

The Impact of COVID-19 on Consumer Durable Industry Based on Fama-French Five-Factor Model

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Abstract. As COVID-19 has negatively impacted the economy in the U.S., this study applies the Fama-French five-factor model to examine the performance of the consumer durable industry before and during the outbreak of COVID-19 using the dataset from Kenneth R. French Data Library. The dataset has been divided into two time periods before and during the COVID-19 outbreak, from February 01, 2019 to March 01, 2020 and from March 1, 2020, and March 1, 2021. By using multiple linear regression, it is significant that the consumer durable industry is affected to great extent. The result shows that the market factor remained significant during two periods, but the HML and RMW factors become insignificant after the outbreak of COVID-19. The significance of SMB factor suggests that investors preferred companies with small market value. The value of interception represents the items that these variables can't explain. Before the epidemic, the interception is insignificant. However, the interception became significant after the epidemic, indicating that the calculation of expected excess return is affected by some unexpected factors. Overall, these changes also inform investors' stock decisions on the consumer durables sector during the outbreak of COVID-19.)

Keywords: COVID-19; Consumer Durable Industry; Fama-French five-factor model; U.S. stock market.

1. Introduction

Capital Asset Pricing Model (CAPM) mainly studies the relationship between the expected return rate of assets and risky assets in the securities market. It is the pillar of the price theory of the modern financial market, and it is widely used in investment decision-making and corporate finance. While the CAPM model is based on several assumptions which cannot be satisfied in the real condition. It found that market capitalization and book-to-market ratio could explain most of the changes in stock prices and that these two factors could substitute for other risk factors, which eliminate the significance of abnormal returns. Then, the Fama-French three factors model was developed and widely used. With the COVID-19 pandemic breaking out, the level of uncertainty had raised in the global economy, resulting in the loss of investors' confidence. Then, the global markets were plunging after the implosion of an alliance between OPEC and Russia caused the worst one-day crash in crude prices in nearly 30 years, fueling panic triggered by the escalation of the coronavirus epidemic. As a result, on March 18 2020, the U.S. stock market suspended trading for 15 minutes due to the intraday fall of more than 7%, marking the fifth circuit breaker in the U.S. history and the fourth in 10 days. A circuit breaker is a set of limits on price movements based on a reference price. When the market fell to a certain extent, the market automatically stopped trading for a period of time, may be a few minutes to prevent the panic from spreading further and hitting the markets even more. The uncertainty brought by the pandemic influenced the stock market by a great extent, which means the coefficient of each factor in the Fama-French model would have changed. So, it is worthwhile to analyze the impact of the epidemic on various industries by applying the Fama-French model to the data of the U.S. stock market.

Dirkx and Peter implement the Fama-French five-factor model and enhance it with a momentum factor for the German market using recent monthly data from 2002 to 2019. To examine the empirical prevalence of the profitability and investment effect in the German market, Dirkx and Peter analyze single-sorted portfolios and conduct Fama-Macbeth regressions. Dirkx and Peter found that the newly introduced profitability and investment factors in German equities do not show attractive, statistically

significant long/short returns. Nor does the Fama-Macbeth regression show evidence of an investment or earnings premium. Dirkx and Peter found that many regressions between the RMW and CMA factor concepts showed strong statistical significance. In general, the international evidence on the importance of newly introduced factors, operating profitability and investment in explaining return on assets is not supported by the implementation of the Fama-Macbeth regression nor by the implementation of the six-factor model for the German stock market [1]. Shao tested Fama-French five factors model in the Chinese A-share stock markets and in the real estate industry. The method of Shao's research is to use cross-sectional regression analysis to find the best model. Shao found that the five factors model performs better in the Chinese real estate industry than in the Chinese A-share market because five out of six factors are significant at 5% level and the factors are less correlated [2]. Liu applied the Fama and French five-factor model to examine the performance of the service industry before and after the outbreak of COVID-19. For the prospect of service businesses, investors should be cautious when investing towards smaller-cap, less-investment activities and weaker-profitability businesses, as COVID-19 is still prevalent [3]. Xu and Zhang examined the extent to which the three factors in the Fama-French three-factor model explain the variation in Chinese stock market returns and points out some of the shortcomings of the three-factor model when applied to Chinese stock returns. Xu and Zhang followed Fama and French using data in the CSMAR database as China data, including the total market value, tradable market value, cash dividend reinvested stock income, etc. Xu and Zhang found that the three-factor model can explain more than 93% of the variation in Chinese A-share portfolio returns. And the results show that the formation of these three factors has a greater impact on the returns of Chinese stocks [4].

Chiah et al. investigated the performance of the five-factor model in pricing Australian equities. They found evidence that the profitability and investment factors have significantly positive premiums, which means the five-factor model can capture patterns of profitability and investment in stock returns that the three-factor model is unable to capture. Chiah, Chai, Zhong and Li also tested the performance of the three- and five-factor models in explaining other well-documented anomalies, such as return on assets, gross profitability, net operating assets, accruals, momentum and long-term contrarian trends. The results show that the five-factor model produces fewer pricing errors, which supports the superiority of this model [5]. Chen et al. implemented both the Fama-French five-factor model and the robust median covariance matrix approach to predict the expected return of the selected stocks and portfolio optimization. Chen, Song, Qiao and Gao identified the first period from the first trading day of 2008 to the last trading day of 2008 using the daily data instead of monthly data. Furthermore, Chen, Song, Qiao, and Gao adjusted the portfolio positions every three months, which is for updating information for recalculation of the expected return. The empirical results indicated that the profitability of the portfolio constructed by selecting stocks based on the Fama-French five-factor model is more sensitive to market sentiment than the Fama-French three-factor model. However, the portfolio return obtained by Fama-French five-factor model was less volatile [6]. Wijaya et al. aimed to test the Fama & French Five-Factor Model (5FF) and the Three-Factor Model (3FF) on stocks listed in the LQ-45 Index over the 2013-2015 periods. They used a multiple linear regression analysis models in the form of panel data for the entire portfolio and each formed portfolio. The result showed that in the selection of stock investments or the establishment of a portfolio, firm size, book-to-market ratio, profitability level, and company investment level are the factors that are characteristics of the company that investors can consider to earn a higher return [7].

Kubota and Takehara investigated whether the five-factor model by Fama and French explains well the pricing structure of stocks with long-run data for Japan. Kubota and Takehara conducted standard cross-section asset pricing tests and examined the additional explanatory power of the new Fama and French factors. Kubota and Takehara found that robust-minus-weak and the conservative-minus-aggressive factors are not statistically significant when conducting generalized method of moments (GMM) tests with the Hansen-Jagannathan distance measure. Kubota and Takehara concluded that the original version of the Fama and French five-factor model is not the best benchmark pricing model for Japanese data during the sampling period from the year 1978 to the year

2014 [8]. Erdinc tried to test the capital asset pricing model (CAPM), three-factor Fama-French (3F-FF) model, and five-factor Fama-French (5F-FF) model for the Turkish stock market. The sample is from June 2000 to May 2017. Erdinc used an equal weight market portfolio for all the models to explain the cross-sectional variations in the stock returns. The results showed that the five-factor model explains better the common variation in stock returns than the three-factor model and capital asset pricing model [9]. James evaluated whether the new Fama-French five-factor model is able to offer a better description of emerging market equity returns than the three-factor model. James used an extensive sample of 18 countries from three different regions. The result showed that the five-factor model consistently outperforms the three-factor model in Eastern Europe and Latin America. However, a profitability or investment premium cannot be distinguished in the Asian factors and the five-factor model fails to provide an improved description of equity returns in the region [10].

The COVID-19 outbreak is an unprecedented pandemic that has severely affected almost all industries around the world. Many companies went bankrupt, and millions of workers lost their jobs due to lockdown and closure of operations. One of the industries most adversely affected was the consumer durables industry. People are going out less and less because of the lockdown and some home quarantine policies. This has led to a reduction in the demand for consumer durables. The consumer durable goods industry is closely linked to the economy as a whole. Influenced by the epidemic, the whole economy is in recession. So, the consumer durable industry has also taken a big hit. Since the Fama-French five-factor has shown to be a valid model in many studies, and few have yet to use the Fama and French five-factor model to analyze the impacts of COVID-19 on industries. The goal of this research is to apply the Fama-French five-factor model on the U.S. stock market to compare the performances of the consumer durable industries before and after COVID-19 had happened, and provide insights and investment strategies for the consumer durable industries to move forward.

2. Method

In 1992, Fama-French three-factor Model (Fama French Model for short) was developed on the basis of Capital Asset Pricing Model (CAPM), in response to the poor performance of CAPM [11]. Scale risk and value risk factors are added into CAPM's market risk factors. Small minus big (SMB) is a scale risk factor that is used to explain portfolio returns. This factor is also referred to as the "small firm effect", or the "size effect", where size is based on a company's market capitalization. And HML is the value risk factor that accounts for the spread in returns between value stocks and growth stocks. This system argues that companies with high book-to-market ratios, also known as value stocks, outperform lower book-to-market values, known as growth stocks. The formula is:

$$R_{it}-R_{ft}=\alpha_{it}+\beta_1(R_{Mt}-R_{ft})+\beta_2SMB_t+\beta_3HML_t+\epsilon_{it} \quad (1)$$

where $R_{it}-R_{ft}$ refers to the expected excess return; $R_{Mt}-R_{ft}$ is excess return on the market portfolio; SMB accounts for publicly traded companies with small market caps that generate higher returns, which is a size premium; HML accounts for value stocks with high book-to-market ratios that generate higher returns in comparison to the market, which is the value premium.

In recent years, researchers have expanded the three-factor model to include other factors. These include "momentum", "mass", and "low volatility". In 2014, Fama and French adjusted their model to include five factors [12]. In addition to the original three factors, the new model also adds that companies with higher future earnings will also have higher returns on the stock market. This factor is called profitability. The fifth factor, known as investment, has to do with the concepts of internal investment and return, which means that companies that direct profits to major growth projects are likely to suffer losses on the stock market. After the two factors of profitability and investment are added to the Fama-French five-factor model, there is evidence that the three-factor model is

insufficient for expected returns. It is because that its three factors ignore many changes in the average return related to profitability and investment. The formula is

$$R_{it}-R_{ft}=\alpha_{it}+\beta_1(R_{Mt}-R_{ft})+\beta_2SMB_t+\beta_3HML_t+\beta_4RMW_t+\beta_5CMA_t+\epsilon_{it} \quad (2)$$

Where RMW is the return spread of the most profitable firms minus the least profitable; CMA is the return spread of firms that invest conservatively minus aggressively.

3. Results

The data used is selected from the database of Kenneth R. French, who is the founder of the Fama-French model, which is obtained from the US stock market [13]. According to the market value of listed companies, they are divided into small market value stocks and large market value stocks, each of which is divided into 50%. Then, according to the book-to-market ratio of listed companies at the end of the year, they are divided into H(high book-to-market ratio), M(medium book-to-market ratio), and L(low book-to-market ratio), accounting for 33% each. After that, the stocks intersect with each other obtaining six different combinations. Using multiple linear regression, it is significant that the consumer durable industry is affected to a great extent. The consumer durable industry includes cars, TVs, furniture and household appliances. (Noted in the data library)

The dataset was then divided into two time periods before and after the COVID-19 outbreak. February 01, 2019, solstice and March 01, 2020 were selected as the early-stage of 2019 coronavirus disease. March 2020 was chosen as the date for the designation because the World Health Organization declared COVID-19 a global pandemic in March 2020. The time after 2019 coronavirus disease was selected March 1, 2020, solstice, March 1, 2021.

The multivariate regression method with covariate as five factors is used to analyze the data set of consumer durable industry. The corresponding statistics are then reported. The data obtained are shown in the following table.

Table 1. The estimated coefficients of the five factors and their corresponding T-statistics for the period before and during COVID-19.

Period	Before COVID-19		During COVID-19	
Item	Coefficients	T-statistics	Coefficients	T-statistics
Intercept	-0.001	-0.026	0.206	3.417
MKT	0.958	20.942	0.918	30.344
SMB	0.790	9.802	1.080	15.683
HML	0.207	2.580	0.061	1.063
RMW	0.553	4.592	0.173	1.464
CMA	-0.108	-0.663	0.073	0.544

As shown in Table 1, it is obvious from the five-factor table that the t-test values of HML and RMW before the epidemic were 2.58 and 4.59, respectively, indicating that they are significant in the five-factor model of the consumer durable industry. However, after the epidemic, the T-test values of these two factors have become 1.06 and 1.46 respectively, indicating that they are significant. They become redundant factors without validity in the calculation of return on investment. The value of intercept become significant after the pandemic, indicating that there must be some other factors influencing the expected excess return apart from the five factors listed. Since the market coefficient before the epidemic is greater than one, the consumer durable industry is relatively sensitive to the movement of the market. The value of CMA change from a negative value, -0.108 to a positive value, 0.073.

4. Discussion

4.1 Interception

The value of interception represents the items that these variables can't explain. Before the epidemic, the interception is insignificant, it shows that the five factors model can fully explain the expected excess return. However, the interception became significant after the epidemic with the value about 0.2, indicating that the calculation of expected excess return is affected by some unexpected factors. For example, the automobile industry and the furniture industry are two important consumer durable goods fields. According to furnituretoday.com, furniture retailers' concerns are at an all-time high, with 97% stating they are concerned COVID-19 will negatively impact their business. More than half of retailers, 55%, also feel that the impact to their business will be long term, four months or longer, which was a 31% increase from prior results. Consumer demand was their top concern with 92% of retailers stating it. According to The U.S. NEWS, auto sales in March and April fell dramatically. Though sales saw a significant recovery in many of the ensuing months, the total number of cars sold in 2020 is still below pre-virus forecasts.

4.2 MKT

Before the epidemic, the coefficient was 0.96, and during the epidemic, the coefficient rose to 1.08, indicating that the price vibration of this industry was more sensitive to the market. After the outburst of COVID-19, the MKT coefficient remained statistically significant. As the consumer durable industry comprised a big proportion of the U.S. economy, the outlook of the economy is clearly an indicator for the performance of the consumer durable industry. As COVID-19 had disrupted the market in general, it is highly likely that the consumer durable industry is hit severely as well. With overall volatility increased in the U.S. financial market, their systematic effects on the industries cannot be neglected. During the epidemic, consumers have less confidence in the economy, so there's a sharp drop in the sales of durable goods, especially for the car industry. According to the statista.com, the automotive industry in the United States experienced a sharp drop in demand amid the outbreak of COVID-19: in March 2020, U.S. vehicle sales were down 38 percent year-on-year. According to the CNBC, sales of new vehicles in the U.S. are expected to close this year down at least 15% compared with 2019. During the depths of the first peak of Covid-19 in the spring, sales of new vehicles collapsed as auto plants shuttered and many dealers were forced to close showrooms. J.D. Power forecast retail sales would decline by as much as 80% in April, leading to likely near-recession sales levels for the year.

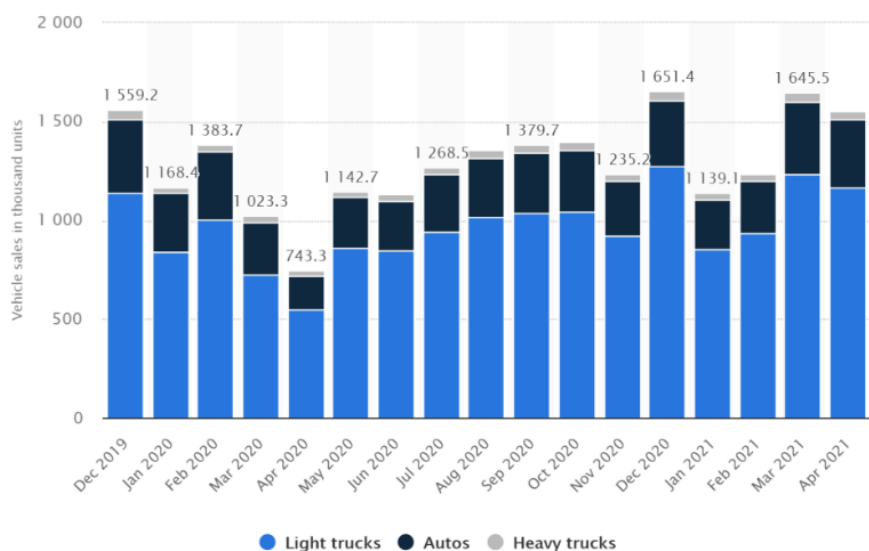


Fig. 1 U.S. vehicle sales between December 2019 and April 2021, by vehicle type

4.3 SMB

For SMB, the values of SMB were significant, and positive before and after the epidemic, indicating that investors preferred companies with small market value. Due to the impact of the epidemic, investing in small market value companies has high returns, relatively high risks, and large compensation for returns. Companies with large market capitalization may face problems such as poor sales during the epidemic. As a result, they may have to pay for large warehousing costs. In contrast, companies with small market value can be more flexible in the face of the uncertainty brought by the epidemic.

4.4 HML

The HML factor showed that it was significant before the epidemic and the coefficient was positive, indicating that investors preferred to invest in value stock before the epidemic. A value stock refers to shares of a company that appears to trade at a lower price relative to its fundamentals. Value stocks are considered safer than growth stocks, but because of this relatively certain operation and undervalued condition, the value stock is typically more likely to have a higher long-term return than a growth stock. Before the pandemic, investors consider that the consumer durable industry firms are more stable than a growth entity developing. After the outbreak of COVID-19, the coefficient of HML become insignificant, which indicates that the epidemic has an essential influence on this industry and people are indifferent between the value stock and the growth stock. The book-to-market ratio is no longer a factor that people will put into consideration when investing.

4.5 RMW

The value of RMW is significant before the epidemic and the coefficient is positive, indicating that the market tends to invest in enterprises with stable profitability. The consumer durable industry is relatively mature and stable, so there are many big companies with stable profitability. Many investors would go for them, as they are less risky. After COVID-19, the profitability coefficient becomes statistically insignificant, which suggests profitability premium is not an important factor. It might because all the industry firms were struggling for profitability during the crisis or all the firms are financially capable and strong.

4.6 CMA

The value of CMA factors before and after the epidemic were not significant, indicating that the epidemic did not affect the influence of investors on their investment style. This may be because the industry's market landscape is relatively fragmented.

5. Conclusion

This article applies the Fama-French five-factor model to analyze the change of performance of the consumer durable industry before and during the outbreak of COVID-19. Through the research and analysis of the Fama-French five-factor model of consumer durable industry, and combined with the model coefficient to judge the development of the industry, the development prospect and investment direction of the stocks of the consumer durable industry are finally obtained. Before the epidemic, the interception is insignificant, it shows that the five factors model can evaluate fund performance more comprehensively. However, the interception became significant after the epidemic, indicating that the Fama-French five-factor model cannot fully explain the expected excess return. The HML and RMW factor become insignificant after the outbreak of COVID-19, which means that the profitability premium and the book-to-market ratio are no longer factors people consider when investing. This suggests that people should find and analyze more factors that might influence consumer durable industries' expected excess return before investing. As for SMB, the values of SMB

were significant, and positive before and after the epidemic, indicating that investors stick to companies with small market value. As the consumer durable industry comprised a big proportion of the U.S. economy, the outlook of the economy is clearly an indicator for the performance of the consumer durable industry.

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