Research on the Fluctuations Caused by the Covid-10 on the Food Industry Based on Fama-french Five-factor Model

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Abstract. Since the outbreak of Covid-19, the epidemic has had a very large impact on various industries. This article focuses on the analysis of the food finance industry and discusses the food industry is affected by the pandemic. By analyzing the Fama-French five-factor model, linear regression is performed before and after the emergence of vaccines during the epidemic. Among them, some factor p-values in the food industry have changed in three periods, and the significance of the remaining factor p-values has remained unchanged. After comparing the changes in the significance of each factor, the coefficients corresponding to the factors are compared. The results indicate that the food industry is more affected by the epidemic and more sensitive to the market and it also has a certain aggressiveness At the same time, it was found that small market value stocks have a higher rate of return for investors.

Keywords: CCS CONCEPTS, Applied computing, Enterprise computing, Business process modeling, Finance, Equities, Covid-19, Fama-French Model.

1. Introduction

Since March 2020, the new coronavirus word has spread very quickly and has spread to the whole world and is confirmed by the World Health Organization. During the pandemic, the impact of covid-19 was mainly concentrated in China and several neighboring Asian countries. However, from the beginning of February, the virus infection gradually spread to other countries in Europe and the United States. In addition, it causes indelible losses to the economy. After the outbreak, stocks fell. On February 24, the US S&P 500 closed down 3.35%, the UK FTSE 100 closed down 3.34%, and the Nikkei closed down 3.7%. On February 25, the S&P 500 fell another 3 percent, and other national stock indexes continued to decline. At the same time, unemployment has risen sharply and financial markets have been unstable. But it is very surprising that after the outbreak of the epidemic, the economy, although declining for some time, began to recover in December 2020. This is the recovery brought about by the popularization of the vaccine, and it is also the economic recovery brought about by the country's macro-control.

Alan and Rajesh built and tested alternative versions of Fama–French, and Carhart. A "skeptical" approach to asset pricing advocated by Lewellen et al., ALAN found that a four-factor model version using decomposition and value-weighted factor components was able to account for cross-sectional returns for large companies or portfolios without extreme momentum risk. A study of the three-factor model found that from the evidence from Fama and French, it is clear from the evidence that on a European scale when pricing a portfolio with momentum skew, even if the factors are formed on a local basis [1]. Kenneth points out that the average return between B/M results is strong, but the average return lacks some correlation with the investment relationship. Fama and French's three-factor model borrows heavily from the five-factor model. As with Fama and French, the model's main problem is its failure to adequately capture the low average returns of smaller stocks, which behave similarly to those of low-profit companies that are actively investing. Eugene Kenneth studies certain small stocks [2]. He and Liu discussed the spillover effects and impacts of the epidemic on the stock market. Using the traditional t-test and the nonparametric Mann-Whitney test, researchers conducted daily empirical analyses of stock markets in the People's Republic of China, Japan and South Korea, France, Germany and the United States. He and Liu and others. The following results were obtained: COVID-19 has a negative but short-term impact on affected areas. [3].

Wang and Horvath evaluated the Fama-French model in the stock market of the United States of America by studying the model's R^2. Wang and Horvath found that the dot-com bubble was significant for the growth model of R^2. R^2 grew during the 2008 financial crisis, portfolios shrank rapidly. The latest Covid-19 outbreak led to a sharp rise in R^2 At this event. In addition, wang found all of them, β Model parameters are irrelevant in GMM models. Wang is committed to demonstrating the Fama-French model's ability to interpret months.. Wang found that the five-factor model keeps R^2 Value at a point high which was considered statistically significant. Only one five-factor model of R^2 rises. During the pandemic, R^2 reached the highest level. [4]. Singh et al. evaluated the outbreak of the deadly COVID-19 virus has not only claimed people's lives but has also severely weakened the economy. Due to the strict lockdown, manufacturing and logistics activities have been the suspension of trading has affected the supply and demand of various products due to restrictions Imposed on shopkeepers and retailers. The effects of COVID-19 are widely observed in each type of unit from different departments. In this study, a simulation model of a public distribution system. The (PDS) network was developed using three different scenarios to illustrate disruptions in the food supply chain. Matching supply and demand in a vast supply chain network has become more difficult for PDS because the situation changes as infection cases grow and recover. And Natural disasters, threatening diseases, or politics has been observed in the past, problems are key factors that lead to supply chain disruptions. But the outbreak of the COVID 19 pandemic is reportedly an exception because of the suspension of almost all manufacturing and logistics activities [5]. Cao and Li found that the new COVID-19 has spread around the world, which is on China's agricultural trade, and all over the world. It turned out that China's agricultural exports were damaged during the pandemic, due to supply chain disruptions caused by COVID-19. Looking to the future, external demand suppression and non-tariff trade barriers may have a more far-reaching and lasting negative impact on China's trade. The pandemic has led to import restrictions. Due to the small size of the market, the export of Chinese agricultural products faced obstacles at that time. This undoubtedly poses more challenges to the export of agricultural products in China. Looking to the future, external demand will be affected. The damage caused by the epidemic to the economy will be the most prominent unfavorable factor affecting the export of agricultural products to China's economy. [6].

Liu and Manzoor Assessed the short-term impact of the coronavirus outbreak on 21 leading stocks market indices of major affected countries such as Korea, Japan, Singapore, The United Kingdom and the United States, Germany, etc. The consequences of infectious diseases are a considerable and immediate influence on global stock markets. The results show the stocks after the outbreak of the epidemic, the markets in the main affected countries and regions fell rapidly. Country Asia has experienced more negative anomalous gains than other countries. Further panel fixation effect regression also supports the adverse effects of confirmed COVID-19 cases on stock indices through the addition of investor pessimism, efficient channels for future returns on excess returns, and concerns about uncertainty [7]. Mazur surveyed how the U.S. stock market performed during the March 2020 crash triggered by COVID-19. We found high positive returns in natural gas, food, healthcare, and software stocks, while the oil, real estate, entertainment, and hospitality industries fell sharply. Mazur thinks the collapse of stock prices in March 2020 marks one of the biggest stock market crashes in history. As measured by DJIA, the market fell 26% in four days. The crash was caused by the COVID-19 pandemic and the government's dramatic response to it [8]. Thorbecke believed the coronavirus crisis has damaged the U.S. economy and used 125 sectors of equity earnings to investigate its impact. It breaks down returns into industry-driven component factors and macroeconomic factors. So he believes that the major recovery of the economy is not because of the macro environment, but because of whether the epidemic will be controlled. Thorbecke also breaks down equity earnings changes into sector-specific factors and macroeconomics-driven factors. Eight macroeconomic variables and the regression returns of Fama and French five factors produced a similar breakdown into special and macroeconomic responses. During the sample period from February 19 to July 10, 2020, the coronavirus crisis as an imminent event drove special reactions [9].

The paper found that while the three-factor model provides a methodology for the study of the financial industry, the five-factor model is more reliable, and the significance and coefficients of the five-factor model are subject to change over time. To study the impact on the financial sector after the spread of COVID-19, and the recovery of the financial sector after the popularization of vaccines. In this paper, multiple regression of statistics is performed based on the Fama-French five-factor model. Compare whether the model is significant and thus compare the risks of different industries. The regression results below explain the significance and relative coefficients in the model, showing the impact of the novel coronavirus. Through the analysis of the food industry, it is clear that its significance has changed, such as CMA, RMW. This article introduces the specific model in the METHOD section, and in the discussion, the section lists the regression results of three different periods and explains its changes and causes.

2. Method

When discussing the application of the stock market, it is usually the use of CAPM. CAPM assumes that all investors in the market's assessment of risk and return are limited to the analysis of expected values and standard deviations of income variables, and all investors are completely rational.

However, this model is difficult to address some situations which are in the stock market. The beta value of the stock market cannot explain the differences in the return of different stocks, while the market value, book value ratio, and price-earnings ratio of listed companies can explain the differences in stock returns. So a more complicated model was necessary to describe investors' behavior. Fama and French proposed the Fama-French three-factor model based on the CAPM model. The three-factor model thinks the excess rate of return of a portfolio can be explained by its three factors: market asset portfolio (Rm-Rf), market value factor (SMB), and book market value ratio factor (HML). This is a three-factor model [10]:

$R_i = R_f + beta_1(R_m - R_f) + beta_2(SMB) + beta_3(HML)$ (1)

But it still has some defects. Thus two more factors need to be added to construct a five-factor model.It is similar with three-factor model [2]. The five-factor model is as follows:

$R_i = R_f + Beta_1(R_m - R_f) + Beta_2(SMB) + Beta_3(HML) + Beta_4(RMW) + Beta_5(CMA)$ (2)

Where RMW is profitability and CMA is the investment style and R is the portfolio expected rate of return, Rf is the risk-free return rate, and Rm is the return of the market portfolio.

3. Results

Regression using daily data from the food industry, derived from Kenneth R. French's database. The daily data were analyzed through a Fama-French five-factor model. These five factors are Rm-Rf, SMB, HML, RMW, and CMA. Treating them as dependent variables and five independent variables, respectively.

The dates were divided into pre-Covid-19 outbreaks and post-Covid-19 outbreaks and later comparisons of Covid-19 vaccines. For comparison, the three dates are May 2019 to March 2020 and March 2020 to December 2020, the latter is from December 2020 to August 2021.

Table 1. Regression results of the food industry from 2019.5-2020.2

Item	Coefficients	S.D.	t-Stat	P-value
Intercept	-0.05	0.04	-1.33	0.18
Mkt-Rf	0.63	0.04	14.06	0.00
SMB	0.17	0.08	2.09	0.04
HML	-0.10	0.09	-1.22	0.22
RMW	-0.15	0.14	-1.04	0.30
CMA	0.74	0.17	4.48	0.00

Table 2. Regression results of the food industry from 2020.3-2020.11

Item	Coefficients	S.D.	t-Stat	P-value
Intercept	0.04	0.06	0.65	0.52
Mkt-Rf	0.71	0.02	28.72	0.00
SMB	0.35	0.06	5.55	0.00
HML	-0.01	0.05	-0.22	0.83
RMW	-0.30	0.11	-2.66	0.01
CMA	0.58	0.14	4.07	0.00

Table 3. Regression results of the food industry from 2020.12-2021.8

Item	Coefficients	S.D.	t-Stat	P-value
Intercept	-0.01	0.05	-0.21	0.84
Mkt-Rf	0.56	0.06	9.18	0.00
SMB	0.23	0.08	2.85	0.00
HML	0.01	0.06	0.14	0.89
RMW	0.13	0.11	1.20	0.23
CMA	0.31	0.13	2.49	0.01

As shown in the above tables, in regression models where significant levels are 5%, the t-value is greater than the threshold or the p-value is less than 0.05. That shows that these data are significant in the five-factor model. Conversely, other data are less important because the factors corresponding to those values are not statistically significant in a five-factor model. Assuming a comparison of the t-value or p-value of the same industry over these three periods, it is clear that some factors have changed between significant and insignificant. For example, Small businesses in the food industry went from significant to non-significant to significant in the three periods above(SMB).

4. Discussion

4.1. MKT

MKT is expected to be an excess return relative to a risk-free investment in the market, which represents a market risk factor. The larger the value of this coefficient, the greater the potential risk, the more the return on investment, and the higher the return on investment. In terms of factor coefficients, the food industry was significant in all three periods, and the coefficients compared to him were all less than 1. After March 2020, the coefficient is closer to 1 and close to market volatility. This means that stocks associated with the food industry have become more aggressive and more sensitive to market volatility. From the above three tables, it can be concluded that the impact of the new crown virus on the food industry is obvious, and the market risk is not greatly affected by the epidemic. Therefore, market risks have always had an impact on the food industry. During these three periods, the market risk factor has changed, but all are less than 1, but on the trading panel, the increase is not obvious, which indicates that the food industry is relatively stable.

4.2. SMB

SMB is the market capitalization factor and it is the risk premium generated by different company sizes. Through the analysis of the food industry, SMB is significant. By analyzing three tables of different periods, it can be concluded that the coefficients are all greater than 0. This means that the sample portfolio is more willing to invest in companies with small market capitalizations. This suggests that U.S. stock market investment is more inclined towards small businesses. Small

businesses are relatively liquid and monetize quickly and small businesses have potential and are more efficient. In contrast, large companies have extremely high operating costs, so in this case, there will be a great price to pay, resulting in a sharp increase in risk and pressure, which is the common "big company disease". No matter what period, large companies will also be subject to very large cash flow pressures. Therefore, no matter before the middle and late stages of the epidemic, more financial companies choose to invest in small market value companies to pursue the stability and efficiency of investment, to seek more opportunities, and to get out of the predicament of the epidemic. Because the rate of return is great.

But there are still some industries that are very special and they are pursuing investments in companies with large market capitalizations. These industries have been greatly affected by the epidemic, and investing in large companies can avoid the negative impact of Covid-19. So this is a special case.

4.3. HML

HML is the value factor. And HML for a high book to market value ratio to reduce the price-to-earnings ratio. It is not difficult to see that the t-value of the HML in the three periods is less than the threshold. This means that the factors corresponding to the values are not statistically significant in the five-factor model. Discussing HML in the food industry is less important. And it shows that Covid-19 has had little impact on the HML of the food industry.

At the same time, the essence of HML is to find the difference between undervalued and overrated, while SMB is looking for differences between different sizes and different potentials. But comparing the data before and after the outbreak and after the vaccine production seems to prove that the epidemic has not changed the data on HML, so there is no need to compare this set of data in the food industry.

4.4. RMW

RMW is a profitability factor or profit level risk that represents a relationship between highly profitable industries and high-risk existence. At the same time, RMW usually calculates the direct difference in returns of high and low-profit companies.

The table above shows the profit returns of the food industry in its entirety. At the same time, it is not difficult to find that it is not significant before the epidemic and after the vaccine is produced, but it is significant in the epidemic. At the same time, in the outbreak of the epidemic, the coefficient is negative, which is worth thinking about. It means that the food industry has suffered the impact of the epidemic.

Analyzing the coefficients in Table 2, it is not difficult to see that the RMW coefficient in the epidemic is negative. This points to the fact that people are willing to lay out in less profitable stocks in the food industry, which is not a good speculative choice. The food industry relies on manufacturing, while the pandemic has caused unemployment to fall, while companies with good profitability face greater risks. This explains why the pandemic has led to significant and insignificant changes, which are associated with speculation.

At the same time, some data related to agriculture were sought, and the significance of agriculture did not change during these three periods. This shows that the epidemic has no impact on agriculture. This seems to be linked to the country's efforts to support agriculture during the pandemic.

4.5. CMA

CMA stands for investment style. At the same time, the CMA can see the investment risk. A high-risk investment leads to a very low return on investment. To observe different investment styles, the t-value and corresponding coefficients after the emergence of vaccines before and after the epidemic are compared.

First of all, comparing the significance of the food industry over three periods, it is not difficult to find that their coefficients are greater than the threshold, so they are all significant. Comparing their

coefficients, the coefficients for the three periods are all positive, proving that the impact of the epidemic on the food industry is insignificant. Therefore, the food industry maintains a certain investment risk, which is caused by the diversification of the food industry. The food industry is very competitive, which is one of the reasons why investment risks are high.

At the same time, through the study and statistics of different industries, many industries have been affected by the epidemic, and the significance and coefficient have changed greatly. This shows that it has been greatly affected by the epidemic. Taking an aviation industry as an example, the return on investment in the aviation industry before the epidemic was very stable, but due to the impact of the epidemic, most people were at home to prevent the epidemic, which reduced the expenditure on air travel, which greatly affected the aviation industry, but after the vaccine was put into use, people traveled more, so the aviation industry has recovered. As the risk gradually increases, these companies become unpopular with investors

5. Conclusion

This paper concludes that investors should consider value and risk when evaluating their investments. At the same time, it was found that CMA was significant in all three periods and the coefficient was greater than 0. And this paper uses a capital asset pricing model to measure corporate returns in the food industry before and after vaccine adoption. Small-cap companies were found to perform better in terms of return on investment because small-cap stocks were less affected and more flexible during the pandemic. Through the study of MKT, it is not difficult to find that market risk has always had a greater impact on the food industry. In addition, the RMW factor fluctuated significantly over three periods, indicating that it has been affected by the epidemic, which means that it needs to be paid attention to by investors. According to the analysis, the price is constantly changing and fluctuating in the value range, which is also a necessary factor to consider before investing.

Investors can bring considerable investment returns to smaller companies, and during the epidemic, there are many uncertainties, some industries are highly resistant to impact, and some industries are very risky

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