

The Impact of COVID-19 on Medical-related American Stocks

Tongke Wei^{1,†}, Yuheng Wu^{2,*},† and Xiaoyu Yang^{3,†}

¹ Business School, Manchester Metropolitan University, Manchester, M15 6BH, UK

² School of Social Science, University of Manchester, Manchester, M13 9PL, UK

³ School of Mathematical Sciences, Queen Mary University of London, London, E1 4NS

*Corresponding author. Email: yuheng.wu@student.manchester.ac.uk

†These authors contributed equally.

ABSTRACT

Since the outbreak of COVID-19 in 2020, there has been a very serious impact on the global economy. In this paper, the period from May 2019 to February 2020 was selected as the pre-epidemic, and the period from March to December 2020 was selected as the mid-epidemic. The stocks of the US healthcare sector are analyzed in these two time periods, respectively. Fama-French five-factor model is used to analyze the risks and returns of investing in the Health, Drugs, and Medical Equipment sectors. Based on the data obtained from multiple linear regressions, it was concluded that all healthcare-related sectors were affected by the epidemic to varying degrees. Some of the significant factors became insignificant in both the healthcare and medical equipment sectors. At the same time, smaller companies in the drugs industry were also affected to a greater extent than larger ones, and the vulnerability reflected in the pandemic also gave a significant impetus to the overall medical-related industries.

Keywords: COVID-19, Healthcare, US stock market, Medical Equipment, Drugs.

1. INTRODUCTION

1.1. Background

COVID-19 has become a pandemic which caused a serious recession in the global economy. Avoiding contact with the virus was the only way to prevent the infection before the successful development of vaccines. Therefore all the countries began to implement the lock-down policies. Then the manufacturing and service industry has shut down, and unemployment has risen significantly. The declines of GDP for many countries have set a record. Meanwhile, international trade and investment have contracted sharply. The pandemic also caused a major upheaval in global financial markets. The liquidity and stability of the American stock market have deteriorated sharply. The 7% slump of the American stock market triggered a circuit breaker for the first time in March 2020, and it was followed by three more in the same month. While the impact on stock markets would be temporary, global stock markets would be hit more if the epidemic continues to spread. Oil, entertainment, hotel, and transportation stocks fell considerably during the beginning of the pandemic.

However, the stocks in the medical-related industries gained high returns, as the demand for drugs and medical equipment increased substantially. The importance that people attached to their own health was promoting the development of the medical industry as well. The reasons for the rises and falls of stocks in these sectors and the origins of these black swan incidents are really important for analyzing the impact of the pandemic on financial markets. And the Capital asset pricing theory can provide full explanations for these appearances. The Capital asset pricing Model (CAPM) can guide the investment behaviour of investors according to the real price and equilibrium price. Different beta coefficients are used to classify assets in this model, and then resources are allocated according to investors' requirements or risk tolerance. All of these explain that CAPM will be widely used in various fields of the financial market, and it provides a theoretical basis for the study of American stocks. Consequently, CAPM is really significant for the research of the impact on the American medical stock.

1.2. Related Research

The impact of the epidemic on the global economy has attracted the attention of many scholars. Harjoto et al. used the case study method to study the World Health Organization's declaration of COVID-19 as a global pandemic on March 11, 2020, and the large-scale loan plan announced by the Federal Reserve Bank of the United States on April 9, 2020. The structure shows that the impact of COVID-19 on the stocks of developing countries is much greater than that of developed countries and large-scale monetary policies are not enough to offset the negative impact of COVID-19 on small companies [1]. Maital and Barzani studied the impact of COVID-19 on the global economy. The definition and history of the pandemic and flu virus showed that scenario plannings and suggestions for the business were necessary. COVID-19 may affect the global economy in three ways. The supply chain should be the most affected side. An example of the supply of essential drugs by the Chinese and Indian factories has strongly proved this point. Also, the considerable position of the Chinese economy was highlighted by this pandemic. While the crisis may be an opportunity, the economy and other systems would be severely tested in the future [2].

The U.S. stock market has also been shaken because of the pandemic, and many researchers have expressed their related opinions and thoughts. Baeket al. researched the effects of COVID-19 on the U.S. stock market volatility. By using the market-switching AR model to determine the regime change from lower to higher volatility, he got the result that the total risk of the U.S. stock market has a significant rise. Machine learning (ML) feature selection methods are used to find the factors that drive daily volatility changes. It has been proved that volatility is influenced by specific economic indicators and is more sensitive to COVID-19 news. Besides, the negative news of COVID-19 is about twice as influential as the positives, which shows a negative bias [3]. Yousfi et al. investigated the comparison of the effects of the first and second waves of COVID-19 in the U.S. on its stock market. Meanwhile, they also researched the risk spillover of the Chinese and American stock markets before and during the outbreak period. To achieve this, multivariate GARCH models (DCC-GARCH and ADCCGARCH), DCC process, and wavelet coherence are used. The result supports the presence of volatility spillovers (contagion effects) between two stock markets during the epidemic. Moreover, there are asymmetric impacts on the relationship between the two stock markets and the studied period. The increasing infections and deaths brought on by COVID-19 during the first and second waves add to the uncertainty of the U.S. stock market and the whole economy [4]. Mazur et al. studied the U.S. stock market crash due to COVID-19 by using

S&P data for 1,500 companies in March 2020. Among the best performers were stocks in the healthcare, gas, food, and software sectors, while real estate, oil, hotels, and entertainment stocks fell significantly. And the figures and tables showed that stocks with extreme negative returns had illustrated extreme asymmetric volatility. Some worst performers chose to decrease salaries, and others chose to increase salaries and give cash incentives to cope with this crash. Overall, the March 2020 stock market crash was one of the biggest in history [5]. Lee discussed the impact of COVID-19 on multiple industries in the U.S. stock market by using Daily News Sentiment Index (DNSI) and Google Trends data on corona virus-related searches from 2020.1.21 to 2020.5.20. And also, through the use of the FAMA model and time series regression model to make different predictions of the impact of DNSI on the earnings of the US industry. The results show that the financial, information technology, and healthcare industries are greatly affected, and DSNI can predict the rate of return in industries such as communications services, energy, finance, and industry [6]. Baig et al. analyzed the impact of COVID-19 on the U.S. stock market from three aspects: the number of cases and deaths caused by COVID-19, human emotions and panic in a pandemic situation, and some mandatory government measures. Finally, it is concluded that various factors of COVID-19 have caused the deterioration of the liquidity and stability of the U.S. stock market [7].

The pandemic has magnified many potential problems in the medical industry, but sometimes a crisis can be an opportunity. Bardet et al. studied how COVID-19 can affect the allocation and use of medical resources and the death rate of other critical illnesses such as various cancers. Using the discrete event simulation model and basing on the patient data from a large French comprehensive cancer centre's discharge database, they conclude that 6-8% of patients do experience a delay of >2 months with the sample of 13000. This will lead to additional death cases. Considering the recurrence of the epidemic, patients should be advised that they should receive treatment as soon as possible, and related medical resources should also be segregated [8]. Kaye et al. discussed the impact of COVID-19 on the U.S. and international economics and also the healthcare system. With the data collected from official organizations around the world like WHO, they analyzed the data. They then found that the world's economies have almost come to a standstill from the declaration of COVID-19 in March 2020. On the other hand, COVID-19 has also exposed the shortcomings of healthcare systems in the face of epidemic infections, thus enabling healthcare industries worldwide to close the gaps and provide better care to patients [9]. Haq et al. reviewed the development of 3D printing and studied its potential during the COVID-19 pandemic, especially

the personal protective equipment (PPE) and ventilator equipment. The advantages of different 3D printed medical equipment were introduced, such as shorter production time and lower cost. Despite the additional time and cost associated with CAD models, which is the prerequisite for 3D printing, this technique with minimal human intervention still is a good choice to make up for the shortages of medical equipment due to COVID-19[10]. Iyengar et al. studied the impact of COVID-19 on the supply chains in healthcare and related solutions. At that time, China blockaded and closed factories to avoid exposure to the virus, India suspended exports to prevent domestic drug shortages. Among other reasons, eventually, the global drug supply chain faced difficulties. Then many companies started digital supply networks to cope with disruptions to the supply chain. In general, to prevent shortages of medical care and personal protective equipment from causing fear among healthcare workers and the spread of the epidemic, the priority investment in healthcare and well-established delivery logistics systems was encouraged[11].

Fama-French's three-factor model and five-factor model usually are introduced to analyze the stock's price changes. Wu et al. conducted research by reorganizing the PSTR of Fama-French's three-factor model and using 58 semiconductor stocks from the Taiwan Stock Exchange as a sample. The result is that when investors are extremely pessimistic or extremely optimistic, the market premium will fall, so at this time, investors' income from holding growth stocks is higher than holding value stocks [12].

1.3. Objective

This paper examines the impact of COVID-19 on the US healthcare sector as a whole, based on the Fama-French five-factor model. The study focuses on Drugs, Hlth, and MedEq in the healthcare industry as the main analysis subjects. Multiple linear regression of the coefficients from the Fama-French five-factor model is used to further determine the relationship between the risk and return of COVID-19 on the US healthcare sector and to provide a reference value for other healthcare sectors and investors.

2. METHOD

In this study, Fama-French five-factor model was adopted to analyze the effect of COVID-19 on industries.

2.1. Capital Asset Pricing Model (CAPM) and Linear Regression Model and Capital

The CAPM model is used to study the relationship between the expected return on assets and risky assets in

the stock market. In the CAPM, the expected rate of return on equities is

$$R_S = R_f + \beta \times (R_m - R_f) \quad (1)$$

Where R_S is the expected return on the stock, R_f represents the risk-free interest rate, R_m represents the expected market return, $R_m - R_f$ is the market risk premium and β (Beta Coefficient) is a risk factor.

2.2. Fama-French three-factor model and Fama-French five-factor model

Fama and French developed the Fama-French three-factor model in 1992, which pointed out that stock returns were not only linearly related to the systematic risk of the stock market as a whole and in 1993 developed a new three-factor model to explain stock returns. The three factors are Small minus Big (SMB), the book-to-market ratio (HML), and new unexplained factors (α). The announcement is as follow

$$R_i = a_i + b_i R_M + s_i E(SMB) + h_i E(HML) + \varepsilon_i \quad (2)$$

In Equation (2), $R_i = E(r_i - r_f)$ the expected excess return of market capitalisation stock i over a risk-free investment. $R_M = E(r_M - r_f)$ is the expected excess return of the market relative to a risk-free investment. $E(SMB)$ is the excess return of small market value firms relative to large market value firm stocks, while $E(HML)$ is the excess return of high book-to-market ratio firm stocks relative to low book-to-market ratio firm stocks, and ε_i is the residual term of the regression.

Based on a three-factor model, Fama and French proposed a five-factor model in 2013, a model that more fully explains the excess returns of each stock. The five-factor model has additional $E(RMW)$ and $E(CMA)$ compared to the three-factor model. The announcement is as follow

$$R_i = a_i + b_i R_M + s_i E(SMB) + h_i E(HML) + r_i E(RMW) + c_i E(CMA) + \varepsilon_i \quad (3)$$

The two extra items in the five-factor model represent earnings level risk $E(RMW)$ and investment level risk $E(CMA)$, respectively.

3. RESULTS

Several methods are being used to discuss the impact of COVID-19 on the global economy. And in this paper, as mentioned above, Fama-French five-factor model is suitable for exploring the relationship between stocks volatility in three different industries and the COVID-19 pandemic.

For the purpose of empirical investigation, we have selected daily data on the average value-weighted returns of three sectors: Healthcare, Medical equipment,

and Drugs. Compared with the average equal-weighted return, the average value-weighted return can be more helpful to see the industry's performance from an investor's perspective.

Two time periods are divided for data analysis, Before COVID-19 and During COVID-19, to see what exactly did COVID-19 pandemic do to the stock market in the healthcare sector during the outbreak. Regarding the choice of timing points, March 2020 is taken as the starting point of the global outbreak of COVID-19. And the birth of the Pfizer vaccine, around December 2020, is an important turning point in the pandemic, which is seen as the ending point for DURING COVID-19. As a comparison, data for the 10 months from May 2019 to February 2020 were selected to analyze the state of the industry before the outbreak.

Through data analysis, multiple linear regressions can be done on the five-factor and the risk premium. As for the Healthcare industry, Table 1 reveals the results of the regression. It indicates that CMA was significant before the epidemic but became non-significant during

COVID-19. This means the investment return for investing in small companies remained higher than investing in big ones during the COVID-19 pandemic. In contrast, the effect of investment level risk was no longer as great as it was before.

According to the results of Medical Equipment, the results provide evidence that all of the 5 factors were significant except SMB before the pandemic. At the same time, only two of them, $R_m - R_f$ and RMW, remained unchanged from March 2020 to December 2020. During COVID-19, investors can gain more by investing in less profitable companies than more profitable ones.

The Drugs industry has not been affected as much as the previous two sectors. The five factors were significant both before and during COVID-19. The only difference is that the second factor SMB is reversed during COVID-19, which means investing in large companies will yield more than investing in small companies.

Table 1. Multiple-linear Regression results of three industries

Industry	Data	Period	Mkt-RF	SMB	HML	RMW	CMA
Healthcare	Coefficients	Before	0.875	0.532	-0.071	-0.162	0.673
		During	0.980	0.770	-0.149	-0.113	-0.308
	t Stat	Before	15.189	4.934	-0.640	-0.893	3.154
		During	25.345	7.754	-1.846	-0.684	-1.461
Medical equipment	Coefficients	Before	0.961	0.089	-0.392	-0.501	0.570
		During	0.939	0.073	0.075	-0.438	-0.007
	t Stat	Before	20.493	1.009	-4.351	-3.389	3.278
		During	29.919	0.906	1.144	-3.262	-0.040
Drugs	Coefficients	Before	0.854	0.284	-0.517	-0.526	1.059
		During	0.833	-0.136	-0.228	-0.588	0.743
	t Stat	Before	24.534	4.356	-7.734	-4.796	8.211
		During	32.836	-2.095	-4.303	-5.412	5.361

4. DISCUSSION

4.1. Healthcare

Similar to the medical device sector, $R_m - R_f$'s coefficient for healthcare was less than 1 both before and during the pandemic. However, there was a small increase during COVID-19 compared to the pre-outbreak period, making the industry more sensitive to the market. The data indicate that the second factor, SMB, did not change in significance in the two periods, both being significant. And the positive coefficient represents that small companies can bring more returns to investors. Compared to drug development and medical equipment production, the threshold for

healthcare services will be relatively low. This will allow more small and medium-sized companies to establish themselves in this sector. The increase in demand for healthcare services during the epidemic also emphasizes the importance of building more primary healthcare services. The epidemic has brought growth opportunities for small and medium-sized companies and increased investment returns. Before and during the pandemic, the regression results indicated that the effects of both factors, HML and RMW, were insignificant. There is a possible reason that in the United States, healthcare services are similar in nature. Because there is no universal healthcare and healthcare is quite expensive, most people have health insurance to avoid incurring huge debts due to illness. Since general

healthcare is almost a necessity, there is no great variation in service content or profitability across the industry. Thus the impact of the B/M ratio and profitability are also decreased. Noteworthy is the factor CMA. As with the medical equipment industry, the pre-pandemic regression results indicate that its impact is significant. Based on the positive coefficients, it is clear that investing in conservative companies has higher returns than investing in aggressive ones. However, it shifted to an insignificant factor during COVID-19. Before the epidemic, a conservative investment policy by companies could help investors avoid risk and also bring in more revenue. But because of the development of the epidemic, almost all industries have been affected. This is an unavoidable risk. The impact of investment style, in this case, is not so obvious, and this could be the reason why this change has occurred.

4.2. Medical Equipment

The coefficients $\beta_{\text{MKT-RF}}$ both were close to 1 before and during the pandemic. They show the same sensitivity as the market in 2019 and 2020. According to the results of the statistic test, it illustrated that neither of two SMB factors are significant in medical equipment industries. One possible reason is that the American medical-related industry is full of monopolies. There were only a few well-known companies. For instance, Fresenius and DaVita controlled 92 percent of the dialysis market. Thus the size effect is not meant for explaining returns on stocks. The HML factor was significant before the outbreak, while it became non-significant after the outbreak by Table 1. The companies with a low book value-to-market value ratio could gain a higher return on the stock as the coefficients β_{HML} was negative. The book value-to-market value ratio of traditional manufacturing is generally not very high. People may prefer more secure companies in healthcare, so emerging industries with high ratios are generally not viewed favourably. Between these two periods, the RMW factors were significant, and the coefficients β_{RMW} were negative, which means the companies with lower profitability got better results. Normally many mature companies did not have high profitability, but they were more stable. Companies with high profitability would take higher risks. Therefore, they are affected more due to other factors or COVID-19. The CMA factor was significant before the pandemic. However, it was not significant after March 2020. The coefficients β_{CMA} was positive. Firstly, hence the return of companies that invest conservatively was higher than companies that invest aggressively. As mentioned above, people don't want to take risks with their own health. That is the reason why companies that invest conservatively had a higher probability of profitability. The demand for medical equipment has surged, and imports have sharply decreased because of the global spread of the epidemic. Then severe domestic shortages

have appeared. All the American companies are encouraged to produce medical protective equipment, which may explain why the HML and CMA factor was not significant later. For example, General Motors Company, with high book value-to-market, was required to produce masks, ventilators, and other medical equipment. Overall, the stocks in the medical equipment industries have been affected seriously.

4.3. Drugs

Hypothesis testing of the multiple linear regression results of the Fama-French five-factor model found that in the pharmaceutical industry, both before and after COVID-19 could be significantly different from zero. It can be concluded that the excess returns from various risks can be represented by five factors for the pharmaceutical industry before and after COVID-19. It is worth noting that when comparing the five factors before and after COVID-19, it is clear that the values of all three factors except SMB and CMA have increased. In contrast, the values for SMB and CMA have decreased. Notably, comparing the five factors before and after COVID-19, the t Stat for SMB is positive before COVID-19 but negative after COVID-19, which indicates that the return on investing in small business stocks is greater than the return on investing in large business stocks before COVID-19. But after COVID-19, the opposite is true. Instead, the return on investing in large firm tickets is higher than the return on investing in small firm stocks.

This situation arises mainly because small businesses when faced with the economic impact of COVID-19, do not have sufficient capacity to offset all the negative effects. Harjoto et al. used a case study approach to investigate the massive lending programme released by the Federal Reserve Bank of the United States on 9 April 2020, suggesting that the massive monetary policy was insufficient to offset the negative impact of COVID-19 on small businesses [1]. This, therefore, makes it more rewarding for investors to invest in larger companies than in smaller ones after COVID-19.

4.4. Summary

Therefore, the impacts of COVID-19 on the entire medical-related industries have been enormous. The spread of COVID-19 has led to a dramatic increase in demand for medical equipment and a shortage of medical resources, reflecting a huge hole in the healthcare service system. Businesses across all sectors have been hit. Small businesses like those in the pharmaceutical industry have struggled to offset the negative impact of the outbreak. On the other hand, COVID-19 has also had a stimulating effect on the industry as a whole. The identification of vulnerabilities

in the healthcare system allowed for continuous improvement, and the entire industry grew.

5. CONCLUSION

This study aims to research the impact of COVID-19 on the medical industry in the US stock market. Based on the Fama-French five-factor model, the data of healthcare, medical equipment, and drugs from 2019.05 to 2020.02 and 2020.03 to 2020.12 are analyzed through the multiple-linear regression. The t-test results indicate that the healthcare and medical equipment industries are greatly affected by the pandemic. Therefore it is suggested that the investment in these two industries can be appropriately reduced now. However, the investment in the drug industry should be maintained because it is barely affected by the epidemic, and vaccines are still in demand. It is worth noting that there's a clear shift from investment in small companies that can gain higher profit to large companies that can get a higher return in the drugs industry. These findings mentioned all could help investors to invest allocate assets more rationally during and after the pandemic.

REFERENCES

- [1] Harjoto, M. A., Rossi, F., & Paglia, J. K. (2021). COVID-19: Stock market reactions to the shock and the stimulus. *Applied Economics Letters*, 28(10), 795-801.
- [2] Maital, S., & Barzani, E. (2020). The global economic impact of COVID-19: A summary of research. Samuel Neaman Institute for National Policy Research, 2020, 1-12.
- [3] Baek, S., Mohanty, S. K., & Glambosky, M. (2020). COVID-19 and stock market volatility: An industry level analysis. *Finance Research Letters*, 37, 101748.
- [4] Yousfi, M., Zaied, Y. B., Cheikh, N. B., Lahouel, B. B., & Bouzgarrou, H. (2021). Effects of the COVID-19 pandemic on the US stock market and uncertainty: A comparative assessment between the first and second waves. *Technological Forecasting and Social Change*, 167, 120710.
- [5] Mazur, M., Dang, M., & Vega, M. (2021). COVID-19 and the march 2020 stock market crash. Evidence from S&P1500. *Finance Research Letters*, 38, 101690.
- [6] Lee, H. S. (2020). Exploring the initial impact of COVID-19 sentiment on US stock market using big data. *Sustainability*, 12(16), 6648.
- [7] Baig, A. S., Butt, H. A., Haroon, O., & Rizvi, S. A. R. (2021). Deaths, panic, lockdowns and US equity markets: The case of COVID-19 pandemic. *Finance research letters*, 38, 101701.
- [8] Bardet, A., Fraslin, A. M., Marghadi, J., Borget, I., Faron, M., Honoré, C., ... & Bonastre, J. (2021). Impact of COVID-19 on healthcare organization and cancer outcomes. *European Journal of Cancer*.
- [9] Kaye, A. D., Okeagu, C. N., Pham, A. D., Silva, R. A., Hurley, J. J., Arron, B. L., ... & Cornett, E. M. (2020). Economic Impact of COVID-19 Pandemic on Health Care Facilities and Systems: International Perspectives. *Best Practice & Research Clinical Anaesthesiology*.
- [10] Haq, M. I. U., Khuroo, S., Raina, A., Khajuria, S., Javaid, M., Haq, M. F. U., & Haleem, A. (2020). 3D printing for development of medical equipment amidst coronavirus (COVID-19) pandemic—review and advancements. *Research on Biomedical Engineering*, 1-11.
- [11] Iyengar, K. P., Vaishya, R., Bahl, S., & Vaish, A. (2020). Impact of the coronavirus pandemic on the supply chain in healthcare. *British Journal of Healthcare Management*, 26(6), 1-4.
- [12] Wu, P. C., Liu, S. Y., & Chen, C. Y. (2016). Re-examining risk premiums in the Fama–French model: The role of investor sentiment. *The North American Journal of Economics and Finance*, 36, 154-171.