

Empirical Research based on the Asset Pricing Model in China's Securities Market under the COVID-19 Epidemic

Chenqi Li^{1, †}, Tong Shi^{2, *, †}, Zilin Wang^{3, †}

¹ Beijing Foreign Studies University, International Organizations, Beijing, China

² Anhui University, Applied Statistics, Hefei, China

³ University of Science and Technology Beijing, School of Economics & Management, Beijing, China

*Corresponding author: st_oct08@163.com

†These authors contributed equally.

Abstract. This paper explores the empirical research based on the asset pricing model in China's securities market under the COVID-19 epidemic. Capital asset pricing model, which are frequently employed in corporate finance and investment decision-making, serve as the foundation for price theory in financial markets. However, the research on asset pricing models in China is still in its infancy, and there is a lack of detailed and profound empirical studies. The COVID-19 epidemic causes some economic damage to China's securities market. Therefore, the empirical research in the era of the epidemic is necessary, and it can help investors find suitable investment portfolios. Using asset pricing models and related indicator formulas, the results of the study show that the risk of bond funds, blend funds, and stock funds, in addition to monetary funds, increases with the arrival of COVID-19. Among them, blend funds and stock funds have better performances, but the operational risk of these three types of funds outweighs the return.

Keywords: Empirical research; capital asset pricing model; beta coefficient; Sharp ratio; Treynor ratio.

1. Introduction

In the 1960s, Sharpe proposed the famous Capital Asset Pricing Model (CAPM) based on asset investment theory, combining the market portfolio principle, the two-fund separation theorem and the market equilibrium principle. It is of great significance to modern financial market price theory [1]. However, the research on capital asset pricing model in China is still in the initial stage of development, and the securities market is not mature enough. Most scholars' research results focus on the influencing factors of capital asset pricing models. The results of these theoretical studies are not necessarily applicable to China at this stage. Some scholars have conducted empirical research on capital asset pricing models in Shenzhen and Shanghai stock markets, and most of the time range involved was before the occurrence of the COVID-19. Investigating the CAPM model's applicability in the epidemic period on the Chinese stock market is important from a practical standpoint. From the perspective of investors, considering the suitability of capital asset pricing model for Chinese securities market at this stage will help to provide a new investment perspective, establish a more reliable scientific investment foundation, correctly analyze portfolio investment issues, consider whether it is necessary to change the investment portfolio, and reduce investment risks and improve returns to a certain extent. From the national level, the study of this topic can help to understand the applicability of CAPM model for Chinese securities market more comprehensively, and help to find a more suitable asset pricing model for China at this stage. At the same time, we should prevent the major impact of similar events on the securities market and reduce the financial losses caused by emergencies in the future.

In comparison to the other pandemics, COVID-19 requires more research. Foreign scholars have done some research on this. Regarding COVID-19's effects on the financial markets, Ramelli and Wagner (2020) analyzed the early 2020 performance of several stocks. [2]. The stocks of businesses with China initially were affected the most, but afterwards businesses stocks with significant

indebtedness and low liquidity suffered the most. Due to the abrupt and massive capital outflow, Beirne et al. showed that emerging economy in Asian and European countries were more seriously influenced by the epidemic than industrialized countries [3]. According to Al-Awadhi et al., all stock returns are significantly impacted negatively by the daily rise in the number of confirmed illnesses and fatalities brought on by the COVID-19 virus [4]. Intriguingly, Arteaga-Garabito et al. (2021) discovered that the dissemination of Covid-related news generally benefits the stock market in many nations, regardless of whether the news is good or bad [5]. This study provides an initial assessment of the impact of Covid-19 on the alpha and beta estimations for the four main categories of China stock exchange traded funds. Its results will support CAPM investigations of stock return trends.

Since the COVID-19, there have been also a number of domestic existing research on the impact of COVID-19 on the Chinese securities market. Ho et al. studied how the Chinese stock market reacts to COVID-19 vaccine approvals, and sectors are influenced in different ways. In the aggregate, the price of the stock was positively affected [6]. As for COVID-19 Chinese equity indices and futures markets in the era of the epidemic, the dynamical fore-lag relations for leapfrogging is investigated and the COVID-19 caused a variation on the lead-lag structure [7]. Chen used event study to quantitatively analyze all A-shares listed companies and finds impacts of the COVID-19 on the abnormal revenue changes of listed companies in different industries, listing boards, and different locations in China [8]. Meanwhile, Su and Zhang used MSGARCH-EVT-Copula model to study the interdependent structure of Chinese and global stock markets [9]. In the short term, the COVID-19 will generate negative effect on the stock market and a positive impact on the bond market [10]. The combination of insurance and capital markets can help expand the capacity and scope of coverage, especially in COVID-19 [11]. In conclusion, the impact of COVID-19 on the Chinese securities market is complex and diverse. On the other hand, there are a number of existing studies based on the CAPM model for the Chinese securities market. Li found that CAPM model has higher validity with smaller span of sample time intervals [12]. However, Zhang found that the CAPM model is not fully applicable in China's securities market using the daily returns of the underlying funds of financing and financing as sample data [13]. Moreover, Liu et al. found that the β value of CAPM is positively correlated with the company's age through the study of China's A-share market [14].

This topic is innovative and practical. According to the literature, it is found that the conclusions of the existing studies on the applicability of asset pricing model in China's securities market are not completely unified. Therefore, the article selects four types of funds under the specified time as samples for empirical testing, and it is of great significance to explore the applicability of CAPM model in Chinese securities market in the era of epidemic.

2. Methodology

2.1 The Capital Asset Pricing Model (CAPM)

The Capital Asset Pricing Model (CAPM) is used to describe the relationship between systematic risk and expected return for assets in this paper:

$$ER_i = R_f + \beta_i(ER_M - R_f) \quad (1)$$

Where ER_i = expected return of investment; R_f = risk-free rate; β_i = beta of the investment; and $(ER_M - R_f)$ = market risk premium. The time value of money is taken into consideration by the risk-free rate in the formula. The additional risk that the investor assumes is taken into account by the other components. Beta indicates how much risk a possible investment will add to a portfolio that resembles the market. CAPM determines the appropriateness of a stock's value by comparing the expected return and risk of the stock with the time value of money.

2.2 Treynor Ratio

This paper uses the Treynor ratio to determine how much excess return was generated for each unit of the portfolio is taking:

$$T = (R_p - R_f) / \beta_p \quad (2)$$

where R_p =return of portfolio; R_f = risk-free rate; β_p =beta of the portfolio. The risk-free return in the Treynor ratio is represented by Treasury bills. Risk is systematic risk as determined by the beta of a portfolio. Beta measures the tendency of a portfolio’s return to change in response to changes in return for the overall market. The Treynor ratio attempts to measure the extent to which an investment effectively compensates investors for the risk they take on the investment. The beta of a portfolio, or the sensitivity of its returns to market movements, is utilized by the Treynor ratio to evaluate risk.

2.3 Sharpe Ratio

The paper uses Sharpe Ratio to calculate the average return earned in excess of the risk-free rate per unit of volatility or total risk:

$$\text{Sharpe Ratio} = (R_p - R_f) / \sigma_p \quad (3)$$

where R_p = return of portfolio; R_f = risk-free rate; σ_p =standard deviation of the portfolio’s excess return. The Sharpe ratio can be used to determine whether a portfolio's superior returns are the result of wise investment choices or undue risk. A portfolio or fund may outpace its peers when it comes to returns, but this is simply a wise investment, provided that the higher returns do not come at the expense of an unacceptably high level of risk.

3. Results and Discussion

This paper uses the CSI 300 as the market return to calculate the beta coefficients of the sample funds in the four periods about the epidemic, namely Before COVID-19 (2019 Q1-2019 Q3), COVID-19 Outbreak (2019 Q4-2020 Q2), COVID-19 Control (2020 Q3-2021 Q2), and COVID-19 Prevention (2021 Q3-2022 Q2).

This paper sampled the quarterly net value gains of each of the 15 funds from Q4 2019 to Q2 2022 from each of the 4 fund categories (monetary funds, bond funds, blend funds, and stock funds). Data from Tiantian Fund Network.

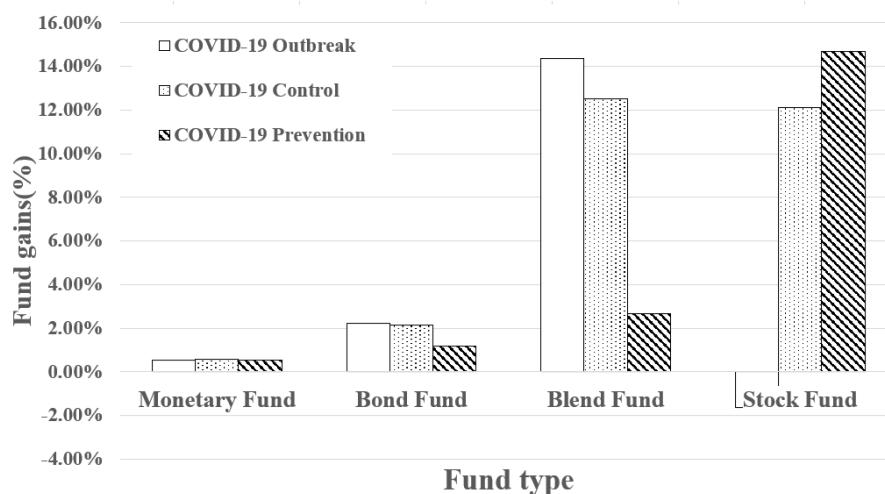


Fig. 1 The average gains of different funds in three periods under COVID-19

After preliminary analysis of the sample a bar chart comparing the quarterly gains of the sample funds can be made. As Figure 1 shows, monetary funds and bond funds have roughly stable growth rates due to their stable and low returns. Blend funds and stock funds, on the other hand, have fallen and risen more because of their greater riskiness.

This paper also fit a linear trend for the blend and stock funds and found that the overall trend for the equity funds in the sample was up, even though there were large declines in the first quarter of 2020 and 2021. In contrast, the overall trend of the sample's blend funds' increase is down.

In addition to this, this paper also finds that there are fund declines in the first quarter of the three years 2020, 2021 and 2022, and the epidemic control is the main reason for this result, which makes it meaningful to study the feasibility of the CAPM model for the Chinese security market in the post-epidemic era.

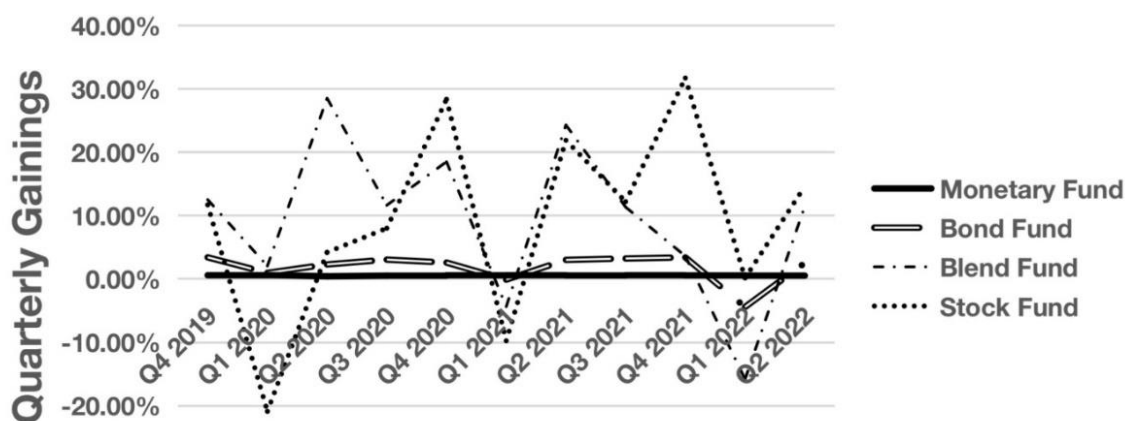


Fig. 2 The trend of gains for sample funds

From Figure 2, it can be seen that the stock fund was volatile with losses in early 2020 and early 2021. By contrast, blend stock's volatility is relatively small, except for early 2022, the gains are basically positive. The earnings of the monetary fund and the bond fund are relatively stable, while the yield is also low. Stable investors are also looking for new solutions and paying more attention to the blend fund. The return rate of blend fund is higher, and its fluctuation is relatively lower than that of stock fund, which shows its superiority in asset allocation. In 2020, the epidemic catalyzed the strength of the pharmaceutical sector. The market generally lowered its expectations in early 2021. However, there are still many funds that maintain high yields. When selecting a fund, historical results are more of a reverse selection. The performance chart is only a performance, Historical results do not represent the future. Investors still need to be cautious.

Table 1. Data feature of the total increase

Fund Type	Average	Median	Variance
Monetary Fund	6.03%	0.56%	<0.01
Bond Fund	20.04%	16.21%	<0.01
Blend Fund	103.87%	98.17%	0.01
Stock Fund	102.27%	96.00%	0.02

It can be seen from Table 1 that the total increase in the epidemic era is positive and the overall trend is upward. Among them, the average and median of the total increase of stock funds and blend funds are similar, which is quite different from the data of monetary funds and bond funds. The fact proves the highly-paid characteristics of stock funds and blend funds. From the variance data, it can be seen that the quarterly average variance of currency growth is very small and highly stable. The total increase of blend funds is similar to that of stock funds, and the increase fluctuation is relatively

unstable, which is in line with the highly-risk characteristics of stock funds and blend funds, but blend funds are more stable than stock funds. In the era of epidemic, CAPM model can be used to explore the applicability of different types of funds in China's securities market and find the most suitable portfolio.

Table 2. Blend Fund beta coefficients for four periods before and after COVID-19

Fund Code	Before	Outbreak	Control	Prevention
005940	0.755	1.843	2.541	0.816
519702	0.824	1.328	0.166	0.554
550009	0.976	0.945	0.961	1.220
519005	1.063	0.815	0.862	1.505
000061	0.870	0.812	0.461	0.696
005165	0.538	1.091	1.343	1.096
163804	0.740	0.519	0.729	1.471
700003	1.019	1.241	1.057	1.637
001856	1.067	1.521	1.844	1.336
005730	0.450	0.312	0.673	0.862
001959	1.035	0.382	1.672	0.107
004394	1.204	0.944	0.690	1.072
005261	0.440	0.809	0.477	0.644

As Table 2 shows, the beta coefficients of different blend funds vary under the influence of COVID-19. Plenty of funds have a gradually increasing beta coefficient after the outbreak of COVID-19, while others have a relatively stable beta coefficient, and some even fall. Then, this study averages the beta coefficients of the collected stock fund, blend fund, monetary fund and bond fund separately.

Table 3. The average beta coefficient of the sample for the four periods

Fund Type	Before	Outbreak	Control	Prevention
Stock Fund	0.845	1.009	1.031	1.032
Blend Fund	0.798	1.277	1.671	0.967
Monetary Fund	0.001	-0.006	-0.001	-0.001
Bond Fund	0.176	0.077	0.154	0.313

As can be seen from Table 3 that the average of monetary funds and bond funds beta coefficient is less than one and the change range is very small, which means that the fluctuation of the net value of the two fund portfolios is less than that of the whole market, and the fluctuation range is relatively stable. It can be noted that the average beta coefficient of monetary funds after the COVID-19 outbreak is less than zero, which means that the fund is negatively correlated with the market. When market returns rise, the return on assets is less than zero.

Besides, as shown in Table 3, in general, the arrival of COVID-19 increases the beta index of both stock and blend funds to some extent, which means that the risk volatility of funds in the market is greater under the influence of COVID-19.

With the changing situation of epidemic prevention, the beta coefficients of both stock and blend funds remain around 1 during the COVID-19 prevention phase, which means that the risks of each fund are hedged to some extent.

In summary, COVID-19 has some impact on the Chinese securities market, and the adaptive change of CAPM in the Chinese securities market is a point of concern.

Table 4. The average beta coefficient of the sample for the four funds

Fund Type	2019	2020	2021
Monetary Fund	0.001	-0.004	-0.001
Blend Fund	0.729	0.829	1.355
Stock Fund	1.733	0.733	1.033
Bond Fund	0.311	0.138	0.071

As shown in Table 4, the monetary fund has the lowest beta index of the four types of funds, indicating that it is the least volatile and risky in comparison to the market. However, the average beta index for 2020 and 2021 to date is negative, indicating that the trend has diverged from the market in a different direction. The stock fund has the highest beta index, on the other hand. The fund's beta index is higher than 1.0, indicating greater risk and potential for larger return. Because blend funds have a greater beta index than bond funds, they often experience fewer volatility than the market. The risk is higher than the monetary index but lower for stock funds.

Table 5. Fund Performance Evaluation Indicators

Fund type	Treynor ratio	Sharp ratio
Monetary Fund	<0.00	<0.00
Bond Fund	0.04	0.08
Blend Fund	0.08	0.65
Stock Fund	0.20	0.51

As shown in Table 5, stock funds and blend funds performed better and were good investment choices. Of these four types of funds, both Sharp and Treynor ratio for monetary funds are less than zero, which are not indicative. For the Treynor ratio, the blend funds perform best, which means that it gains the highest excess return per unit of systematic risk taken. For the Sharpe ratio, the stock funds perform best, which represents the highest return the fund can earn for the risk which it takes.

Table 6. Funds of Top 10 Yield Rankings

Fund code	Fund type	Total increase	Beta coefficient
005940	Blend	1.59	1.70
000828	Blend	1.52	1.32
001790	Stock	1.47	1.13
000409	Stock	1.42	0.86
700003	Blend	1.38	1.25
001856	Blend	1.38	1.39
004997	Stock	1.26	0.06
001576	Stock	1.24	0.95
550009	Blend	1.23	1.25
519702	Blend	1.20	0.72

As shown in Table 6, the ten funds with the highest returns in the sample during the epidemic period are all of the types of stock and blend. Of these ten funds, six funds are stock-type and four are blend-type. The beta coefficients of these ten stocks were relatively close to each other, fluctuating around 1, in line with the high return and risk characteristics of stock and blend funds.

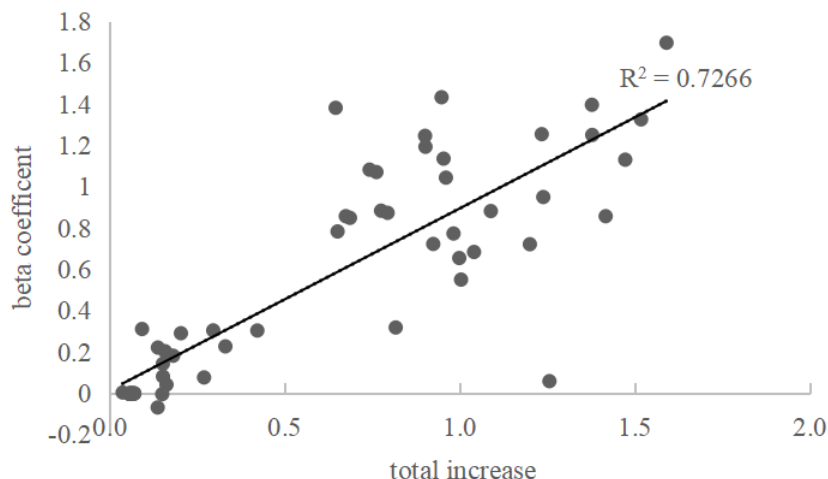


Fig. 3 Beta coefficient and total increase per fund

As can be seen from Figure 3, there is a certain trend in the scatter distribution, with the higher the return the higher the risk coefficient. The beta coefficient is mostly distributed around 0.2 and 1 fluctuating.

4. Conclusion

This paper examines the risk profile of different types of funds at different time periods under the influence of COVID-19 in China and provides a comparative analysis. Using a sample of quarterly returns for 15 funds in each type of funds from the fourth quarter of 2019 to the second quarter of 2022, the empirical results show that the beta of each fund, except monetary funds and bond funds for their high security, high liquidity and stable income, which is estimated by CAPM, increases to some extent under the impact of the COVID-19 outbreak, which means that the fund's risk increases with the arrival of COVID-19.

Meanwhile, this paper also investigates Treynor ratio and Sharpe ratio of bond funds, blend funds and stock funds. The results show that, in general, the performance of blend funds and stock funds is better, indicating that the returns are relatively higher for the same risk taken. However, the operational risk of the three types of funds outweighs their payoffs as their Sharpe ratios are less than 1.

The limitation of this paper is that the above conclusions are drawn by calculating the coefficients related to risk only for the quarterly returns of the sample funds. The analysis of the mechanism by which the COVID-19 affects fund risk and the reasons for the variability among different types of funds are not studied in depth. Future research could provide further empirical evidence to explain the mechanism of the COVID-19's impact on the fund market and explore the differences between funds in more detail.

References

- [1] Jin Y and Liu L. An empirical study of CAPM in the Chinese stock market. *Journal of Financial Research*, 2001, (07): p. 105-115
- [2] Ramelli, S., Wagner, A.F.. Feverish Stock Price Reactions to COVID- 19. *Swiss Finance Institute Research Paper*, 2020, No. 20- 12.
- [3] Beirne, J., Renzhi, N., Sugandi, E., Volz, U.. *Financial Market and Capital Flow Dynamics During the COVID19 Pandemic*. Asian Development Institute Working Paper, 2020, No. 1158.
- [4] Al-Awadhi, Abdullah M. et al. Death and contagious infectious diseases: Impact of the COVID-19 virus on stock market returns, *Journal of Behavioral and Experimental Finance*, Elsevier, 2020, vol. 27(C).

- [5] Arteaga-Garavito, M.J., Croce, M.M.M., Farroni, P., Wolfskeil, I.. When the Markets Get Covid: contagion, Viruses, and Information Diffusion. CEPR Discussion Paper, 2021, No. DP14674.
- [6] Ho Ken C et al.. Covid-19 vaccine approvals and stock market returns: The case of Chinese stocks. *Economics letters*, 2022, 215.
- [7] Liu, W. and Gui, Y. and Qiao G.. Dynamics lead-lag relationship of jumps among Chinese stock index and futures market during the Covid-19 epidemic. *Research in international business and finance*, 2022, 61: p. 669
- [8] Chen, G.. Analysis of the impact of the new coronavirus outbreak on A-shares based on abnormal returns perspective. *Journal of Wuyi University (Natural Science Edition)*, 2020, 34(02): p. 60-64.
- [9] Su, Z. and Zhang. Z.. Dependency Structure and Risk Spillover Effects of China and Global Stock Markets under the Shock of New Coronary Pneumonia Epidemic An Empirical Study Based on MSGARCH-EVT-Copula Model. *Businesses Economic Review*, 2022, p. 1-20.
- [10] Chen, B. and Qian, H.. Impact of the New Crown Pneumonia Outbreak on China's Equity and Debt Markets. *Journal of Industrial Technological Economics*, 2021, 40 (11): p. 53-60.
- [11] Tao, Z.. Insurance Industry and Insurance-linked Securities Market under the COVID-19. *Journal of Catastrophology*, 2021, 36(01): p. 128- 133.
- [12] Li, J.. Effect of sample time span o CAPM applicability. *Times Finance*, 2014, 6: p. 23-24+29.
- [13] Zhang, Y.. Applicability of CAPM in Chinese Market: An Empirical Analysis of Funds Based on Margin Trading. *Market Weekly*, 2020, 33(10): p. 149- 151.
- [14] Liu, H., et al.. Firm age and beta: Evidence from China. *International Review of Economics & Finance*, 2022, 77: p. 244-261.