

Application of Fama-French 5-factor model on investigating the influence of Covid-19 on meal industry in U.S. stock market

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Abstract. At the end of 2019, New Coronavirus first swept China and spread to the whole world, which affected almost all industries globally. Therefore, both the economy and the stock market in this world received a punch. This essay uses the Fama-French model to calculate the rate of return of a given asset in the meal industry. The periods chosen for this research are September 2019 to February 2020 and March 2020 to August 2020, which are before and during the Covid-19. Due to the impact of the Covid, to control the flow of people and prevent cross-infection, many public places were forced to close, so were restaurants. Therefore, the industry selected in this paper is the meal industry. In conclusion, because of the volatility of the US stock market, the shares of the beverage industry have also been seriously affected. Due to the epidemic's impact, large enterprises tend to overestimate themselves, but investors have fewer expectations of them. Therefore, although the risk of small enterprises in the catering industry is greater, the income of small enterprises is greater than that of large enterprises, and the small-scale effect is enhanced. Therefore, investors are more inclined to invest in small enterprises. In addition, Fama-French five-factor model also shows that investors are more inclined to choose companies with aggressive investment styles.

Keywords: Covid-19; Fama-French Model; Meal's industry; U.S stock market.

1. Introduction

In early 2020, the outbreak of Covid-19 affected both people's work and life. The impact of the pandemic on the economy can be classified as direct and indirect. For the direct impact: tourist attractions, restaurants, and cinemas are forced to close. Due to the Covid-19, many enterprises cannot run their businesses, resulting in no output for a period, which is the direct loss of production. Besides, for the tertiary industry, most areas are restricted from traveling. Therefore, the number of visitors is greatly reduced. The second is indirect influence. For instance, in Vietnam, a batch of goods was planned to be exported to China. However, due to Covid, China's consumer demand for that declined. Thus, this batch of goods was not needed for the time being, which caused huge losses for Vietnamese manufacturers. Besides, Covid-19 also influences the stock market, which is unprecedented compared with other outbreaks. 22 trading days and 18 market jumps can be found between February 24 and March 24, 2020, which was more than any other period in history with the same number of trading days. At the same time, the frequency of this jump during this period is 23 times the average pace since the year 1900. From 2011 to 2017, the income of China's catering industry showed an increasing trend. In 2015, the growth rate was the fastest, with sales reaching 3231 billion yuan, a year-on-year increase of 16.0%. In 2017, the sales volume of China's catering industry reached 3964.4 billion yuan, a year-on-year increase of 10.7%. However, due to the Covid, most of the restaurants are forced to close. Therefore, in terms of shareholder returns, the meal industry has low performance as it has more serious influence than other industries. Therefore, the investment prospect of the catering capital market is not optimistic.

The Fama-French Model, the corollary of the Capital Asset Pricing Model (CAPM), values the outperformance tendency. During a long period, small-cap stocks always outperform large-cap

companies, and value stocks beat the growth stocks. Similarly, like the CAPM model, it can establish the relationship between capital risk and return, clearly indicate that the expected return of securities is the sum of risk-free return and risk compensation, and reveals the internal structure of securities returns. Besides, both of them can disperse the non-system risk through the portfolio to leave only system risk. At the same time, the coefficient β is introduced into the model to represent the system risk.

MacEvan et al. used the method of documentation to see the influence of the pork industry in Canada and found out that the will for pork producers was reduced due to the market change. Secondly, due to the quarantine measures, the supply chain of pork in China broke down, which caused some problems in the Canadian market. Also, in 2020, the pork price fluctuated, largely due to the changes caused by the Covid-19 pandemic in the labor market and raw materials [1]. The Covid-19 has brought great impacts on both financial and commodity markets globally. Hohler and Lansink analyzed the stock price and information through financial reports to test the influence of the Covid-19 on stock price volatility and businesses' profits in the food supply chain. This report used the data of 71 major listed companies in the food value chain from stock indices in a few countries and got the result that stock markets have impacts on increased price volatility, which can be noticed from manufacturers of fertilizers, agrochemicals, and food distributors. However, in the stocks of food retailers, price volatility was much lower [2]. Souza and Dunshea researched the impact of Covid-19 on the pork industry in Australia. The paper used the method of documentation. It first analyzed the pork market in Australia and summarized the current situation of the market. Then, it concluded the new influences on the pork industry in the face of the Covid-19 pandemic. First, the shortage in labor caused some problems. Secondly, the stricter quarantine measures, the decline in air travel, and the increase in freight costs together led to port importation problems. Thirdly, the domestic needs for pork were raised due to the lockdowns [3]. Li and Duan used the application of Fama-French five-factor models to explore the impact of Covid-19 on the industries in the USA. The research also included investigating some other factors such as HML and CMA to form a better model to develop a more accurate estimation of the influence imposed by the Covid-19. By comparing various industry portfolios in the USA to see how the market responds to the global pandemic [4].

Zi et al. researched the relationship of the spread of Covid-19 and the food by comparing the current state of knowledge of SARS-CoV-2 with the Covid-19 to explore how food can act as a source of infection as well as the pathogen. The author researched to find a way to eradicate and prevent further spread. Several characteristics that differ the Covid-19 from the SARS-CoV-2 are also of the Covid-19 is also included to have a deeper understanding of the global pandemic [5]. Blain et al. use the online survey method to explore how people from different countries, including New Zealand, the USA, UK, and Ireland, adjusted their eating habits after the outbreak of Covid-19. The result of the online survey shows that the pressure on the food system has significantly increased due to bulk purchasing becomes a common phenomenon among most countries mentioned above. Therefore, organizations that provide food are suggested to make a plan ahead to avoid the shortage [6]. Horvth and Wang used the Fama-French model to illustrate the model's ability to explain the excess returns of selected stocks during the crises, including Covid-19. The parameter for testing the model's ability is the R^2 coefficient which rolls over time with a window containing 12 months of data. The estimation of OLS finds that only risk-free market rate and profitability matter to OLS [7].

Scoot et al. used tables and figures to illustrate the impact of Covid-19 on the U.S stock market and compared with 1918-19, 1957-58, and 1968 show that the unprecedented stock market reaction to Covid-19 cannot be explained simply by the lethality of the virus. Evidence offers grounds for reflection on the wisdom of heavy-handed restrictions on commercial activity in efforts to contain the coronavirus pandemic. However, those policies bring great damage to the economy [8]. Baek, Seungho, et al. used the Markov Switching AR model to analyze the impact of Covid-19 in the U.S stock market. Results show that volatility is affected by specific economic indicators and is sensitive to Covid-19 news. Both negative and positive Covid-19 information is significant, though negative news is more impactful, suggesting a negativity bias. Significant increases in total and idiosyncratic

risk are observed across all industries, while changes in systematic risk vary [9]. Ashraf, B. N, used daily Covid-19 confirmed cases and deaths and stock market returns data from 64 countries from January 22, 2020, to April 17, 2020. Stock market returns declined as the number of confirmed cases increased. Found that stock markets responded negatively to the growth in Covid-19 confirmed cases. The results suggest that stock markets quickly respond to the Covid-19 pandemic, and this response varies over time depending on the stage of the outbreak [10].

During the outbreak, the number of patients in the United States was increasing every day and both entity economy and the fictitious economy encountered are affected by the Covid-19. However, the securities market as the main fictitious economic market is facing changes due to unprecedented infection. Long time isolation and intervention by city blockade policy have allowed a lot of cash flow to swarm into the U.S stock market. Therefore, the overall liquidity of the market could increase, and there will be more trades. Moreover, because of the epidemic's impact, consumers' investment habits in stocks will also change, so some companies that are not optimistic can also succeed.

2. Method

The CAPM was firstly suggested in the Year 1962, which included the return rate of investment, return rate of free risk, and return rate of the market.

$$P_t = P_f + \beta(P_m - P_f) \quad (1)$$

Where R_i is the return rate of investment, while R_f is the return rate of free risk, R_m , therefore, means the return rate of the market.

The CAPM has failed to indicate the simple relationship between the market factors and the expected return. Therefore, it is not a good model to connect the influence of the size of business and the Book/Market ratio. So that the Fama-French 3-factor model is then being developed in the year 1993 by Fama and French, which is designed to connect the other two factors, SMB and HML. SMB stands for Small Minus Big, which is the measurement of the size of the business. It is used to calculate the difference between different investment portfolios' returns in small and big stocks. HML is the return of the high B/M ratio minus the return of the low B/M ratio, which helps to distinguish value stock and market stock. In the situation of a high B/M ratio, it indicates that the stock is a value stock. Oppositely, if it is low, then the stock is a market stock.

$$R_{it} - R_{ft} = \alpha + \beta(R_{mt} - R_{ft}) + \psi \text{SMB} + \delta \text{HML} + \varepsilon_{it} \quad (2)$$

However, it is still not enough to construct a complete model because it failed to connect the profitability of the investment and the investing style in the previous Fama-French 3-factor model. Thus, Fama and French redesigned the model by including these two factors, RMW and CMA, and named it Fama-French five-factor model in 2015. Therefore, the Fama-French 3-factor model has been replaced because the Fama-French 5-factor model can deal with the relationships with underlying factors.

In Equation (3), RMW presents the profitability of the investment. Meanwhile, CMA is the indicator of the investment style, which is conservative minus aggressive. It tells the difference between the stocks with high investment activities and low investment activities. The last item, ε_{it} , is the zero-mean residual.

3. Results

The data are collected from Kenneth R. French's database. Based on the information related to the U.S stock market, to illustrate the change in the meals industry before and during the Covid-19 pandemic. We chose the daily data from June 1, 2019, to November 30, 2020, as the period before

the Covid-19, on the other hand. June 1, 2019, to February 29, 2020, is the period that is affected by Covid-19. Multi-regression is the measurement we use to demonstrate the difference between two periods, and the results are shown in two tables under the condition of confidence interval 95%.

Table 1. Regression Results During 2019.06-2020.02

Item	Coefficients	Stander Deviation	t Stat	P-value
Intercept	0.0134	0.0518	0.26	0.7958
$R_m - R_f$	0.8370	0.0657	12.75	6.2E-24
SMB	0.3070	0.1205	2.55	0.0121
HML	0.1560	0.1221	1.28	0.2038
RMW	0.2837	0.2119	1.34	0.1832
CMA	0.0503	0.2421	0.21	0.8356

Table 2. Regression Results During 2020.3-2020.11

Item	Coefficients	Stander Deviation	t Stat	P-value
Intercept	0.0838	0.1623	0.52	0.6062
$R_m - R_f$	0.9672	0.0662	14.62	3.62E-30
SMB	1.0958	0.1794	6.11	9.02E-09
HML	0.5253	0.1484	3.54	0.0005
RMW	0.8570	0.3030	2.83	0.0053
CMA	-1.994	0.4120	-4.84	3.31E-06

Overall, as the tables are shown before and after the Covid-19, β_{Mkt} is significant both before and during the Covid-19. This is evidence indicating that the stock price of the meals industry has always been sensitive to market prices. The SMB factor is also significant in both stages, β_{SMB} increased during Covid-19, which showed that the small-scale effect is enhanced, and investors are more interested in investing in small companies. However, after the Covid-19 pandemic, the HML factor, RMW factor, and CMA factor became significant. β_{HML} inclined, which means investors favor value stocks, and growth companies may pull back. In addition, β_{RMW} also increased. This indicated that companies with stable profitability are more welcome for investors. Moreover, β_{CMA} became negative after the Covid-19, showing that people are more likely to invest in more aggressive clothing companies.

4. Discussion

4.1 Mkt

$MktR_m - R_f$ represents the risk-return rate of the market portfolio. From the data provided, it can be noticed that t statistics of $R_m - R_f$ of the meal industry before and during the Covid are significant, which means that both of them are obvious. At the same time, the coefficient of $R_m - R_f$ increased from 0.84 to 0.97, which is close to 1. Therefore, it means that the volatility of the stock of the meal

industry is close to that of the market, and the sensitivity has risen as well. Affected by Covid, the performance of the chain meal industry declined sharply. On April 29, Yum China disclosed its first quarterly report. Its revenue was US \$1.75 billion, a year-on-year decrease of 24%, and its net profit was the US \$63 million, a year-on-year decrease of 68%. Besides, KFC, one of the most popular meal industries in this world, achieved the US \$1.27 billion in the first quarter, a year-on-year decrease of 20%. At the same time, Pizza Hut achieved revenue of US \$324 million in the first quarter, a year-on-year decrease of 40%.

4.2 SMB

The coefficients of SMB of the meal industry before and during the Covid-19 are both significant. Hence, both of them are obvious as well. At the same time, the coefficients are positive, which represents that the investment return of small enterprises is greater than that of large enterprises. Besides, the coefficients show a significant increase, meaning that the small-scale effect is enhanced, which can be understood as the profitability of small-scale enterprises is increasing. Therefore, based on the impact of the Covid-19, more investors will choose to invest in some small businesses, although there will be more risks. On the other hand, as the Covid-19 is very serious, it will significantly impact most of the meal industry. To keep the share price of catering stable, investors need to invest more money. Therefore, the cost will be much higher than that of restaurants with smaller market value. In addition, due to the Covid-19, large companies themselves tend to be overvalued, but investors will have lower expectations of them. Therefore, large companies may be short by market speculators, and investors will choose small companies to avoid risks.

4.3 HML

Before the Covid-19 breakouts, the value of HML is not distinctive from 0, and it has changed dramatically to be significant. Meanwhile, the coefficient is greater than 0. Therefore, more people tend to value a stock because they are more mature than the growth stock. The reason there could be the growth stock might not be stable enough. The value might even fall back in the case of a growth stock.

4.4 RMW

RMW showed a similar trend as the HML changed. It does not significantly differ from zero before the Covid-19 took place and become remarkably different from zero after the Covid-19 had a breakout. At the same time, the value of the coefficient is greater than zero, which indicates that investors are preferable to invest in those firms that have stable profitability.

4.5 CMA

Before the Covid-19 outbreak, the value of β CMA is not significant. However, this number goes to -4.84 after the Covid-19, the coefficient is negative, indicating that investors tend to invest in aggressive meal companies. During the epidemic period, the aggressive style meal companies normally have a better financial foundation. Therefore, they could attract investors because they are more likely to increase their market share at a very low price. For the meal industry, the emergence of the epidemic may be a great opportunity. In the face of the epidemic, the meal industry has improved the sensitivity of new technologies. The food enterprises, with the blessing of the intelligent Internet, will win a broader market: intelligent manufacturing, unmanned distribution, online consumption, and other operations. Aiming at the epidemic also creates new development opportunities and space for the food industry in the post epidemic period. As a result, it is reasonable for investors to favor aggressive style meal companies, and they may be optimistic about their market share in the future.

5. Conclusion

During the epidemic period, all walks of life in the United States were impacted, especially the meals industry. It is no exaggeration to say that the epidemic has brought a disastrous impact on the catering industry in the United States. According to the report of the National Restaurant Association (NRA) in July, in the next six months, 75% of restaurants are expected to be unprofitable, and the economic loss of the entire catering industry may reach 240 billion US dollars (about 1.6 trillion yuan) by the end of 2020. The catering industry has become one of the hardest-hit industries in the epidemic.

Therefore, this paper used the Fama-French methods to investigate the impact of the Covid-19 on the industries in the USA. We quoted the data from Kenneth R. French's database and divided the time into before the Covid-19 and during the Covid-19 to develop a precise outcome and conclusion. After the epidemic, the stock of the food industry now tends to fluctuate similarly with the change of the USA stock market. Investors have also become more sensitive to the changes. Meanwhile, examples have proved that small businesses in the meal industry are even more profitable than the big ones. And this phenomenon has become more and more serious after the outbreak of Covid-19. The firms with value stock are preferable in the market due to their maturity. Investors also weigh more the firms with more stable profitability than those less stable. Another thing that the Fama-French 5-factor models showed is that investors are more likely to choose the firms with aggressive investing styles.

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