Research on Medical Equipment Industry Based on Fama-French Five Factor Model

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Abstract. The Covid-19 outbreak since 2019 has affected various industries in the United States to varying degrees. While many industries have stagnated, others have been stimulated. This paper focuses on the stock market of medical equipment to explore the impact of the epidemic on the U.S. healthcare field. The data of various industries in the United States from Kenneth R. French's database was adopted to analyze. By selecting two time periods before and after the epidemic, the parameters were estimated by multiple regression. Based on the CAPM model, Fame-French five-factor model is introduced since it has been tested by more actual data and has a better explanatory ability. By comparing the parameters before and after the epidemic, it was found that all factors were significant before Covid-19, but SMB, CMA, and HML became insignificant after the outbreak. In addition, the impact of the epidemic has even caused many factors to produce an opposite effect. In view of these phenomena, reasonable speculation and explanation are made according to the operation rules of the stock market and the specific characteristics of the medical industry. In conclusion, the epidemic has raised expectations for the healthcare sector, making factors such as the size of firms and the type of stock less significant. The medical equipment industry as a whole grew rapidly during this period, while some investors tended to favor speculative stocks. The increasing number of trades has steadily increased the value of shares.

Keywords: Covid-19, Medical Equipment Industry, Fama-French Five Factor Model

1 Introduction

The global ravages of the Covid-19 have had a devastating impact on the world economy. Both agriculture, industry, and the service sector have been greatly affected. In the first place, the global econmy suffered a great burden, with many countries' stocks had huge losses several times in a short period. Besides, the global trade was significantly influenced by this case, and the volume of global trade even decreased. Thirdly,

the Covid-19 has caused an impact on the industrial chain, particularly in sectors with a high degree of globalization, including many industries. Moreover, the business sales and investors' confidence were also affected. In addition, unemployment rates are rising as the Covid-19 spreads. This could affect the stability of the economy and society. At the same time, per capita income has mostly tended to decline during the Covid-19, which has reduced people's spending power and willingness to spend. The United States is an extremely important part of the world economy. Its various industries have inevitably been affected to varying degrees, such as the garment industry and the petrochemical industry. The travel, airline, catering, and entertainment industries are under enormous pressure due to Covid-19's difficulties in operating normally, which will also lead to redundancies that may have to take place. And the increase in unemployment is certainly huge bad news for the US.

The CAPM model is very practical while analyzing the stock market. Although the CAPM model has certain limitations, it is still very important. The CAPM is very simple to operate, which makes it very easy to use the CAPM model. It assumes that the people have similar preference for invessting. The assumption that investors hold a similar portfolio to the economy. Also, the CAPM considers systematic risk (beta), unlike other return models such as the DDM, which exclude systematic risk, making the CAPM model more practical. However, CAPM is troubled because the one factor has a limitation for many explanations. At the same time, ATP's multi-factor model does not know exactly how many factors scholars need to valuate the market. Fortunately, two researchers put forward a genius view in 1992. Since CAPM can't explain the market phenomenon in practice, we should look for the factor directly from these anomalies. As soon as this method is introduced, it has become one of the standard methods for all kinds of research and strategy design because of its good explanatory power and simplicity. In 2015, Fama and French added more factors for this problems, including the areas of profitability and investment. Many researchers in recent years have applied the five-factor model.

The COVID-19 is definitely a very famous black swan problem in recent years. With the spread of the epidemic, countries around the world have been affected. Many factories have shut down, and people's lives have also been affected. In some countries with low per capita savings rates, such as the United States, sudden shutdowns have had a great impact on daily life and have also led to rapid negative effects in the capital market[1]. Among them, the United States experienced multiple circuit breakers in March, and the protective measures of various countries have dealt a heavy blow to economic globalization. Several major economies, including the United States and China, have experienced severe declines. In addition, the medical industry has actually benefited the most from this incident, and people have gradually realized the important value of medical resources. For the government and public safety, there has been a significant increase in demand for related drugs and medical resources, such as ventilators, which are very important equipment and have even been looted. With the successful development of vaccines, people's confidence has gradually recovered. So, research on the medical industry, especially analyzing it during the pandemic, has strong theoretical significance and practical application value.

Li analyzed the big data, especially studied people's emotions about the COVID-19, and related to the final impact on the stock market. Among them, the indicators of mood changes and the returns of the stock market can be well explained by the three factor model. During this period, there were excess returns, which is worth learning for investors [2]. Baig et al. conducted research from a micro perspective, dynamically monitoring the volatility and liquidity of multiple industries, and found that the number of deaths from cases is a key indicator, which has a very important impact on the stock market[3]. Giardino and Rinaldi believe that the COVID-19 epidemic has provided a key opportunity for the reshaping of the global medical industry chain, because many countries have been affected, and the government's response ability has led to great differences in the efficiency of their resumption of work, which has led to imbalance in the development of the medical industry in different countries, which also provides opportunities for SMEs in some countries to participate in the global supply chain through this opportunity [4].

Horváth and Wang used GMM model to study, and analyzed the results of statistical model regression, mainly aiming at the impact of R square to evaluate the impact of COVID-19 on the stock market. The magnitude of the R-squared value reflects whether there are other influencing factors that have interfered with the model [5]. The study conducted by Sun validated the effectiveness of the five factor model and reflected the impact of the epidemic through the intercept term, with clear results. The decline in regression efficiency of the epidemic model in many industries indirectly reflects the impact of the epidemic on the stock market [6]. The five factor model is an upgraded version of the three factor model. For the impact of the COVID-19, the five factor model seems to have a better effect and a higher matching degree for stock data. From the perspective of factor significance, it can also be seen that the model has enhanced the matching of results. The results of 30 industries support these views from a statistical perspective [7].

It can be said that the five factor model has been widely recognized, especially in the papers of many scholars who have repeatedly verified it. This article focuses on the US stock market and uses this model for application research. Multiple regression analysis methods are used to calculate and discuss the data, and significant effects are judged and evaluated. Then according to the definition and purpose of each factor, combined with the particularity of the industry, we discussed each factor. Finally, we hope to provide investors with relatively high reliability of investment reference.

2   Method

In Fame-French three-factor model [8]:

$$R_i = R_F + \beta_{mkt}(Rm - Rf) + \beta_{SMB}SMB + \beta_{HML}HML + \varepsilon_i \tag{1}$$

where R_i refers to the rate of return of stock i minus the risk-free rate; R_m-R_f, means market excess return; Small Minus Big (SMB) refers to the simulated portfolio return rate based on size factor; High Minus Low (HML) is a book-to-value factor, referring to the excess financial dilemma risk comparing higher appraisement in the market with

the inner corporation. Afterwards, the five factor model was proposed in Equation (2) [9,10]:

$$Ri=RF+\beta mkt(RM-RF)+\beta_{SMB}SMB+\beta_{HML}HML+\beta_{RMW}RMW+\beta_{CMA}CMA+\varepsilon_i \qquad (2)$$

Robust Minus Weak (RMW) is the profitability factor; Conservative minus Aggressive (CMA) presents the investment level risk. With Equation (2), we compare the factor change and significant change before and during the COVID-19 to analyze the Phenomena and causes of the stock market.

3　　Results

For evaluating the influence of epidemic, this study uses the yield data of various industries in the United States. The adopted periods are February 2019 to February 2020 and March 2020 to March 2021, reflecting differen situation. Also, the coefficiences and significances will be obtained in Table 1 and Table 2:

Table 1. Multiple Regression Results of Medical Equipment Before Covid-19 (2019.02-2020.02)

Item	Coefficients	Standard Error	t Stat	P-value
Intercept	-0.002	0.036	-0.044	0.965
MKT	0.973	0.045	21.578	0.000
SMB	0.171	0.079	2.151	0.032
HML	-0.538	0.079	-6.790	0.000
RMW	-0.558	0.119	-4.702	0.000
CMA	0.820	0.160	5.116	0.000

Table 2. Multiple Regression Results of Medical Equipment After Covid-19 (2020.03-2021.03)

Item	Coefficients	Standard Error	t Stat	P-value
Intercept	-0.010	0.055	-0.189	0.850
MKT	0.921	0.028	33.137	0.000
SMB	-0.014	0.063	-0.222	0.824
HML	0.098	0.053	1.859	0.064
RMW	-0.278	0.109	-2.552	0.011
CMA	-0.120	0.124	-0.975	0.330

As shown in the tables, the coefficient of all five indicators is significant before Covid-19, but after that, SMB, CMA, and HML became insignificant. Meanwhile, it noted that after Covid-19, the coefficient of SMB became smaller than zero, which is the same as that of CMA, but the coefficient of HML is just the opposite. However, since SMB, HML, and CMA were no longer significant after the Covid-19, there is no need to care about their coefficients.

4   Discussion

4.1   MKT

Both the coefficients of the duration before Covid-19 and the duration after Covid-19 are less than 1, representing that the sensitivity of the medical equipment industry's stock price to market is insensitive. However, there are still some differences between these two tables. It is obvious that the table for the duration before Covid-19 (0.973) is higher than for the duration after Covid-19 (0.921). The higher the coefficient is, the stronger relationship between the Ri and market will be. Therefore, the difference between the table for these two durations means Ri is less sensitive to market change after the Covid-19. The total sales of the global medical equipment market in 2019 are approximately 450 billion dollars, while the data in 2020 is about 475 billion dollars. The market share of the U.S is about 40 percent during these two periods. There is an increase in sales of U.S medical equipment.

The reason might be that the medical equipment industry's impact suffered from Covid-19 is more slight than other industries. The Covid-19 brought more serious impacts to other industries like airways and traveling. People may not travel or take airplanes due to the Covid-19. However, they are not able to disregard the health of their bodies. That may be why the medical industry is less sensitive to the changes in the market.

4.2   SMB

SMB data was significant before the Covid-19, and the coefficient was greater than zero. It means that the return on investment in small businesses is higher than that in large ones. However, it was no longer significant after the outbreak of Covid-19, which may show that the filtering of market factors was disappearing for medical equipment. This phenomenon may be explained as follow. As a result of the epidemic, both large and small enterprises have relatively high orders and market expectations, so there is little difference in stock return. However, before the epidemic, investing in small businesses is generally considered to entail more risk, so higher yields are needed to compensate. Meanwhile, small enterprises have more potential for growth who might bring new products and services that affect the market. Thus, investors aiming at making more profit will tend to invest in the small-cap firm than larger ones.

4.3   HML

HML factor expresses the corporations with high-value stocks outperform those with growth stocks. Since HML before Covid-19 is significantly smaller than zero, the investors prefer growth stocks rather than value stocks in the medical industry. This may because for medical equipment, it usually represents the advanced medical technology, which will attract high expectation from the market and thus believe growth stocks will bring more return value. This will also be reflected in share prices.

In addition, after the outbreak of the epidemic, its significance tends to disappear, and the market's preference for growth oriented targets is not as good as before. The reason may be that during the epidemic, large medical equipment enterprises gradually took control of the situation, and both large and small enterprises were recognized by the market, leading to a significant decrease in this aspect.

4.4   RMW

As shown in Tables 1 and 2 above, the t-value of RMW reveals that the coefficient is significant both before and after Covid-19. That is, its coefficient is significantly different from 0. Therefore, this indicator can explain part of the total return.

According to the definition of RMW, robust-minus-weak, plus the negative coefficient, we know that the investors prefer weak companies to robust ones. This shows that they are more inclined to invest in speculative companies before and after Covid-19 rather than those with large and stable profits. Usually, these so-called small and weak companies are more uncertain about their relative earnings, and their stock prices are relatively low, which may soar or fall to the bottom. In the medical equipment industry, investors like to invest in speculative companies because the weak companies in this industry may suddenly increase a lot of orders due to the epidemic situation. If such information is disclosed, the company's stock price may suddenly rise by a large margin, which is what investors expect.

For instance, Cytodyn Inc., a relatively small biotechnology company, made unexpected progress in the treatment of the epidemic. Thus, after February 2020, its closing price is nearly triple from \$1.048 to \$2.7.4.5 CMA

4.5   CMA

For CMA factor, before the epidemic it presents significance with a positive coefficient. However, during the Covid-19, the t-value of CMA became insignificant.

This change shows that before the epidemic outbreak, investors tend to invest in the stocks of companies with relatively low reinvestment ratios, that is, conservative stocks. However, after the outbreak of the epidemic, the coefficient of the factor becomes insignificant. That is to say. The factor lost the ability to explain the rate of return. The explanation for this phenomenon maybe because of the reason of Covid-19. Investors are divided into roughly two factions. One group believes that Covid-19 has brought opportunities to the industry. It should invest in radical companies that reinvest most of the funds and the quality assets are low in price and strive to gain large profits in the epidemic situation. The other group thinks that Covid-19 has brought a crisis. When it comes to investing, it should choose a relatively conservative and well-regulated company. Most of them have stable decisions and relatively stable returns.

5   Conclusion

This article adopted five-factor model to explore the impact of influce of the epidemic. For medical equipment sector, the coefficients of two periods reflect the difference. Before the epidemic, investors tend to invest in small enterprises and high-value stocks, but after the baptism of the epidemic, SMB and HML indicators become insignificant; Simultaneously, investors prefer speculative stocks in the industry throughout the study period. We can also see that the NASDAQ medical index is rising steadily before and after the epidemic. The outbreak of the epidemic is undoubtedly a huge opportunity for the medical equipment industry. Compared with the normal period, the order scale has expanded geometrically, and investors are willing to buy shares in the industry. Therefore, this paper strongly suggests that these stocks should be considered, especially the small and speculative companies.

Authors Contribution

All the authors contributed equally and their names were listed in alphabetical order.

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