# The Long-term Impact of Covid-19 on Insurance Industry: Evidence from Time Series Model

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**Abstract.** The worldwide COVID-19 pandemic had a significant influence on the global financial market. As one of the most important compositions of the market, insurance industry, inevitably, was also influenced severely by such pandemic both in China and abroad. To study the impact of COIVD-19 on the profit of business insurance, the source of data and the methods utilized to estimate it, including Unit Root Test, VAR Model, and ARMA-GARCH Model were introduced in this paper. The analysis pointed out that two influences COVID-19 brought to the insurance field were opposite. First, the growing demand for business insurance benefited the insurance company. Nevertheless, the capital escaped from the financial market due to its tendency of avoiding risks, which led to the drastic diving of the market. In the short term, the disadvantage of the pandemic to the insurance industry overwhelmed the advantage. Nonetheless, the market will recover and return to normal in the long run.

**Keywords:** COVID-19, Insurance Industry, Self-repairing.

## 1. Introduction

The COVID-19 broke out in China at the beginning of 2020 and went viral among the world. The considerable growth of infections went beyond the market's expectation. The impact was so great that 250 million infected cases and over 5 million deaths world-wild had been recorded by the World Health Organization at the beginning of the December 2021. Facing such significant treat of suffering from the disease and even death, citizens were forced to change their lifestyles greatly all over the world. In China, this pandemic also showed a tremendous impact in the field insurance business, which serve the role of steadying the development of the economy.

It is human's nature to avoid risks. Therefore, individuals are seeking for some kind of insurance to guarantee their safety. The action of finding insurance is named preventing disadvantage. Families, groups, and societies in the early time were organizations to improve individuals' security level. Nowadays, because of the division of labour in society, the estrangement between group members are getting stronger, people have to find another way to avoid risks. Hence, the insurance gradually generated and matured. When facing risks, like COVID-19, societies today largely rely on the insurance industry to reduce loss.

Many researchers around the world had reflected on the problem in the aspect of the engagement of the insurance business. Goodell considered such pandemic to be an insurable risk in that it possessed the possibility of going viral [1]. Through a profound survey, Smith emphasized the importance of public hygiene, especially the investment in precaution [2]. According to Tanne, COVID-19 revealed many weak points of American healthy security. Though under the pressure of the government, the hygiene insurance which insured for 160million Americans had to give up all the co-payments and avoid the accidental payment, there are still 30 million American citizens who failed to possess insurance, left at the risk of getting infected [3].

Experts in China also showed a significant interest in the insurance industry. For example, when it came to the aspect of how could the insurance industry help release the financial pressure on the

government, Wang pointed out that the insufficient emergency supplies should be improved. Meanwhile, the pandemic also brought about new chances for the development of the insurance industry [4]. By observing the policies of the country and individual cities, Ding reckoned that problems still existed when it came to the field of insurance establishment and economic development [5]. Based on the previous model of SARS in 2003, Xu analyzed the short-term impact of COVID-19 on the insurance industry from three aspects of income, payment, and investment, and the long-term influence from the commercial logic, development model, product creation and the technology of insurance [6]. It indicates that a remarkable relationship exists between business and life insurance and the pandemic. In addition, instead of being ephemeral, the impact of the outbreaks is more likely to be a long-lasting one on the insurance industry.

Moreover, the problems and weak points of the policy and the insurance industry when facing such a severe public accident were also mentioned in each essay and each researcher has provided the analysis and solutions of such problems from individuals from various aspects. For example, Shi analyzed the problem of the insurance industry from the aspects of traditional insurance, cash flow, and financial circumstances [7].

Fortunately, the pandemic also brought the chance to the insurance industry. According to Xiang, to adapt to the new market, the insurance industry switched from traditional insurance to a new-type insurance model, which would benefit the future development of insurance [8]. Additionally, Chen suggested that putting business health insurance online was beneficial for insurance companies [9].

Based on the previous findings above, this paper researches the connection between the pandemic and the change in the insurance industry. Firstly, a VAR model is established, serving as a system considering three variables of the increased infected cases in both China and overseas and the profit of the business and life insurance. The improvement the paper has done is to analyze such intricate interactions. Additionally, model-based predictions of the value of variables can be easily made by this VAR system. In the next part, an ARMA-GARCH model is built to find out if COVID-19 possesses an impact on the volatility of the business insurance industry and how serious this impact is, comparing both and the Chinese district cases and the overall situation around the world. In the end, the discussion and the conclusion will be raised to reflect and reinforce the results from both previous research and the paper to figure out how could the insurance industry achieves further improvement in such a brand-new market environment.

## 2. Research Design

### 2.1 Data sources

The stock data presented in this study is comes from CHOICE Financial Terminal, which is a professional financial data analysis and asset management software of Oriental Wealth, and it is dedicated to supplying high-quality financial information to financial institutions, academic research institutes and professional investors. The terminal covers many fields such as stock, commodity, fund, and fixed income. It is an essential and useful tool for financial market participants, which can greatly improve efficiency.

The number of confirmed cases in China of COVID-19 is obtained by the Health and Wellness Commission. Its main duty is to formulate departmental rules and standards, organize the establishment of national health policies, and draft legislation and regulations, and policies for health development. It also enacts the plan for disease prevention, the national immunization program, and measures for public health problems that may harm people's health.

The number of confirmed cases overseas of COVID-19 is acquired from World Health Organization. The purpose of the World Health Organization is to let the health level of people from all over the world as high as possible. The main duties of the World Health Organization are to promote the prevention and control of epidemics and diseases, provide and improve medical treatment of diseases, teach and train people on how to prevent in daily life, promoting the formulation of international standards for biological products.

## 2.2 Unit Root Test

The unit root test is a hot topic that is used to check out the presence of a unit root in a time series, if it exists, which means the time series is not stationary. We need to check whether the time series is stationary before we go into the quantitative analysis of the time series. So if the time series is not stationary, we need to find possible methods to improve it. And we can generally use the method of difference to eliminate the unit root to get the stationary series.

We usually assumed the time series $x_t$ can be written as follow:

$$x_t = c_t + \beta x_{t-1} + \sum_{i=1}^{p-1} \phi_i \Delta x_{t-i} + \varepsilon_t \tag{1}$$

If the coefficient β = 1, this shows that the series has a unit root and is non-stationary. And if the coefficient β < 1, this indicates that the series is stationary.

Table 1 presents the test results of the raw data and the processed series:

**Table 1** ADF test

| Variables | t-statistic | p-value |
|---|---|---|
| Insurance Industry | | |
| Index | -1.989 | 0.6072 |
| Yield | -17.213 | 0.0000*** |
| New confirmed cases | | |
| China | -4.427 | 0.0020*** |
| Overseas | -7.319 | 0.0000*** |

## 2.3 VAR Model Specification

VAR model is a non-structured system of equations model, and it is also classic and powerful. Not based on economic theory, the model adopts the form of the equations of more, in each of the model equations, the endogenous model variable of all the endogenous regression delay variables, and then to estimate the dynamic relationship between all the endogenous variable, often used to forecast time series of interconnected system and the dynamic impact analysis of random disturbance on the variable system.

The impulse response function reflects the dynamic impact on other variables in the VAR model when a variable is submitted to an "exogenous shock". We will trace the impulse responses in relation to the dynamics of these variables over a period after this shock. The impulse response function is a conditional prediction, or more like a point-in-time estimate, except that the value is estimated at various points after the shock.

$$Y_t = \alpha_1 + \phi_{11} Y_{t-1} + \cdots + \phi_{1p} Y_{t-p} + \beta_{11} X_{t-1} + \cdots + \beta_{1p} X_{t-p} + \delta_{11} Z_{t-1} + \cdots + \delta_{1p} Z_{t-p} + e_{1t} \tag{2}$$

$$X_t = \alpha_1 + \phi_{21} Y_{t-1} + \cdots + \phi_{2p} Y_{t-p} + \beta_{21} X_{t-1} + \cdots + \beta_{2p} X_{t-p} + \delta_{21} Z_{t-1} + \cdots + \delta_{2p} Z_{t-p} + e_{2t} \tag{3}$$

$$Z_t = \alpha_1 + \phi_{31} Y_{t-1} + \cdots + \phi_{3p} Y_{t-p} + \beta_{31} X_{t-1} + \cdots + \beta_{3p} X_{t-p} + \delta_{31} Z_{t-1} + \cdots + \delta_{3p} Z_{t-p} + e_{3t} \tag{4}$$

## 2.4 ARMA-GARCH Model Specification

As a modern financial event sequence model, GARCH model is modeled based on the characteristic of volatility aggregation. Volatility aggregation indicates that there is a certain relationship between the current volatility and the prior volatility, and the theory of variance is thus extended to include conditional variance. The supposed conditional contrast refers to the variance in

relation to the information known at the last moment. The GARCH model considers the conditional variance of the present period as a linear combination of the conditional variance of the previous N periods and the square of the series, while the series is the product of the conditional variance of the present period and the white noise.[10]

ARMA model is an important method to study time series, which is composed of AR model and MA model. It is often used in market research to study long-term tracking data.

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \cdots + \alpha_p \varepsilon_{t-p}^2 \quad (5)$$

where $\sigma_t^2$ is the forecast variance in period $t$. $\varepsilon_t$ refers to the actual variance in period t. $\alpha_0$ is constant.

## 3. Empirical results

According to the Wealth Report of Chinese Family, posed by the Chinese family wealth research center of Southwestern University of Finance and Economics, in the first quarter of 2020, the demand for insurance among Chinese families grew rapidly: The willing index of equipping business health insurance was 114.5 and the willing index of equipping business life insurance was 111.6 [11].

No matter which market it was, the Chinese market, the American market, or the European market, all investors showed a sense of panic after a short time when the pandemic broke out rapidly. Based on the information above, it could be found that the impact of COVID-19 possessed two opposite influences on the insurance industry. First, as a severe sudden risk event, the pandemic promoted the insurance demand of the investors, which was beneficial to the industry. However, the hedge tendency of funds drove a large scale of capital to escape the financial market and led to the drop of all the indices of the market. This was a globality impact on the market. It was obvious that, according to the past data, the latter had a greater impact than the former, leading to the short-term net influence being negative, which meant the profit of the insurance industry also suffered from falling.

Then it came to the question that, considering the long-term situation, with the improvement of the public's understanding of COVID-19, their action would return to rationality and whether such influence mentioned above would still exist, which required empirical test.

### 3.1 VAR Model Result

In the first part, the paper put three stationary series: the increased infection cases in both China and abroad and the profit of the business and life insurance. Firstly, according to the VAR model identification result shown in Table 2, the optimal lag order is seven order and such data should be taken into consideration.

**Table 2** VAR model identification

| Lag | LL | LR | df | p | FPE | AIC | HQIC | SBIC |
|---|---|---|---|---|---|---|---|---|
| 0 | -652.602 | | | | .0017 | 2.1744 | 2.1829 | 2.1963 |
| 1 | 159.354 | 1623.9 | 9 | 0.000 | .0001 | -.4887 | -.4546 | -.4011 |
| 2 | 270.445 | 222.18 | 9 | 0.000 | .0000 | -.8273 | -.7676 | -.6740 |
| 3 | 310.65 | 80.409 | 9 | 0.000 | .0000 | -.9308 | -.8456 | -.7118* |
| 4 | 328.676 | 36.052 | 9 | 0.000 | .0000 | -.9607 | -.8499 | -.6760 |
| 5 | 348.257 | 39.161 | 9 | 0.000 | .0000 | -.9958 | -.8595* | -.6454 |
| 6 | 359.063 | 21.612 | 9 | 0.010 | .0000 | -1.0018 | -.8399 | -.5857 |
| 7 | 370.919 | 23.712* | 9 | 0.005 | .0000* | -1.0113* | -.8238 | -.5295 |
| 8 | 373.871 | 5.9035 | 9 | 0.750 | .0000 | -.9912 | -.7781 | -.4437 |
| 9 | 380.049 | 12.357 | 9 | 0.194 | .0000 | -.9819 | -.7432 | -.3687 |
| 10 | 387.85 | 15.601 | 9 | 0.076 | .0000 | -.9779 | -.7137 | -.2990 |
| 11 | 390.887 | 6.0752 | 9 | 0.732 | .0000 | -.9581 | -.6683 | -.2135 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 12 | 394.459 | 7.1434 | 9 | 0.622 | .0000 | -.9401 | -.6247 | -.1298 |

As long as the model is built, after estimating the parameters of a vector autoregression, to confirm the eigenvalue stability condition, a code-named varstable tool in Stata is employed, which would make the result visualized. According to Figure 1, all dots indicating the eigenvalues locate inside the unit circle, which means that the VAR estimates prove to be stable.

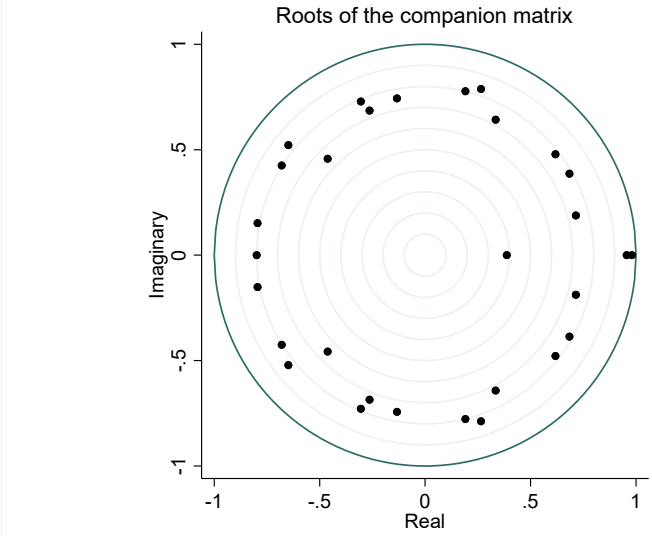


**Figure 1** VAR stability test

### 3.2 Impulse Response Graph

According to the estimation of the pulse response, when t=0, when the increase in infected cases raised 1%, the influence on the net effect of the insurance industry was still negative. The maximum value of the negative effect came when t=7, a little bit lower than 0.2%. Nonetheless, the increased infected cases abroad did not possess such influence.

From the perspective of the time effect, the impact of t=0 was reduced to 0 when t=15.

According to the results above, the investor nearly repeated the history in a shorter scale of time. Nevertheless, there was something different. When the pandemic became a normal situation, the investors no longer had such a severe sense of panic as before and the influence on the insurance industry was reduced.

China Overseas

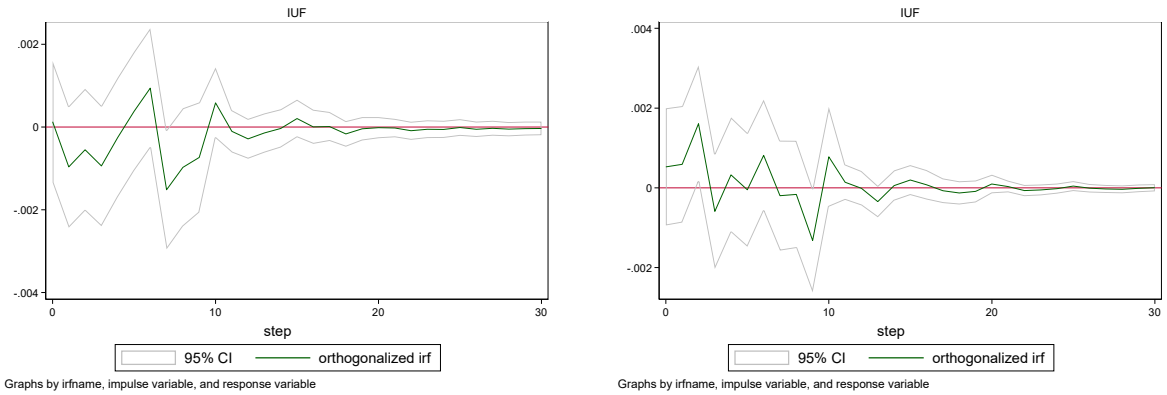


**Figure 2** Impulse and response

### 3.3 ARMA-GARCH

A GARCH term must be taken into consideration if conditional heteroscedasticity is found existing in the initial sequence. Therefore, before building the ARMA-GARCH model, checking the variance

condition of the profit rates of insurance industry is needed. According to the previous plot, the return rate series possesses conditional heteroscedasticity.

According to Figure 3, the black rectangle is the benchmark for determining the statistically significant term in the AR model, and it can be observed that the lag 15 terms of the original series have a substantial impact on the data.

The information criteria is also utilized to determine the right order p of the AR model to check the outcome. The result reveals that there are 15 possible orders for the AR model. In this paper, the autocorrelation plot (ACF Plot) is utilized to determine the MA component of the series.

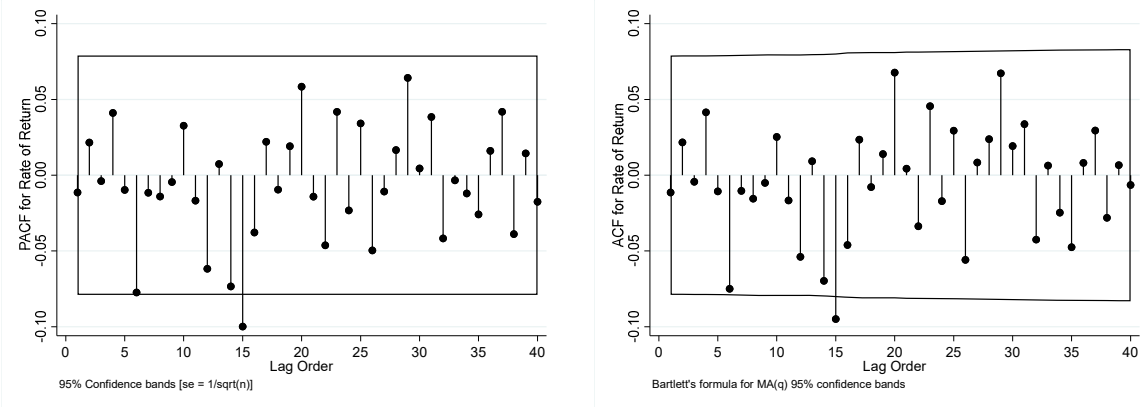


**Figure 3** PACF and ACF

According to the result of ARMA-GARCH estimation, no matter whether autocorrelation was inserted in the average function， ARCH, as well as GARCH, were significant, which means the profit rate of the insurance industry possesses heteroscedasticity under statistic significant conditions and can build the GARCH model.

From the perspective of the estimation of the external explanatory variable, both the growth of the infected cases in China and abroad will no longer possess a significant influence on the profit rate of the insurance industry in the long term.

**Table 3** ARMA-GARCH estimation results

| Variables | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Mean equation | | | | |
| AR (-1) | | -.5307 | | -.5803 |
| | | (.7711) | | (.7303) |
| MA (-1) | | .4943 | | .5466 |
| | | (.7926) | | (.7525) |
| Constant | -.0005 | -.0005 | -.0005 | -.0005 |
| | (.0007) | (.0007) | (.0007) | (.0007) |
| Variance equation | | | | |
| China | -.0498 | -.0506 | | |
| | (.0494) | (.0474) | | |
| Overseas | | | -.0122 | -.0137 |
| | | | (.0513) | (.0498) |
| ARCH (-1) | .1032*** | .1073*** | .1002*** | .1028*** |
| | (.0215) | (.0235) | (.0203) | (.0218) |
| GARCH (-1) | .7725*** | .7505*** | .7849*** | .7708*** |
| | (.0487) | (.0555) | (.0450) | (.0496) |
| Constant | -9.8391*** | -9.7057*** | -9.9486*** | -9.8375*** |
| | (.3605) | (.3558) | (.7551) | (.7381) |

## 4. Discussion

Compared with the previous conclusion in another existing document, the results brought by the epidemic have not changed much. Result in the long run the insurance industry does not have a significant impact. This pandemic is just a repeat of history. However, the duration of the turmoil has

been shorter than in historical outbreaks. Perhaps the experience of previous outbreaks has allowed people to calm down more quickly. From this study, we can see that the insurance industry has a certain long-term ability to repair such an emergency as the epidemic. Although there will be a significant negative impact in the short term, the long-term impact will gradually recover and be smooth. Therefore, in terms of policies, it is suggested that the government should strengthen ideological work on the impact of the epidemic in the early stage and carry out a lot of popular science popularization, so that people can be more rational about the epidemic, shorten the short-term impact, and make the insurance industry enter a smooth period earlier. For investors, insurance investment can be properly restrained at the initial stage of emergencies such as the epidemic to reduce the loss of funds in the financial market, which will have a less short-term impact on the insurance industry.

## 5. Conclusion

From this study, this paper can see that there are two opposite effects of COVID-19 shock on the insurance industry. The first is the slight advantage brought by the increasing demand for insurance. The second is the huge impact of capital loss in the financial market on the financial industry. Generally speaking, the insurance industry is facing threats in the short term. But the short-term and long-term impact of the pandemic on the insurance industry is also different. Finance has shown an adaptive capacity for repair in the long run compared with the short run. When investors' panic gradually stabilizes, the impact of the pandemic on insurance yields will gradually stabilize. For the historical epidemic time, this short-term scale is getting shorter and shorter. Compared with foreign countries, major sudden risk events such as the epidemic have a significant impact on the world in the short term. However, there is no such negative effect as that seen in China as the increasing positive rate of the pandemic. So, the key to recovery from such a shock should be how quickly to calm people's fears.

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