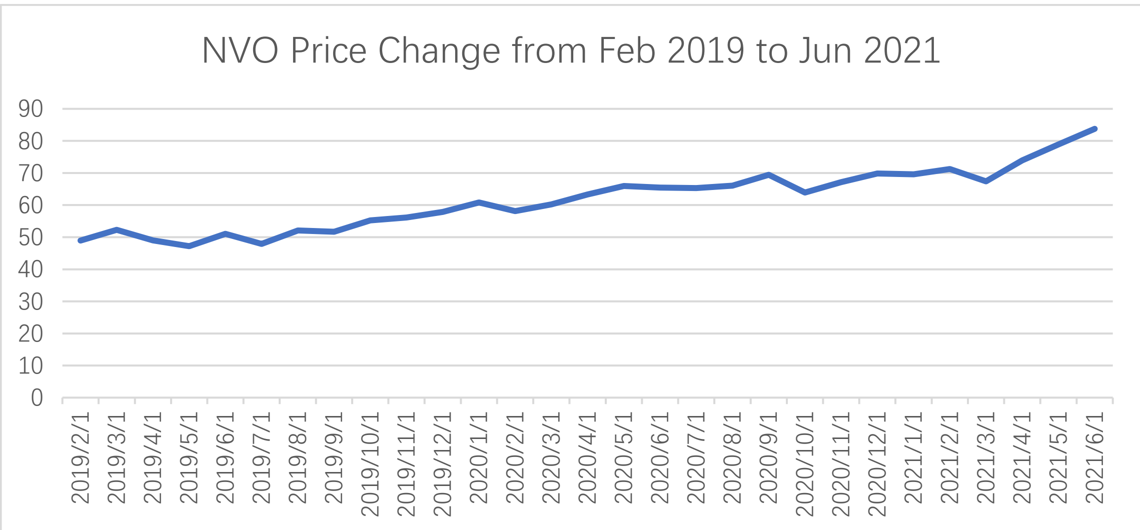

Figure 2. NVO Price

The stock return of Nov is 2% monthly on average during this time period, known from the graph, this stock has a fluctuated pattern during these 29 months in a way. Moreover, in the first 7 months, its price per share seems to bump. But overall, it draws an upward trend since it has increased from 48.95 dollars to 83.77 till the June of 2021 (see Figure 2).

2.1.3 Citi group Inc

Citi group is a financial bank providing financial services that enable growth and economic progress, including five main businesses which are: banking, markets, services, US personal banking, and global wealth management. With more than 4 trillion financial flows and a global network across 160 countries.[5]

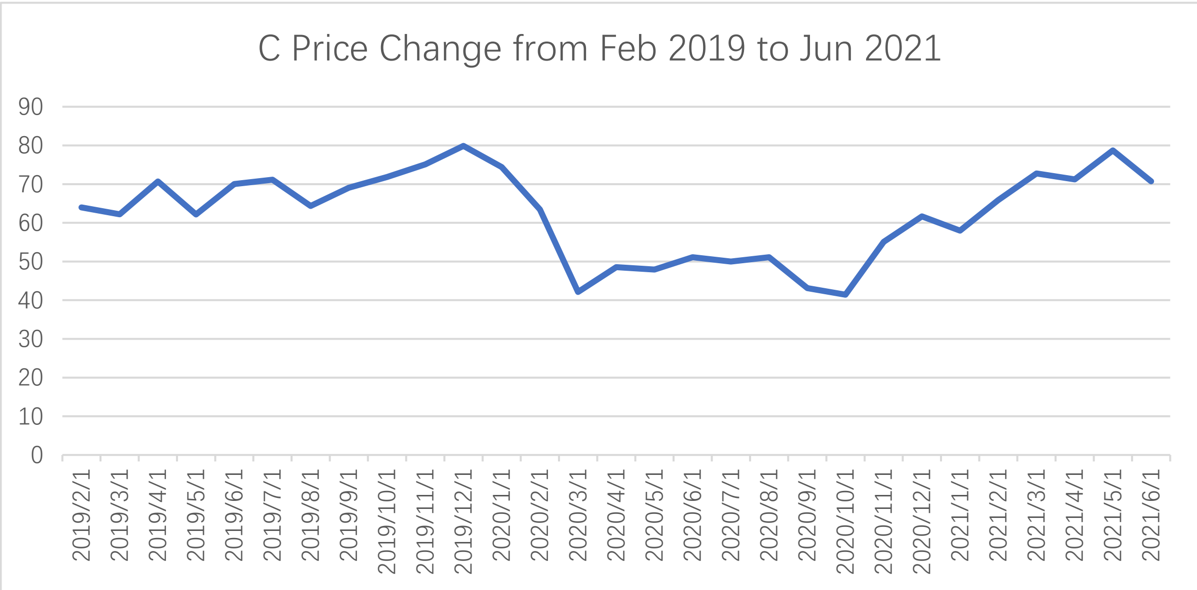

Figure 3. C Price

Unlike the other three stocks, C tends to have big fluctuation and experienced a trough in 2022 Feb, and reach the lowest price within the time period as 41.42 dollars per share in 2020 Oct. Whereas from Feb to Dec of 2019 it has a clear upward trend, a larger increase in the last 8 months. Ultimately reached 70.75 dollars in the last month, and held 1 percent return per month on average (Figure 3).

2.1.4 Coca-cola Company

Coca-Cola company has been one of the most famous beverage companies formed in 1886 by Dr. Pemberton. And has expanded to more than 2000 brands, and serves ranges from soft drinks and water, to coffee and teas. With its products serving over 200 countries each day, more than 225 bottling partners help deliver refreshments around the globe [6].

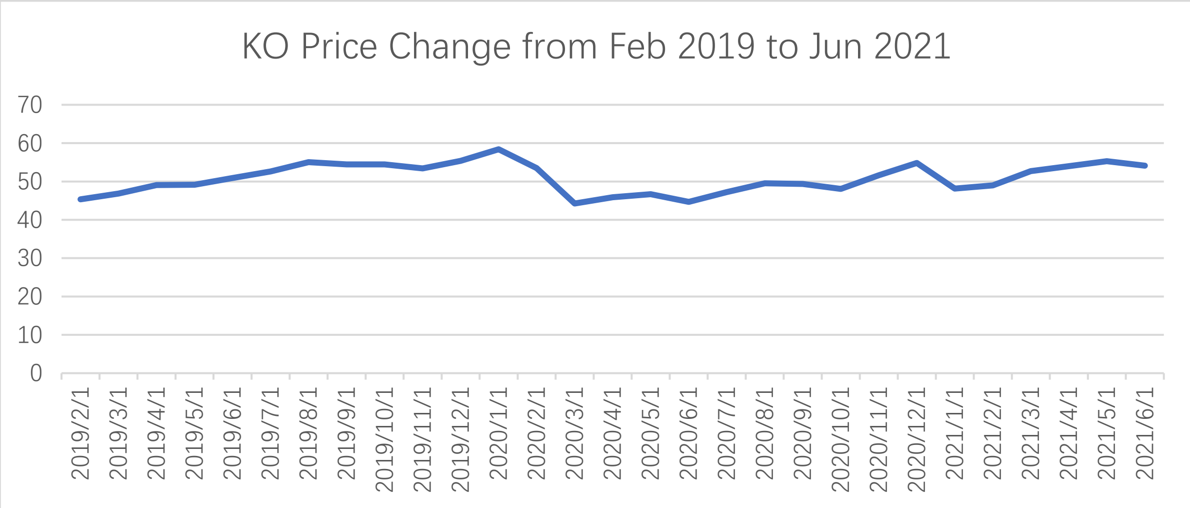

Figure 4. KO Price

As we could see from the graph, KO tends to have a stable price change and had two peaks respectively showed up in Jan 2020 (P/S:58.4$) and Dec 2022 (P/S:54.84$), and the total difference between the 29 months price change is 8.77 dollars and its stock gives an average of 1 percent return monthly (Figure 4).

2.2 Relationship Between Companies

Table 1. Covariance Between Stocks

	NVDA return	KO return	C return	NVO return
NVDA return	0.01102464	0.000774879	0.00244186	0.002300005
KO return	0.000774879	0.00320111	0.004582009	0.000422093
C return	0.00244186	0.004582009	0.015737642	0.000163275
NVO return	0.002300005	0.000422093	0.000163275	0.002389489

Lastly, we calculated the covariance between these four companies, and as we could notice, the covariance between every two companies tends to be a very small value, which means that there is only a little connection between each company, and also indicates that this portfolio could have a low risk due to each stock would not affect each other by much. Another conclusion that should be mentioned is that the covariance of each company with themselves is much bigger than their covariance with each other, which is shown in the upper right to downward left diagonal (see Table 1).

3. Methodology

In order to find the profit-optimal solution of our portfolio, we will introduce two measurements, one of them is the efficient frontier, and the other one is the introduction of H.M. Markowitz's model (also known as Mean-Variance Model), both of the methods are aiming to lower the risk and increase the portfolio return as much as possible. The efficient frontier is a set of most optimal portfolios that offer the highest expected return at a given level of risk or the lowest risk at a given level of expected return [7]. The mean-variance analysis is the process of weighing the risk, expressed as variance, against the expected return [8]. And these two measurements enable us to find the allocation with the largest return at a preset level of risk or the solutions with the requested return but with the least risk, with the aid of a solver and data analysis from Microsoft Excel software, we could find our most desirable portfolio.

To achieve the portfolio best fit our expectations, firstly, we find the price changes from Jan 2019 to Jun 2021 for the 4 companies, calculate the return rate for each month and get the average return of each stock. The US treasury return rate within these 30 months is also listed beside to make a comparison with the return rate of the stocks, to make sure that the investment is meaningful.

After collecting all these data, we could use the formulas of Mean and Variance to build several functions within excel, to let it help us to find the variance for each company. With the formula provided below and we get the results as shown. And we could use the solver function to find the correspondent expected to return with preset limits of portfolio risk. And we tested the value of portfolio risk from 0.1 to 0.05 to get its respective expected return (Table 2).

$$\max_{r} \mathrm{E}(\mathrm{r_p}) = \sum_{\mathrm{i}=4}^{4} \mathrm{wi} \times \mathrm{E}(\mathrm{r_i}) \tag{1}$$

$$\mathrm{st.}\,\sigma_{\mathrm{p}} = \sqrt{\sum_{\mathrm{i}=1}^{4} \sum_{\mathrm{i}=1}^{4} \mathrm{w_i w_j}\ \mathrm{Cov}(\mathrm{r_i}, \mathrm{r_j})} = \mathrm{k} \tag{2}$$

$$\mathrm{st.} \sum_{\mathrm{i}=4}^{4} \mathrm{w_i} = 1 \tag{3}$$

$$\max_{r} SR = \frac{E(r_p) - r_f}{\sigma_p} \tag{4}$$

Table 2. Efficient Frontier for Independent Portfolio Risk

Portfolio	
ER	Portfolio risk
0.066971279	0.100000007
0.063894921	0.095000004
0.060779672	0.08999997
0.057622269	0.084999982
0.054412477	0.080000011
0.04777329	0.070000006
0.040649257	0.060000001
0.036756232	0.054999996

Finally, we set the capital market line (CML) through the point of portfolio risk as 0.08, and its expected return is around 0.54. Concluding all the test data and the CML value we could ultimately get a graph as follow.

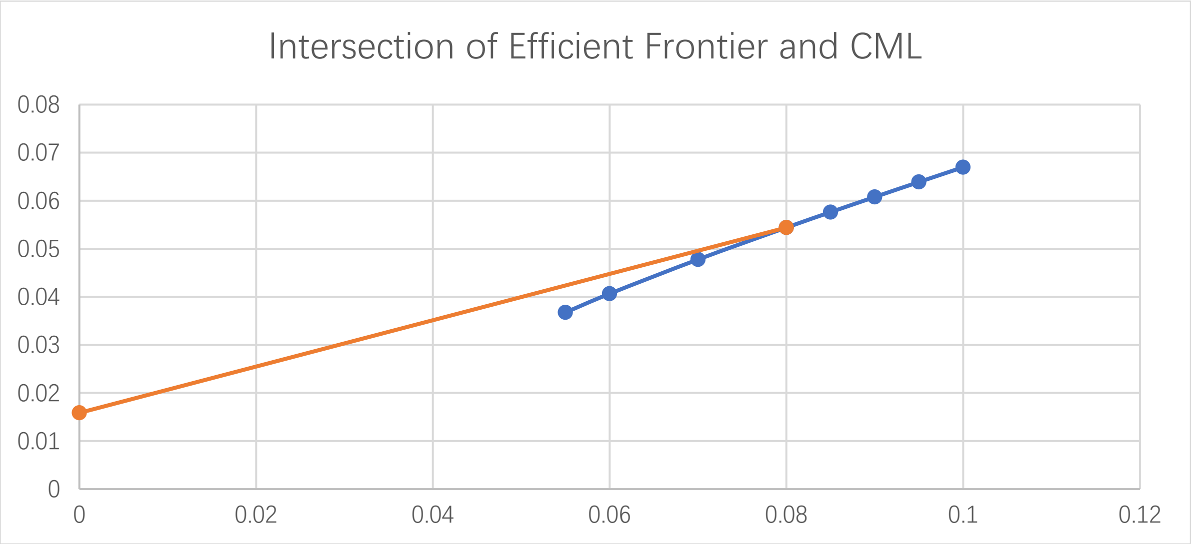

Figure 5. Interaction of Efficient Frontier and CML

4. Discussion

Although the Mean-Variance model and the efficient frontier have given a highly statistically reliable portfolio that most fits in our required risk limit and finds the highest return, there are still many unpredictable extraneous variables in the real world, which may lead to an unexpectedly low return or high-risk underneath. And it may make the tables turn, even with these authoritative formulas and highly regarded models.

Therefore, other than the statistical analysis, the updated news and sustainability of a company are essential as well. We could not build a conclusion without the data, but we could not carry the conclusion forward if we cannot see its sustainability. The data is from the past but the news and what they do every day are present, which proves the reliability of the data. And where could we see these sustainable signs. The environmental, social, and governmental factors (ESG factor) of a company may give us a clue. We could find clear ESG reports on each company's websites, but it may be hard to rationalize all this information like the programs and environmentally friendly activities. And to make a more sensible comparison we could use the Dow Jones Sustainability index family [9]to find an exact grade for each company, and gives the weight of this grade to form a more practical portfolio that are sustainable and more reliable.

Moreover, there are also other models that can also be introduced, like the Porter five force analysis, which focuses on five competitive forces of a company which is: 1. The competition within the industry 2. The threats from potential entrants 3. The threats of substitutes 4. The purchasing power of the consumer 5. The bargaining power of the suppliers [10]. With the aid of the potter five analysis, we could learn the weaknesses and strengths of a company more easily, and make the suitable adjustment when encountering the difference between calculation and reality.

5. Conclusion

In this article, we tried to discover the efficient frontier of our portfolio with the aid of the Mean-Variance model. And in our portfolio NVDA, KO, C, and NVO (the stock code for each company) are the four main components. We value the potential of these four companies by drawing out their price change patterns and calculating their average return. The risk has been proved low by the introduction of the covariance table. After collecting data, we introduced the model and by testing the different preset values of risk we find a CML value that best fits in expectations. At last, we got the most suitable portfolio, and met all the requirements, with really specified values of weights for each stock.

Nevertheless, even if we have got satisfied value using the mean-variance model and the efficient frontier, it does not mean that there is no space to promote. It is just an ideal model in the virtual world, which means that it may function differently in the real market. There are still many other factors that also could contribute to the return and risk that we haven't mentioned, like the ESG factors, overall environment, potential competitors, or the power of a business, which the Potter five model will analyze about. Therefore, to shape a stronger, more inclusive, and more practical portfolio, we would introduce the ESG factor and Potter Five model to the future analysis, to further consider the sustainability of a company, and the potential of the firm and industry.

References

[1] Lynch, P., & Rothchild, J. (2000). One up on Wall Street: how to use what you already know to make money in the market. Simon and Schuster.

[2] Maital, S., & Barzani, E. (2020). The global economic impact of COVID-19: A summary of research. Samuel Neaman Institute for National Policy Research, 2020, 1 - 12.

[3] Corportation, N. V. I. D. I. A. (2022). *About Us*. NVIDIA. Retrieved February 9, 2023, from https://www.nvidia.com/en-us/about-nvidia/#slide-98-d7b608ae.

[4] Nordisk, N. (2023). *Financial results, events and calendar*. Financial results and events Overview - Novo Nordisk. Retrieved February 5, 2023, from https://www.novonordisk.com/investors/financial-results.html.

[5] Inc, C. (2023). *Global Investment Bank and financial services*. Citi. Retrieved February 9, 2023, from https://www.citigroup.com/global.

[6] Co, C.-cola. (2022). *More than a beverage company*. The Coca-Cola Company. Retrieved February 9, 2023, from https://www.coca-colacompany.com/company.

[7] Chen, J. (2022, February 8). *Mean-variance analysis*. Investopedia. Retrieved February 9, 2023, from https://www.investopedia.com/terms/m/meanvariance-analysis.asp.

[8] Ganti, A. (2023, January 27). *Efficient frontier: What it is and how investors use it*. Investopedia. Retrieved February 9, 2023, from https://www.investopedia.com/terms/e/efficientfrontier.asp.

[9] Inc., S. P. G. (2022). *DJSI Index family*. S&P Global Homepage. Retrieved February 9, 2023, from https://www.spglobal.com/esg/performance/indices/djsi-index-family.

[10] Team, T. I. (2022, November 3). *Porter's 5 forces explained and how to use the model*. Investopedia. Retrieved February 9, 2023, from https://www.investopedia.com/terms/p/porter.asp (10).