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Research on the Influence of Covid-19 on U.S. Business Service Industry Based on Fama-French Five Factor Model

Xuecheng Dai[1,*,a,†], Huizhu Jin[2,*,b,†], Yuchen Tian[3,*,c,†], Xiaohan Zhu[4,*,d,†]

[1] *Faculty of Business and Economics, The University of Hong Kong, Hong Kong 999077, China*
[2] *Faculty of Economics, Renmin University of China, Beijing 100872, China*
[3] *School of Finance, Capital University of Economics and Business, Beijing 100070, China*
[4] *Division of Business and Management, Beijing Normal University – Hong Kong Baptist University United International College, Zhuhai 519087, China*
[*] *Corresponding author. Email: [a] u3560297@connect.hku.hk, [b] 2019201964@ruc.edu.cn, [c] tyc20000216@163.com, [d] n830024385@mail.uic.edu.cn*
[†] *These authors contributed equally.*

ABSTRACT
The outbreak of COVID-19 has had a huge impact on the economy of various industries. The volatility of the stock market was exacerbated by the instability of economic activities, which led to the U.S. stock market experiencing four meltdowns in March 2020. Future economic trends are linked to the impact of the epidemic. Therefore, it is reasonable to assess the extent of the impact of the epidemic on the industry. This paper aims to analyze the market changes in the business service industry before and during the epidemic, based on the Fama-French five factor model. Data collected from the Kenneth R. French-Data Library were used to make a multiple linear regression analysis of the business service industry in the US. Data from 2019.3 to 2020.2 have been selected as the data before the epidemic and 2020.3 to 2021.2 as the data during the epidemic. The results indicate that before and during the epidemic, βMKT increased, βSMB was always insignificant. βHML changed from significant to insignificant, and βRMW and βCMA changed from insignificant to significant. After analysis, companies with weak profitability or aggressive investments are worth investing in after the epidemic.

Keywords: *Fama-French Model, Covid-19, Business service, U.S. stock market*

1. INTRODUCTION

Under the spread of the Covid-19 epidemic that propagates rapidly around the world, economy suffered severe costs economically with limiting operations for many industries, especially catering, tourist and business operation. The GDP growth rate of the world dropped from positive in 2019 to negative in 2020 and export and import amount between countries such as China and USA decreased significantly [1]. The disruptions of Covid-19 in United States evoked panic of Americans and capital market and the surplus of oil production due to the disruption to business service industry caused a decrease in the demand of oil. These were contributing factors of the four meltdowns in US stocks in March 2020. On March 9, 2020, the New York stock market opened sharply, hit the 7% limit, and then triggered the circuit breaker mechanism. The circuit breaker mechanism means when the volatility index of US stock market reaches a certain melting point, the stock exchange market will cease stock trading to control the risk. Under this uncertain environment, asset pricing seems to be more vital for analyzing the dramatic changes in US stock market. Asset pricing models can help to explain the relationship between risk and expected returns of assets and help to find the reasons for reactions and performance of different industries in the stock market. The asset pricing models experienced many changes. Capital asset pricing model (single factor model) studies the relationship between expected return and market risk premium for risky assets based on one single factor beta that represents the degree of risk [2]. The higher the degree of risk, the higher the compensation. However, if the predicted direction deviates from the real market, then modifications are made to adjust the explanatory power of the model. For example, Fama-French three-factor and five-factor models use more factors than CAPM model to explain the stock market performance.

Recently, Fama and French propose a five-factor model by adding profitability and investment factors to their three-factor model [3]. French introduced a five-factor model, adding two limitation factors (RMW and CMA) to the three factor model to observe the return premium associated with profitability and investment [4]. Since then, many economists have proved the effectiveness of Fama-French five-factor model and analyzed the risk of the epidemic to the stock market through the five factor model. For example, Cox and Britten tested the effectiveness of the Fama-French five-factor model in interpreting the Johannesburg stock exchange returns [5]. The applicability of the model is tested by two aspects [5]. The first is a model comparison that the five-factor model is compared with the traditional three-factor model and the CAMP model to test which of the models presented best explains the returns of portfolios based on different sorts [5]. The second evaluates the five-factor model based on the cross-section of the returns [5]. It turns out that the five-factor model outperforms in explaining the cross-section of returns on portfolios sorted by various characteristics [5]. Li and Duan compared the efficiency of Fama-French model in explaining the changes in expected excess return of 30 main industries in US stock market before and during the Covid-19 [1]. The ordinary least square estimations conducted using three and five-factor Fama-French models provided evidence that the Pandemic improved the explanatory power of Fama-French model and the five-factor model is more efficient than the three-factor model [1].

In 2020, Covid-19 not only affected the normal life of human beings, but also affected the whole market economy. For example, Lee studied the effects of Covid-19 sentiment on US stock market by industry [6]. The Covid-19 sentiment is examined by daily news sentiment index and google trends big data on related articles. And the significance of the relationship between Covid-19 sentiment and US stock market index is measured by one-side t-test. The study showed Covid-19 sentiment had various impact on different industries, with communication, consumer discretionary, industrial industries having relative high correlations [6]. Mou studied the macroeconomic impact of Covid-19 on GDP, commodity trade and three industries in various countries [2]. Not only Comparing the impact of Covid-19 on global GDP in 2019 with the economic crisis in 2009, but also comparing the changes in the amount of import and export affected by Covid-19 in China, the United States, Japan and South Korea in the first quarter. Research shows that the epidemic has a great negative impact on the macro economy [6]. Based on the research, Mou presents that the global crisis requires a global collaboration in trade, finance and macroeconomic policies [2]. Rujoiu studied the impact of the Covid-19 pandemic on economic in the countries with different monetary policies, which using some available data and the macroeconomic elements analysis to understand the relations and influences between the Covid-19 and the economic [7]. And the study showed that the Covid-19 pandemic illustrated how completely insufficient rivalry between states is to counter the spread and heal the people in an interdependent global economy [7]. He et al take an empirical analysis which conduced different stock markets, conventional t-tests and non-parametric Mann-Whitney tests [8]. On the basis of the evidence from two parallel timelines-domestic timeline and the foreign timeline and daily return data of stock markets [8]. The study shows that getting Covid-19 has negative but short-term impacts on stock markets when the Covid-19 pandemic subsides worldwide [8].

Based on Fama-French five-factor model and CAPM model, this research should compare and analyze the impact of Covid-19 on the business service industry.

The epidemic is maximizing stock market jitters and volatility. Future economic trends are directly related to how much Covid-19's impact expands and affects the U.S. stock market. Therefore, through the analysis of various factors of Covid-19 on the industry, it is a reasonable response to the current situation that the relatively large-impact parts and non-impact parts are judged. The purpose of this paper is that evaluating the impact of Covid-19 on the business service industry to compare and analyze the changes and provide some approaches for the investors based on the Fama-French five-factor model and CAPM model.

2. METHOD

William Sharpe and John Lintner et al studied out the Capital Asset Pricing Model (CAPM), and the model shows the relationship between the expected return rate of assets and risky assets of the securities market [9,10]. But in 1993, Fama and French found that the above excess returns were the compensation for the risk factors that were not reflected in the CAPM's β in the study of the differences of different rate of return of the stock in American stock market [11]. It validated that it can build up a three-factor model to explain the rate of return of the stock. The model said the investment portfolio’s excess returns can be explained by these three factors--Rm-Rf, SMB, HML.

$$R_i - R_f = \beta_{MKT}(R_m - R_f) + \beta_{SMB}SMB + \beta_{HML}HML \quad (1)$$

Rf is time’s risk-free rate of return. Rm is time’s market return. Ri is the i for time’s rate of return. Rm – Rf is the market risk premium.

Then in 2013, Fama and French found that the three-factor model could not explain all the excess rate of return. Thus, they suggest another model with five factors [4]:

$$R_i - R_f = \beta_{MKT}(R_m - R_f) + \beta_{SMB}SMB + \beta_{HML}HML + \beta_{RMW}RMW + \beta_{CMA}CMA \quad (2)$$

Rm is the market risk, which is caused by the uncertain changes in market trend. SMB is the market value risk, and it depend on the company's size. HML is the book-to-market value, which is the book equity divided by the market value. RMA is the factor about profitability and the CMA is the factor with investment.

3. RESULTS

The data were adopted from the Kenneth R. French-Data Library, this study selected data from the Fama-French 5 Factors [Daily] and business service of 49 Industry Portfolios. For the period during the epidemic, it chose the data from 2020.3 to 2021.2. Also, for comparison, data from 2019.3 to 2020.2 have been selected as the data before the epidemic. Besides, multiple linear regression was applied to obtain the coefficients of five factors in the Fama-French model at the 95% confidence level.

Table 1. Descriptive statistics of FF-5 model of business service industry before the epidemic (2019.3-2020.2)

	Coefficient	Std	t Stat	P-value
Mkt	1.03	0.03	34.89	0.00
SMB	-0.03	0.05	-0.52	0.60
HML	-0.33	0.05	-6.19	0.00
RMW	-0.02	0.08	-0.28	0.78
CMA	-0.18	0.11	-1.72	0.09

Table 2. Descriptive statistics of FF-5 model of business service industry during the epidemic (2020.3-2021.2)

	Coefficient	Std	t Stat	P-value
Mkt	1.12	0.02	53.51	0.00
SMB	0.04	0.05	0.72	0.47
HML	0.07	0.04	1.66	0.10
RMW	-0.16	0.08	-1.98	0.05
CMA	-0.51	0.09	-5.46	0.00

As shown in Table 1, it is clear that the t-values for SMB, RMW, and CMA are -0.52, -0.28, and -1.72 respectively, which means that they are not significant in the model for the business service industry. These factors can be ignored in the explain of returns. Besides, the absolute value of the t-value for HML is greater than the threshold, so it is significant at the 95% confidence interval. For Table 2, the absolute values of t-values for SMB, HML during the epidemic are less than the threshold, so they are insignificant. While the t-values for RMW and CMA were -1.98 and -5.46 respectively, which indicates that they were significant in the model. Before and during the epidemic, βMKT was always greater than 1, βSMB was always insignificant. βHML changed from significant to insignificant, and βRMW and βCMA changed from insignificant to significant. βHML, βRMW, and βCMA were all negative when they were significant.

4. DISCUSSION

4.1. Mkt

The epidemic situation has a direct impact on the stock market. Before the outbreak, the coefficient of MKT was 1.03 > 1. It shows that business service industry is sensitive to market economy. During the outbreak period, the coefficient of MKT increased to 1.12, which was more sensitive to the market than that before the outbreak. The epidemic has a direct impact on people's business activities, which has a huge economic impact on business service. Affected by the novel coronavirus pneumonia, the global multi-national economic activities are in a state of near depression. According to the latest data of PMI, the purchasing manager index reflecting private activities, also set a record low in many countries. As for the data released by IHS Markit on the 24th, U.S. business activity shrank in March, the largest contraction since the end of the recession. The purchasing managers' index (PMI) of the service industry fell to 39.1 in March from 49.4 in February, far lower than the expected 42.0. As most consumers stay at home, retailers, hotels, restaurants and other consumer service enterprises that rely on customer flow are forced to close down or shorten business hours. The logistics industry, including airlines, has almost stopped operation, and the service industry, as a pillar industry of the U.S. economy, has suffered a heavy blow [12].

4.2. SMB

The SMBs of the business service industry are both insignificant before and during the pandemic. It means market value is not a vital factor in distinguishing the returns of companies. Although several large companies occupy a large part of the profits of the market, investing in some stocks with small market values may obtain high returns with high risks. During the Covid-19, although large cap stocks may have smaller volatility in stock returns than small cap stocks, the small companies have higher ability to turnover. The whole industry took a beating and it is hard to differentiate returns of companies based on the market value.

4.3. HML

The HML of the business service industry is significant before the epidemic but insignificant during the epidemic. The coefficients of HML before the epidemic is negative, meaning the stocks with low book-to-market ratio perform better than high book-to-market ratio. In other words, growth stocks have higher returns than value stocks. However, it turns to be insignificant during the epidemic. When the economic condition is good and investors may be more optimistic and willing to bear more risks, so the growth stock will have higher return than value stock. However, this distinction between growth stocks and value stocks is not significant during the epidemic. This is because that the returns of value and growth stocks both dropped significantly to a low rate during the Covid-19, these companies are hard to differentiate. The spread of the pandemic caused dramatical reductions in the service volume for the whole industry and many business service companies ceased their services. As for trade fields, it will be negatively impacted, owing to the shutdown of factories, reduced access to raw materials and commodities due to supply chain challenges. Also, trillions worth of trade for both imports and exports will be lost due to the lockdowns, seaports and border closure [13]. For example, WarnerMedia announced it plans to cut thousands of jobs in order to reduce costs by 20%. The company's first round of cuts in August were expected to impact 600 employees, mostly at Warner Brothers and DC Comics. Those cuts included top executives [14]. Therefore, the whole business service industry experienced large damage of Covid-19 in their returns regardless of the book-to-market value of the company and the HML factor becomes insignificant in the model during the pandemic.

4.4. RMW

The RMW of the business service industry is significant during the epidemic, but it is insignificant before the epidemic. Besides, the coefficient of the RMW is negative during the epidemic. That means, the profitability of the stock of the company with the worse profitability is better than the profitability of the stock of the company with the stable profitability. Thus, the reason why investors would like to invest those company’s stocks is that people have speculation on the stock. The speculation is that people sometimes would like to invest several companies with the low rate of return, because in some specific circumstances which will bring a positive improvement to the stocks, the stocks of these companies may increase to a very high level than before, and then it will make the investors get more income from the stocks. People want to grasp the opportunity even it may not have good probability. For example, the business service is one of the most important operations in society, but during the Covid-19, most of the vehicles have stopped working, which caused the stock become worse than before. The investors prefer to buy the stocks because after the epidemic people will have more outdoor activities and then the business service industry in the world will have an explosive growth in the rate of return. For instant, United Rentals had a very low yield rate but its stock yield has a positive increasing, since when the epidemic of the Covid-19 is under controlled, the tourists will travel around the world, and this condition will create an explosive boom on business service. Therefore, the stock of United Rentals will attract more and more investors. And the situation of the business service industry is similar to United Rentals.

4.5. CMA

The coefficient of CMA was insignificant before the epidemic and became significant during the epidemic. A negative coefficient on the CMA during the epidemic means that stocks of aggressively invested companies provide higher returns than stocks of conservatively invested companies. Companies that are aggressively investing undertake large-scale investment activities through their own funds and external financing to expand their main business or diversify their business. Most of companies that make aggressive investments indicate that they have sufficient cash flow or have a good reputation to get loans from the market. Aggressive investment is also an opportunity for the company to consolidate its market position and enhance its competitive strength, then it will have a better market value in the future and show good prospects. The epidemic has had a huge impact on the economy of the business service industry, and the instability of economic activities have led investors favor well-funded companies. During the epidemic, Herc Rentals Inc., announced that it has acquired substantially all the assets of Houston-based Champion Rentals Inc. Terms were not disclosed. Champion is a full-service general equipment rental company comprising approximately 100 employees and four locations serving contractors and industrial, manufacturing and government customers in the Houston metropolitan area. The company was founded, owned and led by James Horsley. The addition of Champion expands Herc Rentals’ Houston-area presence to 12 physical locations, which collectively provide general and specialty equipment rental solutions and related services. The acquisition can further expand the company's market size and consolidate its market position, and get a relatively cheaper price under the epidemic conditions [15]. Therefore, every crisis is not only a challenge but also an opportunity for the company.

5. CONCLUSION

This paper uses the Fama-French five-factor model and CAPM model to study the response of business service industry to the epidemic and the impact of the epidemic on the U.S. stock market. It shows that the coefficient of RMW, CMA are significant during the epidemic but insignificant before the epidemic. On the contrary, the coefficient of HML is significant before the epidemic but indicative during the epidemic. SMB has always been insensitive to the epidemic. According to the research, it is suggested that investors invest business service industry which adopt aggressive corporate policies and decisions and have large-scale of investment. The reasonable investing could bring high returns for the industry of business service. Also, this crisis can be considered as an opportunity to find some investment opportunity, and it is expected that there will be a good prospect for future development. In addition, it is also a good way to correctly grasp human speculative psychology and choose companies with low profitability.

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