

The Market of Console Games and Investment Portfolios of Corresponding Video Game Companies Impacted By COVID-19

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Abstract. At the beginning of 2020, the global COVID-19 outbreak brought about dramatic changes in people's lifestyles. Governments enacted quarantine policies. Everyday activities such as work, study, and entertainment became online. The reduction of offline socialization led people to focus on gaming entertainment. More people became interested in console games as an immersive pastime. This brought investment opportunities to the console game market. The study selected four stocks in the console game market, Nintendo, Take-Two Interactive, Sony, and Ubisoft. The research used the Markowitz Portfolio Optimization Model (MPT) to create low-risk and high-return portfolios and analyzed the investment potential and investment strategies of the console game market. The conclusion indicated that the four stocks all have different levels of changes after the outbreak of the epidemic. Investors reasonably use the investment portfolio established by the MPT model to buy and sell stocks, which can effectively reduce investment risks and obtain doubled returns.

Keywords: Console games, COVID-19, Investment portfolio

1. Introduction

1.1 Background

Before the Covid-19 pandemic, people may not use the internet as frequently as we are now, they may travel all around the world or go to work every day, so they will have less chance to get to know about console games. Since Covid-19 Pandemic has already been continuing for two years, people are usually self-quarantined at home from the pandemic, and the only way for them to connect with the outside world is through the internet. Console games are a way for people to connect with others through the network, not only the same ages, but also other generations [1]. Also, console games could be the same as PC to have an electronic library to help people find information more quickly, and it will be more flexible by comparing PC and console games [2]. Moreover, due to the pandemic, more and more people have begun to play console games through many different ways: learning, streaming, friends' recommendation and so on. As a result, Covid-19 pandemic is a good start for console games' stock price to rise. Doing the research will help to analyze which console game company will have more chances to have a higher growth rate for stock price.

1.2 Related research

Hera et al. claimed that digital games can enhance intergenerational relationship, and some digital games can help elder generation to against the aging, and collaborative digital games can help different generations to have a closer and stronger social relationship, so this could be an aspect of why console games could have a better future market [1]. Kirriemuir suggested that console game could be same as PC to have a electrical library in it, also the price of the console game is lower than PC, and since console game is being much more popular nowadays, and console game can use different kinds of network to connect, so it will be more convenient for people nowadays. Also console game is more concentrate on speed and playability, so it will be quicker for people to access

to the things they wanted [2]. Babb et al. used statistical methods to study video game sales by a platform in the global market from 2006 to 2011. Research had found that gamers were looking for high-tech gaming platforms. Console game platforms developed by Nintendo, Sony, and Microsoft are popular in the market. The portability of game consoles means they are likely to have a place in the video game sales platform scene [3].

Voida and Greenberg researched that people will play console games solo or socially. Console games can provide a comfortable way to communicate and entertain people at a party. The sales of console games had also increased significantly in the 21st century. Console games are very popular in American households [4]. Czech found that the cultural value of interactive entertainment benefits the video game industry. Due to the popularity of social networking sites, the environment of the gaming community is no longer closed. Indigenization challenges in different countries as it opens up to a wider and more demographically diverse public. With the expansion of video games for foreign markets, translation has become an integral part of the game development process [5]. Consalvo claimed that console video games have been going into a new path, it successfully has contributions to the global media culture, and it do have some future potentials, author mentioned several games, such as Final Fantasy X. And at the end, the global digital games industry has been hybridized, and it allowed them to seek more markets [6].

Jennifer et al. introduced that giving students opportunity to play console games that is relating to educations will eventually help student to boost their interest in studies, and since students are really into it, teacher can see their interest as motivation, as long as school conquer some difficulties, this console game theory will eventually help them to learn better, so this will boost the market of the console games [7]. Maddison and other author suggest that playing console video games might be an good aspect for children nowadays, since children's learning environment has changed compared with past, their sitting time is more than the past, so they might don't have that much time playing sports, so some console video games may be the options since playing video games can raise heart rate and activity counts [8]. Vrtana et al. believed that Nintendo's outstanding international marketing strategy had brought its net income rising year by year. Its net income was \$10,914 million in 2019. Nintendo focused on producing professional platforms for video games and game consoles. Its innovative products and marketing strategies for segmenting target customers made the industry prospects very promising. Nintendo had an advantage in the competition in the international game industry [9].

Johnson and Woodcock showed that live game streaming contributes to the growth of the gaming industry. They found that gaming videos on Twitch.tv helped promote independent games. Many old games, released over 10 years, attract the public's attention again. The social media industry was changing the way they promote the game industry. Let many people quickly understand the current popular games[10].

1.3 Objective

This research is dedicated to study the portfolios in the console gaming sector under the COVID-19 pandemic. Our research was based on the Markowitz Portfolio Optimization Model (MPT). The study selected four stocks, Nintendo, Take-Two Interactive, Sony Corporation, and Ubisoft Entertainment, to examine the annual returns and investment risks of each stock. A minimum risk portfolio and a maximum return portfolio were then created for the four stocks based on MPT. Our research then discussed the investment changes in the field of console games under the influence of COVID-19. Also, the study explained the practicality of the Markowitz Portfolio Optimization Model in the investment field.

2. Method

The Markowitz Portfolio Optimization Model (MPT) is a practical investment model for choosing to create the lowest-risk portfolio or the highest-return portfolio, which maximize its overall expected

return with a relatively low risk. There are four factors involved in the model, expected return, risk, weight, and sharpe ratio. The risk is the function of the variance of each stock and the covariance of each pair of stocks in the portfolio. Weights are the proportion of capital that will be invested in the corresponding stock. The sharpe ratio represents the expected performance of a portfolio by estimating the expected return earned in excess of risk-free rate. The ratio represents the expected risk-free return that the portfolio is looking for. U.S. Treasury Yield 10 Years (^TNX) is used for risk-free rate in this model.

The expected returns for each individual stock can be calculated by the natural logarithm of today's price divided by yesterday's price. Then do the average and times twelve for the annual return:

$$E(r_i) = \text{Average} \left(\text{LN} \left(\frac{\text{Today's Price}}{\text{Yesterday's Price}} \right) \right) \quad (1)$$

where $E(r_i)$ refers to the expected return on each individual asset.
The expected return for the portfolio can be estimated as:

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

where $E(r_p)$ is the overall expected return on the portfolio, W is the column vector of weights of each individual asset in the portfolio, and R is the vector of expected returns of the individual assets.

The risk of a portfolio is the variance-covariance matrix of the covariances between each pair of stocks' returns in the portfolio.

The variance of the portfolio can be estimated as:

$$\sigma_p^2 = W^T S(W) \quad (3)$$

The standard deviation of the portfolio is calculated as:

$$\sigma_p = \sqrt{W^T S(W)} \quad (4)$$

where S is the risk of the investment portfolio, S is the variance-covariance matrix, W is the column vector of weights.

The optimal weights for assets in a portfolio are the ones that maximize the value of the Sharpe Ratio for the Portfolio:

$$S_p = \frac{E(r_p) - r_f}{\sigma_p} \quad (5)$$

The lowest-risk portfolio is created by minimizing the standard deviation and the optimal asset return portfolio is created by maximizing the sharpe ratio.

The monthly data processed with the Markowitz Portfolio Optimization Model within the time range from October 2017 to March 2022. Four stocks, Nintendo (NTDOY), Take-Two Interactive Software (TTWO), Sony (SONY), and Ubisoft (UBSFY), are selected from Yahoo Finance. The fitting results of the two portfolios are created by the above model from 2017 to 2022 respectively.

3. Results

In order to assess the impact of the COVID-19 outbreak on the console game stock market, we divided the collected data into two sections for research. Our research compared portfolio outcomes before and after the pandemic began. We took October 2017 to December 2019 as the first phase.

Then January 2020 to March 2022 was used as the second phase. Each piece of data was allocated 27 months for the study. We found that the COVID-19 outbreak had an impact on the allocation of funds under the MPT model.

3.1 Price Trend

As shown in Figure 1, the study found that the four selected stocks showed stationary until 2020. After 2020, each of the four stocks had an overall trend of growth or decline.

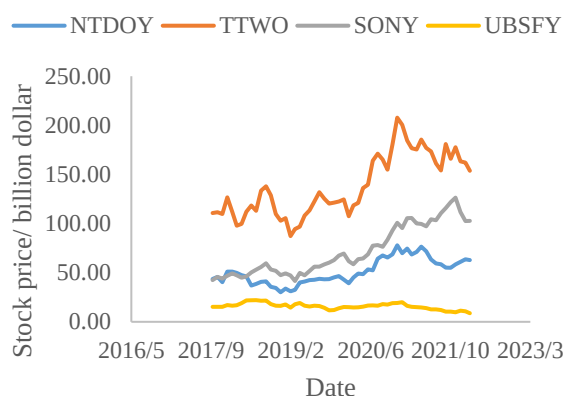


Figure 1. The Price Change of Stocks from Oct. 2017 to Mar. 2022

3.2 Individual Stock Returns and Risks

We first calculated the annual return and corresponding risk for each stock before and after the start of COVID-19. As shown in Table 1 and Table 2.

Table 1. Annual Returns and Investment Risks (From Oct. 2017 to Mar. 2022, USD)

	From Oct. 2017 to Dec. 2019		From Jan. 2020 to Mar. 2022	
	Annual Return	Risk	Annual Return	Risk
NTDOY	3.07%	34.10%	17.70%	28.16%
TTWO	4.67%	31.81%	9.68%	30.43%
SONY	21.29%	24.65%	18.01%	23.91%
UBSFY	-4.65%	37.71%	-25.24%	28.42%

Before the outbreak of COVID-19 (From Oct. 2017 to Mar. 2022), Sony had the highest annual return of 21.29% and the lowest investment risk of 24.65%. Ubisoft had a negative annual return of -4.65%, which means each \$100 invested in Ubisoft, the investor would lose \$4.65. Ubisoft also had the highest investment risk of 37.71%. Nintendo had an annual return of 3.07% and the investment risk was 34.10%. The annual return of Take-Two Interactive was 4.67% and its investment risk was 31.81%.

After the start of COVID-19 pandemic (From Jan. 2020 to Mar. 2022), Sony had the highest annual return of 18.01% and the lowest risk of 23.91%. Ubisoft had an annual loss of 25.24% and the investment risk of 28.42%. The annual return of Nintendo was 17.70% and the risk was 28.16%. Take-Two Interactive had an annual return of 9.68% and the investment risk of this company was 30.43%.

3.3 Minimum Risk Portfolios

As shown in Table 2, the study used the MPT model to create the lowest-risk portfolios before and after the onset of the COVID-19 pandemic.

Table 2. Minimum Risk Portfolio (From Oct. 2017 to Mar. 2022, USD)

	Oct. 2017 to Dec. 2019	Jan. 2020 to Mar. 2022
Nintendo	3.24%	31.99%
Take-Two Interactive	20.97%	-4.59%
Sony	60.11%	45.46%
Ubisoft	15.67%	27.14%
SUM	100.00%	100.00%
Expected Return	13.15%	6.56%
Risk (std.)	21.23%	17.75%
Sharpe Ratio	0.5074	0.2836

Before the outbreak began, our principal allocation recommendations for investors were as follows. Our research suggested an investor invested 3.24% of assets in Nintendo, 20.97% in Take-Two Interactive, 60.11% in Sony, and 15.67% in Ubisoft.

After the COVID-19 started, our research suggested investing 31.99% of assets in Nintendo, 45.46% in Sony, and 27.14% in Ubisoft. This portfolio created an expected return of 6.56% and lower the investment risk to 17.75%.

3.4 The Highest Expected Return Portfolios

Our research studied the optimal asset weights portfolios through MPT model before and after the COVID-19 outbreak. As shown in Table 3.

Table 3. Optimal Asset Weights Portfolio (From Oct. 2017 to Mar. 2022, USD)

	Oct. 2017 to Dec. 2019	Jan. 2020 to Mar. 2022
Nintendo	-49.66%	101.96%
Take-Two Interactive	7.45%	236.11%
Sony	167.88%	191.92%
Ubisoft	-25.68%	-429.99%
SUM	100.00%	100.00%
Expected Return	35.76%	184.03%
Risk (std.)	37.37%	106.89%
Sharpe Ratio	0.8932	1.7075

Before the outbreak, our research found that an investor would sell 49.66% of Nintendo stocks and 25.68% of Ubisoft assets. Then invested 7.45% of assets in Take-Two Interactive and invested the rest of assets in Sony to gain the highest expected return.

After the start of the COVID-19 pandemic, we found that an investor would keep invested assets of Nintendo, Take-Two Interactive, and Sony. But the investor sold all assets of Ubisoft and then allocated returns to Nintendo, Take-Two Interactive, and Sony to gain the largest overall expected return of 184.03%.

4. Discussion

4.1 Fundamentals of Companies

Since the beginning of 2020, the epidemic has swept across the world, but the console game stock market has shown an overall upward trend. Especially in the 2020-2021 fiscal year, quarantine policies have led to more and more people staying at home. People's demand for home entertainment has increased significantly. This has led to the growth of the console game market.

Nintendo, a major Japanese game maker, operates a business in the home entertainment field. Sales of its popular products, such as the Switch console and gaming software, could have a material impact

on its operating results. Earnings figures for the fiscal year ending in March 2021 showed higher revenue. Its full-year net sales increased by \$4.093 billion from the previous fiscal year to \$15.990 billion, a year-on-year increase of 34.4%. Gross profit increased by \$2.988 billion to \$8.821 billion from the previous fiscal year; a year-on-year increase of 51.2%. Its game console hardware sold 28.83 million units, up 37.1% year-on-year. Its revenue was mainly derived from the sale of Nintendo Switch, which accounted for \$15.149 billion, an increase of 36.7% from the previous fiscal year. In 2020, the Switch game console will have nearly 90% of the game console market share in Japan. Nintendo's software sales also hit a new high. The sales volume of game software was 230.88 million units, a year-on-year increase of 36.8%. Among them, Animal Crossing: New Horizons was popular, accounting for 20.85 million sales.

Take-Two Interactive is an American game publishing company. Games published by the company land on console devices such as Sony's PlayStation series and Nintendo's Switch. The good adaptability of the game system and the intellectual property of game development make the company competitive in the console game market. For the fiscal year ended March 31, 2021, Take-Two Interactive's net income was primarily derived from games in the franchise. For the fiscal year ending in 2021, the company's net revenue increased to \$3,372.8 million. It had an increase of 9.2% compared to the fiscal year ending in 2020. Its net income reached \$588.9 million, compared with \$404.5 million in the previous fiscal year. Take-Two Interactive's market valuation reached \$118.61 billion in March 2020, while the number rose to \$207.79 billion in December 2020. The market value doubled for the year.

Sony, one of the biggest technology firms in Japan, generates console games. Its PlayStation is now popular all round the world. And the operating income for income statement changes from \$845,459 to \$971,865 from fiscal year 2020 to 2021, and it rose about 14.95%. Also, for the income before income taxes, it rises from \$799,450 to \$1,192,370, which increased about 49.148%. The change is dramatic and obvious for Sony during the Covid-19 Pandemic.

Even in July 2020, Ubisoft Entertainment was affected by public opinion due to the departure of executives due to a sexual harassment scandal. After that, Ubisoft's sales in the third quarter of the 2020-2021 fiscal year still increased from 416 million euros (about \$437 million) to 965 million euros (about \$1.015 billion), an increase of 131.9%. Its full-year sales rose 39.4%.

4.2 Data Analysis

Due to the Covid-19 pandemic, stock distribution has been changed. From the Min Risk Portfolio, Sony is always be in the biggest percentage, and Nintendo is the second most. But Ubisoft and Take-Two Interactive has been dropped tremendously. This might be because Sony and Nintendo are the companies that has famous products other than Games, such as game consoles and other kinds of electronic products. However, Ubisoft Entertainment and Take-Two Interactive are the companies that major in Games. Therefore, their product selling of Games might be affected due to the Covid-19 Pandemic. Compared with Sony and Nintendo, although their Games product selling will be affected, their other products will also boost their selling and cover the lost from the game product. Even games developed by Ubisoft and Take-Two Interactive are released on console platforms from Nintendo and Sony. Also, from the Optimal Asset Weights portfolio, Ubisoft and Take-Two Interactive's returns are going down tremendously due to the COVID-19. This means we need to sell their stocks to lower the loss to the minimum, and Nintendo and Sony's returns has been increased from -49.66% to 101.96% for Nintendo, and from 167.88% to 191.92% after the start of the COVID-19. But Ubisoft changes from -25.68% to -429.99%, it means that we need to sell all of the Ubisoft stocks to keep our interest to the biggest.

4.3 Method Comparison

The minimum risk portfolio helps investors maximize returns with relatively minimum risk. Before the COVID-19 outbreak, the overall risk of the portfolio was lower than the risk of investing in any single stock. Even though its expected return was lower than Sony, it was higher than the other

three stocks. The situation was similar after the start of the COVID-19 pandemic. The optimal asset weights portfolio helps investors gain the most returns with allocating investment weights to each stock. Although the overall investment risk in this portfolio was high, the expected return is higher than that of investing in individual stocks and the minimum risk portfolio. After the COVID-19 began, the high rate of expected return in the optimal asset weights portfolio was further enhanced. This contrasts with the lower overall expected return of the minimum risk portfolio. Compared to investing in individual stocks, creating portfolios could help improve the rate of returns and investment security.

Our study also compares the pros and cons of two MPT-based portfolios by comparing their sharpe ratios. Sharpe ratio can be understood as the ratio of expected return to investment risk. It helps investors examine whether a stock is worth investing in. The higher sharpe ratio indicates that the investment is more recommended. From the minimum risk portfolio, the sharpe ratio was lower than 1 and it decreased after the COVID-19 began. However, the sharpe ratios in the optimal asset weights portfolio were higher than that of the minimum risk portfolio. It even increased to 1.7 after the start of the COVID-19 outbreak. This means the expected return relative to the risk was high and the investment was recommended.

Our research found that in the absence of the impact of the COVID-19, the minimum risk portfolio based on MPT reduced investment risk. However, its return on investment would be affected and decreased after the outbreak of the epidemic began. The optimal asset weights portfolio would give a more advantageous investment return after the outbreak started. Therefore, according to the situation and investment needs, investors can select an appropriate investment portfolio to reduce risks and improve overall returns.

5. Conclusion

This article analyzed the investment potential of the four selected stocks in view of the changes in the console game market before and after the COVID-19 outbreak. The research used the MPT model for portfolio constructions. These portfolios helped investors apply investment strategies under the global influence of the COVID-19 epidemic. The rise of the game market during the epidemic indicated people's need for immersive entertainment in special times. Especially the giant in the console game market, Nintendo, the annual return from January 2020 to March 2022 increased by 14.63% compared to October 2018 to December 2019. In special times, investors should pay attention to well-known companies that are already in the corresponding potential market. Popular products from well-known companies are more likely to be accepted and purchased by people who need them, thereby increasing the company's stock price. The Sharpe ratio of the optimal asset weights portfolio after the start of the epidemic can be increased to 1.7, which is nearly double the Sharpe ratio of the same period before the start of the epidemic. However, this research did not mean that all corresponding companies in the market have great investment potential. Ubisoft's annual rate of return rose in 2020-2021, during the height of the epidemic. However, the company had a downward trend in returns after 2021. Investors need to focus on the investment period. In future black swan events such as COVID-19 with global influence, investors can grasp the changes in people's lifestyles brought about by policies. By tracking the current consumption needs of people, investors can make timely portfolio investments.

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