

How does the COVID-19 Affect the Shanghai Composite Index and How does this Affect Investors' Portfolio

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Abstract. In the period of COVID-19, Chinese economy were affected negatively so does the financial system since it had the first confirmed case. The article aims to find to what extent does the pandemic affect Shanghai Composite Index in comparison with no virus. ARIMA model is used to estimate prices of the index in the absence of COVID-19. The results show different degree of decreasing prices of the index in comparison of two cases. Some stocks are impacted negatively, while others such as pharmaceutical, education and information technology mitigate the extent of decreasing prices of stock. There a few studies using ARIMA model to predict how Shanghai Composite Index would be influenced in the absence of COVID-19 and compare it with the actual observations. Through this study, the effect of the pandemic on the index can be found, which implies the whole investing environment. Researchers can use this result to compare the effects of the virus on the financial market in absence and presence of the pandemic. Moreover, investors may be aware of timing that the government and dealers take actions to avoid huge decrease of the price of the index. They may have some understanding of when to do bottom hunting to earn profits. Finally, policy makers and investors may know how long the monetary policies takes effect in the market, which is beneficial for future policy uses.

Keywords: ARIMA model, Shanghai Composite Index, COVID-19, Chinese economy.

1. Introduction

Since the first sample of COVID-19 appeared in Wuhan province, the following impacts on global stock markets and economics were disastrous. The Chinese economy shrank 6.8% in the first three months in comparison with a year ago. Other economies experienced different degree of recession. In the period of economic recession, residents' living standards and income were affected negatively. With special polies such as lockdown, people' lifestyle changed in this special time.

There are numerous studies about effects of COVID-19 on global market. It has concluded that the stock market return decreases as the number of confirmed cases increase [1]. Spill-over effects could be found between Asian countries and European countries and American countries [2]. Not surprisingly, some are about how news affect the price of the index. It has been found that the announcements of keeping social distance decrease the stock market return as investors have a negative view about economic development. Ashraf also concluded that there is an indirect positive effect on the return because those announcements lead to a reduction of number of confirmed cases [3]. In addition, there is a statistically significant positive return in the day when optimistic news was posted last day [4]. It has been concluded that there is dual causality between investors' sentiment and financial market indices [5]. Research mentioned there was a very negative effect on the consumer industry, but the industry recovered quickly because of the effective monetary policies and well-developed e-commerce industry [6]. There is a study that compare stocks that stay at home and the ones which chose to go outside, and suggested that positive news could be moderately interpreted, and negative news could be underestimated by the Chinese stock market [7]. It has been supposed that industries which reacted positively to the announcements of lockdown drive the overreactions of the Chinese stock market [8].

In the perspective of individual portfolio, it has been found that investors could gain an abnormal profit by purchasing pharmaceutical company stocks in the first stage, followed by gradual reduction of this kind of stock and purchase of stocks highlighted by the government. This study also claimed that investors should avoid stocks which have characteristics of high risk, such as high P/E ratio, high

P/B ratio and so on, during the middle and late stage of the pandemic [9]. Another researcher claimed that the traditional industries are affected negatively, while education, information technology, manufacturing, and health industries provide a strong confidence to the stock market [10].

The research mentioned above focus on how the market return would be impacted by different factors, such as sentiments, number of confirmed cases, government monetary policies, and announcements of lockdown. Other studies claimed about which kinds of stocks and industries were more likely to earn profits or be affected negatively.

Normally, there is a positive correlation between financial market and the economic situation. But what would the situation be if there was not the pandemic? For the purpose of exploring how the stock market will be without shock, the article uses ARIMA model to predict. Shanghai Composite Index is used in this essay as it is a well-known and large-scaled index in China. By studying the difference between the predictions and actual prices, estimation of what extent the shock affects the index can be achieved.

The following parts of this paper are organized as follows: Section 2 introduces the methodology of the research, and the Section 3 explains the empirical results from the model. The Section 4 is the discussion of the research, and the final part is the conclusion.

2. Methodology

2.1. Dataset source

The historical data of the Shanghai Composite Index from January 2010 to July 2023 is taken. The reason for using data after January is that the index was affected by the financial crisis in 2008 which may increase errors in the model. 201024/01/2020 is set to be the beginning of the pandemic. Therefore, data before this date is used to predict how the Index perform without the pandemic. By treating COVID-19 as an experiment, the treatment group is the actual value of the index, and the control group is the predicted values. The estimation of the effects of the pandemic on the index is derived from the difference between these two groups.

2.2. Weak Stationarity Test

The Augmented Dickey-Fuller (ADF) test helps estimate whether the time series is stationary. The ADF test has the t-statistic based on the least squares estimates of the test regression and is given by:

$$ADF_t = t_{\hat{\theta}=1} = \frac{\hat{\theta}-1}{SE(\hat{\theta})} \quad (1)$$

The ADF test has the null hypothesis that the series has a unit root, which is non-stationary, while the alternative hypothesis says that there is no unit root in the series so that the series is stationary. After using the ADF test on the data, the following results are obtained:

Table 1. Weak stationarity test

	t	p
Daily		
Raw	-3.120	0.3605
1st order difference	-35.457	0
Weekly		
Raw	-2.467	0.3446
1st order difference	-14.202	0
2nd order difference	-25.707	0
Monthly		
Raw	-2.713	0.2309
1st order difference	-7.775	0
2nd order difference	-12.24-	0

From table 1, all the raw observations of daily, weekly, and monthly data are non-stationary as the p-value are greater than the significance level 5%. Therefore, the null hypothesis failed to reject. After differencing the raw observations, they become stationary as the p-value is smaller than the significance level. For the weekly and monthly observations, they are differenced twice due to better performance.

2.3. ARIMA Model Specification

ARIMA model is shown in equation (2).

$$Y_t = \mu + \sum_{k=1}^p \phi_k (Y_{t-k} - \mu) + \epsilon_t + \sum_{i=1}^q \theta_i \epsilon_{t-i}, t \in \mathbb{Z} \# \quad (2)$$

Where Y_t is the stationary process, μ is the process mean and $\{\epsilon_t\}$ is a white noise process with mean 0 and variance σ^2 .

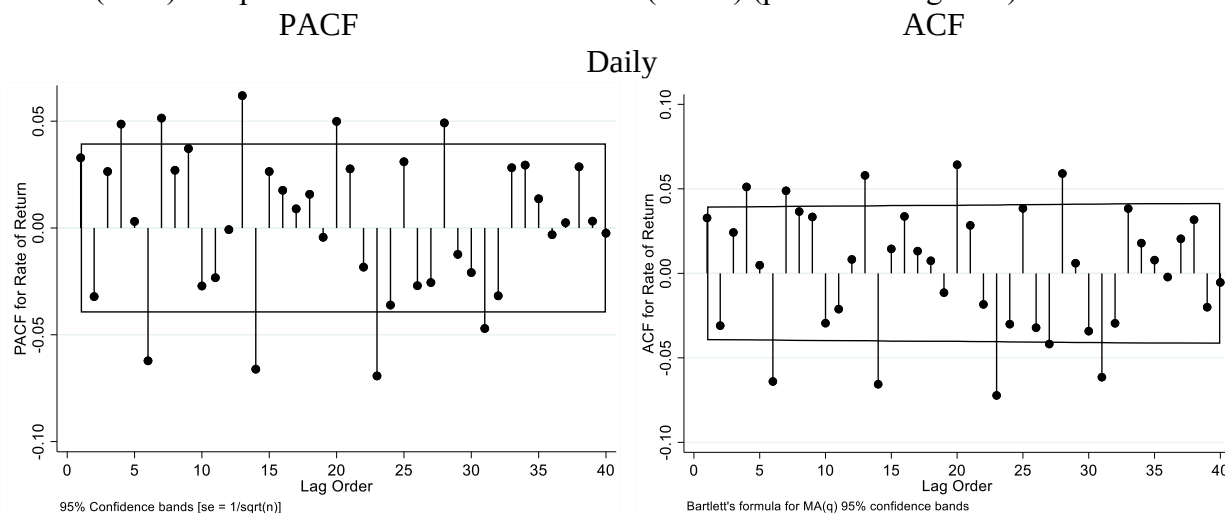
The ARIMA model includes the AR model and the MA model, The “I” in the model refers to “Integrated” which implies differencing of raw observations to allow the time series to become stationary. The model ARIMA (p, d, q) is derived from ARMA (p, q), which is the integrated ARMA model. The parameters in ARIMA are defined as: (1) p: the number of lag observations in the model; (2) d: the number of times the raw observations are differenced; (3) q: the order of the moving average.

In this article, ARIMA is used because the raw observations are non-stationary. To estimate correctly, those observations are required to be differenced to allow them to become stationary.

3. Empirical results

3.1. Order determination

As the ARIMA model is used, the order of AR and MA terms are determined via the autocorrelation function (ACF) and partial autocorrelation function (PACF) (please see Figure 1).



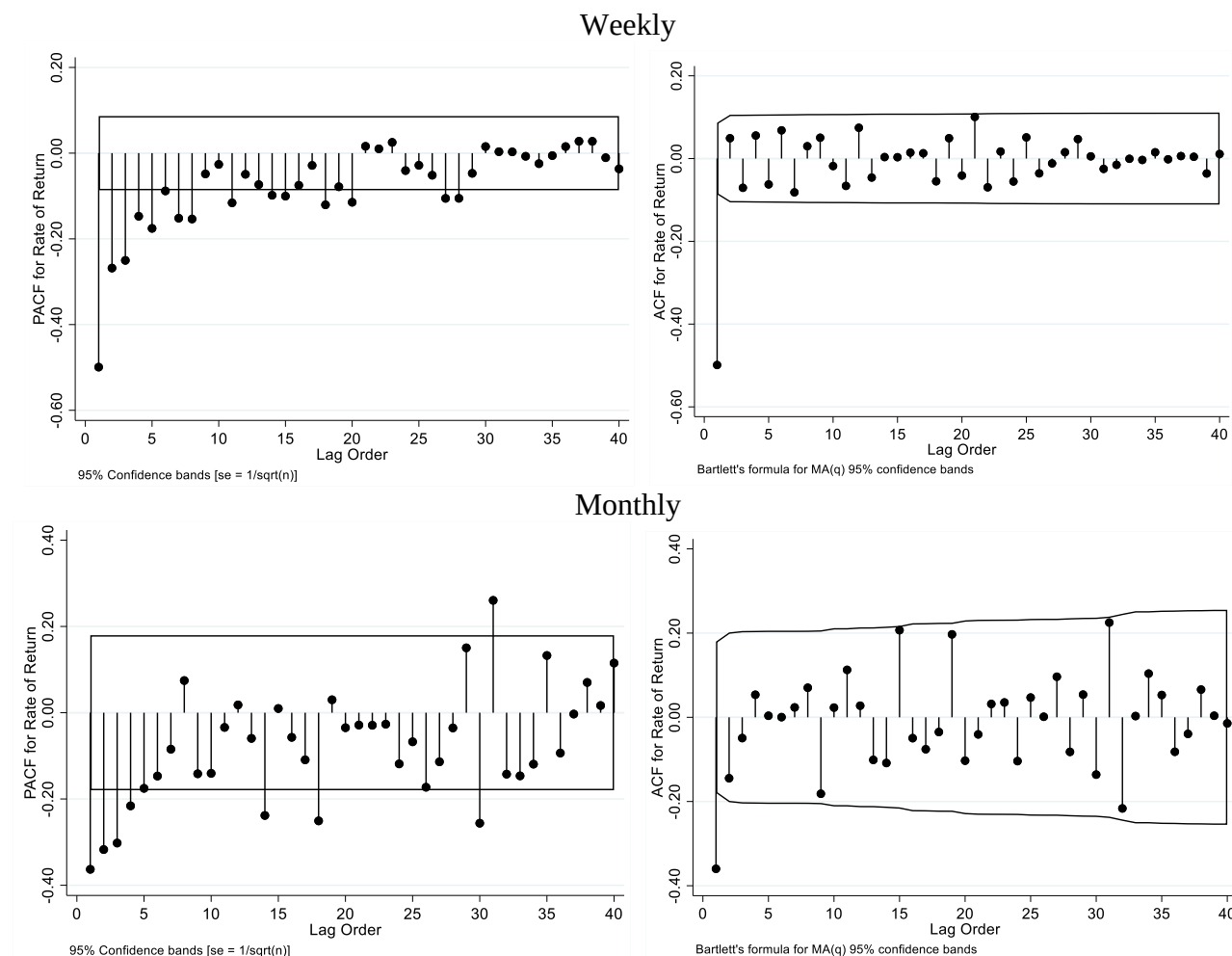


Figure 1. ARMA (p, q) identification

Note: The y-axis for two kind of diagrams is PACF, ACF of the natural logarithm of rate of return. The time lag order is represented by the x-axis. The 95% confidence interval for AR(p) and MA(q) is shown as the bound area.

Photo credit: Original

For the daily observations, ARIMA (7,1,7) is chosen for the purpose of predicting 1 week's observations of the index price. This can be done as the PACF and ACF of the rate of return are out of bounds at lag order 7. As the raw observations are differenced once, the $d=1$. For the weekly observations, ARIMA (8,2,1) is used to predict 8 weeks index price. The reason for choosing 8 weeks is that it is roughly 2 months. $d=2$ is because the raw observations are difference twice, and $q=1$ because there is only 1 lag out of bound which has the lag order 1. This is the same for the monthly observations, while the prediction of 4 months is required in this article. Therefore, ARIMA (4,2,1) is modelled for the monthly observations.

3.2. Results and Explanations of Models

After deciding the models, they are running on the daily, weekly, monthly data respectively. The residuals of each model are predicted with the aim to test the validity of the regressions. The Portmanteau test is used in this case, and the following table shows the results.

Table 2. Residual test

Model	Portmanteau (Q) statistic	Prob > chi2
Daily-ARIMA (7,1,7)	55.7405	0.0502
Weekly-ARIMA (8,2,1)	30.8690	0.8496
Monthly-ARIMA (4,2,1)	33.165	0.7705

For the Portmanteau test, it has the null hypothesis that the residuals do not have the autocorrelation, which implies the error term is the white noise. The significance level here is 0.05. The probabilities as shown in Table 2 are all greater than 0.05. Thus, all the models failed to reject the null hypothesis, which means all of them are valid.

After the testing, the results are virtualised in order to illustrate the difference between the real observations (actual value) and prediction of treatment group (fitted value).

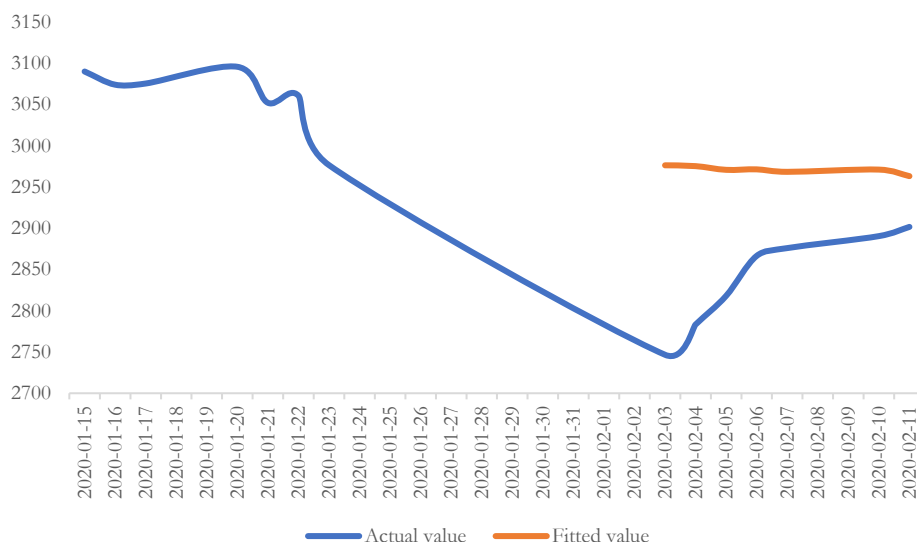


Figure 2. Actual value and fitted value, daily
Photo credit: Original

Figure 2 shows the difference of two values based on daily observations. From the graph, it is noticeable that there is a decreasing trend from 21/01/2020 to 03/02/2020. Recalling the shock is set to be at 24/01/2020 which has the price around 2950. The reason for unknown exact price is that the index did not open at this date. On 03/02/2020, the price reached the minimum at 2746.61. After this date, the price increased to just below 2950. The increment may be related to the actions of dealers in the market as sharp decrease of price may harm their profits. There is a clear difference from the fitted value and the actual value. Without the COVID-19, the model predicts that there will be a steady trend of the index price.

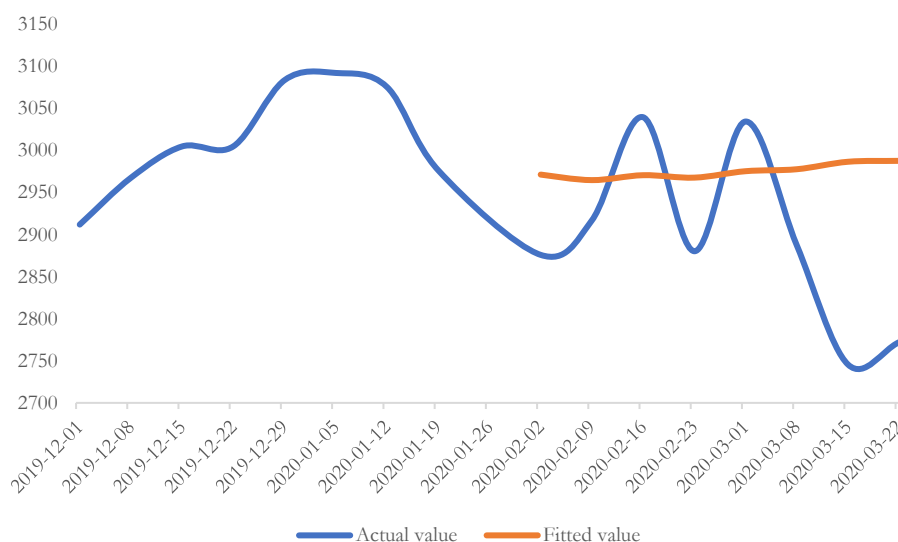


Figure 3. Actual value and fitted value, weekly
Photo credit: Original

Figure 3 shows the weekly observations and prediction of prices. Similarly, there is a declining tendency from 12/01/2020 to the beginning of the February 2020. The following parts are the fluctuations of weekly price from 09/02/2020 to mid of March 2020. The price reached the minimum at 2750 on 15/03/2020. The increase of price may attribute to the government monetary policies. Interestingly, the prediction seems to be the average of fluctuations of the index price. Overall, as shown in the graph, the price decreased after the shock. The model predicts a steady and slow growth of price of 4 weeks later than the shock.

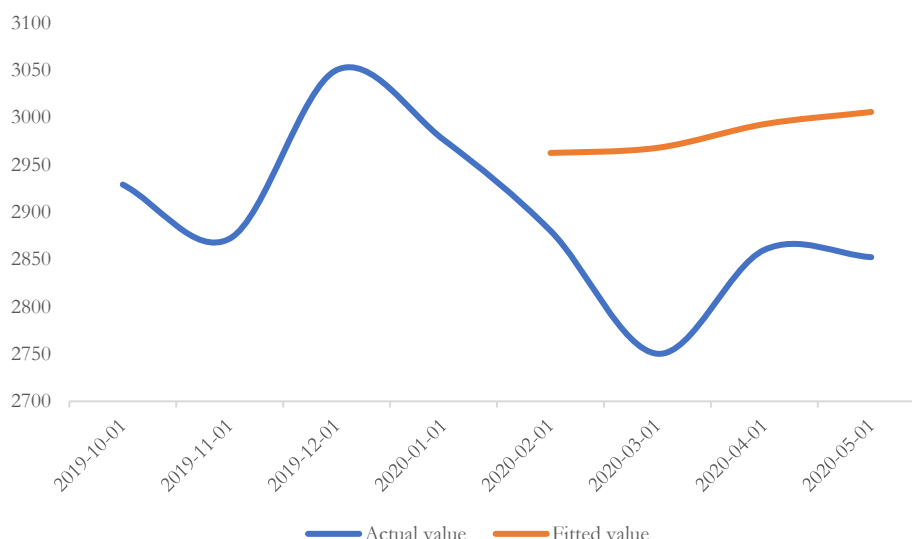


Figure 4. Actual value and fitted value, monthly
Photo credit: Original

Figure 4 shows the monthly observations and predictions of values for 4 months. Obviously, there is a dramatic decrease of index price from maximum 3050 to minimum 2750 between late December 2019 to beginning of March 2020, following by the sharp rise to around 2850. In contrast, the model predicts that there will be a steady growth in price to 3000 at 1st of May 2020. The government monetary policies may take effects as there is time for the market to respond. There is a significant difference between actual value and fitted value as they have opposite trend overall.

Table 3. Actual and fitted value, daily

	Actual value	Fitted value	Difference	
2020-01-15	3090.04			
2020-01-16	3074.08			
2020-01-17	3075.5			
2020-01-20	3095.79			
2020-01-21	3052.14			
2020-01-22	3060.75			
2020-01-23	2976.53			
2020-02-03	2746.61	2976.337	-229.727	
2020-02-04	2783.29	2975.3407	-192.051	
2020-02-05	2818.09	2970.8356	-152.746	
2020-02-06	2866.51	2971.4327	-104.923	
2020-02-07	2875.96	2968.4244	-92.4644	
2020-02-10	2890.49	2971.138	-80.648	
2020-02-11	2901.67	2963.1739	-61.5039	-4.40%

Table 3 shows the exact actual and fitted value respectively. The modelled percentage change in the price can be derived by dividing average difference by actual value. The result shows the effect

of COVID-19 on the Shanghai Composite Index is decreasing 4.40% price of 7 observations after the shock.

Table 4. Actual and fitted value, weekly

	Actual value	Fitted value	Difference	
2019-12-01	2912.01			
2019-12-08	2967.68			
2019-12-15	3004.94			
2019-12-22	3005.04			
2019-12-29	3083.79			
2020-01-05	3092.29			
2020-01-12	3075.5			
2020-01-19	2976.53			
2020-02-02	2875.96	2971.4349	-95.4749	
2020-02-09	2917.01	2964.8611	-47.8511	
2020-02-16	3039.67	2970.7209	68.9491	
2020-02-23	2880.3	2967.8097	-87.5097	
2020-03-01	3034.51	2975.4705	59.0395	
2020-03-08	2887.43	2977.8188	-90.3888	
2020-03-15	2745.62	2986.6868	-241.067	
2020-03-22	2772.2	2987.7564	-215.556	-2.73%

In the side of weekly observations (Table 4), the average predicted price is less than average actual price by 2.73%. The difference between the daily result above and this result may be government and dealers took actions to save the index price in order to avoid more losses.

Table 5. Actual and fitted value, monthly

	Actual value	Fitted value	Difference	
2019-10-01	2929.06			
2019-11-01	2871.98			
2019-12-01	3050.12			
2020-01-01	2976.53			
2020-02-01	2880.3	2962.549	-82.249	
2020-03-01	2750.3	2967.9113	-217.611	
2020-04-01	2860.08	2992.9691	-132.889	
2020-05-01	2852.35	3005.8068	-153.457	-4.91%

For the monthly data (Table 5), average actual price is less than predicted price by 4.91%. Although both prediction line and actual value line show the increasing trend after May 2020, the difference figure is the greatest among three kinds of data. The upward trend indicates effective actions by government.

4. Discussion

The result of this article is similar to research which uses pooled OLS estimation to predict the return of stock market as both of them claim that COVID-19 affect the Shanghai Composite Index negatively [11]. The highlight of this article is that using ARIMA model to predict how the price of index will change in case of no pandemic. There are a few studies on this Index using ARIMA model, which is almost a new area. Researchers can use this article to compare the difference of the same index with and without COVID-19. Also, the extent of how COVID-19 affect the index can be founded in 3 different periods. Policy makers and investors may find that how long does the monetary take effects in the case of shock. They may find how optimistic sentiment affect the market return. Moreover, investors may have views about when is the right time to do bottom hunting as there were

many fluctuations of prices. They may be aware of how the price of index changes in the case of shock and accumulate experience to earn profit or lose less in the next shock.

5. Conclusion

In conclusion, the paper provides a new perspective of studying how COVID-19 affect Shanghai Composite Index. Since the first case of the pandemic was confirmed, negative news was reported with keeping social distance policies. These announcements were harmful to the financial market as investors become less confident due to uncertainty and economic recession attributed to policies. This paper use data from 2010 to 2020 to predict what the price of the index will be in daily, weekly, and monthly data. The prediction of the price of the index indicates how the index and being macro, the whole economy, will be. By studying the difference, it can be concluded that COVID-19 exert a harmful effect on the index.

The greatest difference is in the monthly data which predicts 4 months price of the index after the shock. Although there were effective actions taken by the government and dealers. The market performed worse than it supposed to be. The same tendency can also be found in the daily and weekly results.

Finally, in the perspective of individual portfolio, pharmaceutical stocks are preferred in the beginning of the virus. Investors should pick stocks with less risk factors and stocks highlighted by the government.

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