



# Analysis of U.S. Banking Industry Based on Fama-French Model Under COVID-19

Xiaoling Wu(✉)

Olin Business School, Washington University in St. Louis, St. Louis 63130, USA  
w.xiaoling@wustl.edu

**Abstract.** The global epidemic of the COVID-19 has further aggravated the imbalance of the world's economic order, and the global economic recession is inevitable. The purpose of this research is to test the performance of factors and the applicability of Fama-French Factor model for the banking industry during the epidemic. The data is used from Kenneth R. French-Data Library to conduct Multiple Linear Regression based on Fama-French 3 Factor model and Fama-French 5 Factor model. The timeline consists of 3 stages, using the outbreak of COVID-19 and the availability of COVID-19 vaccines as time point. The result shows that Fama-French Five Factor Model can better explain the performance of the industry, and all of the factors have an impact during the epidemic.

**Keywords:** Fama-French Model · COVID-19 · U.S. Banking Industry · COVID-19 Vaccines · Variants

## 1 Introduction

### 1.1 Background

Covid-19 has generated significant impacts on global economics, the US banking industry which performs key functions in economy has been one of the sectors that was affected the most. US banking industry faced problems with cost of risk, commercial models and traditional bank business model, the core banking profitability was decreased due to low interest rate scenario, and banks have built higher capital-to-asset ratio during the epidemic. After Dec 2020, with the beginning of the national vaccination program, the Covid-19 vaccines gave confidence to people for returning to work, allowing economics to restart. However, new variants such as Delta and Omicron led to a reversal of the decline in Covid-19 cases in previous months, adding a level of uncertainty about what lies ahead. The Fama-French Three Factor Model makes extension on market risk factor from capital asset pricing model (CAPM), adding size risk factor (SMB, small minus big) and value risk factor (HML, high minus low). Fama-French Five Factor Model adapts two more factors: robust-minus-weak profitability (RMW) and conservative-minus-aggressive investment (CMA). The application of these two models will help the author to evaluate the stock performance in banking industry before and after the break-point of the epidemic, it will also explain the question: "What is the economic effect of vaccines for the banking industry, despite the occurrence of COVID-19 Variants".

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## 1.2 Related Research

In recent years, the epidemic has attracted many scholars' attention, and Fama-French Model has been widely used for analysis. As an extension of CAPM, Belen Blanco employs a database from American NYSE market, and the empirical results from the expected returns of portfolios show that Fama-French Three Factor Model is better than CAPM [1]. Yinqiao Li and Renée Spigt et al. use both the Fama-French three-factor model and five-factor model to study the impact of FinTech start-ups on incumbent retail banks' share prices by capturing the expected stock returns of these banks. The results show a positive relationship between the growth in FinTech funding and the contemporary stock returns of incumbent retail banks [2]. Yuhan Cai and Yue Shen et al. have made an examination on finance-related industry before and after the breakpoint of the epidemic, they tell us that all the factors have an impact on the return of the portfolios in banking industry but do not cause a statistically significant change for these factors. The reason is that the increasing focus on stress testing, risk monitoring, and stricter capital and liquidity requirements as a result of the 2008 financial crisis [3]. As pointed out by Suborna Barua, banks and other financial institutions have suffered direct external shocks, which require them to prepare for extremely difficult and diverse future challenges. It triggered the preventive response of depositors and counterparties of financial intermediaries [4]. Ghulam Ghouse and Muhammad Ishaq Bhatti et al. employ the GARCH model to evaluate the estimated volatility series for commercial banks, they observe that the epidemic significantly impacts the insured and run-prone uninsured depositors choice between various commercial banks [5]. Horváth Dominik and Wang Yunglin examine the  $R^2$  of the model. Due to the impact of the epidemic, the  $R^2$  of the model has decreased significantly. That is, the strength of model interpretation has decreased. However, they also find that the additional two factors "RMW" and "CMA" from Fama-French Five Factor Model can increase the explanatory power of the model in US stock markets [6]. Elena Carletti and Stijn Claessens et al. illustrate that the business model of banking has been challenged by low interest rate, increased prudential requirements and massive application of digital technologies. In a post-covid-19 world, the period of low or negative interest rates will be deepen, and central banks have taken measures to ensure liquidity to banks by planning to purchase \$75 billion and providing up to \$2.3 trillion in loans [7]. After Dec 2020, as the COVID-19 vaccines became available, it helps alleviate the health crisis in the United States. In addition, it has also slowed down economic turbulence by improving consumer confidence. R. Khalfaoui a and H. Nammouri et al. study the time-varying connectedness between the COVID-19 vaccination and S&P 500 stock market returns in the United States. The result shows that there are positive and significant connectedness between them [8]. Generally speaking, these studies mainly focus on the application of Fama-French Model before and after the outbreak of COVID-19, and impact of COVID-19 on some industries, while there is less literature on the impact of the vaccines and variants on the banking industry after the availability of Covid-19 vaccines.

## 2 Method

### 2.1 The Capital Asset Pricing Model

The CAPM represents the relationship between an asset's undiversifiable risk and expected return. The equation of the model is

$$E(r_i) = r_f + \beta_i(E(r_i) - r_f)$$

where  $E(r_i)$  represents the expected return of investment,  $r_f$  is risk-free rate,  $\beta_i$  is the beta of the investment,  $E(r_i) - r_f$  equals to the market risk premium. CAPM can help evaluate whether a stock is fairly valued under certain amount of risks and time value of money. However, CAPM fails to capture various market anomalies of asset returns. For example, DeBondt and Thaler (1985) find evidence on reversals in the long-term returns, Jegadeesh and Titman (1993) find the evidence on momentum that short-term returns tend to continue.

### 2.2 Fama-French Model

#### 2.2.1 Fama-French Three Factor Model

This model adds two more factors: size risk factor (SMB, small minus big) and value risk factor (HML, high minus low) to Capital Asset Pricing Model. The equation of the model is

$$R_{it} - R_{ft} = \alpha_i + \beta_1(R_{mt} - R_{ft}) + \beta_2SMB_t + \beta_3HML_t + \epsilon_i$$

where  $R_i$  represents total return of a portfolio or stock  $i$ ,  $R_f$  represents risk free rate,  $R_m$  means total market portfolio return. The three factors:  $(R_m - R_f)$  means excess return of market portfolio, SMB means size premium and HML means value premium.  $\beta_{1,2,3}$  are the coefficients of these factors. If these three factors can fully explain the abnormal return of assets, then the intercept  $\alpha$  in the model should tend to be 0. However, many scholars subsequently found that  $\alpha$  in some portfolios is significant different from zero, indicating that the three factors are flawed, such as the existence of earnings anomalies. Fama and French (1996) pointed out that it fails to capture the continuation of short-term momentum anomalies.

#### 2.2.2 Fama-French Five Factor Model

Therefore, in 2015, Fama and French further proposed a five factor model, adding profitability and investment style factors to the three factor model to better describe the excess returns of the portfolio. The equation of the model is

$$R_{it} - R_{ft} = \alpha_i + \beta_1(R_{mt} - R_{ft}) + \beta_2SMB_t + \beta_3HML_t + \beta_4RMW_t + \beta_5CMA_t + \epsilon_i$$

Among them,  $RMW_t$  represents the profitability factor, reflecting the difference between the return of stock portfolios with robust profitability and weak profitability.  $CMA_t$  represents the investment style factor, which reflects the difference between the yield of stock portfolios with conservative and aggressive investment styles [9].

## 2.3 Data

The data of this paper is selected from the database created by Kenneth R. French, it uses 49 Industry Portfolios (Daily) and the Fama/French 5 factors ( $2 \times 3$ ) (Daily). This paper selects the data obtained by French, the founder of Fama French model, based on the relevant information of the U.S. stock market CRSP and Compustat databases contain samples of all listed companies' stocks, including the New York Stock Exchange, the American Stock Exchange and the Nasdaq stock market.

The time period is divided into 3 parts. The first period is from May 1st, 2019 to Feb 28th, 2020, 9 months before the outbreak of Covid-19 in US. Since the WHO declared a pandemic officially by March 11, this paper sets May 1st, 2020 to December 1st, 9 months after the outbreak of COVID-19 as the second period. The third period is set from January 1st, 2021 to June 30th, 2022. This is because starting on December 14, 2020, the first doses of COVID-19 vaccine were administered. With the rise of alpha variant and delta variant after March in 2021, and the emergence of Omicron on January 2022, the mutation becomes more infectious, making more and more people seeking A resilient economy in search of normalcy.

## 3 Results and Analysis

This paper uses multiple linear regression method to process the data of Banking industries in the US stock market, calculate the coefficients of the three factor and five factor models in the three-time period and test the significance to verify the matching degree of the model, the significance of the factors and the changing trend. For the convenience of comparison, the factor coefficients are judged according to the significance of 5%. This paper mainly makes an analysis of coefficients from Fama-French Five Factor Model.

### 3.1 Comparison of Fama-French Three Factor Model and Fama-French Five Factor Model in Different Time Periods

Comparing  $R^2$  of the 3 factor model with 5 factor model, the  $R^2$  of the latter all increase, this represents that Fama-French Three Factor Model can be better applied in explaining the performance of Banking industry behavior. Compared  $R^2$  of Table 1 with Table 2, in period 1 and 2, the matching degree of the five factor model is only slightly improved compared with the three factor model, indicating that the profit factor (RMV) and investment style factor (CMA) have a poor explanation for the yield of this time period in banking industry. In period 3,  $R^2$  in the five factor model is 5.8% larger than the three factor model, this means the matching degree of is improved by adding 2 more factors compared with period 1 and 2.

However, both  $R^2$  of the 2 models decreased a lot in period 3, and  $R^2$  was the highest in period 2, this means the matching degree is best during the burst period of epidemic which was not very easy to be controlled by the government. The accuracy of Fama-French model in the pricing of Banking industry after the COVID-19 is higher than that before the epidemic.

**Table 1.** Banking Industries' regression result of Fama-French Three Factor model. (From May 2019 to June 2022, made by author)

<b>Coefficient of 3-factor model of banking industry before epidemic</b>					
<b>Factor</b>	<b>Coefficient</b>	<b>Std err</b>	<b>t Stat</b>	<b>P value</b>	<b>R Square</b>
<b>MKT-RF</b>	1.144	0.026	44.532	0.000	0.925
<b>SMB</b>	-0.088	0.051	-1.722	0.087	
<b>HML</b>	0.540	0.039	13.818	0.000	
<b>Coefficient of 3-factor model of banking industry after epidemic</b>					
<b>Factor</b>	<b>Coefficient</b>	<b>Std err</b>	<b>t Stat</b>	<b>P value</b>	<b>R Square</b>
<b>MKT-RF</b>	1.098	0.023	48.620	0.000	0.956
<b>SMB</b>	-0.057	0.054	-1.039	0.300	
<b>HML</b>	0.894	0.031	28.874	0.000	
<b>Coefficient of 3-factor model of banking industry after vaccination</b>					
<b>Factor</b>	<b>Coefficient</b>	<b>Std err</b>	<b>t Stat</b>	<b>P value</b>	<b>R Square</b>
<b>MKT-RF</b>	1.251	0.032	38.867	0.000	0.834
<b>SMB</b>	0.028	0.042	0.662	0.509	
<b>HML</b>	0.720	0.029	24.951	0.000	

## 3.2 Coefficient Analysis from Fama-French Five Factor Model

### 3.2.1 $R_{mt}-R_{ft}$ Coefficient

The coefficient in period 1 is 1.166, and decreased to 1.078 in period 2, and back to 1.187 in period 3 and they are all statistically significant. This represents that the banking industry's sensitivity to market risk did not make much change.

### 3.2.2 $SMB_t$ Coefficient

The coefficient in period 1, 2 are both smaller than 0 and statistically significant. This means that large U.S. banks can withstand the impact of the epidemic better than small banks. As announced by Federal Reserve on Dec 2020, in the stress test, under the two scenarios of assuming a severe global recession, from the third quarter of 2020 to the third quarter of 2022, the 33 large U.S. banks tested will lose more than \$600 billion, large U.S. banks could still withstand the impact of the COVID-19 and the economic recession. In period 3, the coefficient becomes statistically insignificant, which means the size factor does not have much effect on returns of portfolio. This reveals that as the society still pays attention to COVID-19, the economic activities are adjusted to restart, struggling to reach a relatively stable state.

**Table 2.** Banking Industries' regression result of Fama-French Five Factor model. (From May 2019 to June 2022, made by author)

<b>Coefficient of 5-factor model of banking industry before epidemic</b>					
<b>Factor</b>	<b>Coefficient</b>	<b>Std err</b>	<b>t Stat</b>	<b>P value</b>	<b>R Square</b>
<b>Mkt-RF</b>	1.166	0.026	44.758	0.000	0.935
<b>SMB</b>	-0.135	0.048	-2.776	0.006	
<b>HML</b>	0.717	0.050	14.307	0.000	
<b>RMW</b>	-0.343	0.082	-4.165	0.000	
<b>CMA</b>	-0.261	0.096	-2.718	0.007	
<b>Coefficient of 5-factor model of banking industry after epidemic</b>					
<b>Factor</b>	<b>Coefficient</b>	<b>Std err</b>	<b>t Stat</b>	<b>P value</b>	<b>R Square</b>
<b>Mkt-RF</b>	1.078	0.022	47.958	0.000	0.962
<b>SMB</b>	-0.114	0.056	-2.039	0.043	
<b>HML</b>	1.037	0.047	22.255	0.000	
<b>RMW</b>	-0.207	0.095	-2.165	0.032	
<b>CMA</b>	-0.467	0.123	-3.789	0.000	
<b>Coefficient of 5-factor model of banking industry after vaccination</b>					
<b>Factor</b>	<b>Coefficient</b>	<b>Std err</b>	<b>t Stat</b>	<b>P value</b>	<b>R Square</b>
<b>Mkt-RF</b>	1.187	0.028	42.972	0.000	0.882
<b>SMB</b>	0.014	0.041	0.346	0.729	
<b>HML</b>	1.016	0.037	27.226	0.000	
<b>RMW</b>	-0.111	0.045	-2.448	0.015	
<b>CMA</b>	-0.743	0.064	-11.566	0.000	

### 3.2.3 HML<sub>t</sub> Coefficient

After the epidemic, the coefficient has increased significantly, and they are all statistically significant, indicating that the epidemic has led the market to prefer value stocks in banking industry. Companies with low book to market value ratio are relatively mature, which proves that the “certainty” under the epidemic has gradually become an important factor for investors' reference investment.

### 3.2.4 RMW<sub>t</sub> Coefficient and CMA<sub>t</sub> Coefficient

The profit factors RMW of three periods are all below than zero and decreasing stably, showing that the investors are more focused on defensive assets. The economic crisis triggered by the epidemic has exposed and exacerbated the financial vulnerability accumulated in the extremely low interest rates and volatile environment of the past decade. Due to the sharp increase in uncertainty, credit spreads across the market have generally widened as investors are reallocating funds from relatively risky assets to safer assets.

As for the increase of  $RMW_t$  Coefficient, this can be explained that the nominal interest rates have risen sharply, and long-term bond yields in U.S, a common indicator of investor sentiment, have returned to pre-epidemic levels.

The investment style factor decreases a lot and significantly smaller than 0, this is because the momentum and quality factors are the winners during the Covid 19 pandemic because they have a better risk-adjusted performance record, as is pointed out by Belén Nieto and Gonzalo Rubio [10].

## 4 Conclusion

This paper applies Fama-French Three factor Model to analyze the banking industry performance before and after the outbreak of COVID-19 and after the availability of COVID-19 vaccines. The results show that Fama-French Five Factor Model can better explain the performance. By analyzing the behavior of five factors, before and after the outbreak of COVID-19, all of the factors are statistically significant, affecting the returns of the portfolio. The market risk factor tend to be stable. The SMB factor become insignificant after the availability of COVID-19 vaccines because both large and small banks could withstand the impact of the COVID-19, economic activities are adjusted to restart. The increasing HML coefficient means the market still prefers value stocks in banking industry. The profit factor represents the market preference for safer assets, and the change of investment style factor insist the winning of momentum investment strategy in banking industry.

The stock market has proved to be able to surpass the influence of covid-19 and focus on other factors, investors also responded to strong fiscal and monetary stimulus. Although Omicron variant may affect the market in the short term, the long-term prospect is still optimistic. In the past two years, due to the negative news related to covid-19, the stock market has often suffered setbacks, but the fact shows that this trouble is temporary. Investors seem to be more concerned about broader economic trends, and the virus is only one of the factors. The epidemic of COVID-19 is another test of the resilience of banks. Once the urgent challenges related to the crisis subside, banks can take measures such as increasing charging revenue or cutting costs to alleviate the pressure on profits, but it may be very difficult to completely eliminate this pressure. At the same time, excessive risk-taking to make up for profits may set the stage for future problems. Therefore, policymakers must quickly find a balance between maintaining financial stability and the robustness of financial institutions. Various strategies should be considered to protect and enhance capital, including limiting dividends and share repurchases. There exists limitation that the period during the emergence of variants can be divided more in detailed.

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