

An Empirical Test of CAPM before and After the Pandemic Outbreak —The Case of American Stock Market

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ABSTRACT

In the context of the COVID-19 pandemic, the validity of the Capital Asset Pricing Model (CAPM) in the U.S. stock market before and after the COVID-19 pandemic outbreak is tested, aiming to help investors have a deeper understanding of the relationship between risk and return in the stock market when large-scale social disasters occur. The sample includes daily data for 49 U.S. industry portfolios over 36 months from September 2018 to August 2021, with a total of 754 observations. Through linear regression analysis, the author concludes that the timely implementation of quantitative easing and interest rate cut by the U.S. government played a role in stimulating the economy after the outbreak of the epidemic. Except for the gold portfolio, the other 48 sectors all demonstrated the validity of CAPM before and after the outbreak, and the validity increased after the outbreak. In addition, the post-outbreak U.S. stock market has been in a high-risk, high-return state for a long time. This research is helpful to the development of the topic and the construction of a specific knowledge network and provides references for future scholars to study related topics.

Keywords: Capital asset pricing model, American stock market, Portfolio returns

1. INTRODUCTION

For a long time, the balance between risk and return has always been the focus of financial and economic research. Risk is defined as the uncertainty between the production and the outcome of labor. In the investment world, the risk is the possibility that an investment's actual return differs from the investor's expected return. In the face of risk, if an investor makes a wrong decision, it may cause the investor's wealth to suffer a serious loss in an instant. Most rational investors are risk-averse, who are eager to have the highest possible return while facing the lowest possible risk. Therefore, determining the risk-return relationship and estimating the cost of equity has become an urgent need for investors and has also become the cornerstone of developing asset pricing models [1].

Capital Assets Pricing Model (CAPM) was developed by William Sharpe and three other American scholars in 1964 based on portfolio theory and capital market theory, mainly studying the relationship between risk and expected rate of return in the securities market and how equilibrium price is formed. CAPM is the pillar of modern financial market price theory, which is widely used in investment decision-making and corporate

finance [2]. It provides an analytical means for individual investors and investment institutions to conduct securities investment analysis and risk control [3].

After the CAPM model was put forward, it attracted the attention of many economists, and many people began to examine the model. However, in practice, the CAPM model has some inherent defects, such as too strict assumptions and ignoring non-systematic risks. All these lead to the randomness and one-sidedness of empirical research results, and scholars cannot give reasonable explanations for these research results with standard financial theories. Therefore, both the development analysis of modern financial theory and the demand of investors to make correct investment decisions in actual financial activities require researchers to conduct a more comprehensive analysis of CAPM [4]. It is precisely because of the continuous development of CAPM that a lot of capital is priced according to the CAPM model, thus promoting the development of the securities market. Investment practice, in turn, provides power and pressure for the continuous improvement of the model and constantly tests the correctness and applicability of the model [5].

The United States stock market is a good object of CAPM empirical research because of its continued prosperity in recent decades. With the help of the resource allocation function of the capital market, the U.S. economy has achieved industrial upgrading and fostered a batch of innovative enterprises. Throughout history, the U.S. stock market has experienced two large and far-reaching corrections and fluctuations: the bursting of the dot-com bubble in 2001 and the financial market turmoil triggered by the subprime mortgage crisis in 2008. However, due to the sound infrastructure and reasonable structure of the U.S. market, well-established risk diversification, hedging and management systems, and timely and appropriate regulatory measures, the market itself has a strong self-repair ability, and the overall market is not affected to the short-term fluctuations too much [6].

The global outbreak is another severe test for the American financial markets. Comparing the empirical test results of the CAPM model in the American stock market before and after the outbreak is helpful for investors to have a deep understanding of the relationship and rules between risk and return in the stock market when large-scale social disasters occur, and it provides an opportunity to test the correctness and applicability of CAPM model.

Using monthly and weekly data from 780 stocks on the New York Stock Exchange between March 1992 and May 2012, Abdulkarim tested the validity of the CAPM by the traditional first/second pass methodology. The difference of CAPM test results between static and rolling least-squares techniques was also examined. Abdulkarim found that the static OLS method could explain the risk premium better than the rolling OLS method [7]. In European, London Stock Exchange (LSE) and Budapest Stock Exchange (BSE) were researched by Arfa and Andor et al. respectively. Arfa reviewed and summarized the empirical test results of CAPM models in stock markets around the world by other scholars at first. Then, Arfa used the least square method to test the effectiveness of CAPM in the U.K. by using the stock returns of 70 companies registered in the LSE from 2004 to 2016. Arfa's empirical results indicated that risk did not affect portfolio return [8]. Andor et al. used the monthly data of 17 Hungarian companies listed on the BSE to give the empirical test results of CAPM in the Hungarian capital market and believed that in Hungary, CAPM's "realistic interpretation" ability lagged behind that of developed capital markets. Andor et al. said that it was difficult to determine whether the results were due to the fact of too little data, the application of data corrections, the explicit segmentation of the role of investors, or simply the general underdevelopment of domestic capital markets [9]. However, Modigliani et al. did the research in the both U.S. market and European market. Given the widespread perception that the European market is less efficient than the U.S. market,

Modigliani et al. used daily price and dividend data for 234 common stocks in eight major European countries from March 1966 to March 1971 to test the effectiveness of CAPM in these eight major European and U.S. stock markets, aiming to make a meaningful comparison between the European and U.S. markets. Despite the short test period and limited samples, Modigliani et al. found that in every market except Germany, there was a positive correlation between realized returns and risks. Therefore, Modigliani believed that even though CAPM was not the only dimension to test market efficiency, there was no evidence that European markets have become less rational or efficient [10].

Basu and Chawla believed that most CAPM tests were conducted in developed countries, so there was a lack of research on the risk-return relationship in emerging markets such as India, where the stock market was relatively volatile. Therefore, Basu and Chawla examined ten portfolios covering 50 stocks over five years from January 1, 2003, to February 1, 2008, to verify the efficiency and validity of the model. Basu and Chawla found that there was a negative correlation between beta and excess return, and the residual representing non-systemic risk was also significant in some cases, and finally concluded that: in India, where capital markets were inefficient, CAPM was not an appropriate model to describe asset prices [1]. As another area in developing country, Hong Kong was researched by Ma. Ma tried to find the actual validity of CAPM in explaining the excess returns of Hong Kong stocks through empirical analysis of the Hong Kong stock market. Ma selected the ten years from 2010 to 2020 as the research period and the stocks of 35 companies listed on the Hong Kong Stock Exchange as the research object. Simple linear regression analysis was used to analyze the monthly market excess return and the excess return of selected stocks. Ma found that in the Hong Kong market, the validity of CPAM was low, meaning that in addition to the market risk premium, the excess return of stocks in the Hong Kong market was significantly affected by other factors (unsystematic risks). In addition, CAPM was less useful for enterprises with high price volatility, such as high-tech enterprises and enterprises driven by economic cycles [11].

Chapter 2 introduces the research methodology, including research design, sample selection, model setting, and variable description. Chapter 3 presents the empirical results and related discussions. In chapter 4, the author describes the main findings, enlightenment, significance, and contribution of this paper and some suggestions for future research.

2. RESEARCH DESIGN

2.1 Research methods and design

All data required for the author's research are secondary data and are available on Kenneth R. French's website. Using the website, the author obtained the following data: average daily returns for the 49 selected industry portfolios before and after the pandemic outbreak; average daily returns for the market portfolio before and after the pandemic outbreak; average daily risk-free rate of return before and after the pandemic outbreak. The convenience of using this website is that it contains comprehensive data, and they are easy to be downloaded. The author can download the required data to the local computer in the form of CSV and conduct descriptive statistics and regression analysis after a series of data arrangements and processing in Excel.

2.2 Sample selection

Since the outbreak in the United States began in March 2020 and continues to the present, and the most recent data available on the website is from August 2021, the author set the post-outbreak study period as of March 2020 to August 2021 (18 months). To ensure consistency and comparability of the study, the 18 months before March 2020 were designated as the study period for the pre-outbreak reference group, i.e., September 2018 to February 2020.

2.3 Model setting and variable description

The CAPM model is best known as the following expression:

$$E[R_i] = R_f + \beta(E[R_m - R_f]) \tag{1}$$

It describes the linear relationship between the expected return of a single asset and the beta value (systemic risk coefficient) of the asset. $E[R_i]$ represents the expected return rate of a single asset while representing the return rate of the risk-free asset in the market. In empirical studies, this value is usually derived from the federal funds rate. $E(R_m)$ is the expected return rate of the market portfolio. β is the systemic risk borne by a single asset, which can be interpreted as the relative volatility of a single asset to the market.

The first step in the risk premium analysis of an asset using the CAPM model must be to transform the ex pre CAPM model into an ex-post form that can use historical data:

$$r_{it} - r_{ft} = \alpha_{it} + \beta_i(r_{mt} - r_{ft}) + \mu_{it} \tag{2}$$

Where μ_{it} represents residual. The author will use the least square method to estimate α and β . There are 49 portfolios in the sample, each with 374 return observations during each study period (pre-and post-outbreak), and the authors will run 49 regression analyses (one for each sector) to estimate the above equations.

3. EMPIRICAL RESULTS AND DISCUSSION

3.1 Descriptive statistics

The study was based on data from 49 U.S. industries from August 2018 to August 2021, with 374 pre-outbreak observations and 380 post-outbreak observations. The detailed industry classification information is shown in Table 1.

Table 1. Industry classification details

Industry	label	Industry	label
agric	Agriculture	guns	Defense
food	Food Products	gold	Precious Metals
soda	Candy & Soda	mines	Non-Metallic and Industrial Metal Mining
beer	Beer & Liquor	coal	Coal
smok	Tobacco Products	oil	Petroleum and Natural Gas
toys	Recreation	util	Utilities
fun	Entertainment	telcm	Communication
books	Printing and Publishing	persv	Personal Services
hshld	Consumer Goods	bussv	Business Services
clths	Apparel	hardw	Computers
hlth	Healthcare	softw	Computer Software

medeq	Medical Equipment	chips	Electronic Equipment
drugs	Pharmaceutical Products	labeq	Measuring and Control Equipment
chems	Chemicals	paper	Business Supplies
rubbr	Rubber and Plastic Products	boxes	Shipping Containers
txtls	Textiles	trans	Transportation
bldmt	Construction Materials	whlsl	Wholesale
cnstr	Construction	rtail	Retail
steel	Steel Works Etc	meals	Restaurants, Hotels, Motels
fabpr	Fabricated Products	banks	Banking
mach	Machinery	insur	Insurance
elceq	Electrical Equipment	rlest	Real Estate
autos	Automobiles and Trucks	fin	Trading
aero	Aircraft	other	Almost Nothing
ships	Shipbuilding, Railroad Equipment		

In addition, Table 2 and Table 3 below completely show the properties of R_i , $(R_m - R_f)$ and R_f : mean,

median, standard deviation, maximum and minimum. There are great differences among them, which is worthy of further exploration.

Table 2. Descriptive statistics of daily returns for 49 portfolios before and after the outbreak

Industry	Mean		Std. Dev.		Min		Max	
	before	after	before	after	before	after	before	after
agric	-0.045	0.089	1.133	2.037	-4.280	10.640	5.020	8.840
food	-0.006	0.105	0.947	1.520	-2.920	-8.610	8.940	7.810
soda	0.057	0.263	1.947	2.425	-6.530	11.460	16.520	8.660
beer	-0.004	0.152	1.356	1.727	-3.990	10.170	12.400	7.850
smok	-0.008	0.149	1.617	2.079	-5.850	11.880	6.510	10.410
toys	-0.070	0.443	1.363	2.619	-4.330	10.910	4.320	21.130
fun	-0.034	0.284	1.167	3.264	-5.520	19.330	3.630	14.720
books	-0.054	0.197	1.562	2.584	-4.660	14.630	17.920	8.910
hshld	-0.031	0.247	1.074	2.280	-3.590	12.350	3.430	8.400
clths	-0.030	0.230	1.358	2.944	-4.680	15.410	5.380	13.070
hlth	0.016	0.247	1.298	2.829	-4.330	15.860	5.090	31.710
medeq	-0.057	0.237	1.228	2.112	-3.870	10.970	4.630	8.090
drugs	0.004	0.221	1.521	2.388	-4.960	12.180	5.820	9.160
chems	-0.070	0.256	1.358	2.428	-5.540	11.760	4.860	8.260
rubbr	0.013	0.317	1.385	2.208	-4.250	12.720	11.740	11.950
txtls	-0.050	0.213	1.600	2.689	-5.440	14.840	7.250	10.490
bldmt	-0.004	0.208	1.303	2.537	-4.960	13.430	9.120	12.980
cnstr	0.017	0.269	1.324	3.006	-4.660	18.330	4.820	13.830
steel	-0.082	0.243	1.540	2.904	-4.990	13.250	5.400	9.300
fabpr	-0.126	0.171	1.648	3.240	-5.270	15.320	7.240	16.280

mach	-0.037	0.220	1.376	2.534	-4.700	12.680	4.610	10.780
elceq	-0.002	0.313	1.343	2.800	-4.250	13.530	4.220	11.310
autos	-0.051	0.275	1.500	2.651	-5.440	12.830	4.590	10.610
aero	0.011	0.205	1.264	3.218	-5.320	14.770	4.170	15.800
ships	-0.114	0.202	1.649	2.760	-5.660	13.170	5.950	9.510
guns	-0.020	0.227	1.347	2.160	-5.320	-8.950	5.110	11.590
gold	0.031	0.285	2.500	3.990	-9.490	14.000	7.600	28.020
mines	-0.103	0.289	1.746	3.360	-5.670	16.410	6.170	12.870
coal	-0.335	0.414	2.207	4.062	-7.480	14.230	8.630	19.770
oil	-0.278	0.330	2.339	4.572	-6.450	27.570	12.680	23.740
util	0.022	0.089	0.828	2.034	-4.390	11.740	2.100	12.540
telcm	-0.048	0.217	1.166	2.326	-4.380	11.620	4.150	8.620
persv	-0.019	0.191	1.114	2.573	-3.650	14.770	4.150	10.730
bussv	-0.027	0.248	1.021	2.322	-3.820	13.630	3.980	8.420
hardw	0.020	0.265	1.352	2.520	-3.970	14.130	7.990	13.900
softw	0.012	0.254	1.265	2.105	-4.600	11.520	4.720	8.500
chips	0.017	0.286	1.291	2.282	-4.240	10.660	3.910	9.610
labeq	0.008	0.267	1.140	2.056	-3.610	11.550	4.210	12.120
paper	-0.057	0.166	1.300	2.523	-3.720	13.300	6.270	9.440
boxes	-0.033	0.123	1.357	2.348	-5.070	11.500	3.950	10.870
trans	-0.102	0.200	1.355	2.465	-5.290	11.840	4.030	11.960
whlsl	-0.060	0.237	1.112	2.360	-4.340	11.280	3.560	9.500
rtail	-0.083	0.320	1.314	2.510	-4.310	12.860	5.010	12.220
meals	-0.039	0.224	0.935	3.038	-4.360	19.540	2.840	17.340
banks	-0.025	0.148	0.940	2.626	-4.320	13.110	3.090	9.990
insur	0.001	0.115	0.901	2.197	-3.760	12.770	3.560	11.470
rlest	-0.024	0.215	1.117	2.579	-3.720	16.000	3.730	10.110
fin	0.005	0.239	1.040	2.245	-3.670	13.330	3.880	10.710
other	0.008	0.244	1.078	2.133	-3.450	12.840	6.260	9.150

Table 3. Descriptive statistics of $(R_m - R_f)$ AND R_f before and after the outbreak

	Mean		Std. Dev.		Min		Max	
	before	after	before	after	before	after	before	after
mktrf	0.004	0.141	1.014	1.818	-4.220	-12.000	5.060	9.340
rf	0.008	0.000	0.001	0.001	0.006	0.000	0.010	0.006

Observing Table 2, the author found an "oddities": the average daily returns of most industry portfolios increase to a certain extent and turn from negative to positive after the outbreak, which does not conform to the general logic that the epidemic will bring negative impact on returns of portfolios. Generally, the outbreak of the epidemic will cause a huge impact on the production, transportation, sales, and other links of various industries, and the consumption level of the public will fall sharply, thus making the stock market performance not optimistic. In response, the Federal Reserve released a \$190 trillion

program designed to subsidize citizens, stimulate overall consumption, and avoid a break in the consumption chain.

According to Pew Research results, 30% of American adults have seen their finances improve since free money became available in the U.S. In addition, 50 percent of citizens said their financial situation was as good as before. Even two-thirds of low-income people say their financial situation is as good or better than it was before the outbreak. Another survey found that millions of people joined the stock market for the first time during

the pandemic outbreak, hoping to accumulate wealth as the S&P 500 soared. The "oddities" in Table 2 are evidence that the quantitative easing policy does work.

The data collected by the author show that the risk-free rate in the U.S. has been adjusted to 0% since April 2020. This rate refers to the federal funds rate. If that rate goes up, banks will also charge more to lend money to companies and individuals. On the other hand, when the interest rate decrease, it would be less costly for companies and individuals to borrow money. Cutting interest rates when the economy is weak and pumping more liquidity into the market can stimulate the economy, so the effect of this policy is to stimulate companies and individuals to lend more, resulting in the economy becoming relatively active. The Federal Reserve adjusts interest rates to achieve one goal: to maintain maximum employment and price stability in the United States [12].

Although the liquidity brought by the rate cut alleviates financial market anxiety, it cannot solve the supply problems caused by the epidemic, such as production stagnation. As Bernard Baumle, chief global economist at the Economic Outlook Group, said, "The Fed cutting rates is like putting a Band-Aid on your arm to cure a headache" [13].

By observing the latter part of Table 2, the author finds that the standard deviation of daily returns of all industry portfolios has increased significantly after the outbreak, and the minimum value of returns has become smaller, while the maximum value of daily returns of some industries has become larger. The outbreak of the epidemic did cause turmoil to the entire market. The stock market turbulence coupled with the Federal Reserve's combination of "interest rate cut + quantitative easing," this extremely expansionary monetary policy is easily reminiscent of the 2008 financial tsunami.

3.2 Pre-outbreak regression analysis

Using the data before the outbreak of the epidemic and taking the excess return on individual assets ($r_i - r_f$) as the dependent variable and the excess return on the market ($r_m - r_f$) as the independent variable, the regression analysis is conducted, and the model formula is as follows:

$$r_i - r_f = \alpha + \beta (r_m - r_f) \tag{3}$$

Regression results are shown in Table 4.

Table 4. Regression statistics (before outbreak)

Industry	α	p-value	β	p-value	R^2	Industry	α	p-value	β	p-value	R^2
agric	0.056	0.240	0.649	0.000	0.338	guns	0.032	0.566	0.812	0.000	0.374
food	0.017	0.680	0.513	0.000	0.302	gold	0.022	0.863	0.004	0.973	0.000
soda	0.045	0.617	0.844	0.000	0.193	mines	0.116	0.090	1.133	0.000	0.434
beer	0.014	0.819	0.589	0.000	0.194	coal	0.348	0.001	1.001	0.000	0.212
smok	0.019	0.812	0.576	0.000	0.130	oil	0.293	0.002	1.424	0.000	0.381
toys	0.082	0.126	0.882	0.000	0.431	util	0.011	0.753	0.430	0.000	0.278
fun	0.046	0.245	0.871	0.000	0.573	telcm	0.060	0.115	0.888	0.000	0.598
books	0.065	0.352	0.771	0.000	0.251	persv	0.031	0.428	0.807	0.000	0.540
hshld	0.042	0.223	0.826	0.000	0.609	bussv	0.039	0.091	0.904	0.000	0.806
clths	0.043	0.353	1.013	0.000	0.572	hardw	0.008	0.853	1.084	0.000	0.661
hlth	0.004	0.931	0.918	0.000	0.515	softw	0.001	0.985	1.095	0.000	0.771
medeq	0.069	0.128	0.852	0.000	0.496	chips	0.004	0.911	1.074	0.000	0.712
drugs	0.009	0.870	1.091	0.000	0.529	labeq	0.004	0.885	0.962	0.000	0.734
chems	0.083	0.042	1.094	0.000	0.668	paper	0.069	0.158	0.882	0.000	0.474
rubbr	0.002	0.975	0.681	0.000	0.249	boxes	0.045	0.368	0.945	0.000	0.499
txtls	0.061	0.400	0.756	0.000	0.230	trans	0.115	0.006	1.075	0.000	0.648
bldmt	0.016	0.726	0.924	0.000	0.518	whlsl	0.072	0.029	0.903	0.000	0.678
cnstr	0.005	0.921	0.934	0.000	0.512	rtail	0.095	0.040	0.950	0.000	0.538
steel	0.096	0.064	1.161	0.000	0.585	meals	0.050	0.109	0.707	0.000	0.588
fabpr	0.138	0.049	0.929	0.000	0.327	banks	0.036	0.257	0.702	0.000	0.574
mach	0.050	0.191	1.147	0.000	0.716	insur	0.010	0.654	0.768	0.000	0.749
elceq	0.015	0.754	0.977	0.000	0.545	rlest	0.036	0.357	0.814	0.000	0.547
autos	0.064	0.239	1.060	0.000	0.514	fin	0.007	0.808	0.874	0.000	0.727
aero	0.001	0.972	0.946	0.000	0.577	other	0.004	0.926	0.731	0.000	0.473
ships	0.127	0.054	1.042	0.000	0.411						

An obvious feature in Table 4 is that, except for the p-value of β in the gold industry portfolio, all the other p-values are equal to 0, meaning that they are all significant at the level of 1%. It can be explained as the market excess return has statistical significance in explaining the excess return of individual stocks, while it has no explanatory significance in the gold industry. The gold market has several peculiarities. First, the daily trading volume of gold exceeds \$20 trillion. No one or syndicate can control it. Second, gold transactions spread around the world, allowing investors to buy and sell around the clock. Third, gold is regarded as a haven, appreciating when paper currencies wobble and lose value as a result of the credit crisis. Given these particularities of the gold market, it is not surprising that it is the only industry that does not conform to the CAPM model.

Excluding the R^2 gold industry portfolio, the R^2 individual stocks fluctuated between 0.130 and 0.805. R^2 is an evaluation index reflecting the fitness of the regression equation to the observations. The closer R^2 is to 1, the better the fitting regression effect of the model is. Generally, when R^2 is greater than 75%, the model is considered to have a high degree of fit, and when R^2 is less than 25%, it can be judged as a low degree of fit. The results in table 3 show that CAPM is quite different in explaining the excess returns of different assets. Seven portfolios (including gold) scored R^2 below 25%, only two portfolios (BusSV and Softw) scored R^2 above 75%, and all other portfolios scored R^2 between 25% and 75%.

3.3 Post-outbreak regression analysis

Regression analysis was performed with the data after the outbreak, and the results were shown in Table 5:

Table 5. Regression statistics (after outbreak)

Industry	α	p-value	β	p-value	R^2	Industry	α	p-value	β	p-value	R^2
agric	0.031	0.646	0.851	0.000	0.576	guns	0.129	0.156	0.688	0.000	0.335
food	0.004	0.918	0.709	0.000	0.719	gold	0.162	0.391	0.869	0.000	0.157
soda	0.122	0.144	0.995	0.000	0.557	mines	0.106	0.392	1.298	0.000	0.493
beer	0.055	0.373	0.679	0.000	0.511	coal	0.238	0.172	1.248	0.000	0.312
smok	0.030	0.678	0.835	0.000	0.533	oil	0.120	0.528	1.487	0.000	0.349
toys	0.319	0.003	0.877	0.000	0.371	util	0.043	0.460	0.933	0.000	0.695
fun	0.100	0.387	1.301	0.000	0.525	telcm	0.071	0.316	1.035	0.000	0.655
books	0.056	0.557	0.992	0.000	0.487	persv	0.032	0.691	1.124	0.000	0.631
hshld	0.102	0.133	1.026	0.000	0.669	bussv	0.093	0.130	1.098	0.000	0.739
clths	0.058	0.564	1.215	0.000	0.563	hardw	0.097	0.150	1.184	0.000	0.730
hlth	0.070	0.420	1.251	0.000	0.647	softw	0.112	0.037	1.007	0.000	0.757
medeq	0.109	0.110	0.908	0.000	0.610	chips	0.134	0.029	1.074	0.000	0.731
drugs	0.087	0.310	0.947	0.000	0.520	labeq	0.129	0.018	0.973	0.000	0.740
chems	0.102	0.158	1.093	0.000	0.670	paper	0.018	0.834	1.042	0.000	0.564
rubbr	0.191	0.014	0.890	0.000	0.537	boxes	0.024	0.742	1.036	0.000	0.643
txtls	0.064	0.512	1.055	0.000	0.509	trans	0.044	0.552	1.102	0.000	0.660
bldmt	0.041	0.557	1.185	0.000	0.721	whsl	0.085	0.212	1.075	0.000	0.686
cnstr	0.083	0.376	1.317	0.000	0.634	rtail	0.164	0.036	1.102	0.000	0.637
steel	0.075	0.457	1.188	0.000	0.553	meals	0.047	0.650	1.253	0.000	0.562
fabpr	0.025	0.855	1.034	0.000	0.337	banks	0.009	0.916	1.109	0.000	0.590
mach	0.051	0.452	1.188	0.000	0.726	insur	0.036	0.505	1.066	0.000	0.778
elceq	0.153	0.121	1.128	0.000	0.537	rlest	0.054	0.499	1.139	0.000	0.644
autos	0.114	0.184	1.134	0.000	0.605	fin	0.085	0.124	1.084	0.000	0.771
aero	0.025	0.828	1.270	0.000	0.515	other	0.111	0.093	0.939	0.000	0.640
ships	0.043	0.654	1.126	0.000	0.550						

After the outbreak of the epidemic, the p-value of the β of all industry portfolios, including gold, is equal to 0. At this time, the market excess return has statistical significance in explaining the excess return of individual

assets. The R^2 of individual assets ranged from 0.157 (gold) to 0.778 (insur). Coal has the lowest R^2 after gold, with a value of 0.312 (greater than 25%), so the gold industry is still a special existence. Three industry

portfolios have R^2 scores higher than 75%: softw, Insur, and fin.

3.4 Comparison of regression analysis before and after the outbreak

The β from the post-outbreak regression analysis (excluding the gold industry) are plotted in Figure 1:

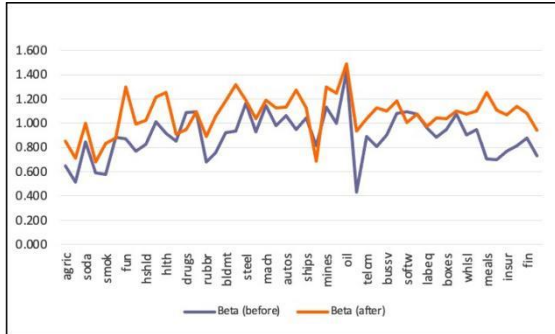


Figure 1 Beta comparison without gold

The author found that, except for a few industries, the β of the portfolios of most industries increased, and the industries with the biggest changes are meals, fun, banks, etc., whose β values all change from smaller than 1 to greater than 1. The β is known as a tool to assess the systemic risk of portfolios, which measures the volatility of a security or an investment portfolio relative to the overall market. The real meaning of β is a measure of systemic risk for a particular asset. The so-called systemic risk refers to the price fluctuation of assets affected by overall factors such as the macroeconomy and market sentiment [14]. The value of β indicates the volatility of returns, thus indicating the degree of its risk. The asset with a large β has a large risk, and the asset with a small β has a small risk. Stocks with β less than one are called defensive securities; stocks with β larger than one are called defensive securities. If the β of an asset exceeds 1.5 or above, it is considered a high-risk stock.

The phenomenon that β of industry portfolios in the market all become higher indicates that after the outbreak, the systemic risks of industry portfolios have generally increased, and the investment risks have increased, but the risk returns have also increased relatively. To invest during the pandemic, investors need to control their risk and focus on choosing portfolios with strong resilience.

The R^2 obtained from the post-outbreak regression analysis (excluding the gold industry) are plotted in Figure 2:

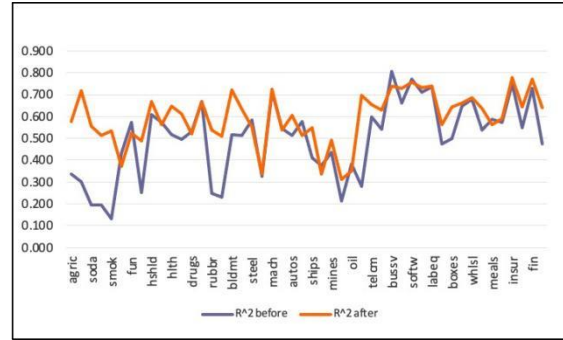


Figure 2 R^2 comparison without gold

R^2 gives the degree of variability of the target variable, explained by the model or independent variable. If the value is 0.7, it means that the independent variable explains 70% of the variation in the target variable. Figure II intuitively shows that value also generally increases after the outbreak, indicating that the CAPM model in the U.S. market becomes more effective after the outbreak.

4. CONCLUSION

This study examines the effectiveness of CAPM in the United States through a regression analysis of portfolio returns for 49 industries before and after the pandemic outbreak. The author uses Fama and Macbeth method to test the CAPM model.

First, the authors found that the average daily return of portfolios in most industries increased by some degree after the outbreak. In addition, the standard deviation of average daily earnings rose sharply in almost all industries. In the regression analysis, the author found that the gold industry was a special existence, which did not conform to the regression model of CAPM before the outbreak but did conform to the regression model after the outbreak, with a low fitting degree. Other industries have confirmed the effectiveness of the CAPM model both before and after the outbreak, and the degree of fit of the model has increased after the outbreak. Finally, the authors find that the β of portfolios have increased in almost all industries.

The above empirical results bring some enlightenment to the author. Although the data showed that the outbreak of the epidemic did bring a lot of shock to the U.S. market, the U.S. government timely a set of "quantitative easing + interest rate cut combination" played a role in stimulating the economy. After the implementation of the policy, the market has not become more stable, and it continues to be in a state of high risk and high return. Speculators can take advantage of the stock market volatility to make huge profits, but the stock price boom, which has been separated from the real economy for a long time, will cause problems for the U.S. market sooner or later.

Outbreak since it has been one and a half years, but the author in the process of the literature found that the topic of literature is less, and the differences of sample data, study period, and selected industry make the subject have no clear conclusion. This research is helpful to the development of the topic and the construction of a specific knowledge network and provides references for future scholars to study related topics.

Future research can further study the industries with the biggest changes in β after the outbreak of COVID-19, and explore the specific reasons for the changes, to provide suggestions for the development of specific industries in the event of major social disasters.

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