



An Empirical Study of the Market Impact of the COVID-19 on the US Agricultural Sector

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Abstract. The diagnosis of the first case of a novel coronavirus in the United States on January 21, 2020, caused considerable volatility in the This paper collects a large amount of data and conducts regression analysis to examine the extent of the impact on industry market returns through a five-factor Fama-French model that looks at five aspects: market, size, the ratio of total shareholders' equity to market capitalization, a firm's ability to make money, and a firm's investment style, and draws four conclusions: investors' propensity to invest before and after the epidemic is reversed in the face of firms with high and low book-to-market ratios. The significance of the element of corporate profitability on industry returns was reversed before and after the epidemic; people's investment preferences were more inclined to invest in positive companies after the epidemic; and the two factors of market and firm size had a significant impact on industry returns both before and after the epidemic. The study found that the New Crown epidemic, a black swan event, had a significant impact on the condiment industry, and investors should avoid investing in related companies and could make short-term investments in companies whose main business is related to eggs.

Keywords: COVID-19, FF Five Factor Model, US Agriculture

1 Introduction

1.1 Background

In the CAPM model proposed by William Sharpe, Jack Treynor, and others, it is argued that among the many risk parts, only the market part, which is systematic risk, has an impact on the expected return on equities[1-2]. In 1993, Fama and French, in their study of past market returns in the US, scope of business production, operation and so on (SMB) and the market capitalization-to-book ratio factor (HML) also affect the expected return of the portfolio, and proposed the FF three-factor model[3-8]. With the development of socio-economic development, to have a better explanation of market returns, Fama and French, after analyzing the data, found that the profitability factor and investment style factor would also have an impact on market returns, so a five-factor model with stronger explanatory power was proposed in 2015[9-15].

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With the outbreak of the New Crown epidemic, which has adversely affected global economic development, the lack of labor elements on US farmland as a major agricultural country, the decline in agricultural production, and the decrease in exports, a series of factors have led to the US agricultural sector economy being in a weak position, drawing the attention of investors in the US agricultural sector.

1.2 Related Research

Foye collected a large amount of data from different countries and tested the explanatory power of the five-factor model against the three-factor model. The five-factor model was found to be stronger than the three-factor model in Latin America; however, in Asia, the effect of the investment and profitability factors was not significant [10-12].

Dirkx and Peter used a five-factor model to test the explanatory power of the market part, value part, size part, investment style part, and profitable part on market returns by collecting monthly data from the German market for 18 years from 2002, augmented by the momentum factor. The profitability and investment style factors were found to be insignificant in explaining market returns[13].

Blitz, Hanauer et al. show the difference between the explanatory strength of the three-factor model and the five-factor model and conclude that the five-factor model does explain market returns more strongly than the three-factor model, in addition to finding that not only are momentum effects not included in the five-factor model, but also the explanatory strength of the investment style and profitability factors on market returns is not very In addition, it is also found that not only are the momentum effects not included in the five-factor model, but also the explanatory power of the investment style and profitability factors on market returns is not very significant[9].

Lam used both time series and cross-sectional tests to investigate which of the CAPM models and a three-factor model nominated by Fama and French to explain industry proceeds further acerbic, concluding that the strength of the two models was not absolute but relative[8].

Nartea et al. collected relevant data from New Zealand to describe the differences between the CAPM model, the FF three-factor model, and a model with four factor proposed by Carhart. The size-to-book-to-market ratio was first arranged in a 2X3 format to see the impact of the size factor and book-to-market ratio factor on the volatility of industry returns, followed by a classification of returns over a certain in the past to analyze the impact of momentum effects on market returns, and finally concluding that the BM and momentum effects were at a higher level of significance[8].

Gaunt concluded that the FF three-factor model does not necessarily explain market returns greater than the CAPM in Australia, Gaunt extended the sample data for Halliwell, Heaney, and Sawicki. concludes that a model with three element introduced by Fama and French to explain market premium greater incisive than the CAPM model, contrary to the findings of Halliwell et al., and also concludes that the size factor with a more significant effect on market returns, also in contrast to the US[3].

Racicot and Rentz used an optimized semi-parametric estimation method commonly used in statistics and econometrics, the generalized method of moments, to investigate the robustness of the FF five-factor model, and to reduce errors also used Hausman's manual regression to test it, concluding that all the influencing factors, only the market factor was consistent and significant[14].

Cox and Britten collected data and looked at the differences between the model with three element and the model with five element. They found that the three-factor model has a significant impact around the time value of returns, while the five-factor model mainly reflects the return matching the risk of the asset. investment style factors have a stronger explanatory power for market returns than the three-factor model[15].

Ciotti and Ciccozzi et al. identify where the virus appears, provide some medical knowledge about the virus, explain that the virus is a disease related to the respiratory tract, and provide details on the treatment of the virus, the development of a vaccine against the virus, and the prevention of the virus[16-17].

Inspired by the above-mentioned experts and scholars, the US agricultural industry is faced with an economic downturn and declining returns in the face of the outbreak of the New Crown epidemic in 2020. This paper, therefore, analyses the factors affecting industry returns before and after the epidemic through the FF five-factor model and expresses its investment preferences concerning the influencing factors.

2 Method

In this paper, the Fama-French five-factor model is used to show market returns. the FF three-factor model increase a component about the scope of production and operation of the enterprise and a market capitalization book value ratio part to the CAPM model to enhance the explanatory power of the market returns. as the economy develops, the explanatory power of the three-factor model for industry market returns needs to be improved, so Fama and French add a profitability factor and an investment style factor to the three-factor model to further improve the explanatory power of the three-factor model for market returns. The FF five-factor model formula is as follows:

$$R_i - R_f = \beta_1 (R_m - R_f) + \beta_2 \text{SMB} + \beta_3 \text{HML} + \beta_4 \text{RMW} + \beta_5 \text{CMA} \quad (1)$$

R_i means the market return's ratio for the industry; R_f means the risk-free ratio, generally using the proportion on US Treasury bills as the risk-free rate; $R_m - R_f$ is the market risk premium and represents market factors; SMB is the rate of return of smaller companies over that of larger companies, representing the size factor; HML is the average yield of group with high book-to-market ratios above the average earnings of group with low book-to-market proportion, representing the valuation factor; RMW is the difference between the yields of companies with good earnings and those with bad earnings, revealing the profitable part; CMA is the distinctness between the revenue of companies with low and high finance to total revenue, representing the

investment style factor; Beta1, beta2, beta3, beta4 and beta5 represent the coefficients of the market part, size part, valuation part, profitability part and investment style part respectively, which clearly reflect the investment trend of investors.

3 Results

Table 1. Before the epidemic

	Coefficients	Standard error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	-0.0109	0.07853	-0.139	0.8896	-0.1656	0.1437
$M_{kt}-R_f$	0.88585	0.10991	8.05945	2.8658	0.6694	1.1023
SMB	0.69581	0.17489	3.97852	9.0156	0.3514	1.0402
HML	-0.0472	0.17284	-0.2733	0.7848	-0.3876	0.2931
RMW	0.58904	0.26385	2.23246	0.0264	0.0694	1.1086
CMA	0.19273	0.35836	0.53782	0.5912	-0.5130	0.8984

Table 2. After the epidemic

	Coefficients	Standard error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	0.2434	0.1757	1.3857	0.1668	-0.1022	0.5891
$M_{kt}-R_f$	1.1439	0.0951	12.0349	1.3288	0.9569	1.3310
SMB	0.4549	0.2080	2.1872	0.0295	0.0457	0.8641
HML	1.6131	0.1746	9.2413	4.1305	1.2697	1.9566
RMW	-1.2856	0.3481	-3.6934	0.0003	-1.9705	-0.6007
CMA	-0.9368	0.4125	-2.2709	0.0238	-1.7484	-0.1251

4 Discussion

The HML is the risk premium due to differences in book-to-market ratios, i.e. the distinction between the return of a company with a high book-to-market rate and the return of a company with a low book-to-market ratio is equal to the ratio of the owner's equity to the market price. As can be seen from the two tables above (Table 1 and Table 2), the effect of the book-to-market ratio factor on industry returns before the epidemic is insignificant, but the effect after the epidemic is significant. The US farms

cover a total area of 3.64 million square kilometers, and agriculture is one of the major industries in the US and the world's largest exporter of agricultural products. In 2020, the outbreak of the New Crown epidemic in the USA caused certain economic fluctuations in the entire agricultural industry. On the one hand, the planting period in the US is from March to May, which is the peak period for the spread of the new coronavirus, and a large number of people are infected, reducing the number of farm workers and the number of seeds sown, which has a certain impact on US food production. ADM, for example, has conducted global research to understand the changing needs of consumers and changes in lifestyle and consumption patterns, to update its products, improve production technology and adopt the measure of "ordering more beverages online and more food products offline" to ensure sales of its products.

RMW is a profitability risk factor, which is the difference between the profitability of a more profitable company and the profitability of a less profitable company; it reflects the premium of a portfolio with a high operating margin over a portfolio with a low operating margin; profitability is defined here as the deduction of main operating expenses, interest expenses, selling costs and administrative expenses from total annual revenue, interest expenses, cost of sales and so on divided by total book equity at the end of the previous financial year. In general, the risk profile is positively correlated with profitability. Looking at the two data tables above, the profitability risk factor is significant in explaining industry returns before the outbreak; however, after the outbreak, the effect of this factor on industry returns is not significant. The profitability risk factor is not significant for industry returns before the epidemic, but not after the epidemic, as in the case of two companies with different profitability: CALM and ADM. In 2019 and 2020, CALM's margins are 1.36% and 0.15% respectively, while ADM's margins are 2.13% and 2.75%, which shows that ADM's profitability as one of the world's four largest grain exchangers before the epidemic is relatively strong. With the outbreak of the New Crown epidemic, CALM raised the price of eggs by 300% in response to the New Crown virus, with eggs per dozen rising from US\$1 to US\$3.44, increasing CALM's profitability by 7.31% to 7.46% in 2021 compared to the previous year, while ADM's profitability increased by just 0.43%.

The CMA is an investment style factor, which is the return on a more conservative portfolio of stocks minus the return on a more aggressive portfolio of stocks, where the investment is the increase in total assets in the previous fiscal year relative to the previous fiscal year, divided by the number of total assets at the end of the previous fiscal year. Based on the data table we can learn that the impact of the investment style factor on sector returns before the outbreak was significant.

Here, for example, the two listed companies, Deere and Bunge in the United States, have total annual revenues of \$39,233 million, \$35,514 million, and \$43,983 million from 2019 to 2021, respectively, and total long and short-term investments of \$200 million, \$181 million and \$178 million, respectively, as a percentage of total revenues of 0.51%, 0.51%, and 0.4%, while Bunge's three-year investment rates are Bunge's investment rates for the three years were 4.2%, 4.9%, and 2.5% respectively, making it an active investor. Bunge, one of the world's top four grain traders with businesses in the fertilizer, agriculture, and food industries, is known for taking its business from the farm to the retail shelf. Bunge has long been engaged in third-party

trading and self-distribution of vegetable oil imports, but for a long time, the oil market has been in a bear market, and the outbreak of the epidemic has made the oil market even weaker, but after 2020 there has been a spate of bad crop production news, which has caused oil prices to rise straight to record highs, but in some countries, the oil market is still relatively weak and the cost of imports is high. However, in response to this phenomenon, Bunge has actively and sensibly used futures instruments to mitigate losses, demonstrating its ability to cope with risk and hedge it, giving investors great confidence and attracting a large number of investors for itself.

Relative to the three risk elements of HML, RMW, and CMA, the impact of the market factor and size factor on industry return was significant, without much change, both before and after the outbreak.

5 Conclusion

The outbreak of the New Crown epidemic left the US agricultural sector economy lacking demand momentum and in a weak state. This paper focuses on the explanatory power of five factors in the FF five-factor model on the US agricultural industry economy before and after the New Crown epidemic and finds that, except for the market factor and the firm size factor, which are significant on industry returns both before and after the epidemic, the other three factors change their impact on industry returns: HML goes from insignificant to significant, and RMW and CMA go from significant to not significant. There are many similar black swan events in history, such as the SARS outbreak in China, the Wenchuan earthquake in China, and the September 11 attacks in the US, which harmed a negative impact on socio-economic development and stock returns. In the face of such events, investors may choose to invest in larger, long-established, broad-based, and highly profitable companies.

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