



A Study of the Impact of Covid-19 in Medical-Related Industries Using Fama-French Five-Factor Method

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Abstract. Since the outbreak of Covid-19, the stock market has suffered from the unstable lash. This article focuses on the impact of Covid-19 on the stock market of the Healthcare industry, Medical Equipment industry, and Pharmaceutical Products industry. 172 trading days in each part of Covid-19 are selected to make regression analysis and the Fama-French Five-factor model is adopted to measure the sensitivity of stock returns. The emphasis of the article is to discuss the changes in five factors caused by Covid-19 and propose a reasonable stock-picking strategy. Caused by Covid-19, the coefficients and significance levels in three industries fluctuate. The results indicate that in different industries, investors should attach importance to different types of stock portfolios. A hedging strategy is suitable in every medical-related industry. Meanwhile, investors should pay attention to the portfolios of different investment rates in the Healthcare industry, the profitability in the Medical Equipment industry, and the stocks which have different book value and market value in the Pharmaceutical Products industry.

Keywords: Finance · Equities · Covid-19 · Fama-French Model

1 Introduction

Coronavirus has swept the world since January 2020. The pandemic has severe damage to personal health and tens of millions of infected persons were died through the pandemic. Also, the relentless crisis has threatened the financial market, especially the medical market. The medical-related industry is one of the vital territories during the pandemic. The events in medical-related areas such as the research of vaccines and the important turning point in the pandemic could infect the stock market significantly.

The stock price is the major reflection of a company. Capital Asset Pricing Model (CAPM) has been generally subscribed in the theoretical circles of securities at that time since it can analyze the sensitivity between securities returns and stock portfolios. In 1993, Fama and French developed a new model with three variables to better describe the returns of a stock or portfolio. The three-factor model has been proved its reliability and rationality over decades of years [1]. In 2013, Fama and French found that it is

hard to explain the excessive returns using the three-factor model, so they created a five-factor model [2]. This model explains the excessive returns more comprehensively by considering market risk, market value risk, book value ratio risk, profit value risk, investment level risk, and other unexplained factors. If the five-factor model could describe the medical-related stock market perfectly, the unexplained factors are hard to observe, which means this method is adopted accurately.

CAPM model is the base of stock analysis, which is used in varieties of stock market analyses. Nie and Cai adopted the Shanghai stock market as a research target. Through 23 months of transaction data, this research analyzed the applicability of CAPM on the Shanghai stock market. In general, the result showed that there is a positive correlation between the risk of the Shanghai stock market and excess profit and other factors are irrelevant, which is similar to the general theory of CAPM [3]. Minović et al. presented the results of testing CAPM by Sharp, and LCAPM by Hearn et al. in the Croatian stock market. Using zero rates measure, the research examined the impact of an overall market factor, a factor related to the firm size, and a factor of liquidity risk on expected asset returns in the Croatian stock market. As a result, LCAPM performs better in explaining stock returns than the CAPM. At the same time, the superiority of LCAPM indicated that it is impossible to establish long-run equilibrium in the Croatian stock market because high liquidity risk distorts the basic mechanism of price discovery [4]. Kumar et al. tested the liquidity-adjusted pricing model of Acharya and Pederson based on the empirical design of Akbas et al. The result of the study indicated that idiosyncratic liquidity risk measured as total volatility of liquidity is priced in the presence of various sources of systematic liquidity risk. [5].

Covid-19 is a sudden global pandemic that has numerous impacts on the global economy and stock market. Duan et al. developed two indexes indicating the stock market under the Covid-19. By applying Native Bayes, SVM, and XGboost processing algorithms for training and measuring the pandemic sentiment in response to Covid-19 as two variables, Duan et al. discovered that stock returns and turnover rates were positively predicted by the Covid-19 sentiments. Additionally, margin trading and short-selling activities intensified proactively with growing sentiment [6]. Using the GASDF method, Li et al. found that there existed multiple bubbles in the three stock prices but not in the overall stock market. Furthermore, the occurrence of bubbles was significantly affected by the COVID-19 related events. Facing the situation of high demand for medical masks, investors or speculators were generally optimistic about medical stocks [7]. Mazur et al. found that during March 2020 stock market crash stocks, natural gas, food, healthcare, and software stocks earn high positive returns, whereas equity values in petroleum, real estate, entertainment, and hospitality sectors fall dramatically. Moreover, loser stocks exhibited extreme asymmetric volatility that correlates negatively with stock returns [8]. Lee explored the initial impact of the COVID-19 sentiment on the US stock market using DNSI and Google Trends big data on coronavirus-related searches. This study offers a comprehensive view of the initial impact of COVID-19 sentiment on the US stock market by investigating the correlation between COVID-19 sentiment. The empirical results reveal the distinct effects of the COVID-19 sentiment across various industries: Communication services, consumer discretionary, industrial, energy, and material sectors are

classified in the high-or middle-level correlation group while the utility sector is classified in the middle-or low-level correlation group. Financial, information technology, and health care sectors are classified in all three groups [9].

The purpose of this article is to research the impact of Covid-19 on medical-related industries. Comparing the different methods, Fama-French five-factor model is more suitable since more factors can reflect the fluctuation better under Covid-19. In addition, the application of Fama-French five-factor model is broad and mature, which means the results of the research are scientific and rational. Fama-French five-factor model is adopted to analyze the sensitivity of different factors. According to the major events during the pandemic, the long period of Covid-19 is divided into three parts. Coefficients and the significance level are calculated in three medical-related industries using regression analysis. Using the results, the impacts of Covid-19 and the possible reasons in different medical-related industries are demonstrated.

2 Method

CAPM has difficulties in measuring the complicated changes in the stock market because it has only a few indicators. To improve this method, Fama and French proposed the Fama-French three-factor model based on the CAPM model [1]. The model explains the portfolios by three factors which include $R_m - R_f$, SMB, and HML. The three-factor model is as follows:

$$r = R_f + \beta_i \cdot E(R_m - R_f) + S_i \cdot E(SMB) + H_i \cdot E(HML) + \alpha \quad (1)$$

where r is the portfolio's expected rate of return, R_f is the risk-free return rate, and R_m is the return of the market portfolio.

Although the three-factor model can describe returns of stocks quite well, it still has some defects. Considering further two factors, profitability and investment, Fama and French construct a five-factor model, which has a stronger explanation of the problem above. The five-factor model has a similar structure as the three-factor model [2].

$$r = R_f + \beta_i \cdot E(R_m - R_f) + S_i \cdot E(SMB) + H_i \cdot E(HML) + R_i \cdot E(RMW) + C_i \cdot E(CMA) + \alpha \quad (2)$$

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:

$$R_i = R_f + \text{Beta1}(R_m - R_f) + \text{Beta2}(SMB) + \text{Beta3}(HML) + \text{Beta4}(RMW) + \text{Beta5}(CMA) \quad (3)$$

where RMW is the profitability factor and CMA is the investment style factor.

3 Results

The data was selected from Kenneth R. French's data library [10], which includes three medical sectors (Health, Medical Equipment, Pharmaceutical Products) and five indicators of Rm-Rf, SMB, HML, RML, and CMA. To measure the relationship between the sectors and five indicators, a linear regression was set with a 95% confidence condition.

The stock market can be affected by information dissemination. The date when the White House announced that the US entered into the Covid-19 emergency moments was appointed as the beginning of the virus (Before). The pandemic entered a new period when Pfizer announced that their vaccine is more than 90 percent effective (After). There are 172 trading days between the two vital moments (During). Between the two points, it is panic. To explore the impacts on medical-related stock returns in different periods of the pandemic, the same trading days were selected both before and after the panic.

It is supposed that the null hypothesis H_0 means two possibilities are the same, while the alternative hypothesis H_1 means every coefficient is significantly different from 0. When the t-stat of beta is more than the threshold or the P-value is less than 0.05, the indicator could be regarded as significant at the 5% level.

SE is the abbreviation of standard error. As shown in Table 1, the great majority of five indicators influenced the stock portfolios, and the influence was adjusted in a different stage of Covid-19. Indicators had different changes in medical-related industries throughout the pandemic which means that the correlative degree in different industries was low.

4 Discussion

T stat and P-value represent the effectiveness of coefficients. If t Stat is more than the threshold or the P-value is more than 0.05 (in the significance of 5% level), the coefficients have no difference with 1 or 0. Generally speaking, RM-RF is floating around 1. SMB, HML, RMW and CMA are floating near 0. As shown in Table 1, Healthcare, Medical Equipment, and Pharmaceutical Products have evident changed in different periods of Covid-19 and three industries have almost the same tendency in the pandemic.

4.1 RM-RF

RM-RF represents the stock market sensitivity of a specific asset. If the coefficients reduce, it shows that this business has lower sensitivity to the stock market. The P-value of the different industries is close to 0, which represents every coefficient has a significant difference from 0. The coefficient of RM-RF is floating around 1. All three medical-related industries decreased the coefficients during Covid-19, especially the Healthcare industry. Before Covid-19, Healthcare superlatively relied on the stock market while Healthcare decreased most during the whole period. This phenomenon can be explained by that the Healthcare industry encountered the earliest and greatest under pandemic.

Table 1. The regression results of three industries

Industry Index	Healthcare			Medical Equipment			Pharmaceutical Products						
	Coefficients	SE	t Stat	P-value	Coefficients	SE	t Stat	P-value	Coefficients	SE	t Stat	P-value	
RM-RF	Before	1.028	0.040	26.021	0.000	0.985	0.035	28.526	0.000	0.878	0.024	36.751	0.000
	During	0.965	0.047	20.396	0.000	0.974	0.038	25.576	0.000	0.857	0.031	27.491	0.000
	After	0.740	0.075	9.807	0.000	0.849	0.064	13.188	0.000	0.606	0.062	9.829	0.000
SMB	Before	0.549	0.109	5.022	0.000	0.158	0.095	1.658	0.099	0.171	0.066	2.582	0.011
	During	0.713	0.114	6.262	0.000	0.092	0.092	1.003	0.318	-0.176	0.075	-2.553	0.020
	After	0.441	0.098	4.496	0.000	-0.087	0.084	-1.042	0.299	-0.044	0.080	-0.553	0.581
HML	Before	-0.198	0.099	-1.995	0.048	-0.319	0.087	-3.682	0.000	-0.386	0.060	-6.424	0.000
	During	-0.054	0.095	-0.562	0.575	0.012	0.077	0.153	0.879	-0.225	0.063	-3.583	0.000
	After	-0.129	0.072	-1.777	0.077	-0.077	0.062	-1.255	0.211	-0.088	0.059	-1.492	0.138
RMW	Before	-0.483	0.191	-2.529	0.012	-0.522	0.167	-3.130	0.002	-0.623	0.116	-5.393	0.000
	During	-0.147	0.197	-0.745	0.458	-0.596	0.158	-3.759	0.000	-0.664	0.130	-5.123	0.000
	After	0.101	0.136	0.744	0.458	-0.093	0.116	-0.805	0.422	-0.365	0.111	-3.302	0.001
CMA	Before	1.040	0.233	4.462	0.000	0.328	0.204	1.611	0.109	0.850	0.141	6.028	0.000
	During	-0.568	0.259	-2.197	0.029	0.045	0.208	0.218	0.828	0.715	0.170	4.200	0.000
	After	-0.203	0.153	-1.326	0.187	-0.028	0.130	-0.216	0.829	0.390	0.125	3.124	0.002

4.2 SMB

SMB represents the different returns of different market-value stocks. If coefficients of SMB are significant with a positive value, it represents small market-value stocks will have higher returns than high market-value stocks. In the Healthcare industry, small market-value stocks always have higher returns although the coefficient decreased to a small degree during Covid-19. The SMB of Medical Equipment and Pharmaceutical Products has changed significantly. In the Pharmaceutical Products industry, market values have opposite significant influences before and during the Covid-19 since P-values are lower than 0.05. However, the P-value of Pharmaceutical Products is 0.582 after the pandemic which means the coefficient is insignificant. In general, the small-value stocks and high-value stocks have opposite returns before and during the Covid-19, while they earn almost the same after the Covid-19 in the Pharmaceutical Products market. Through the progress of the pandemic, the ability of value stock is prominent.

During the pandemic, people prefer the companies which have stable operations with less risk, which also have more capability to research new products for Covid-19. For example, Pfizer successfully researched the medicine and vaccine against the coronavirus. After the announcement of their effective vaccine, Pfizer's stock price skyrocketed in the succeeding period. Big companies have better research ability, which is vital during a disaster. Meanwhile, due to its mild price growth in normal times, the preference for the big companies is not so obvious.

4.3 HML

Book-to-market ratio (B/M) is book value divided by market capitalization. The risk of the Book-to-market ratio described the plight of the companies that have lower appraisal in the stock market. It means that low B/M companies need higher interests to compensate. In the Healthcare industry, the P-values in different periods are almost higher than 0.05, which means different B/M companies have no significant difference in the rate of returns. In Medical Equipment and Pharmaceutical Products industries, the coefficients are significantly different from 0 before the pandemic, which means low B/M stocks get more returns. Nevertheless, the P-values in Medical Equipment and Pharmaceutical Products are higher than 0.05 after the Covid-19, which means that the distinction of stock returns between stocks in different levels of B/M is not obvious.

Different B/M ratio stocks can be divided into value stocks and growth stocks. During a normal period, people prefer growth stocks considering their higher potential returns. After the pandemic, the differences between value stocks and growth stocks are shrinking. That is because the influence of Covid-19 on medical-related industries is elusive, and the new product has some risk of failure.

4.4 RMW

RMW means the companies that have higher profitability are confronted with higher risks and have higher returns. In the Pharmaceutical Products industry, the coefficients in the different period are remarkably distinctive with 0 although it fluctuates in different stages. In Healthcare and Medical Equipment industries, the coefficients are disparate

with 0 and higher profitability represents more considerable returns before the pandemic. However, the companies that have different profitability have no significant differences after Covid-19.

Medical-related industries are speculative mainly because there are plenty of uncertain factors in the progress of the application, sanction, entering the clinic, and so on. As shown in Table 1, Pharmaceutical Products is stronger than Medical Equipment and stronger than Healthcare along the timeline with the distinction of respective complication. For example, Gilead Science researched Remdesivir after Covid-19 swept the global, which led to a skyrocket in its stock price. However, Remdesivir was digging out some side effects and was regarded as an orphan drug soon after. Compared to Pharmaceutical Products, Medical Equipment is more stable during different periods of the pandemic.

4.5 CMA

CMA could be measured by investment rate. The companies which have lower investment rates are considered to have higher risk and investors have more expectations on these stocks. In the Healthcare industry, the fluctuation was obvious. Before and during the pandemic, the P-values are significant while the coefficients are opposite. There is no significant difference between different investment rate companies after the pandemic. In the Medical Equipment industry, the differences are insignificant all along. Meanwhile, the higher investment rate brings higher expected returns in the Pharmaceutical Products industry throughout the Covid-19.

Comparing the Pharmaceutical Products industry and the Medical Equipment industry, people prefer conservative stocks in the Pharmaceutical Products industry the whole time. That means the Pharmaceutical Products industry is more stable since decades of years has witnessed the mergers and acquisitions of Pharmaceutical Products companies. Meanwhile, in the Medical Equipment industry, investors have more investment opportunities because the variety of equipment is enormous, which means that there are not only stable types of equipment but also chances in new equipment, such as IVD (In Vitro Diagnosis), medical robots, etc. Besides, Covid-19 disturbed the Healthcare industry, which makes the coefficients fluctuate irregularly.

5 Conclusion

Since Fama-French five-factor model has higher maturity and applicability, the article adopted Fama-French five-factor model to evaluate the fluctuation caused by Covid-19 in medical-related industries, which include the Healthcare industry, the Medical Equipment industry, and the Pharmaceutical Products industry. To make the results more comparable, the pandemic was divided into three parts and each part have 172 trading days. Through making the regression analysis and discussing the results, the article presents that each industry has its unique feature and needs a correspondent strategy.

In the Healthcare industry, investors should pay attention to the investment rate because the coefficient has a significant change. Investors can choose conservative stocks during the pandemic and make a hedge after the pandemic. In the Medical Equipment

industry, profitability should be emphasized because the significance level changed from 0 to 0.4. Choosing robust stocks during the pandemic and gradually increasing the ratio of worse stocks is a good choice. In the Pharmaceutical Products industry, investors should attach importance to the market value and book value of stocks. Considering the transformation in P-value, investors could adopt some hedge strategies.

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