Investment Analysis of Airline Companies in Pandemic
A Comparative Study of CEA and UAL

Zeyu Gu[1,*,a,†], Xiaohan Liang[2,*,c,†], Yanman Yu[3,*,b,†]

[1] *Department of Science, Xi'an Jiaotong-liverpool University, Suzhou,215007,China*
[2] *Department of Economics, University of Warwick, Coventry, CV4 7AL, UK*
[3] *School of Information Engineering, Hangzhou Dianzi University*
Corresponding author. Email: [a]Zeyu.Gu18@student.xjtlu.edu.cn, [b]xiaohan.liang@warwick.ac.uk
[c]*zjyym852673247@163.com,*
[†]*These authors contributed equally.*

ABSTRACT

Due to the outbreak of COVID-19, the aviation industry was revealed highly vulnerable to such a crisis, and the stock prices of worldwide airline companies all faced significant declines. The airline companies would have to adapt themselves to a world with lasting impacts from the pandemic to recover from the decline. Government and investors would also need new approaches and precautions to invest or intervene. This paper employs a regression model, hypothesis test, and moving average to analyze the financial performances of United Airlines (UAL) and China Eastern Airline(EAL) before and during the COVID, using stock prices and net profits as key indicators. It can be found that after the onset of the pandemic in 2020, two completely different strategies would lead to two different outcomes. According to the seasonal distribution of the stock prices of UAL and CEA in an unknown period and the characteristics of each airline, the model of seasonal effect is adopted to analyze the market share of the two airlines in 2021. Finally, through the possible errors in the prediction, it is found that the errors were small before the pandemic and became large immediately after the pandemic. It can be concluded that in the period of severe crisis such as COVID-19, government intervention affected the normal development of the airline companies. The paper would give suggestions on government interventions, firm responses, and investor decisions accordingly.

Keywords: Airline companies, Investment analysis, regression model, hypothesis test

1. INTRODUCTION

1.1. Overview

The unprecedented COVID-19 pandemic acted an enormous impact on global society. According to WHO, by 29th April 2021, the number of global cumulative cases has reached 15million, while worldwide, there have been over a 3.15million of deaths. According to IMF, the world GDP of 2020 has declined by 3.267%, comparing to 2019. Hence, the global passenger transportation industry was under significant impact, both from the lockdown actions and the downwards economic behaviors. The aviation passenger flight industry was under an enormous impact, as people were banned from frequent traveling or vacation plans. From February 2020, international flights were massively grounded and canceled until October, when some countries get their situation under control, the demand

for passenger flights gradually recovered. Before the COVID-19 pandemic, the statistics for global passenger traffic had been in continuous increase for over ten years, since the global financial crisis. In 2019, ACI predicted a 3.7% compounded annual growth rate for the 2019-2040 Business-as-usual passenger forecast. In their latest media release on 22 April 2021, Airports Council International (ACI) revealed a 64.6% shrink in global passenger traffic at the world's airport in 2020. According to Circum, overall global flights declined by 49% in 2020. While the global aviation industry is still struggling to recover from the still ongoing impact of the COVID-19 pandemic, the media release also stated that in 2020, seven of the top 10 airports for passenger traffic are in China, while the other 3 in the United States. It reveals that the impact on a different country and their aviation industry is uneven and suggests that their future performance and state of recovery may also differ. Since vaccination has begun to take place

worldwide, it is believed that the demand for passenger flights would rise.

1.2. Literature Review

Chinese researcher Yi Lu (2009) used the non-parametric test method and the Logistic regression method to identify two core financial indicators - quick ratio and ROE and established a financial evaluation model for the transportation industry based on the two indicators.[1]He suggested that the model could be used to examine whether a firm is worthy of investment. The method is based on a horizontal study of firms within the Chinese transportation industry.

There also have been researching papers that compared relative and absolute valuation tools, as Yahui Liang (2015) illustrated, in which he made a specific demonstration on stock value analysis, using Vistech as a reference firm.[2] He states that the Chinese stock market and Western stock markets are at different phases of development. Contemporary Western stock markets are mainly dominated by institutional investors, whereas the Chinese stock market is still sensitive to government policies due to its rather recent establishment. The research concluded that the Chinese stock market analysis could not be conducted with unadjusted stock value investment theory from Western markets.

A collaborated study of the airline industry by Kang Wensheng, Perez de Gracia Fernando, and Ratti Ronald A. (2021) examined economic policy uncertainties and oil price shocks on stock returns of US airlines.[3] The study applied the Structural Vector-Autoregressive(SVAR) model from 1985 to 2017, proving a positive link between oil price and US airline stock return volatility. They observed that between Feb 2020 and Mar 2020, during this period of the COVID pandemic, while WTI oil price dropped 42.2% and the economic policy uncertainty index jumps 76.40%, airline stock returns declined substantially. The study provides an examination of the impact of the economic policy uncertainty index and oil price on airline stock returns.

Likewise, Mollick André Varella and Amin Md Ruhul (2021) conducted similar research on aircraft occupancy and oil price on stock returns by exploiting fixed-effects regression models.[4] The research documented a positive relationship between occupancy and stock returns and concluded that the airline industry respond to oil price more than the overall stock market

1.3. Research Contribution

The existing studies mainly focused on economic or financial indicators but could not provide an investment overview or review of the COVID-19 situation. The previous authors and studies may not have foreseen the occurrence of such a widely-spread virus, nor its lasting damage on the industries worldwide. Hence we would like to study the states of operation of airlines during the pandemic as a complement to previous studies on airline investments.

We would mainly focus on the indicators of United Airlines, with China Eastern Airline as a reference. Both airline companies are outstanding airlines that perform domestic and overseas flights, both of front ranks in their home country's airlines. However, the performance of their economies during the pandemic, the different policies they are undergoing, and the strategies they take would differentiate their stock performance.

We would research and analyze the financial indicators of the two airlines, observe their past fluctuations and ongoing trend. There would be an overview over the past five years, from 2016 to 2021. We aim to use the example of UAL and CEA to suggest new value investment research methodologies for airlines and make suggestions on investment and response methods of airlines.

2. DATA AND METHOD

2.1. Data

The research object of this paper is the aviation enterprises under the COVID-19. The selected enterprise representatives are UAL and CEA. The time period selected for the study is 2016 to 2020. Data can be divided into two categories. One is stock data, including the information and trend of stock prices of CEA and UAL from 2016 to 2020. The second category is the official website information, including the net profits of CEA and UAL and the latest news of enterprises from 2016 to 2020.

2.2. Method

2.2.1. Regression Model

The regression model is a mathematical equation that measures and verifies the influence and direction of one or several independent variables (cause variable) on a dependent variable (result variable). [5]The basic idea of modeling is: firstly, according to certain economic theory or experience, a priori a mathematical equation is used to express the causal relationship between economic variables in the system under study; Then, according to the available sample data, the appropriate methods are selected to obtain the estimated value of the model parameters. If the model passes the relevant tests, it can verify economic theories, analyze economic structures, evaluate policy decisions, simulate economic systems, and predict economic development.

2.2.2. Hypothesis Test

Hypothesis testing is to make some assumptions about the distribution law or distribution parameters of the ξ of the whole.[6] According to the sample observed values, the correctness of such assumptions is tested using the analytical method of mathematical statistics to decide whether to accept or reject the hypothesis. The specific methodology is as follows: according to the needs of the problem, make some hypothesis on the population under study, denoised as H0: select appropriate statistics, which should be selected so that the distribution is known when the hypothesis H0 is true; According to the measured samples, the value of statistics is calculated, and according to the pre-given significance level, the test is made to reject or accept the false H0 judgment.

2.2.3. Moving-average

In statistics, a moving average is a calculation used to analyze data points by creating a series of averages of different subsets of the full data set. In finance, a moving average (MA) is a stock indicator that is commonly used in technical analysis. The reason for calculating the moving average of a stock is to help smooth out the price data by creating a constantly updated average price.2.2.4. Return and log-return

Logarithmic rate of return, also known as the continuous compound rate of return, is used to make the rate of return have satisfactory statistical properties to be effectively applied in the process of financial modeling.It is an important index to study the investment behavior and risk management of financial assets or portfolio.[8]

3. RESULT AND DISCUSSION

The financial condition could be a good choice to measure the state of operation of an airline under different circumstances. Among all the aspects of the financial condition, the stock price is the most direct way. It shows the real value of the company, including profitability, risk, and potential. Also, the increase and decrease of the stock price reflect the attitude of the investors towards the industry. Thus, the stock price is chosen to be the main object of this part.

3.1. Stock Price

In 2020, a new virus called COVID-19 attacked human space, leading to serious financial crisis and social problems. The airline was one of the most industries which were heavily affected by the virus. Due to the policy, almost all the flights had to be stopped for several months. With great liquidated damages and maintenance fees of the aircraft, the airlines suffered great losses.

The graph below shows the stock price of United Airlines Holdings, Inc. (UAL) before the COVID-19 virus. The price tended to increase with fluctuation as the airline industry has a seasonal change in a year with the unfixed term.
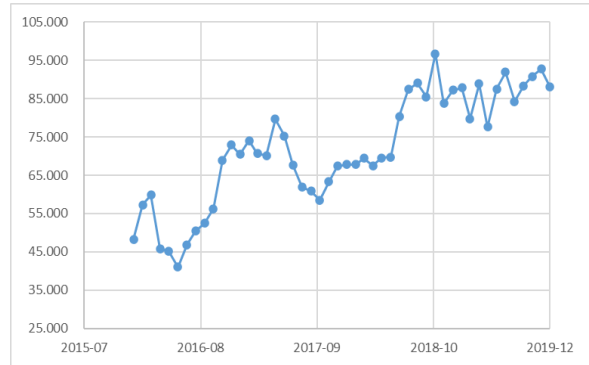

Figure 1 Stock Price of UAL(2016-2019)

After adding the data for 2020, we get another graph below. Obviously, since the end of 2019, the stock price had collapsed immediately and bottomed out. The price reached the minimum amount over the 5 years. After that, the price recovered a few at the end of 2020.

Figure 2 Stock Price of UAL (2016-2020)

After the USA government released the policy to stop the flights, the airlines' incomes were cut off. The policy also gave the citizens a signal that the total cash flow and the company's total revenue would decrease rapidly. Owing to this, the investors began to dump the stocks in their hands to cut their loss, leading to a further decline in stock prices. The airline had no choice but to use the cash flow to fill the gaps and financial deficits.

China Eastern Airlines Corporation Limited (CEA) is also chosen as a typical airline. The stock price of CEA. The price reached a peak at the end of 2017 and decreased after that. The data changed little in 2019 compared with that in 2016.
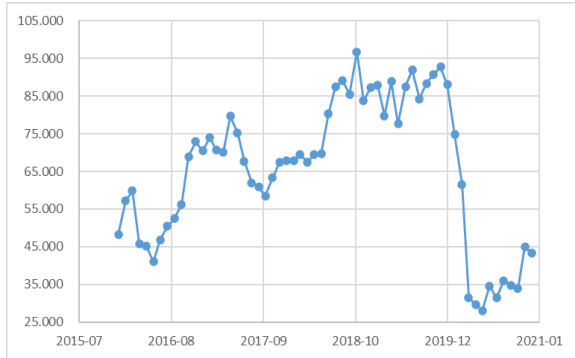
Figure 3 Stock Price of CEA(2016-2019)

After been affected by the virus, The stock price decreased quickly at the same rate as the UAL had. However, after comparing the two graphs, we found that the extents of the declines of the two companies are different. The UAL lost much more than the CEA with the same virus conditions. To figure out why UAL lost more potential investors, we turned to the financial statement of the two companies and found the net profit of each year.

Figure 4 Stock Price of CEA(2016-2020)

3.2. Net Profit

The graph analyzes the regression of the net profit of the UAL. The coefficient of determination(R^2) of the UAL is 1, which means that the model is fitted with the data perfectly. The net profit of UAL has an obvious tendency to increase greatly in 2020 if there are no accidents. The data were boomed in 2019 compared to within 2018.
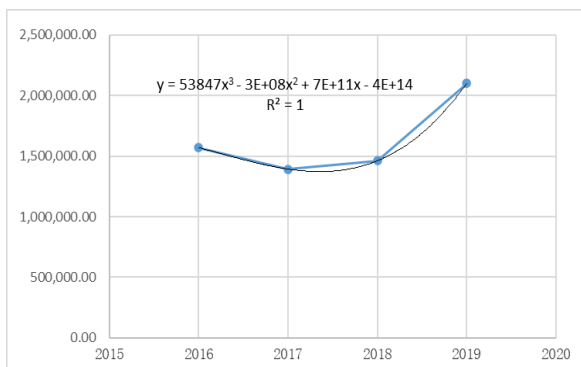

$y = 53847x^3 - 3E+08x^2 + 7E+11x - 4E+14$
$R^2 = 1$

Figure 5 Regression of Net Profit (UAL, 2016-2019)

It seems that there could be some difference between the UAL and the CEA. Due to some reasons, the profit of the CEA could not be analyzed easily as the increase in 2019 is very limited, which indicates that the company's policy is still in adjustment or the company adopted a conservative management strategy.
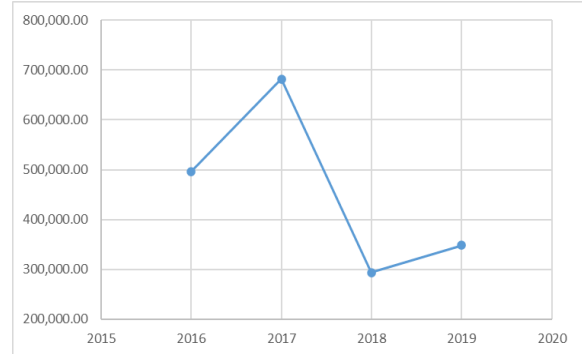

Figure 6 Regression of Net Profit (CEA, 2016-2019)

From Table 3-1, the sum of the profit from 2016 to 2019 of UAL is three times as same as CEA. According to the regression of UAL, the expected net profit in 2020 will be above 3,500,000. So the loss of the UAL from expectation is more than 8 million dollars. Compared with the sum, the loss rate is 123%. For the CEA, the linear regression states that the slope of the regression line is negative, while the cubic regression shows that there could be an increase in 2020. As a result, another method is applied called moving-average. We set a 3-years moving average to approximately forecast the net profit in 2020, which is 450,000. So the loss rate of CEA is 93%.

Table 1. Net profit of UAL and CEA

Year	UAL	CEA
2016	1,569,843.10	496,500.00
2017	1,392,438.02	682,000.00
2018	1,461,175.28	294,100.00
2019	2,099,138.58	348,300.00
2020	4,612,451.81	1,255,400.00
Sum of 2016 to 2019	6,522,594.98	1,820,900.00

3.3. Forecast of 2021

Based on the acknowledgment and the analysis in 3.1, the stock price of UAL and CEA may follow a seasonal distribution with the unknown term. According to the different character of airlines, we use the model with a seasonal effect to forecast the stock price.

Table 2. Season Table of UAL

Year	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total
2016	165.400	131.940	149.770	198.060	645.170
2017	215.200	225.130	190.520	189.200	820.050
2018	205.080	206.860	256.880	265.940	934.760
2019	254.860	254.060	264.630	271.730	1045.280
Total	840.540	817.990	861.800	924.930	3445.260

Table 3. Season Table of CEA

Year	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total
2016	74.390	78.630	77.200	68.940	299.160
2017	81.370	86.100	79.560	91.130	338.160
2018	124.030	114.110	94.950	86.940	420.030
2019	97.320	91.230	75.210	77.460	341.220
Total	377.110	370.070	326.920	324.470	1398.570

Figure 7 Quarter Analysis of UAL

Figure 8 Quarter Analysis of CEA

The two tables reveal the season table of CE, A, which divided the year into 4 equal parts(1-3, 4-6, 7-9, 10-12). By employing these data, we could get the rate of occupation below.

Table 4. Occupation Rate

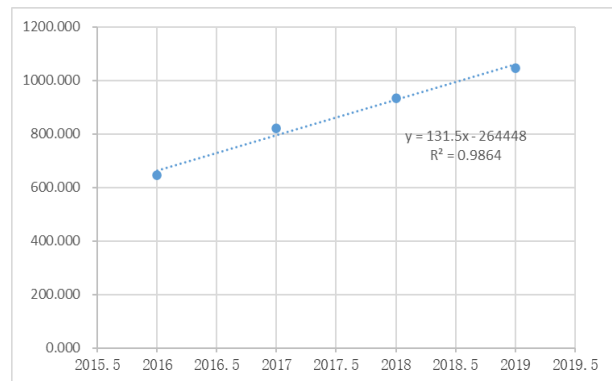| Firm	Quarter 1	Quarter 2	Quarter 3	Quarter 4
UAL	0.244	0.237	0.250	0.268
CEA	0.270	0.265	0.234	0.232

Figure 9 Prediction Line of UAL

According to the Prediction Line of UAL, we could get the slope which is 131.5. Take the point (2020, 484.46). We could get the Line:
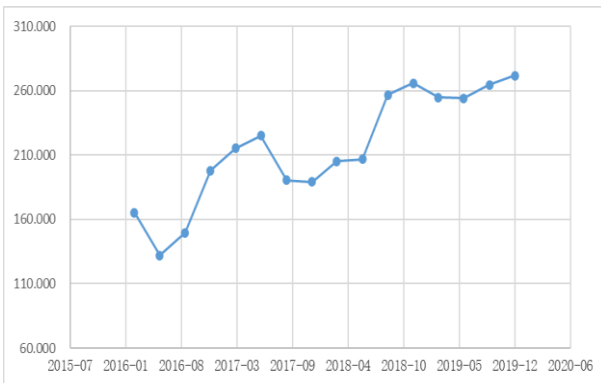
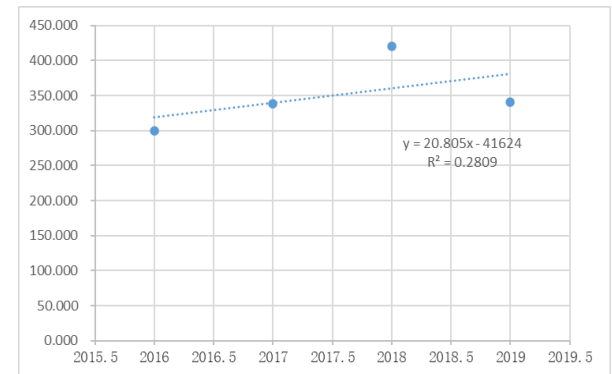Y=131.5X-265145.54

And point (2021,615.96)

Figure 10 Prediction Line of CEA

According to the Prediction Line of CEA, we could get the slope which is 131.5. Take the point (2020, 239.99). We could get the Line:

Y=20.805X-41786.11

And the point(2021,260.795)

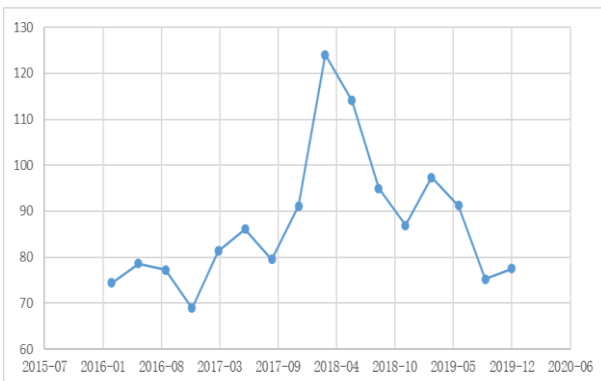So the prediction for the next term is shown below in table 3-5.

Table 5. Prediction Table

Firm	Quarter 1	Quarter 2	Quarter 3	Quarter 4
UAL	150.275	146.244	154.076	165.363
CEA	70.3206	69.007	60.9616	60.5047

3.4. Possible Error of Prediction

In 3.3, we use the regression line to predict the data in 2021. We assume that the increasing rate is fixed at any time according to the high regression rate whose coefficient of determination is more than 0.98(UAL). However, the return rate is not always the same at any time. In 3.2, we use the quarter data, but if we set the time interval into months, the rate will be quite different. The two pictures below show the difference in changing rate of UAL and UAL-hat(the predicted changing rate of UAL) and give the Epslion, which is the error of estimation. The epslion is the distance of the real data to expected data. If the epslion is huge, the stock has a higher risk with a large standard deviation.
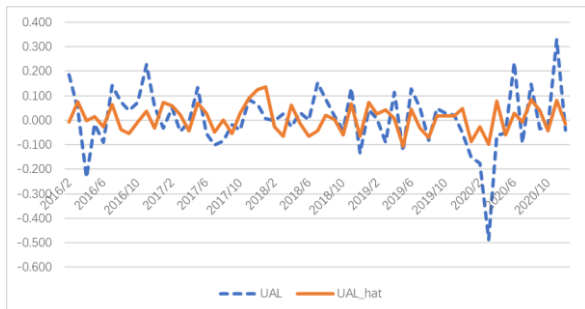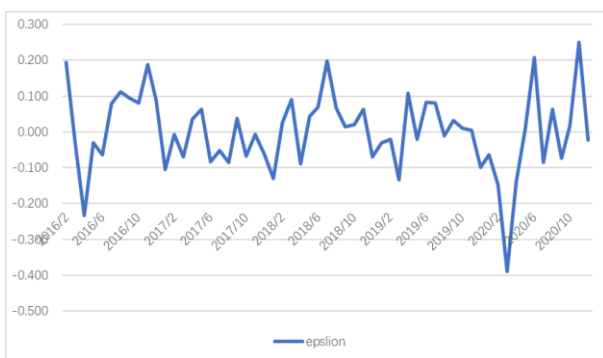

Figure 11 UAL and UAL-hat

Figure 12 Epslion

*Hint：Epslion is the error of estimation

As it is not easy to estimate the graph of UAL and UAL_hat, we transfer the data to a log-return graph. The graph shows that the data before the COVID-19 virus follows the trend with a very small error of estimation. However, after the COVID-19 virus had taken place, the error increased immediately. There is

such a long distance between the expected data and the real data because the virus just stopped the progress of the aircraft transports industry. The government had to control the spread by air, so the flight was forbidden at that time, which caused great damage to the industry, leading to the huge error of the estimation.
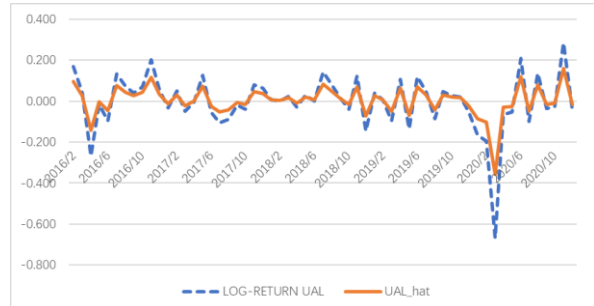

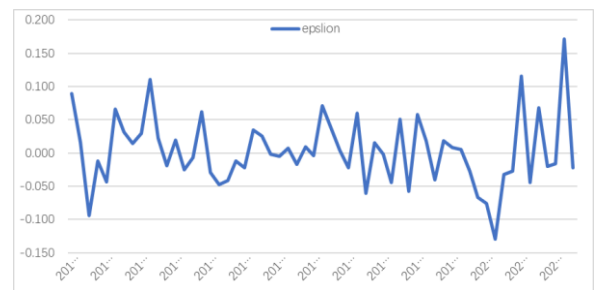**Figure 13** Log-Return UAL and UAL-hat

Figure 14 Epslion

4. CONCLUSION

From 2016 to 2019, according to the financial conditions of UAL and CEA, data analysis shows that UAL adopted a relatively aggressive business strategy and showed a trend of relatively stable profit growth, while CEA was more conservative. It can be seen that before the outbreak of the epidemic in 2020, UAL and CEA adopted two completely different business strategies. According to the regression analysis of UAL's net profit, it can be predicted that if there were no outbreak of the epidemic, UAL's net profit would show an obvious upward trend in 2020. However, according to the regression analysis of UAL's net profit in 2020 and the application of the method of average movement, it can be concluded that the loss suffered by UAL is much higher than that suffered by CEA. Therefore, it can be found that after the onset of the epidemic in 2020, two completely different strategies will lead to two different outcomes. According to the seasonal distribution of the stock prices of UAL and CEA in an unknown period and the characteristics of each airline, the model of seasonal effect is adopted to analyze the market share of the two airlines. The method of regression analysis is used to predict the stock prices of the two airlines in 2021. Finally, through the possible errors in the prediction, it is found that the errors were small before the epidemic and became large immediately after the epidemic. It can be concluded that

in the period of the severe epidemic, the government intervention affected the normal development of the aviation industry.

By comparing the financial status of UAL and CEA before and after the epidemic and analyzing the stock prices, the following suggestions are made on the investment and response methods of the aviation industry under COVID-19:

First of all, the government must adopt active and effective policies to deal with sudden non-economic events like COVID-19 and reduce the time and scale of such events to reduce the impact on the aviation industry to a certain extent. Although the impact of COVID-19 is global, how effectively the government can control it will also determine the extent of the impact on the aviation industry. Although UAL and CEA were both greatly affected by the epidemic, the way the Chinese and American governments dealt with the epidemic also affected the development of the aviation industry during the epidemic. In particular, since the epidemic in the United States was not effectively controlled, the government loosened its policies on air flight even later, which led to a greater impact on UAL. Secondly, the government should introduce policies and provide financial assistance to enterprises to promote the economic recovery of the aviation industry. The aviation industry has a huge flight cost, and the stagnation of the industry has a huge loss and impact on the enterprises. Without timely financial assistance, some small private aviation industries may have declared bankruptcy before the end of the epidemic.

For aviation industry enterprises, first of all, they should adjust their operating costs timely, reduce unnecessary waste of resources, and accept the challenges brought by such sudden events as COVID-19. The company's business strategy affects the impact of the company during the epidemic to some extent. The relatively conservative business strategy at this time can better protect the airline company and reduce the loss caused by the epidemic. Secondly, the rigid cost demand of the aviation industry is high, and enterprises can maintain their cash flow by financing through bank loans and issuing bonds.

For investors, the market performance of enterprises during the period of the epidemic gradually flattened with the weakening of the epidemic. Investors should more rationally turn their eyes to high-tech products and industries valued by the government. The aviation industry is related to national travel, and the government will inevitably attach importance to it. Therefore, the aviation enterprises affected by the epidemic will receive financial assistance from the state. Therefore, aviation financial products can be prioritized, rational investment.

In terms of theory, this paper studied corporate strategy theory under the COVID-19 and realized the background expansion. On the other hand, the research object of strategic theory was broadened by studying the adaptability of corporate strategy in the aviation industry under the COVID-19. In practice, this paper analyzes the two major aviation enterprises from many aspects to provide reference suggestions for investors' investment. The research results of this paper are of practical significance to the development of the country and enterprises and the investment direction of investors.

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