Do Investors Repeat History: Evidence from Post-pandemic Pharmaceuticals Industry

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Abstract. The pharmaceuticals industry in China has boomed because of the outbreak of COVID-19, but investors' overreaction brings it to a sharp volatility. With the time going on, the pandemic has been well controlled recently, and investors have developed a deeper perception of it, thus the situation becomes different. However, few researchers move their attention to problems in the post-pandemic world: how the pharmaceuticals industry perform now and whether investors learn something from the history. These problems do make sense as they are more related to what people face of the moment. By building VAR and ARMA-GARCH-X model, this research conducts a time series analysis on these topics in the post-pandemic background. Since the series are stationary after some processing and the models pass strict test, some reliable conclusions are reached. It is found that the pharmaceuticals industry is less affected by COVID-19 nowadays as the pandemic has been normalized. What's more, although investors repeat history, the degree of their irrationality is mitigated, indicating that history lessons at least leave some positive impacts on investors' behaviors. Such conclusions suggest that policy makers should carry out hedging measures to reduce possible overreactions, and that investors should not follow the trend blindly, or the bubble will burst at any time.

Keywords: COVID-19; Pharmaceuticals industry; Investor behavior.

1. Introduction

1.1 Background

COVID-19, starting in China at the end of 2019, is a serious global public health event. The pandemic quickly broke out and spread all over the world. It is so infectious that only one year after the first case, nearly 100 million people had been diagnosed. Another year later, the number rises up to 250 million. The considerable infectivity and high transmitting speed of COVID-19 force governments to set some limitations on face-to-face interactions in public areas, which changes social picture a lot: entertainment places like cinemas, shopping centers are closed; many companies have no choice but to cease on-site working. These changes bring about a great hit on all kinds of economic activities. A dramatic decline occurs in the financial market after the break out of the pandemic, and most companies suffered a lot.

However, certain industries seem to be needed much more in such conditions. For example, the demand for medicine creates business for pharmaceuticals industry; online work and education require the support from industries concerning information technology. In theory, if companies in these industries, especially the pharmaceuticals industry, can grab the opportunities and well satisfy social needs in this particular time, they will make large profits and experience an apparent growth.

1.2 Related Literature

Existing researches have gained a deep insight into the impact that the outburst of COVID-19 have on the world's major economies. The conditions of some specific industries, such as the pharmaceuticals industry, are also explored a lot.

Beirne, Jhone, Renzhi, Nuobu, Sugandi, Eric, Volz, and Ulrich draw a whole picture of the global financial market under the strike of the COVID-19 outbreak. Among the 38 economies they research, 14 emerging market economies suffer more when compared with advanced economies, and the Asia security market is among the most suffered ones. Although the fiscal policy and monetary policy put

forward by advanced countries do make sense to some degree, COVID-19 still leaves some permanent effects on global financial markets and capital flows [1]. Wang and Park compare the vulnerability of US and South Korea financial market. Despite the financial market of South Korea is found to be more vulnerable, US stock return declines a lot as the confirmed cases increase [2]. Further research concerning US stock market is conducted by Khalfaoui, Nammouri, and Labidi. They discover a positive relationship between the COVID-19 vaccination and S&P 500 returns at major business cycle frequencies [3]. This not only indicates that success in fighting the pandemic does well do the stock market, but also reveals the importance of pharmaceuticals industry in economic recovery. In Europe, financial market infrastructures (FMIs) are faced with large amounts of challenges brought by COVID-19. Lber and Papsdorf point out that the failure of FMIs negatively influence the the functioning of economy, the stability of finance, and the conduct of monetary policy. Therefore, the power of the pandemic crisis cannot be underestimated [4]. Corbet, Yang G H, and Yang H concentrate on the effectiveness of CSI300 index futures after COVID-19 occurs. By comparing different hedging strategies, they conclude that the capability of the CSI300 index futures to hedge against the risks of the COVID-19 is impaired, regardless of whether constant or time-varying hedge ratios are used. These results transfer attention from market rewards to risks, showing that stock market has more volatility during the crisis [5].

When shifting to pharmaceuticals industry, things are totally different. Zdurak, Alcan, and Guvenbas conduct deep research into pharmaceuticals and biotechnology company stocks returns. Although the financial market is noisier, hard to predict, and Dow Jones Industrial dropped nearly 1200 points during the pandemic time, pharmaceuticals industry does welcome some bull news. Furthermore, compared with that of small ones, the growth of outstanding pharmaceuticals companies is beyond expectation [6]. Sun, Bao, and Lu study this from another perspective: investor sentiment. News about COVID-19 have different effects on different investors' sentiments, but in a whole picture, investors all make the same decision, that is to invest medical portfolios. Thus, they reach the point that such news does not trigger irrational investment decisions [7]. This provides explanation for the boom of medical industry from a different angle. However, the results only show investors react towards the correct direction. Whether overreaction exists is not examined.

In fact, pharmaceuticals industry experienced a considerable drop after its initial growth, so the growth may be excessive. Chen, Li, and Wang check the high rewards of bio-tech stocks. By analyzing investors' behaviors, overreaction is determined as a possible factor [8]. Then Wang, Dong, and Liu confirm the guess. Their research of 505 firms demonstrates the impact of COVID-19 to different industries, among which medical industry experience significantly positive spillover effects [9]. Apart from that, Haroon, Ali, and Khan reach a similar conclusion in Islamic world. They focus on the changes of beta in different portfolios. The betas of healthcare sector can depict an overreaction in Islamic equities [10].

1.3 Motivation and Goal

According to the literature, it is proved that the COVID-19 outbreak in early 2020 led to turmoil in global financial markets. No matter advanced US and European markets, or emerging Asia markets, or the special unconventional Islamic market, all suffer from this crisis. The rapid spread of COVID-19 arouses panic among investors, causing a large amount of capital to flee the financial markets, which leads to a precipitous drop in many market indexes. Even so, there are a few industries survived, and pharmaceuticals industry is one of them. In the short term, bull news led investors to pharmaceuticals industry which boomed quickly, but after 2021 it plummeted again because of overreaction.

However, in the long run, people's perception of COVID-19 deepens, which means the pandemic is not a black swan incident any more, and it has become normalized instead. This post-pandemic world does not catch much attention from scholars, but it is quite significant since it takes time for humans to get rid of COVID-19. The post-pandemic world will last for some time and the knowledge of pharmaceuticals industry and investor behavior in this situation will help policy makers promote

the recovery of economy in a proper way. Therefore, this study will explore pharmaceuticals industry the post-pandemic period. The goal is to test whether investors' behavior returns to rationality without overreaction, and to analyze the impact of COVID-19 on pharmaceuticals industry after the pandemic becomes normalized, so that both the investors and policy makers can be more rational.

1.4 Methods

This research will be conducted with the method of time series analysis. First, unit root test will be employed to test the stationarity of the series. Stationarity ensures that there is some valuable information buried in the series. Second, a VAR model will be constructed with model identification to decide the parameters, so that the impulse response function can be calculated to analyze the influence of the pandemic. Then this research will build ARMA model based on the log return series of pharmaceuticals index. By using autocorrelation function and partial autocorrelation function, the orders for AR term and MA term will be determined. Finally, an ARMA-GARCH-X model will be established on the foundation of front models. It takes the volatility into consideration, and summarize both the internal and external impacts.

2. Research Design

2.1 Data Sources and Data Processing

COVID-19 first break out in China, but now it is well controlled. What's more, Chinese investors are likely to have irrational behaviors [11]. Hence, this research will focus on Chinese markets. In order to cover the whole industry, Chinese pharmaceuticals index is used in this study. Since China has entered the post-pandemic period and most people have been vaccinated, the death cases are very rare, which means that the series of confirmed cases along can well represent the situation of the pandemic. To sum up, this research is based on four series: Chinese pharmaceuticals index, domestic confirmed cases, foreign confirmed cases, and global confirmed cases. The data of all the four series are daily data, and the range is from 2020-01-21 to 2022-08-11. The source of the data is Choice Finance Application

It is common that the series of stock price or index have a trend, which is much more difficult to analyze than a stationary series. Considering that, this research will transform the pharmaceuticals index data from a price series to a reward series through certain calculations. In order to further improve the level of stationarity, the reward series and three confirmed cases series are taken by the log form.

2.2 Unit Root Test

Unit root test can help determine whether a series is stationary. There are many ways to conduct unit root test, among which ADF test usually has a good performance. ADF test generalized DF test, which can only test AR(1) model, to test AR(p) model, where p can be any positive integers. If a series $\{x_t\}$ fits AR(p) model, it has the following forms:

$$x_t = c + \alpha_1 x_{t-1} + \cdots + \alpha_p x_{p-1} + \varepsilon_t \tag{1}$$

Formula (1) can be rewrite to formula (2):

$$x_t = c + \beta x_{t-1} + \sum_{i=1}^{p-1} \varphi_i \Delta x_{t-i} + \varepsilon_t \tag{2}$$

If $\{x_t\}$ is stationary, it will have a constant mean value. Suppose $E(x_t) = \mu$, where μ is a constant for any integers t, which means $E(\Delta x_t) = 0$. Then take the expectation of both sides of equation (2), and the results are as follows:

$$\mu = c + \beta\mu \tag{3}$$

If μ can be uniquely determined, which indicates $\{x_t\}$ is stationary, β must not equal 1. Therefore, hypothesis test can be set: $H_0: \beta = 1$ and $H_1: \beta < 1$. In order to test it, ADF statistics is equal to $\frac{\widehat{\beta}-1}{Standard\ error\ of\ \widehat{\beta}}$. After that, P-value can be used to determine whether the null hypothesis should be rejected. If it is rejected, $\{x_t\}$ can be viewed to be stationary.

2.3 Vector-autoregression

This research mainly analyzes four time series--Chinese pharmaceuticals index series and three confirmed cases series. The aim is to study the interactions between these theories, so VAR model can be a good choice. Instead of treating different series as separate units, VAR model combine them into an integral system. Then the system will be used to make some predictions, the result of which is ensured to be mutually consistent. In this case, the system consisting of different series is also called "multivariate time series".

Although this research will study four variables, taking two-variable VAR(p) model as an example can make the theory easier to explain. Set (4) shows the expression of it:

$$\begin{cases} y_{1t} = \beta_{10} + \beta_{11}y_{1,t-1} + \cdots + \beta_{1p}y_{1,t-p} + \gamma_{11}y_{2,t-1} + \cdots + \gamma_{1p}y_{2,t-p} + \varepsilon_{1t} \\ y_{2t} = \beta_{20} + \beta_{21}y_{1,t-1} + \cdots + \beta_{2p}y_{1,t-p} + \gamma_{21}y_{2,t-1} + \cdots + \gamma_{2p}y_{2,t-p} + \varepsilon_{2t} \end{cases} \tag{4}$$

Set (4) can also be rewritten into the matrix form:

$$\begin{pmatrix} y_{1t} \\ y_{2t} \end{pmatrix} = \begin{pmatrix} \beta_{10} \\ \beta_{20} \end{pmatrix} + \begin{pmatrix} \beta_{11} & \gamma_{11} \\ \beta_{21} & \gamma_{21} \end{pmatrix} \begin{pmatrix} y_{1,t-1} \\ y_{2,t-1} \end{pmatrix} + \cdots + \begin{pmatrix} \beta_{1p} & \gamma_{1p} \\ \beta_{2p} & \gamma_{2p} \end{pmatrix} \begin{pmatrix} y_{1,t-p} \\ y_{2,t-p} \end{pmatrix} + \begin{pmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{pmatrix} \tag{5}$$

Suppose $Y_t \equiv \begin{pmatrix} y_{1t} \\ y_{2t} \end{pmatrix}$, $E_t \equiv \begin{pmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{pmatrix}$, and the coefficients are$\Gamma_0, \Gamma_1, \cdots, \Gamma_p$, then the standard form of VAR(p) model is built:

$$Y_t = \Gamma_0 + \Gamma_1 Y_{t-1} + \cdots + \Gamma_p Y_{t-p} + E_t \tag{6}$$

In the model, the order p can be determined through criteria like FPE, AIC, HQIC, and SBIC.

It is obvious that VAR model has some advantages. First, the form of VAR model is flexible: VAR model is not based on any specific economic or financial theory, so all kinds of explanatory variables can be easily incorporated to some degree. Second, the parameter estimation is relatively easy: if all variables are stationary and meet OLS assumptions, then OLS estimation can be performed directly.

To test the model, eigenvalue can be used. If all the eigenvalues locate within the unit circle, the VAR system can be considered stationary. One use of a stationary VAR model is to calculate the impulse response function (IRF):

$$\Psi_s = \frac{\partial Y_{t+s}}{\partial E_t'} \tag{7}$$

IRF shows the impact of error terms in period t on the variables s periods later.

2.4 ARMA-GARCH-X Specification

The ARMA-GARCH-X model consists of three parts: ARMA model, GARCH model, and exogenous variables.

ARMA model is the combination of AR model and MA model. AR model takes advantages of the autocorrelation of time series, using history value to predict the future, while MA model uses history error terms which indicate the impulse from the past to predict the future. Suppose p to be the order of AR model and q to be the order of MA model, then the ARMA(p, q) model has the following form:

$$x_t = \phi_0 + \sum_{i=1}^{p} \phi_i x_{t-i} + a_t - \sum_{i=1}^{q} \theta_i a_{t-i} \tag{8}$$

Partial Autocorrelation Function (PACF) and Autocorrelation Function (ACF) can be used to determine parameters p and q respectively.

GARCH model is used to predict the future volatility, namely the variance of the series. The model can be divided into an ARCH term and a GARCH term. Similar to ARMA model, ARCH term is about history error terms (past impulse), and GARCH term is about history value (past variances). Suppose p to be the order of GARCH term and q to be the order of ARCH term, then GARCH (p, q) model can be expressed as follows:

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^{q} \alpha_i \, \varepsilon_{t-i}^2 + \sum_{i=1}^{p} \gamma_i \, \sigma_{t-i}^2 \tag{9}$$

The assumption of GARCH model is that conditional heteroscedasticity exists. One direct way to test this is to estimate the model and see whether the coefficient α and γ are significant.

Expression (8) is called the mean equation and expression (9) is called the variance equation. Use mean equation (8) and variance equation (9) to form an equation set, and add exogenous variables to variance equation (9), then the ARMA-GARCH-X model will be well constructed. This model is useful in analyzing both rewards and volatility, and it takes exogenous impulse into consideration as well.

3. Empirical results and analysis

3.1 Stationarity of the Series

In order to improve the stationarity of the series, this research calculate the log rewards of pharmaceuticals index. Other series are also taken the log form. Then the ADF test are conducted with the series after data processing. The results are shown in table 1.

Table 1 ADF test

Variables	t-statistic	p-value
Index		
Price	-2.2560	0.4583
Yield	-17.0560	0.000***
New confirmed cases		
China	-3.6910	0.0229**
Overseas	-16.9590	0.0000***
The global	-17.7450	0.0000***

From the p-value listed in table 1, it can be clearly seen that the log price of pharmaceuticals index is not stationary, but the log yield of it is stationary, which indicates the log yield series does not have any trend or seasonal term but the price series does. Apart from that, three log new confirmed cases series are stationary as well. Therefore, this research will be conducted base on the log yield series and three log new confirmed cases series.

3.2 Order Selection of VAR model

In the VAR model, the maximum lag order p should not be too small or too big. If it is too small, the residuals may be autocorrelated, leading to the inconsistency of parameter estimation. Appropriately increasing p can eliminate the autocorrelation in the residuals, so the value of likelihood function will be larger. However, if p is too large, there will be too many parameters to be estimated, then the degree of freedom decreases seriously, which directly affects the effectiveness of model estimation. Therefore, a balance should be determined where the value of likelihood function is high enough and the order p is not too large. Considering that, some criteria are created based on the likelihood function and the order p. When the value of the criteria reaches its nadir, the balance point occurs. Table 2 presents the identification of VAR model, with four criteria included.

Table 2 VAR model identification

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-1086.33				0.000725	4.12224	4.13488	4.15453
1	-332.21	1508.2	16	0.0000	0.000045	1.33161	1.39481	1.49308
2	-222.879	218.66	16	0.0000	0.000031	0.97875	1.09253	1.2694
3	-191.607	62.545	16	0.0000	0.00003	0.921009	1.08535	1.34084
4	-175.584	32.046	16	0.0100	0.00003	0.920922	1.13583	1.46993
5	137.966	627.1	16	0.0000	9.60E-06	-0.204031	.061445*	.47416*
6	161.736	47.539	16	0.0000	9.30E-06	-0.233406	0.082637	0.573964
7	179.047	34.622	16	0.0040	9.30E-06	-0.238362	0.128248	0.698187
8	191.075	24.057	16	0.0880	9.40E-06	-0.223347	0.19383	0.842382
9	200.873	19.596	16	0.2390	9.60E-06	-0.199898	0.267846	0.99501
10	231.846	61.945	16	0.0000	9.10E-06	-0.256505	0.261806	1.06758
11	259.779	55.868*	16	0.0000	8.7e-06*	-.301623*	0.267254	1.15164
12	267.291	15.024	16	0.5230	9.00E-06	-0.269532	0.349913	1.31291

According to FPE and AIC, the order for VAR model should be 11, while HQIC and SBIC indicate the best order is 5. What's more, the likelihood ratio test (LR) shows that the coefficients of VAR(11) have the highest level of significance. Therefore, VAR(11) will be constructed in this research.

After the order is determined, unit circle test is conducted to check the validity of the model. The result is shown in figure 1.

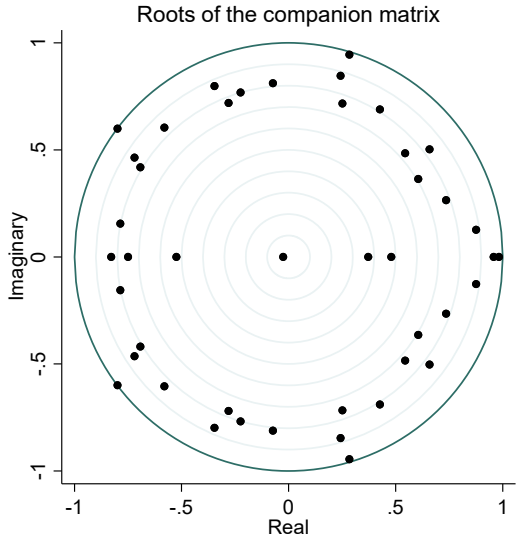


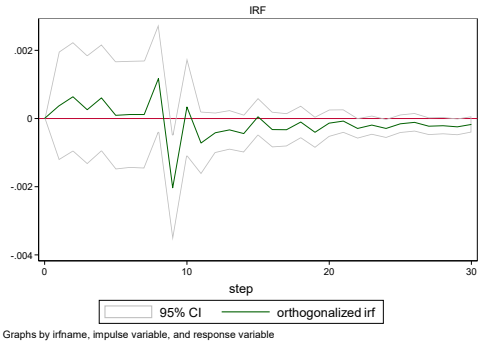
Figure 1 Unit circle test

All the roots of the companion matrix locate inside the unit circle, which means the VAR system based on log yield series and three log new confirmed cases series is stationary, so the interactions within the system can be detected.

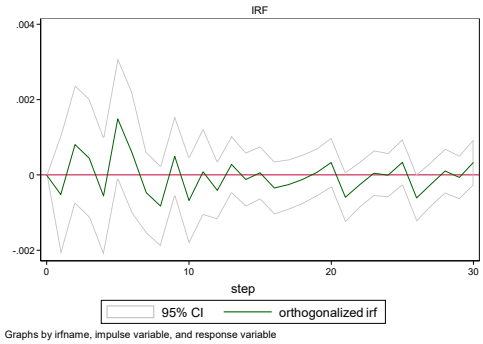
3.3 Impulse Response Function

Based on the VAR model constructed before, the impulse response functions are calculated. As this research cares more about how pharmaceuticals index is influenced by new confirmed cases, the following three impulse responses are emphasized:

China



Overseas



The global

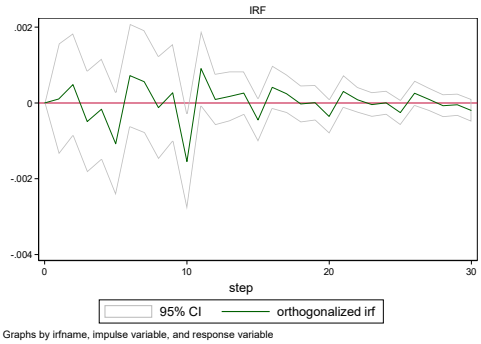


Figure 2 Impulse and response

From the estimate of the impulse response function, the 1% increase in newly confirmed Chinese cases in the period t=0 has a positive influence on pharmaceuticals industry when t moves from 0 to 8, and the maximum value of impact occurs in the t= 8 period, which is about 0.1%. From t= 8 to t=12, the impact of one unit impulse on index yield is negative, lower than 0.2%. The influence of overseas and global confirmed cases on the pharmaceutical industry does not have an effect which is first positive and then negative. They only cause the yields to fluctuate around 0. Besides, from the time effect, the impact of the period t=0 gradually decays to 0 after 20 periods.

According to the results above, investors do not seem to learn from previous experience, and the yield of pharmaceutical industry has almost repeated the history, though this time the period is shorter. However, one thing is different is that investors' panic sentiments are not so serious in the post-pandemic era, thus the impact on the yield of pharmaceutical industry is small in value.

3.4 Order Identification of ARMA model

As is mentioned in session 2.4, this research will use partial autocorrelation function (PACF) to determine AR's order and autocorrelation function (ACF) to determine MA's order. The results of PACF and ACF is demonstrated in figure 3.

PACF ACF

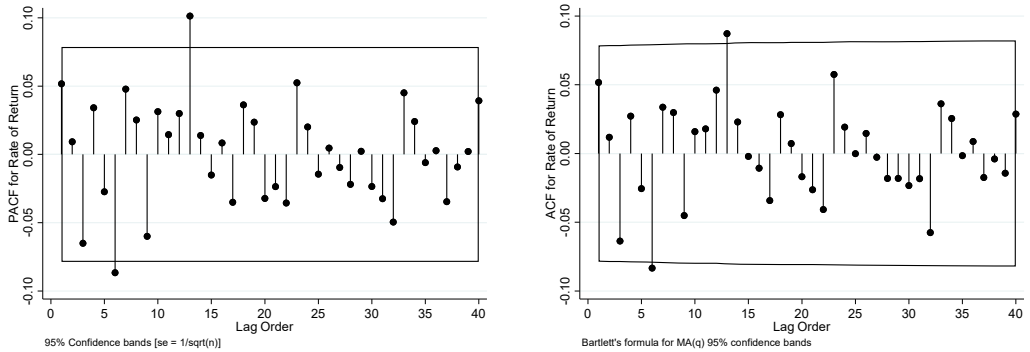


Figure 3 PACF and ACF

In figure 3, the first lag order where PACF first exceeds the boundary of 95% confidence level is 6, and that where ACF does is also 6, indicating that ARMA (6, 6) is the best fitted model.

3.5 ARMA-GARCH-X Estimation

The ARMA part is estimated in session 3.4, and the GARCH part will be estimated in this session. In this research, there are 3 exogenous variables: Chinese, overseas, and global new confirmed cases. Separately adding them to the ARMA-GARCH model, 3 ARMA-GARCH-X model are established. The estimation results are listed in table 3.

Table 3 ARMA-GARCH estimation results

Variables	(1)		(2)		(3)	
	Coefficient	Std.err	Coefficient	Std.err	Coefficient	Std.err
Mean equation						
AR. L6	-0.2899	0.3127	-0.3055	0.3404	-0.3068	0.3400
MA. L6	0.1700	0.3175	0.1960	0.3451	0.1974	0.3448
Constant	-0.0001	0.0007	0.0000	0.0007	0.0000	0.0007
Variance equation						
New confirmed cases						
China	0.0185	0.1053				
Overseas			-0.0213	0.0753		
The global					-0.0312	0.0961
GARCH (1, 1)						
ARCH (-1)	0.0799***	0.0265	0.0818***	0.0308	0.0816***	0.0307
GARCH (-1)	0.8697***	0.0434	0.8559***	0.0610	0.8560***	0.0610
Constant	-10.8994***	0.7799	-10.3652***	1.0931	-10.2371***	1.3157

Based on the estimation of 3 ARMA-GARCH-X models, both ARCH and GARCH terms of the log rewards of pharmaceutical industry are significant, that is, the log rewards series has significant conditional heteroscedastic property, which is appropriate for GARCH modeling. See from external explanatory variables, this research finds no matter the new confirmed cases are domestic, overseas, or global, they all do not have a significant impact on the volatility of pharmaceutical industry earnings.

Such results reveal that, in the long run, provided there is no outbreak of another large-scale epidemic, the volatility and rewards of pharmaceutical industry will not be affected by the epidemic any more.

4. Discussion

Compared with the existing literature, this research is more up-to-date and practical. Since COVID-19 has been well controlled in China as well as many other countries, theories about the impulse from the outbreak of the pandemic may not apply to current situation anymore. This research will motivate people to rethink the relationship of COVID-19 and financial market in the present. What is interesting is that this research seems to confirm the idea that Chinese investors are irrational

[11], as they repeat the history, overreacting even in the post-pandemic period. However, the significantly dropped volatility of index reward indicates that investors' sentiments are not that strong, namely the overreaction is reduced. This proposes a new idea that irrational investors can also learn something from history. One irrational behavior does not mean all that they do are irrational. Another finding is that the pandemic cannot leave a permanent influence on pharmaceutical industry, which is different from the view of Beirne, John, etc [1]. This study shows that the impact of COVID-19 will decay in the long run, and in the post-pandemic era, without a second outbreak, pharmaceutical industry will not be relatively stable.

Such results offer several enlightments: First, for researchers, latest information will make more sense, and past conclusions are not always the truth, because this is a changing world. Second, policy makers, especially in China, should put forward some hedge strategy to calm investors down. Too much sentiments can lead to not only the flee of capital but also overreactions, which will both push the market into decline. For example, after the outbreak of the pandemic, governments can make some investments to stimulate economy recover. When pharmaceutical industry increase too much, central bank can increase the rate to call back some capital. Last but not least, investors should keep in mind history lessons. When bull news occurs, it is wise to invest accordingly, but the premise is not to ignore the limitations of the growth.

5. Conclusion

To summarize, this research study the impact of COVID-19 on pharmaceutical industry as well as investors' behaviors based on time series analysis. Stationary series are chosen to fit the VAR model and ARMA-GARCH-X model, with all kinds of test passed. The two findings of the research are related to each other. On the one hand, the impulse from COVID-19 is smaller and smaller as the pandemic goes to normalization, which cannot be seen as a black swan event nowadays like in early 2020. This change also indicates that investors behaviors have changed. Although overreaction still exists which prove the irrationality of investors, the degree of it is mitigated a lot. This provides valuable information for both policy makers and investors. Only when investors are more careful about history lessons and policy makers give some correct instructions can the financial market be more stable. Finally, the interesting findings of this study can also provoke later researches to analyze how irrational behavior occurs and how can it be effectively eased, which is meaningful project that deserves further exploration.

References

[1] Beirne, John, Renzhi, Nuobu, Sugandi, Eric, Volz, Ulrich. Financial Market and Capital Flow Dynamics During the COVID-19 Pandemic. Asian Development Bank Institute, 2020.

[2] Wang W, Park H. How Vulnerable Are Financial Markets to COVID-19? A Comparative Study of the US and South Korea. Sustainability, 2021, 13(10):5587.

[3] Khalfaoui R, Nammouri H, Labidi O, et al. Is the COVID-19 vaccine effective on the US financial market? Public Health, 2021, 198:177-179.

[4] Lber K, Papsdorf P. The COVID-19 pandemic: Implications for financial market infrastructures and the payments ecosystem in the euro area. Journal of Payments Strategy & Systems, 2020.

[5] Corbet S, Yang G H, Yang H, et al. The influence of the COVID-19 pandemic on the hedging functionality of Chinese financial markets. Research in International Business and Finance, 2021.

[6] Zdurak C, Alcan G, Guvenbas S D. The Impact of Covid-19 to Global Pharmaceuticals and Biotechnology Company Stocks Returns. Pressacademia, 2020, 9(2):68-79.

[7] Sun Y, Bao Q, Lu Z. Coronavirus (Covid-19) outbreak, investor sentiment, and medical portfolio: Evidence from China, Hong Kong, Korea, Japan, and U.S. Pacific-Basin Finance Journal, 2021, 65(4):101463.

[8] Chen Y R, Li M X, Wang Y. How Do Investors React to Investment-Opportunity Shock? Evidence from the COVID-19 Pandemic and Taiwan Bio-Tech Firms. Social Science Electronic Publishing.

[9] Wang Z, Dong Y, Liu A. How does China's stock market react to supply chain disruptions from COVID-19? International Review of Financial Analysis, 2022, 82.

[10] Haroon O, Ali M, Khan A, et al. Financial Market Risks during the COVID-19 Pandemic. Emerging Markets Finance and Trade, 2021, 57.

[11] Fu Q. The Explanation of the Abnormal Phenomena and Normal Investor's Irrational Behavior in the Chinese A Stock Market from the. 2014.