

Analysis of Meal Industry in U.S. Stock Market during COVID-19 Based on Fama-French Five-Factor Model

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ABSTRACT

The outbreak of COVID-19 seriously affected the economic development of the whole world, especially the United States, which is the world's largest economy. All sectors in the U.S. have been negatively affected by COVID-19 to a greater or lesser extent, but there are also many opportunities in such a turbulent economic context. This paper focuses on the stock market in the U.S. meals industry and examines the specific impact of COVID-19 on U.S. meals stocks. Data relating to the U.S. meals industry from Kenneth R. French's database was used for the analysis. Two time periods before and after the outbreak of COVID-19 were chosen to estimate the relevant coefficient through multiple linear regression analysis. Finally, the Fama-French Five-Factor Model was introduced to explain specifically the coefficients and significance changes of each factor. By comparing data before and after the COVID-19 outbreak, this paper finds that the U.S. meals industry was not sensitive to market volatility, with a small increase in the coefficient after the COVID-19 (almost equal to one). In contrast, the more significant phenomenon after the COVID-19 outbreak was that the SMB, HML, and RMW in the U.S. meals industry all had a significantly deeper degree of an impact than before COVID-19 and were strongly correlated with yields. In addition to this, there was a strong negative correlation between the CMA and the rate of return. In conclusion, after the outbreak, the key indicators for investors to invest in the U.S. meals stocks were growing small and medium-sized enterprises (SMEs), high book-to-market (B/M) ratios, strong cash flow and profitability, and companies with a more aggressive investment style.

Keywords: COVID-19, Meal Industry, U.S. Stock Market, Fama-French Five-Factor Model

1. INTRODUCTION

In 2020, the outbreak of COVID-19 dealt an almost unrecoverable blow to economies across the globe. Almost all industries were negatively affected by the devastating effects of COVID-19, especially tourism, airlines, restaurants, and other such service industries. First of all, the United States, as the world's largest economy, suffered from the unprecedented impact of the COVID-19 epidemic and is one of the countries with the most severe epidemic in the world. Secondly, The huge negative impact of COVID-19 has led to severe volatility in global financial markets and is also hitting market sentiment hard, especially in the U.S. For example, in just ten days between 9 and 18 March 2020, the U.S. stock market saw an unprecedented four meltdowns and continued to break new highs for the largest single-day drop in the Dow. Thirdly, the U.S. meals industry is arguably one of the few industries

most affected by COVID-19. The most significant way in which it has been affected is through the U.S. government's "stay-at-home order" for the prevention and control of COVID-19, which means that eating out and gathering together are prohibited and restaurant hours are significantly reduced. To be specific, COVID-19 has not only caused the forced closure of many small and medium-sized restaurants in the U.S. but has also caused a significant decline in performance for many large catering companies. For example, McDonald's 2020 second-quarter net profit was US\$484 million, down 68.11% from last year. In terms of shop closures, McDonald's has closed around 200 U.S. restaurants in 2020, accelerating its plans to close shops in the coming years. At the same time, the dramatic increase in unemployment in the U.S. meals industry is already a given, with millions of jobs facing redundancy due to the huge impact of COVID-19. In short, COVID-19 was a devastating and unrecoverable blow to the U.S. meals

industry, so that it even changed the original business model and business landscape of the U.S. meals industry.

CAPM model is a very popular model that mainly analyzes the relationship between the rate of return and risky assets, and it has been widely used to analyze the stock markets. However, the CAPM model assumes that the rate of return of stock or asset only relates with the systematic risk in the stock market, ignoring other factors, for example, Book-to-Market effect (B.M. effect), Earning-to-Price effect (E/P effect), etc., which has been proved by Banz [1]. As a result, Fama and French put forward a three-factor model (Rm-Rf, SMB, HML) [2] to better analyze stock markets. Furthermore, Fama and French put forward a new model, adding RMW and CMA into the three-factor model to build a five-factor model [3]. Both the Fama-French Three-Factor model and Fama-French Five-Factor model are widely applied by researchers.

Ramos researched the differences between the Capital Asset Pricing Model (CAPM) model and the Fama-French Three-Factor model for explaining the excess returns of an exchange-traded fund (ETF) in the U.S. banking industry. The result is that the addition of size factor (SML) and book-to-market factor (HML) into the original CAPM model can more accurately explain the excess return of the portfolio invested in the U.S. banking industry [4]. Nguyen investigated the explanatory power of the Fama-French Five-Factor model for the stock returns of the Vietnamese stock market from 2011 to 2015 and whether the investment patterns factor (CMA) and the profitability factor (RMW) are related to stock returns. Among several different Capital Asset Pricing models, the Fama-French five-factor model has the strongest explanation for Vietnamese stock returns, with an R-square value of 34%. However, the two additional variables CMA and RMW, are not significant for explaining the return of Vietnamese stocks [5]. Emon and Chowdhury investigated the impact of COVID-19 on the U.S. stock market by Event Study Method (ESM) models, Generalized Autoregressive Conditional heteroskedasticity (GARCH), and Vector Autoregressive (VAR). The U.S. stock market has been negatively affected by the number of confirmed COVID-19 cases and deaths, with the entire stock market experiencing extreme volatility. The main reason for the volatility is likely to be the uncertainty about COVID-19 and related economic losses [6].

Thorbecke divided U.S. stocks in different industries into two parts: the impact of specific factors and the impact of macroeconomic factors to study the impact of COVID-19 on different industries. Airlines, aerospace, real estate, tourism, retail, and clothing were found to have been harmed by specific factors, while industries such as production equipment, machinery, and

electronic and electrical equipment were found to have been harmed by macroeconomic factors caused by COVID-19 [7]. Based on the Fama-French Five-Factor model, Hou and Chen compared the steel industry in the U.S. stock market before and after the COVID-19 outbreak with different market changes. They found that COVID-19 had a dramatic impact on steelwork in the United States, and the entire industry experienced a significant decline, which made steel stocks insensitive to the market and the profitability factor (RMW) insensitive [8].

Chiah et al. applied the Five-Factor model to analyze the Australian equities market and found that the five-factor model could better explain abnormal asset pricing compared to other asset pricing models, which supported the claim that the five-factor model was superior. Moreover, they found that despite the results shown by Fama and French, the B.M. factor retained its explanatory power when considering the RMW and CMA factors [9]. Petkova et al. studied Fama-French Factors and found that HML and SMB were highly correlated with variables innovations that described CMW. Besides, they found that when innovations' loading in the predictive variables were in the model, HML's and SMB's loadings could not explain the cross-section of returns. Their results are consistent with an ICAPM explanation for the empirical success of the Fama-French portfolios [10].

Cakici examined 23 developed stock markets by applying the Five-Factor model. By collecting data from July 1992 to December 2014, she formed the 25 sizes for B.M., gross profitability, and investment portfolios. She also used regional and global factors to explain the returns on these portfolios by applying Three-Factor, Four-Factor as well as Five-Factor models. Moreover, she found that the results for the five-factor model in Global markets were similar to the results for the U.S. stock market. However, results for gross profitability as well as investment indicated that these two factors (gross profitability and investment) could not be well explained for Japan and the Asia Pacific portfolios. The results also suggested that regional models outperformed the global models [11]. Susanti et al. used the CAPM method, classified and evaluated L.Q. Forty-five index companies by the magnitude that the company was undervalued and overvalued. The results showed that there was an inversely proportional relationship by comparing the beta value with the expected return, 20 out of 45 were undervalued companies, and 25 out of 45 were overvalued companies [12]. Yu Sifan, based on the Three-Factor model used monthly data from February 2014 to December 2018, found that the investor's sentiment was one of the elements of systemic risk. The Three-Factor model with investors' sentiment could better explain the stocks' rate of return in the U.S. stock market. By comparing the trend of investor's sentiment and market

index, investor's sentiment would affect asset pricing and market volatility, i.e., verified the effectiveness of investor sentiment index in the U.S. stock market [13].

It is well known that the Fama-French Five-Factor Model is highly explanatory and credible for the stock at present. The purpose of this paper is to examine the impact of COVID-19 on the U.S. meals industry through the Fama-French Five-Factor Model. Moreover, multiple linear regression is used to analyze the data related to the U.S. meals industry before and after the COVID-19, and the different coefficients and significance of each of the five factors before and after the COVID-19 are obtained. The five factors are then analyzed objectively according to their different nature and significance, as well as the characteristics of the U.S. meals industry. Finally, it is hoped that this paper will provide investors with meaningful investment reference suggestions.

2. METHOD

To specifically investigate the impact of COVID-19 on the Meals industry in the U.S. stock market, this paper conducts a specific analysis based on the Fama-French Five-Factor Model.

In Fama-French Five-Factor Model [14]:

$$R_i - R_f = a_i + b_i(R_m - R_f) + s_iSMB + h_iHML + r_iRMW + c_iCMA + e_i \quad (1)$$

In the model, R_i is the return rate of security or portfolio I ; R_f refers to the risk-free return; R_m is the return on the value-weight market security or portfolio; SMB (Small Minus Big) is the return rate based on the size factor of the security or portfolio, which refers to the return on the small-cap stocks in the portfolio minus the return on the large-cap stocks in the portfolio; HML (High Minus Low) is the difference based on the book-to-value(B/M) factor of high and low B/M stocks; RMW (Robust Minus Weak) is the difference based on the profitability factor of stocks with robust and weak profitability; CMA (Conservative minus Aggressive) is the difference between the returns on diversified portfolios of low and high investment stocks, as measured by the firm's reinvestment ratio which called conservative and aggressive investment styles; e_i Is the zero-mean residual.

In addition, b_i, s_i, h_i, r_i, c_i Respectively represent the sensitivity of different impact factors to the excess return of stocks. If the sensitivities to the five factors (b_i, s_i, h_i, r_i, c_i) capture all variation in expected returns, the intercept a_i zero for all stocks or portfolios i .

With the Fama-French Five-Factor Model, this paper analyzes and compares the significant changes and sensitivity changes of five factors in the Meals industry of the U.S. stock before (2019.5-2020.2) and after (2020.3-2020.12) the COVID-19.

3. RESULTS

Based on the model, this study collects data in the meals industry from Dartmouth College's Kenneth R. French database. The periods of the data are from May 2019 to February 2020, and from March 2020 to December 2021, the former represents the normal time while the latter represents the pandemic COVID-19 period. By running multiple regressions, the results are as follows.

Table 1. Results of meal industry before covid-19 (2019.05-2020.02)

Item	Coefficients	Standard Error	T Stat	P-Value
Intercept	-0.008	0.038	-0.201	0.841
MKT-RF	0.777	0.045	17.298	0.000
SMB	0.364	0.084	4.336	0.000
HML	0.122	0.086	1.415	0.159
RMW	0.265	0.142	1.867	0.063
CMA	0.046	0.167	0.276	0.782

Table 2. Results of meal industry during covid-19 (2020.02-2020.12)

Item	Coefficients	Standard Error	T Stat	P-Value
Intercept	0.065	0.120	0.546	0.586
MKT-RF	0.969	0.056	17.249	0.000
SMB	1.090	0.139	7.833	0.000
HML	0.468	0.116	4.040	0.000
RMW	0.833	0.238	3.494	0.001
CMA	-1.714	0.307	-5.580	0.000

Table I demonstrates that the regression results before the outbreak of COVID-19, Table II illustrates that the results during COVID-19. The results show that before the outbreak of COVID-19, only MKT-RF and SMB in the model were significant and positively correlated with the $R_i - R_f$. However, after the outbreak of COVID-19, all of the five factors in the model are significant. Besides, the coefficients of MKT-RF, SMB, HML, and RMW become bigger after the COVID-19. Moreover, the coefficient of CMA changes from positive to negative after the pandemic.

4. DISCUSSION

4.1. MKT

As shown in Table 1&2, it can be found that both the coefficient of the U.S meals industry before the outbreak of COVID-19 (0.777) and after the outbreak of COVID-19 (0.969) was less than 1. Hence, it can be

concluded that the U.S meals industry was relatively less sensitive to the economic fluctuations of the entire market before and after the epidemic of COVID-19. However, the coefficient of the U.S meals industry after the outbreak of COVID-19 (0.969) is significantly higher than the data before the COVID-19, which means that the excess returns on U.S meals stocks became more relevant to the market.

The COVID-19 has dealt a huge blow to the entire U.S meals market. According to the National Restaurant Association (NRA), about 110,000 restaurants had closed by the end of 2020, and about 17 percent of them had closed permanently. In such drastic market volatility, the sensitivity of the U.S meals industry stocks to the market has increased (almost equal to 1), which means that the volatility of U.S. meals industry stocks is almost in line with the volatility of the market.

4.2. SMB

SMB data was significant before and after the outbreak of COVID-19, and the coefficients were both greater than 0. It refers to that the rate of return on investment in small and medium-sized enterprises is better than the rate of return on investment in large enterprises. What is more, after the COVID-19, the coefficient jumped from 0.364 to 1.090, which means that investors prefer to invest in growing small and medium-sized meal companies because they have a higher rate of return on investment than large companies.

The reason for this phenomenon might be that there are still many high-quality business opportunities in the severe challenges of COVID-19, especially the delivery business in the U.S meals industry. The U.S meals industry has seen a surge in demand for the meal delivery business due to the U.S government's strict home-staying rules. According to statistics, by June 2020, the total size of the U.S. meal delivery market has directly doubled compared to 2019, which was expected to exceed \$26.5 billion by the end of 2020. In addition, the number of users of meals delivery in the U.S will reach 100 million, making it the second-largest meal delivery country after China. Therefore, many small companies focusing on meals delivery business have achieved better development in this context, which is a higher rate of return on investment for investors. For example, DoorDash accounted for 45% of the U.S. meals delivery market in June 2020, outperforming other meal companies in the same period and reaching a total valuation of \$16 billion.

4.3. HML

HML is the valuation factor, which represents that the difference of rate of return between relatively high book-to-market ratio (B.M. ratio) stock portfolios and

relatively low book-to-market ratio (B.M. ratio) stock portfolios. Also, it presents that the magnitude that the investor prefers value stock over a growth stock.

Before the outbreak of COVID-19, according to Table I, the P-Value of HML is 0.159, which shows that the relationship between investors' preferences of value stock and growth stock and rate of return does not exist. However, during the outbreak of COVID-19, according to Table II, the P-Value of HML is 0.000, and the Coefficient is 0.468, showing that there is a strong positive relationship between the rate of return and HML, companies with a high B.M. ratio have a higher rate of return on average. This might be explained by the severe damage brought by the COVID-19 outbreak. According to the National Restaurant Association, the industry ended 2020 with total sales of around \$659 billion, far smaller than 2019's \$863 billion in sales. Normally, a stock with a low B.M. ratio might have some operating or financial problems when the pandemic struck the meal industry, and those companies would be wiped out by firms with larger financial risks, only those firms with stronger operating capability and large B.M. ratio would survive. This would result in a higher rate of return of stocks with a higher B.M. ratio.

4.4. RMW

RMW is the profitability factor, which represents that the difference in the rate of return between high profitability stock portfolio and a low profitability stock portfolio.

Before the outbreak of COVID-19, according to Table II, the P-Value of RMW is 0.063, which shows that within 95% confidence interval, the relationship between investor's preferences of high profitability and low profitability stock and rate of return does not exist. However, during the outbreak of COVID-19, according to Table II, the P-Value of RMW is 0.001, and the Coefficient is 0.833, showing that there is a strong positive relationship between the rate of return and RMW, companies with high profitability have a higher rate of return on average. This could also be explained by the negative impacts brought by the pandemic. As the COVID-19 brought huge negative impacts in the meal industry, only companies with high and stable profit could survive and even operates well against the COVID-19, and those companies could earn higher profits. As those companies have higher cash flow, they might be able to merge and also acquire other companies to expand the market share, and eventually, they would have a higher rate of return. Therefore, based on that, the RMW is positively correlated with the rate of return.

4.5. CMA

CMA refers to the Investment Style factor, which represents that the difference in the rate of return between conservative stock portfolio and radical stock portfolio.

Before the outbreak of COVID-19, according to Table II, the P-Value of CMA is 0.782, which shows that the relationship between investors' preferences of conservative stock portfolio and radical stock portfolio and rate of return does not exist. However, during an outbreak of COVID-19, according to Table II, the P-Value of CMA is 0.000, and the Coefficient is -1.714, showing that there is a strong negative relationship between the rate of return and CMA, the radical stock portfolio has a higher rate of return on average. That might be partly because as the pandemic severely hit the meal India story, the stocks prices industry has relatively lower prices than usual. Radical companies might seize the chance to take some radical actions, for example, merge and acquire other companies, as mentioned previously, to achieve higher profits. Therefore, those radical companies' stocks would have a higher rate of return.

5. CONCLUSIONS

This paper uses the Fama-French Five-Factor model to investigate the impact of COVID-19 on the U.S meals industry and verifies the important role of capital asset pricing in specific case studies. This paper finds that the U.S meals industry is not sensitive to market fluctuations because its market factor (MKT) coefficient is smaller than one both before and after the COVID-19, but with a small increase. After the outbreak of the COVID-19, SMB, HML, and RMW in the U.S meals industry market have a significantly greater effect and a strong correlation with the rate of return than before the COVID-19. This means that the main indicators for investors to invest in meals stocks during the COVID-19 are growing small and medium-sized enterprises, high book-to-value (B/M) ratios, and strong cash flow to profitability. In addition, in terms of CMA, there is a strong negative correlation between CMA and return during the COVID-19, which means that companies with more aggressive investment styles, such as corporate mergers and acquisitions, tend to achieve higher profits.

REFERENCES

- [1] Banz, R. W. (1981). The relationship between return and market value of common stocks. *Journal of financial economics*, 9(1), 3-18.

- [2] Eugene, F., & French, K. (1992). The cross-section of expected stock returns. *Journal of Finance*, 47(2), 427-465.
- [3] Fama, E. F., & French, K. R. (2015). A five-factor asset pricing model. *Journal of financial economics*, 116(1), 1-22.
- [4] Ramos, J. (2020). CAPM OR FF MODEL? AN EMPIRICAL ANALYSIS IN THE US BANKING INDUSTRY.
- [5] Nguyen, N.P. (2015). THE FAMA-FRENCH FIVE FACTOR MODEL: EVIDENCE FROM VIETNAM.STOCK MARKET
- [6] Emon, Kalyan & Chowdhury, Emon & Abedin, Mohammad. (2020). COVID-19 Effects on the US Stock Index Returns: An Event Study Approach.
- [7] Willem Thorbecke (2020). "The Impact of the COVID-19 Pandemic on the U.S. Economy: Evidence from the Stock Market," Discussion papers 20068, Research Institute of Economy, Trade, and Industry (RIETI)
- [8] Hou, D & Chen, Z (2021). Research on the application of Fama-French 5-factor model in the steel industry during COVID-19.
- [9] Chiah, M., Chai, D., Zhong, A., & Li, S. (2016). A Better Model? An empirical investigation of the Fama-French five-factor model in Australia. *International Review of Finance*, 16(4), 595-638.
- [10] Petkova, R. (2006). Do the Fama-French factors proxy for innovations in predictive variables?. *The Journal of Finance*, 61(2), 581-612.
- [11] Cakici, N. (2015). The five-factor Fama-French model: International evidence. Available at SSRN 2601662.
- [12] Susanti, E., Grace, E., & Ervina, N. (2020). The Investing Decisions during the COVID-19 Pandemic by Using the Capital Asset Pricing Model (CAPM) Method in L.Q. 45 Index Companies. *International Journal of Science, Technology & Management*, 1(4), 409-420.
- [13] Yu, S. (2021). The impact of investor sentiment for the U.S. stock market based on Fama-French 3-factor model. In *E3S Web of Conferences* (Vol. 275, p. 01055). EDP Sciences.
- [14] Fama, E. F., & French, K. R. (2015). A five-factor asset pricing model. *Journal of financial economics*, 116(1), 1-22.