

The Application of the Fama-French Five Factors Model on the U.S Meals Industry During COVID-19

Xinhe Du^{1, a, *, †}, Yuhan Zhao^{2, b, *, †}

¹Dulwich International High School Zhuhai Zhuhai, China

²Dulwich International High School Suzhou Suzhou, China

*Corresponding author: ^a22dud1@dulwich-zhuhai.cn ^bHeidi.Zhao23@dchigh-suzhou.cn

[†]These authors contribute equally.

Abstract. The COVID-19 pandemic has posed unexpected threats to the world, and the healthcare system was overwhelmed and imposing enormous problems for the governments. People's living environment, consuming behaviors, and investment decisions are primarily affected and changed under the new environment. The dramatic fluctuations in the stock markets reflect the investors' pessimistic sentiment towards the future. This paper presents an approach to give an overview of the changes in the Meals Industry by using the Fama-French Five Factors Model. The results obtained from the research reveal three significant changes in the determinants of investment decisions for the meals-related industry, which are HML, RMW, and CMA. The preliminary results will help investors identify the change in market preferences and help the firms to recognize the proper adjustment during the epidemic period.

Keywords: Fama-French Model; COVID-19; Meals Industry; U.S stock market

1. Introduction

Measures for evaluating the intrinsic value of an asset are essential for professional investors and investment institutions. For example, investors need to estimate the actual value of a security or a purchase so they can determine the right price to buy and sell, ensuring the investment is profitable. Asset pricing also plays a vital role in most people's routine life. For instance, a person can choose different forms of savings such as cash and bank deposits, fixed assets such as houses and cars, or financial assets such as securities. However, different assets have unique characteristics and functions but can all be associated with expected return and risk. Therefore, they have to judge whether the price is reasonable based on these two elements and other needs when making a purchasing decision.

In addition, asset pricing is a keystone of economic development as consumption and investment compose most Gross Domestic Product (G.D.P). Trade happens because of different beliefs on intrinsic value and various methods used to predict the intrinsic values. A more advanced pricing model will reduce the risk of financial volatility as fewer inaccurate predictions and speculations are made. Moreover, the mispricing of assets could lead to a severe financial crisis where the entity economy does not match the virtual economy. From the tulip mania in the 17th century to the subprime mortgage crisis in 2008, people have suffered from the economy's recession, and the true culprit behind this is greed and malfunctioning of the asset pricing model used. All of these fundamental roles of asset prices testify to the importance of its pricing model.

In 2020, the global economy was struck by the outbreak of the COVID-19 pandemic. When the COVID-19 first discovered in China, it was commonly recognized as flu. However, it did not become a worldwide concern until it was defined as a pandemic by World Health Organization (WHO). Then the number of confirmed cases continuously and exponentially rising as the virus quickly spread to different countries through various channels, such as trade, tourism, and other social activities. To control the spread of COVID-19, the governments in different nations implement policies such as mandatory quarantine and lockdown of the cities. Hundreds of millions of people have to stay at home, and many businesses face the challenge of online transition, from off-line works to telecommuting. Almost every country experienced a tremendous fall in the economy, and the spillover effects reinforced the negative impacts. The unemployment rate has surged as enterprises

have to shut down their dispensable factories. Significant changes occurred in both living habits and investment decisions.

Since the outbreak of COVID-19 ignited the scare, people started to panic. Countless people were desperately selling their financial assets. While some of the prices of necessities increased significantly due to market supply and demand disequilibrium, the prices of most securities in the secondary market plummeted. The U.S. stock market's circuit breaker mechanism has been triggered four times, indicating a solid will to short and departure from the market.

Donnell et al. examine the impact on equity markets in five regional epicenters (Spain, Italy, China, the United Kingdom, and the United States) in the pandemic as the confirmed cases continuously accumulated. They stated that the overall effect brought by the virus on major market indices is negatively related to the total cases, especially for indices in Spain, Italy, the U.K., and the U.S.A. However, they suggested that the Chinese SSE 180 index fluctuations were not mainly resulted from the COVID-19, instead, explained by trading volumes, Brent crude oil price, implied market volatility, and the T.E.D. spread [1].

Xianglan Fu et al. focused on the role of Chinese culture and institutions in its post-pandemic recovery. They admitted that negative impacts on China's economy are significant; however, they will only exist for a short time. A V-shaped recovery of China's G.D.P. and Foreign Direct Investment (FDI) has been witnessed, attributing to the swift and effective responses by the regional and national governments. Although the Chinese economic outlook in the next decade is optimistic, the progress in other nations' economic recovery remains uncertain as China's experiences may not be replicated due to differences in culture and institutions [2]. Adrian et al. provide a different perspective to look at the influence of COVID-19 on different nations. They pointed out that cultural difference is a crucial factor determining people's reactions to this challenging economic situation. "They conclude that countries with low individualistic behavior and high uncertainty avoidance tendencies react more negatively and with greater volatility than countries with high individualism and low uncertainty avoidance" [3].

Rujoiu emphasizes the effectiveness of different monetary policies and their social and geopolitical influences globally and in Europe. Rujoiu applied many concepts in different economic schools to the current situation. Her project studied and analyzed how the COVID-19 crisis-affected countries exhibited macroeconomic mismanagement before and during the crisis by establishing explanatory models of external manifestations and possible scenarios. The result shows that low-income countries have to leave to fend for themselves, and it becomes even more dramatic, and the chaotic situations which should follow will make it more difficult to control the pandemic [4].

Chen and Yeh investigated the performance of stock prices under the 2008 financial crisis and COVID-19 and the effectiveness of quantitative easing implemented by the governments. They point out that both of these events negatively influence most industries. However, the implementation of quantitative easing effectively relieves the investors and boosting their confidence. Additionally, they find out the industries that experienced more adverse effects from the COVID-19 pandemic will significantly rebound in the stock prices once the Fed announced a Q.E. plan on March 15, 2020, and Congress passed the CARES Act quickly on March 27, 2020 [5].

In terms of the Fama-French model's examination, Trimech et al.'s research combined the Fama-French three-factor model with wavelet analysis to analyze the effectiveness of a multiscale pricing model for the French stock market. They examined the relationship between stock returns and Fama-French risk factors at different time scales. The results they obtained show a positive correlation between the explanatory power of the Fama-French three-factor model and the wavelet scale. Additionally, the relationship between the portfolio returns and the risk factors depends significantly upon the considered time horizon [6]. Dominic Horvath et al. evaluate Fama-French models' performance on U.S. stock markets during the selected events by studying the R² of the models. They find that the impact of the dot-com bubble on the R² of the growth model is statistically significant. The R² of growth portfolios decreases rapidly during the financial crisis of 2008. The latest COVID-

19 outbreak drop has led to a substance in the R2 during this event. In addition, they find that all of the beta model parameters are insignificant in the G.M.M. model [7].

Last but not least, Stephen Byrne et al. investigated the impact of COVID-19 on consumer spending. The combination of demand and supply pressures due to the virus has resulted in recessions in consumer spending. They used a high-frequency measure of spending from the Central Bank to establish several stylized facts about consumption developments in Ireland during the pandemic. They found that between March and October, consumption declined by 6.8 percent compared with 2019 levels. In addition, approximately half of the savings accumulated during the second quarter of 2020 were precautionary, while the other half were forced savings. Those who can consume are those with relatively low marginal propensities to consume. That means the boost to consumption might be lower than would be the case if the shock had been equally distributed across households when the pandemic is over [8].

However, little attention has been focused on the usefulness of the explanatory function of the five factors applied in Fama and French's model on the changes of a specific industry in the U.S. stock market during the COVID-19 period. Therefore, this paper's main objective is going to analyze how the consumers' and investors' behaviors have changed after the pandemic started and how different industries are affected by using the Fama-French five factors model. The results calculated imply the changes in investor's preferences and investment decisions during the pandemic window.

2. Methods

2.1 Capital Asset Pricing Model

The fundamental concept of the Capital Asset Pricing Model (CAPM) was first conceived and developed by William F. Sharpe, the winner of the Economics Nobel Prize in 1990, built on the theory “one-factor model” originated by Harry Markowitz [9]. His work was later complemented and improved by other great economists which could demonstrate the relationship between the expected return for an asset or a portfolio and the risk in the market, including idiosyncratic risk and systematic risk [10].

$$R_a = R_f + \beta_a * (R_m - R_f) \quad (1)$$

The Capital Asset Pricing Model provides an expression of R_a (expected return on security) related to the risk-free rate (R_f), expected return of the market (R_m), and the beta of the security (β_a).

According to CAPM, idiosyncratic risks can be reduced through portfolio diversification. Nonetheless, the systematic risks are inevitable and cannot be diversified. For instance, a large number of stocks often falling when the market falls sharply. Therefore, the systematic risks measured by β_a need high returns as compensation which is the equity market premium ($R_m - R_f$). In short, CAPM divides the total risks described by the mean-variance model into systematic risks and non-systematic risks in a fine manner. However, the CAPM as a predecessor was built on many unrealistic assumptions, and it is incapable of explaining many abnormal cases [11].

2.2 Fama-French Three Factors Model

Researchers have found that the CAMP model has its limitations in empirical tests. In 1992, Eugene F. Fama and Kenneth R. French came up with a new formula for CAPM as they suggested the expected return would be influenced by other factors rather than a simple coefficient, beta. They take two more factors into considerations: the size of market capitalization (SMB) and the book-to-market ratio (MHL). This innovative idea came from the observations as they found out that the companies with higher high book-to-market ratios and a smaller market capitalization will usually outperform the companies with the contrasting features. Therefore, they concluded that value stocks

represented by high book-to-market ratio and small-cap stocks would generate a higher return and adjusted the CAPM model in the equation below:

$$R = \alpha_i + \beta_1(R_m - R_f) + \beta_2SMB + \beta_3HML \quad (2)$$

2.3 Fama-French Five Factors Model

Later in the time, Fama and French improved this model further by adding two more factors, RMW and CMA, to become a five factors model.

$$R = \alpha + \beta_1MKT + \beta_2SMB + \beta_3HML + \beta_4RMW + \beta_5CMA \quad (3)$$

Robust Minus Weak (RMW) measures the profitability of a company or a portfolio. Robust indicates high and steady profitability, and weak means low profitability. Conservative Minus Aggressive (CMA) measures the return spread of the stocks in the portfolio used for investment. A firm which takes a large proportion of their revenue to invest is said to be aggressive. In contrast, the firm is conservative if the amount of money used for reinvestment only accounts for a small percentage of its revenue [12]. Later in the time, Fama and French improved this model further by adding two more factors, RMW and CMA, to become a five factors model.

3. Results

The research selects the equal- and value-weighted daily return for 30 industries and the five factors in the Fama-French model in the CRSP (Center for Research of Security Prices) database to be our sample. The two periods with the same length of time are chosen to compare the changes resulting from the COVID-19 outburst. The first group selected was from June 3, 2019, to February 28, 2020, and the second group selected was from March 2, 2020, to November 30, 2020 [13].

The multiple linear regression was adopted to process the data by making the values of the five factors as independent variables x and the excess return (represented by $R_m - R_f$) as the dependent variable y . The result is drawn from a regression statistics table that records the coefficient, t Stat, and P -value, and other data of the five factors in different 30 industries.

Table 1. Meals Industry Before COVID-19

	<i>Coefficients</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	0.001	0.023	0.982
$R_m - R_f$	0.784	16.531	0.000
SMB	0.358	4.029	0.000
HML	0.142	1.563	0.120
RMW	0.191	1.277	0.203
CMA	(0.019)	(0.108)	0.914

Table 2. Meals Industry After COVID-19

	<i>Coefficients</i>	<i>t Stat</i>	<i>P-value</i>
Intercept	0.073	0.559	0.577
$R_m - R_f$	0.973	16.822	0.000
SMB	1.042	6.782	0.000
HML	0.537	4.292	0.000
RMW	0.799	3.020	0.003
CMA	(1.878)	(5.650)	0.000

4. Discussion

4.1 Mkt

$R_m - R_f$ indicates the expected excess return of the market relative to risk-free investments. Equity market premium is the compensation of systematic market risk to the investors. $R_m - R_f$ is the cornerstone of CAPM and Fama-French models because it is always statistically significant, meaning the market factor consistently influenced the performance of a stock. In this case, the t-values are 16.531 and 16.822 in each period. The coefficient of market value before and during the shock of COVID-19 are 0.784 and 0.973, respectively, which indicate a positive correlation between the excessive return and the market return. Furthermore, the magnitude of the coefficient represents the industry's sensitivity to market changes.

In terms of the metals industry, the leading industries are McDonald's Corporation, KFC Corporation, and Pizza Hut Corporation, whose market values are \$171.545 billion, \$17.175 billion, and \$20.975 billion, respectively. The market impact of the epidemic is usually upbeat. McDonald's stock dropped 9.25% in February 2020. By March 2020, McDonald's shares had fallen to 14.84%. Since February 2020, the stock prices of KFC and Pizza Hut have been falling wildly in line with market changes.

4.2 SMB

The hypothesis test results for the Small Minus Big (SMB) factor remain significant after COVID-19. However, the magnitude of its coefficient has increased from 0.358 to 1.04. It shows investors' preferences in investing in small market capitalization companies after COVID-19 have been enhanced.

The arrival of the novel coronavirus has led to a drop in the sales in brick-and-mortar retails and places like hotels, motels, and restaurants while the costs of raw materials, land (refers to the rented houses and workplace), and labor has significantly increased.

Large-scale companies are much more expensive to run than small ones and are more likely to experience a more significant loss in the epidemic. Large companies have to bear the cost of more idle labor, while small companies can quickly cope with the crisis because they have fewer employees than the extensive incorporation. On the other hand, famous chain restaurants and chain hotel companies have many heavy assets, which could not generate a return when the number of travels reduced dramatically. The maintenance charges now become a financial burden for those big companies.

In addition, the valuations of large companies are too high before the COVID-19 spread as they are chased by many huge mutual funds and other financial institutions due to features of high liquidity and minor operation and management risk. The active trading made by retail investors and speculators also explains the higher volatility of large-cap companies.

4.3 HML

The ratio of book value to market value (HML factor) changed obviously and became statistically significant, compared with the T-value coefficient around the Covid-19 period. Before the epidemic, the coefficient of HML was not significantly different from 0. However, after the epidemic, the coefficient of HML became significant. This positive coefficient demonstrates the Book Market effect, indicating that firms that have a high book-to-market ratio (BM ratio) performed better than those with a low BM ratio. In general, when the market value of a company is often higher than the valuation of the company's fixed assets, it indicates that the market recognizes its future potential. When the company's market value is lower than the valuation of its fixed assets, the market is relatively unappreciative of its future potential as Meals brick-and-mortar stores are a mature industry and in high demand. Nevertheless, in an epidemic, brick-and-mortar stores would be hit hard, potentially putting many companies out of business. In addition, the book-to-market ratio can reveal the characteristics of a company, that is, investor preferences.

4.4 RMW

The robust minus Weak (RMW) factor represents the differences between the profitability of a portfolio, and it can be measured by return on equity (ROE). Its existence implies that the companies or industries with higher profitability usually accompany higher risk. Therefore, part of the excess return of the company or the industry can be explained by the risk compensation. Before the COVID-19 outbreak, the t-value of RMW in the Meals industry is statistically insignificant, which excludes the importance of RMW as a factor to explain the excessive return.

Nevertheless, this has become statistically significant during the COVID-19 period, indicating it became an important reason for investors to make up their investment decisions. The coefficient of RMW is 0.799, which means that the market now prefers the companies with high and steady profitability and dislike those with low profitability. Understandably, the pandemic brings challenges and uncertainty to the operation of restaurants, hotels, and motels. Thus, businesses with more robust profitability show their qualification to successfully overcoming the problems. This preference change might explain why even though the stock prices of STKS (The ONE Group Hospitality, Inc.), CHUY (Chuy's Holdings, Inc.), PLAY (Dave & Buster's Entertainment, Inc.), and BFI (BurgerFi International, Inc.) all plummeted at the beginning of the pandemic, however, STKS, CHUY, and PLAY stock prices quickly recovered and performed much better than BFI.

4.5 CMA

Similar to HML and RMW, the CMA also became a determinant of the stock returns after the announcement of COVID-19. The t-value before the pandemic started was -0.108, which shows no statistical significance in interpreting the excessive return of a stock. However, it decreased to -5.650, which the absolute value shows it is significant to take this factor into account.

The level of investment can be measured by the reinvestment rate, which shows the capacity of an enterprise to expand its production. Investors believe that businesses with a low investment rate are riskier than those with a high reinvestment rate. Hence, they demand higher returns for these companies and vice versa. During the COVID-19 period, the firms which invest aggressively become more favorable in the market, indicated by the negative coefficient. This new trend can be associated with the expected growth. When there is a more ongoing investment, the investors will believe that the business's financial statement is robust to support the money outflow. Moreover, the higher investment rate implies a potential increase in the future revenue; hence, the expected stock prices will be higher, explaining the excessive return.

5. Conclusion

This article mainly uses data before and during the COVID-epidemic, based on the Fama-French five-factor model, to study the impact of COVID-19 on the meal industry. The correlation coefficient was obtained through pluralistic regression of the situation of the meal industry during the epidemic period. According to the data, only three factors were significant. The meal industry has always been significantly affected by risks in the market, and companies with solid profits are always more popular. The results indicate that investors preferred to invest in companies with small market value after the outbreak of the epidemic. In addition, investors prefer to invest in meal-related companies with high book value, namely BM value.

References

- [1] O'Donnell, N., Shannon, D., & Sheehan, B. (2021). Immune or at-risk? Stock markets and the significance of the COVID-19 pandemic. *Journal of Behavioral and Experimental Finance*, 30, 100477–100477.
- [2] Fu, X., Zhang, J., & Wang, L. (2020). Introduction to the special section: the impact of Covid-19 and post-pandemic recovery: China and the world economy. *Journal of Chinese Economic and Business Studies*, 18(4), 311–319.

- [3] Fernandez-Perez, A., Gilbert, A., Indriawan, I., & Nguyen, N. H. (2021). COVID-19 pandemic and stock market response: A culture effect. *Journal of Behavioral and Experimental Finance*, 29, 100454–100454.
- [4] Rujoiu, O. I. . (2020). The geoeconomic impact of covid-19 on the global economy. *Ovidius University Annals, Economic Sciences Series*, xx.
- [5] Chen, H.-C., & Yeh, C.-W. (2021). Global Financial Crisis and COVID-19: Industrial Reactions. *Finance Research Letters*, 101940.
- [6] Trimech, A., Kortas, H., Benammou, S., & Benammou, S. (2009). Multiscale Fama-French model: application to the French market. *The Journal of Risk Finance*, 10(2), 179–192.
- [7] Horváth, D., & Wang, Y.-L. (2020). The examination of Fama-French Model during the Covid-19. *Finance Research Letters*, 101848.
- [8] Byrne, S., Hopkins, A., Mcindoealder, T., & Sherman, M.. (2020). The impact of covid-19 on consumer spending. *Economic Letters*.
- [9] Nobel Prize Outreach AB 2021. (n.d.). The Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel 1990. NobelPrize.org. <https://www.nobelprize.org/prizes/economic-sciences/1990/sharpe/biographical/>.
- [10] 2020 UniAssignment.com. (n.d.). History Of The Development Of Capm Finance Essay. <https://www.uniassignment.com/essay-samples/finance/history-of-the-development-of-capm-finance-essay.php>.
- [11] McClure, B. (2021, May 19). Explaining The Capital Asset Pricing Model (CAPM). Investopedia. <https://www.investopedia.com/articles/06/capm.asp>.
- [12] Kenneth R. French - Description of Fama/French Factors. (n.d.). http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/Data_Library/f-f_5_factors_2x3.html.
- [13] French, K. R. (n.d.). Kenneth R. French - Data Library. http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.