

Impact of Covid-19 on U.S. Fun Industry based on Fama and French Five-Factor Model

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Abstract. As the Covid-19 pandemic sweeping the globe in 2020, it had a profound impact on the economic circumstances of the world. This paper applied Fama-French five-factor model to evaluate the influence of the Covid-19 on the fun industry in America. The fun industry's data and daily return data from Kenneth R. French's database were adopted to make multiple linear regression. The difference of coefficients of the five factors illustrates the significant changes in the entertainment industry due to the pandemic. The sensitivity to the market risk increased as the coefficients of MKT added from 0.73 to 1.02. The income effect of small companies has gradually been higher than that of large-cap companies as coefficients of SMB reached 0.99 from 0.54 during the pandemic. Stocks of fun company with a high book-to-market ratio performed better in general during the covid-19 as the HML factor became significant with a positive value of 0.66. The firm's operating profitability has become a crucial factor in investors' decisions for the entertainment industry under the uncertainty provided by the Covid-19 pandemic as the RMW factor became significant with a positive value of 0.65. Investors are more willing to put their money into the aggressive companies as CMA factor became substantial with a negative value of -2.44.

Keywords: Fama-French model; Covid-19; Fun industry; U.S. stock market.

1. Introduction

One of the critical components in finance fields is asset pricing, which investors utilize to maximize their return by constructing an efficient portfolio. In 1964, Sharpe developed the capital asset pricing model (CAPM), a linear regression model with only one beta factor [1]. Afterward, Fama and French build on the capital asset pricing model (CAPM) and construct a three-factor model to explain the variation in stock prices, including excess return on the market ($R_m - R_f$), the size of the firms (SMB), and the ratio of book value to market value (RMW) [2]. According to the problem of anomaly, Fama and French expand on the three-factor model by adding another two factors, the operating profitability factor (RMW) and the investment factor (CMA)[3]. Much research has examined the empirical significance of the five-factor model, with the majority of them focusing on the effectiveness of the model under normal circumstances, during the validity of five-factor model in a period of turmoil warrants investigation.

The Covid-19 pandemic has disrupted social activities and put the global economy in recession. In the United States, Covid-19 has caused 30 million in April 2021, with the death toll of over half a million. Many industries in the United States have suffered significant losses during the pandemic, especially the entertainment industry, due to stay-at-home order and gathering restrictions. For

example, AMC Entertainment suffered a 4.6 billion loss in 2020 as a result of the pandemic. Baek et al. indicate that the U.S. stock market has become more volatile due to the Covid pandemic. Many industries have experienced large shocks to stock prices [4]. Therefore, this paper focuses on investigating the difference in the ability of the five-factor model in explaining the excess return of stocks in the entertainment industry before and during the Covid-19 period.

Based on the arbitrage pricing theory model, this article uses the Fama-French five-factor model to carry on the empirical research on multiple risk factors affecting stock returns in the American stock market, aiming to study sensitivity variation of stock return to each risk factors in the fun industry before and after the outbreak of COVID-19. From multiple perspectives, this article analyzes the reasons for these changes. Through the study of some specific companies' instances, the research is intended to explore the positive and negative impacts on the fun industry and the enterprises it covers from a microscopic perspective in the overall context of COVID-19. Finally, the investigation will conclude the investment value of the fun industry and provide relative recommendations.

Akhtaruzzaman et al. examined the oil price risk exposure around the world in the midst of the Covid-19 pandemic in both financial and non-financial industry by using the Fama-French five-factor model. The study used a baseline model which augments the oil price return and an adjusted model by adding an interaction term between oil price return and Covid-19 dummy variable to compare the data from before pandemic and after the pandemic. The research concludes that the pandemic moderates the relationship between changes in oil prices and stock returns and oil supply and infrastructure provider industries exhibit weaker positive exposure to oil price risk compared to the non-COVID-19 period [5]. Ji et al. used the Fama-French Three-Factor Model to analyze stocks of Chinese blockchain firms and detect the existence of size effect and book-to-market ratio effect in this field. The research also tried to investigate the influence of Internet information related to the stock performance by mining and quantifying Internet public opinion information. The sentiment factor was added into the traditional Fama-French three-factor model for research. By comparing the two models, an enhanced explanatory power can be seen due to the addition of sentiment factor. The results also indicate a weaker size effect and book-to-market effect in the Chinese blockchain industry. [6].

Zaremba et al. investigated the relationship between the impact of government interventions and the stock return volatility amid pandemic by using four different models including the Capital Asset Pricing Model, the Fama-French three-factor model, the Asness, Moskowitz and Pedersen three-factor model, and the Carhar four-factor model. Four models were used to assess the change in stock volatility immediately followed the governments' policy responses on a day to day basis. The research found that government interventions significantly and robustly increase the volatility in international stock markets and the effect is driven particularly by the role of information campaigns and cancellations of public events [7]. Horvath and Wang assessed the performance Fama-French model on US stock markets by three aspects, including the result of rolling R square, rolling beta coefficients of OLS and estimation. They also focus on that how the model explains the excess returns during COVID-19 pandemic and how Dotcom bubble influences R square of growth model during the Financial Crisis of 2008. Moreover, they apply GMM models with considering the potential errors. Therefore, the results of this paper are statistically significant. R square of growth portfolios decreases rapidly during the Financial crisis of 2008 and COVID-19 outbreak. But it is necessary to notice that the outbreak is ongoing, so we are supposed to have further study and calculate the final impact [8]. Lee et al. explored the initial impact of COVID-19 sentiment on the US stock market through the use and analysis of large databases. The data used in the analysis is information from the Daily News Sentiment Index and data on coronavirus-related searches provided by multiple social networks. The research uses the excess returns of various industries as dependent variables to estimate the time series regression model. This is used to test the changes in the Daily News Sentiment Index, the results of which predict the magnitude of the difference in the output of each industry. The part of the excess return uses the analysis of the Fama-French three-factor model. The results of the research show and

visualize the relevant changes in the stock market during the epidemic after adding time lag factors. [9].

Mohamed et al. made the first comparative assessment of the impacts of the first and second waves of the ongoing COVID-19 pandemic for the US stock market and its uncertainty. They also claimed that the volatility spillover between the Chinese and US stock markets has been higher during the COVID-19 period compared to the pre-COVID-19 one, by examining the conditional correlations between the Chinese and US stock indices. Besides, the research suggested a long and persistent relationship between the US market and the global daily COVID-19 cases and deaths. Thereby, the authors draw a conclusion that the COVID-19 health crisis has had harmful consequences for financial markets and the macroeconomic conditions in the US. [10]. Baek et al. focused on understanding the impact of the COVID-19 pandemic on the US stock market volatility. The research used a Markov Switching AR Model, machine learning selection methods and other tools to quantify volatility at the sector level and to explain changes in volatility by choosing economic indicators. Results showed increases in total and idiosyncratic risk for all industries. Additionally, volatility is affected by specific economic indicators and is more sensitive to negative news of COVID-19 compared to the positive ones. [11].

According to the essential influence of Covid-19, the Fama-French five-factor model is adopted to conduct the empirical research on multiple risk factors affecting stock returns in the American stock market, aiming to study sensitivity variation of stock return to each risk factors in the fun industry before and after the outbreak of COVID-19. From the multiple perspectives, this article analyzes the reasons for these changes and through the study of some specific companies' instances, the research is intended to explore the various impacts on the fun industry and the enterprises it covers from a microscopic perspective in the overall context of Covid-19. Also, the investigation will get to the conclusion of the investment value of the fun industry and provide relative recommendations.

2. METHOD

Fama-French Five-Factor Model is selected in this research. As is widely known, Fama and French proposed a three-factor model in 1992, which better explained the excess return of stocks compared to CAPM by using new SMB and HML factors. The formula of Fama-French three-factor model is as follows:

$$R_i = \alpha_i + \beta_{iM}R_M + \beta_{iSMB} \cdot SMB + \beta_{iHML} \cdot HML + e_i \quad (1)$$

Where R_i is the expected excess return of the portfolio, R_M is the excess return of the market, SMB (small minus big) is size factor as the return of a portfolio of small stocks in excess of the return on a portfolio of large stocks, HML(high minus low) is value factor as the return of a portfolio of stocks with a high book-to-market ratio in excess of the return on a portfolio of stocks with a low book-to-market ratio, betas are gradients calculated by multiple linear regression.

In 2015, Fama and French extended this model to include two additional factors, RMW and CMA [12]. Thereby, the formula developed as follows:

$$R_i = \alpha_i + \beta_{iM}R_M + \beta_{iSMB} \cdot SMB + \beta_{iHML} \cdot HML + \beta_{iRMW} \cdot RMW + \beta_{iCMA} \cdot CMA + e_i \quad (2)$$

RMW (robust minus weak) is the difference between the returns on stocks with robust and weak profitability, CMA (conservative minus aggressive) is the difference between the returns on stocks of conservative and aggressive investment firms. Moreover, according to Acaravci and Karaomer, all the beta coefficients represent the slope of the regressions, which also mean sensitivity coefficients [13].

3. RESULTS

In order to ensure the consistency of the research content in this research, all data sources come from Kenneth R. French's currently updated Data Library. All data before the Covid-19 epidemic was intercepted from June 2019 to February 2020. In addition, all data during Covid-19 epidemic period was intercepted from March 2020 to November 2020 when the vaccine came out. After the historical data of risk factors such as MKT-RF (Market risk factor), SMB, HML, etc., are determined, the average return of the Fun industry in that year is subtracted from the risk-free return of the year to obtain the excess return of the fun industry. The excess return of the Fun industry will be used as Y-variable. Market risk factor, SMB risk factor, HML risk factors, the profitability factor and the investment factor will be included in X-variable at the same time. Then, multiple regression can be adopted to obtain the coefficients.

Table 1. Multiple regression results before Covid-19 of fun industries

	Coefficients	Standard error	t Stat	P-value
Intercept	-0.021	0.054	-0.396	0.693
Mkt-RF	0.725	0.073	9.969	0.000
SMB	0.545	0.119	4.597	0.000
HML	-0.097	0.122	-0.797	0.427
RMW	0.275	0.203	1.351	0.179
CMA	-0.418	0.238	-1.758	0.081

Table 2. Multiple regression results during Covid-19 of fun industries

	Coefficients	Standard error	t Stat	P-value
Intercept	0.015	0.155	0.099	0.921
Mkt-RF	1.015	0.066	15.399	0.000
SMB	0.996	0.180	5.538	0.000
HML	0.663	0.147	4.515	0.000
RMW	0.653	0.303	2.156	0.033
CMA	-2.441	0.405	-6.022	0.000

When two sets of data of the same type in different periods are used, the industry situation before and after the Covid-19 epidemic can be directly displayed and compared. As shown in Table 1 and Table 2, there is no significant change in interception under the significance level of 5%. Taking 1 as the boundary, the market risk factor has a significant difference after the outbreak. In contrast, SMB risk factor has not changed. Small and medium-sized companies in this industry have always had higher returns than large companies. HML risk factor was insignificant before the epidemic and became positive during the epidemic. The stocks in this market are changing to value stock. RMW factor tended to be significant and positive during the epidemic, which means that companies with higher profitability can get better results. Also, CMA factor became significant and negative after the outbreak.

4. DISCUSSION

4.1 MKT

As is shown in Table 1 and Table 2, the coefficients of Mkt factor before and after the Covid-19 epidemic, increasing from 0.7247 to 1.0146, are both significant and show an obvious increase which means an augment in the sensitivity of stock returns to the market risk. Given that the sensitivity to market risk has the following relational expression: $\beta = \rho \frac{\sigma(A)}{\sigma(B)}$, where ρ means the correlation coefficient between fun industry stocks and market portfolio, $\sigma(A)$ means the volatility of the

fun industry stocks, $\sigma(B)$ means the volatility of the market portfolio. The reasons of the increase of the sensitivity to the market risk are explained from the following three parts.

For ρ , after the outbreak of the Covid-19 in American, people have more demand for recreational activities, thus giving birth to a huge consumer market, the monthly activity of video applications, such as Duo, Houseparty and Nextdoor, has significantly surged. Many of them developed a variety of new products and services during the epidemic in an effort to expand their business. As a result, a closer link between fun industry and other industries such as Internet industry, communication technology industry can be easily seen, and there will be a bigger correlation coefficient between fun industry stocks and market portfolio.

According to $\sigma(A)$, since the Covid-19, the global film companies have experienced a bleak period. Cinemas have closed their operations, filming crews have been forced to suspend, many live concerts terminate, so that the outstanding debt accumulated made the companies in fun industry face an intensified cash flow risk. Stock prices of Live Nation, Madison Square Garden Entertainment and many other enterprises have experienced a decline to a varying degree due to poor financial position and degraded profitability and dividend payout rate.

From the point of view of $\sigma(B)$ the demand and supply levels have plummeted, short-term unemployment has risen, in addition, the rise of US Treasury bond which has climbed as high as 1.498% and the continuous interest rate cuts affected greatly the stability of the market; the information disclosure of Covid-19 affected sentiment changes of investors which led to a greater volatility and a more frequent stock trading; as the Covid-19 spread to the whole world, the fluctuation of foreign exchange interest rate and the price of commodities is large enough to lead to an unstable market.

Therefore, investors should be more cautious as the fun industry stocks return become more sensitivity to the market risk and consider the above factors comprehensively before buying and selling fun industry stocks.

4.2 SMB

Regarding SMB factor, the effect of scale will definitely be mentioned. First, the stocks of listed companies will be divided into 3 categories. Usually, more than 10 billion US dollars will be classified as large-cap stocks, and 2-10 billion US dollars will be classified as mid-cap stocks. Stocks under 2 billion US dollars are usually be put into the category of small-cap stocks. Most small capital companies are start-ups with high growth potential or relatively young companies. The theory of small company effect believes that small companies have greater growth opportunities than large companies, and the corresponding company's expansion capability is also much larger or even several times larger than that of large-cap companies. But the business environment of relatively small companies is also often more unstable. At the same time, small-cap stocks tend to have lower stock prices, and these lower prices mean that price appreciation is often greater than that of large-cap stocks. Compared with growth stocks like Microsoft and Apple, small-cap stocks are generally more like value stocks. Because Small-cap stocks also tend to be more volatile and riskier for investors than large-cap stocks.

From the tables, it can be seen that the size factor before the epidemic was 0.54, while it had reached 0.99 during the epidemic and was close to 1. It can be seen from this that the income effect of small companies has gradually been higher than that of large-cap companies. From the perspective of value investment, although the market value of small companies is smaller, it is easier to find a way to survive during the epidemic, and it is faster to make adjustments based on the current situation. And because for small companies, social attention is not so high compared to large companies, and they are less affected by public opinion pressure. For example, Disneyland and Universal Park in Orlando are in a state of suspension due to the impact of the epidemic and the pressure of public opinion, and they have suffered huge losses throughout the vacant period. But at the same time some small amusement parks and private museums, such as the automobile museum in State College. There is not too much pressure on the relative control, and visitors only need to wear a mask to get in.

Secondly, a large number of people who are at home quarantine are also more willing to go to the entertainment facilities near their homes. The reason for the growth of SMB factor can be found here.

4.3 HML

The HML factor had a T-statistic of -0.797 before the outbreak of Covid-19, which indicated the excess return of companies in American's fun industry was irrelevant to their book-to-market ratio. As the fun industry belongs to the entity industry, the profitability of a fun company mainly depends on the operating conditions of its entertainment venues, including cinemas, casinos, night clubs. Thereby, the popularity condition of its stock reflected by book-to-market ratio has a minimal influence on its future return, according to the result of T-statistic.

During the pandemic, the T-statistic tended to be 4.515, illustrating the significance of the coefficient of HML factor, which has a positive value of 0.663. Consequently, stocks of fun companies with high book-to-market ratio performed better in general during the covid-19. Because entertainment venues were often forced to close down to restrict the spreading of Covid-19 while renting fee had to be paid, making its owners under great financial pressure. High book-to-market ratio of a fun company often marks its full realization of its potential as well as maturity in scale. In contrast small book-to-market ratio is usually associated with companies that are still small and developing. Therefore, companies with a high book-to-market ratio will have more chances to survive the pandemic, according to the positive value of HML factor.

4.4 RMW

The coefficient of RMW factor is statistically significant during the pandemic with a positive value of 0.65 while the coefficient of RMW factor is statistically insignificant at 5% level before pandemic. This indicates that the firm's operating profitability has become a crucial factor in investors' decisions for the entertainment industry under the uncertainty provided by the Covid-19 pandemic. The entertainment industry in the United States was thriving before the pandemic hit in March 2020. Investors had little worries over the companies' ability to fund day-to-day operations and generate profit. After the pandemic disrupted social activities, the entertainment industry has taken a huge hit as industry revenues slump 6.7% in 2020 [14]. As a result, there's growing fear in the market that companies with low operating profit may not do well or even survive the crises. The positive value of the coefficient also indicates that investors prefer companies with robust operating profitability to companies with weak operational profitability due to a high level of uncertainty. For example, The Walt Disney Company stock price has almost doubled during the pandemic, from around \$100 per share in March 2020 to almost \$200 per share in April 2021. The key factor behind the increase in its stock price is the ability to generate considerable profit, which mainly owing to its dominance over streaming services.

4.5 CMA

According to the results tables, the coefficient of CMA is negative during the epidemic, which is -2.44. This data directly explains the relationship between investments and companies. The investors are more willing to put their money into the aggressive companies. On the one hand, strong companies could come up with more aggressive strategies during the outbreak, because these companies would like to create new opportunities when facing a crisis. In this way, the aggressive companies would obtain additional market share at a lower cost and raise their status in the competition. Thereby, the investors are more likely to notice such aggressive companies and then invest. Taking an example of Disney, the company made a rapid strategic shift and then focused on online entertainment business, Disney+. In the business plan, Disney+ will have a cooperation with VR in order to provide better service and attract more customers. At the end of 2020, the number of paying users was more than 86 million, which made a significant profit in the financial report. As a result, most investment firms are optimistic about Disney investment. On the other hand, the fun industry is a booming business in the United States. Such an industry trend is more suitable for radical companies because these

companies with innovative and radical strategies have a larger possibility to catch the opportunities and expand the market. Consequently, the radical companies are able to perform stable during the Covid-19. So investors prefer to invest in aggressive companies rather than conservative companies.

5. CONCLUSION

This article aimed to investigate the effect of Covid-19 on the fun industry based on the arbitrage pricing theory model and the Fama-French five-factor model. The results lead to the conclusion that Covid-19 has a significant impact on the fun industry. Considering the economic volatility and the intensified market risk, investors have shifted their investment objectives from some successful companies that organize offline activities before the Covid-19 to some arisen video applications. As the SMB factor experienced an obvious augment, investors are more interested in small companies that have shown good growth potential during the Covid-19. This article notices that several high book-to-value companies which have the advantage in a large scope of business and that are financially sound have performed well during the pandemic. As the outbreak also presents new investment opportunities, aggressive companies who have seized the opportunities to expand their business are showing new vitality and value.

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