

The Time-varying Impact of COVID-19 Pandemic on Consumption: Evidence from the A-share market

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Abstract: The COVID-19 pandemic has had an impact on global economics, affecting the development of all industries, and the consumer industry is certainly one of the most obvious sectors. VAR and the ARMA-GARCH model are built based on empirical research to investigate the effects of the COVID-19 newly confirmed cases on the return rate and volatility of the consumption index. The conclusions are as follows: In the short term, global and Chinese consumption will be significantly impacted by the COVID-19 pandemic. However, it is unclear whether COVID-19 will have a negative long-term effect on the consumer industries.

Keywords: Covid-19 pandemic, Time-varying impact, SSE Consumption Index, Yields and volatility.

1. Introduction

The two years since the end of 2019 have had a profound impact on the world. In the past two years, the whole China and even the whole world have suffered a great impact due to the outbreak of COVID-19. This kind of impact is reflected in many aspects, such as consumption, national relations, people's health, and so on. The most severely impacted part must include the consumer industry. Whether from the perspective of individuals or countries, the consumer industry is an important and indispensable part. In "on the significance and role of consumption", it is mentioned that the consumption industry is not only closely related to production, distribution, and exchange in the economic field but also closely related to culture and politics [1]. From the microeconomic perspective, consumption can meet people's needs and realize the value of commodities. From the perspective of the macro-economy, the consumption industry promotes the circulation of money and commodities and promotes economic growth [1]. As a result, the Covid-19 pandemic's effects on the consumption have had an impact on everyone's level of living and even the global economy. Take China, for example, the impact of the pandemic is mainly reflected in the following aspects: the economic growth rate has declined significantly, and the actual growth rate of residents' income has also declined to some extent. It is also clear how the pandemic has affected residents' psychological well-being and consumption habits. Consumption spending by residents has decreased significantly, and the decline is now comparatively more severe. In this case, the consumption ability, consumption concept, consumption object, and consumption mode of consumers have changed imperceptibly. In the "study on the impact of the COVID-19 on Residents' consumption" written by Liuhong Bo and others, it is mentioned that according to the national

household survey data, the nominal growth rate and actual growth rate of national per capita consumption expenditure in the first quarter of 2020 decreased by 8.2% and 12.5% respectively. Within 17 weeks after the outbreak of the pandemic (from January 20 to mid-May 2020), the consumer expenditure of residents with cash standards decreased by an average of 19.5%. Among them, the contribution rates of consumption restriction factors, income decline factors, risk awareness rise factors, and consumption scenario change factors to the average decline of residents' consumption were 29.6%, 29.4%, 15.9%, and 13.0% respectively [2]. Nowadays, the COVID-19 in the world has not been fully alleviated or even the situation is getting worse and worse. COVID-19 has become a historical event that has had a serious impact on the world. It is of great academic and practical significance to deeply study the time-varying impact of the COVID-19 pandemic on the consumption.

Many Chinese scholars have studied the impact of COVID-19 on China's consumption by analyzing data. According to Guan Lixin, The epidemic, which lasted for several months, had a significant impact on both the supply and demand sides of the consumer market in addition to altering inhabitants' consumption and living patterns on the demand side. As an exogenous shock, the pandemic had a significant impact on the consumer market and the original balance between supply and demand was broken [3]. Fu Zhihua et al. believe that the pneumonia outbreak caused by a novel coronavirus infection is having a negative impact on China's economy and consumption. Logically, in addition to limiting consumption directly, the pandemic also has a negative impact on consumption through the income effect, wealth effect, and real purchasing power effect [4]. Zheng Jianghuai et al. believe that the pandemic has exerted negative impacts on China's economy, such as the decline of total retail demand, slowing investment, CPI fluctuation, and shrinking imports and export, which has exerted a great impact on consumption [5]. Song Wei collected data through a questionnaire survey and found that the pandemic has a long-term impact on residents' health consumption intention, but a short-term impact on residents' conformity consumption [6].

Numerous foreign academics are concurrently researching how COVID-19 has affected consumption in diverse nations all around the world. Peng Jiang et al. believe that from the perspective of energy, the pandemic has had a significant impact on energy demand and consumption [7]. Amory Martin et al developed a microeconomic model, in which they assumed the crisis period and recovery period of the pandemic. They discovered that, under the assumption that the resettlement phase would last three months, the Bay Area's poverty rate would momentarily increase from 17.1% to 25.9% in the absence of social security. Relatively speaking, the lowest income group would suffer the most. However, the extent of the economic damage varies geographically, with some places having greater than normal populations, and it could take more than a year to recover [8]. According to Jagdish Sheth, the COVID-19 pandemic and social isolation lockdowns have disturbed preexisting customer behaviors and caused the consumer business to adopt a number of new policies and processes [9]. In response to COVID-19, Suphanit Piyapromdee et al. assessed the effectiveness of mitigation measures in the UK and discovered that 70% of households in the bottom fifth of the income distribution lacked sufficient assets to cover current expenses for more than a week. As a result, these households significantly reduced their consumption [10].

In previous studies, researchers have agreed that COVID-19 is having an impact on consumption. However, most researchers use superficial data to conclude without in-depth study. In this paper, the author constructed a series of models by combining the daily increase of COVID-19 from February 3, 2020, to the present with the Daily SSE Consumption Index, to deeply study the time-varying impact of COVID-19 on the consumption. The data used in this paper include the new number of confirmed cases of COVID-19 in China and the world since February 3, 2020, and the daily changes in the SSE Consumption Index. The advantage of data is that it is accurate to the

daily changes, the frequency of recording data is relatively high, and the data as a whole is very representative. At the same time, since the stock only opens on weekdays, this paper removes the new data of COVID-19 on Saturday and Sunday, combines the new data of COVID-19 on weekdays in China and the world with the daily SSE Consumption Index, and uses empirical research methods to construct VAR and ARMA-GARCH models to further study the impact of COVID-19 on the consumption. With the help of this study methodology, it is possible to assess the pandemic's effects on yield and the volatility of the consumption index as well as their overall and impartial effects on the consumption.

The contents of the following parts of this paper are as follows: The second part is the research design, which introduces the data sources and formulas, and models used in this paper. The third part analyzes the results obtained by VAR and ARMA-GARCH models. The fourth part discusses the above results. The last part is a summary of the content of the article.

2. Research Design

2.1. Data Resources

Every piece of information utilized in this post, including the daily SSE Consumption Index and the daily new COVID-19 cases in China and throughout the world, came from the Choice financial terminal, a software program for managing investments and analyzing financial data professionally. Choice Financial Terminal is dedicated to provide high-quality financial data and related services to financial institutions, academic research organizations, and professional investors. Terminal content covers stocks, fixed income, funds, commodities, foreign exchange, macro industries, and other fields, provides Excel plug-in, quantitative interface, portfolio management, and other application tools, set information query, statistical analysis, and application in one. Its data are very complete and accurate, quite reference value

2.2. ADF-test

It is important to check the stationarity of each variable before building a model. Because there is no regularity in the uneven data. If the time series is not stationary, it is very difficult to reflect on its past and future with models, that is, it is difficult to model. In Table 1, the ADF-test shows that the p-value of SSE Consumption Index yield, new confirmed cases in China and the global are all less than 0.05, they are all stationary. But the SSE Consumption Index is not stationary, it is with a p-value that is larger than 0.05.

To sum up, because both new confirmed cases in China and new confirmed cases in the global are stationary, so they can appear as appropriate lead-in variables in the ARMAX model.

Table1: ADF test.

Variables	t-statistic	p-value
Consumption index	-1.916	0.6462
Consumption index, yield	-16.644	0.0000***
New confirmed cases, the global	-10.065	0.0000***
New confirmed cases, China	-4,361	0.0025***

2.3. Model Specification: VAR

VAR model can care about the prediction and dynamic dependence of multiple variables simultaneously. Its model form is flexible and parameter estimation is easy. In order to build VAR

models to study the effect of COVID-19 on the rate of consumption return, the necessary variables are combined in this section to generate predictions as a system.

The model is set as follows:

$$y_t = \begin{pmatrix} \beta_{10} \\ \beta_{20} \end{pmatrix} + \begin{pmatrix} \beta_{11} & \gamma_{11} \\ \beta_{21} & \gamma_{21} \end{pmatrix} \begin{pmatrix} \gamma_{1,t-1} \\ \gamma_{2,t-1} \end{pmatrix} + \dots + \begin{pmatrix} \beta_{1p} & \gamma_{1p} \\ \beta_{2p} & \gamma_{2p} \end{pmatrix} \gamma_{t-p} + \varepsilon_t \quad (1)$$

In (1), suppose that there are two time series variables $y_t = \{y_{1t}, y_{2t}\}$, respectively as the explained variables of the two regression equations. The explanatory variable is the p -order lag value of the two variables, and ε_t is the disturbance term.

The purpose of using the impulse response function is to see how much a unit of shock causes other variables to change over time.

The model is set as follows:

$$\frac{\partial y_{t+s}}{\partial \varepsilon'_t} = \varphi_s \quad (2)$$

The equation represents the influence on the value $y_{i,t+s}$ of the i -th variable in the period $(t+s)$ when the disturbance term ε_{jt} of the j -th variable in the period t increases by 1 unit while the other variables remain unchanged with the disturbance term of the other period.

2.4. Model Specification: ARMA-GARCH

In this part, the ARMA-GARCH model was constructed. The purpose of constructing ARMA-GARCH model is to set the mean equation of GARCH model as ARMA process, so as to predict return rate and volatility at the same time, and the newly confirmed COVID-19 cases in China and the global were taken as exogenous variables to predict the return rate of consumption.

Therefore, the newly confirmed COVID-19 cases in China and the world can be used as exogenous variables to predict the return rate of consumption.

The model is set as follows:

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \dots + \alpha_q \varepsilon_{t-q}^2 + \gamma_1 \sigma_{t-1}^2 + \dots + \gamma_p \sigma_{t-p}^2 \quad (3)$$

In this model, $\alpha_1 \varepsilon_{t-1}^2 + \dots + \alpha_q \varepsilon_{t-q}^2$ is ARMA term and $\gamma_1 \sigma_{t-1}^2 + \dots + \gamma_p \sigma_{t-p}^2$ is GARCH term. GARCH (1,1) is equivalent to the infinite order ARCH model. Therefore, if σ_{t-1}^2 is introduced as an explanatory variable, the high-order ARCH (p) model can generally be simplified to GARCH (1,1).

3. Research Design

3.1. VAR identification and its stability

In Table 2, through the test results, it can be found that the 1-6 order models are significant. In addition, LR, FPE, and AIC all reached minimum values at order 6. So the order of VAR model can be 6.

After the VAR model is constructed, it is very important to check whether the VAR system is a stationary process.

The model is set as follows:

$$VAR(k): Y_t = C + AY_{t-1} + U_t \quad (4)$$

Table2: VAR model identification.

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-676.979				.002238	2.41127	2.42028	2.43433
1	-57.1662	1239.6	9	0.000	.000257	.24527	.281275	.337506
2	35.6779	185.69	9	0.000	.000191	-.052049	.010958	.109362
3	68.0184	64.681	9	0.000	.000175	-.134817	-.044806*	.095771*
4	83.1888	30.341	9	0.000	.000172	-.156698	-.039684	.143067
5	95.3388	24.3	9	0.004	.00017	-.167868	-.023851	.201073
6	104.648	18.619*	9	0.029	.00017*	-.168966*	.002054	.269152
7	110.981	12.666	9	0.178	.000171	-.159508	.038515	.347785
8	115.199	8.4355	9	0.491	.000174	-.14255	.082476	.43392
9	120.445	10.492	9	0.312	.000176	-.129239	.122791	.516408
10	125.907	10.924	9	0.281	.000179	-.116693	.16234	.59813
11	131.303	10.791	9	0.290	.000181	-.10391	.202126	.680089
12	136.003	9.4014	9	0.401	.000184	-.088664	.244374	.764511

The VAR model is stationary in (4) if all of the eigenvalues are contained within the unit circle. The results of the calculation are shown in Figure1. Obviously, all the black dots are contained within the unit circle. Therefore, the model is stationary.

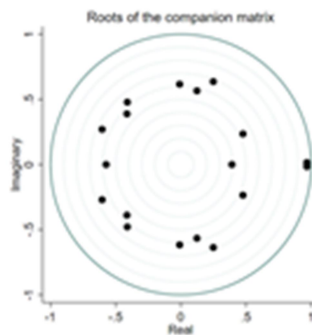


Figure1: VAR stability.

3.2. Impulse Response

In Figure 2, the impulse effect calculated by VAR can be seen. In the short term, The consumer index yield will be impacted by both the number of new cases in China and the number of new cases globally. The future consumption index yield will fluctuate by plus or minus 0.1 percent for every 1 percent increase in the number of newly confirmed cases. However, the effect was short-term and gradually disappeared after 10 periods.

According to the aforementioned findings, COVID-19's long-term effects on consumption are minimal in terms of amplitude and duration. For example, according to the National Bureau of Statistics of China, after the impact of the pandemic, China's national economy will continue to recover in 2021, and the development targets are still well achieved [11]. Therefore, it can be found that COVID-19 is more like a short-term huge shock. In the long run, if there are enough proven

cases, this effect will have a long-lasting effect; nevertheless, if there are few confirmed cases, there won't be a significant change in consumption.

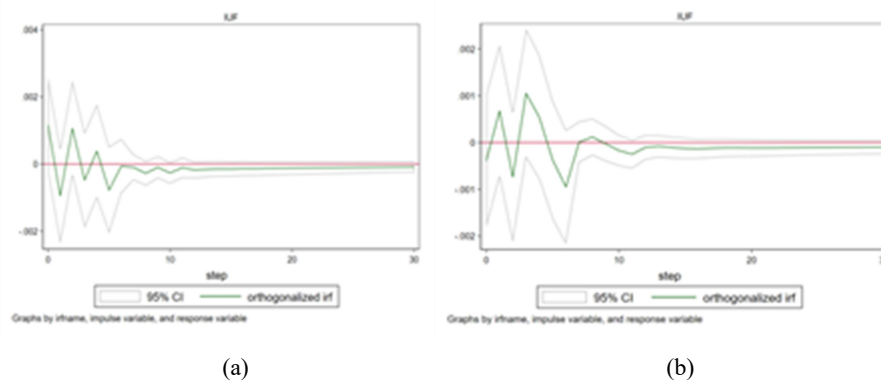


Figure2: Impulse and response.(a) Impulse variables: China's new confirmed cases;(b) Impulse variables: The global new confirmed cases.

3.3. ARMA-GARCH

Figure 3, it shows that both PACF and ACF start to fall in the 95% confidence interval after lag=25. Therefore, lag order 26 for the model can be taken.

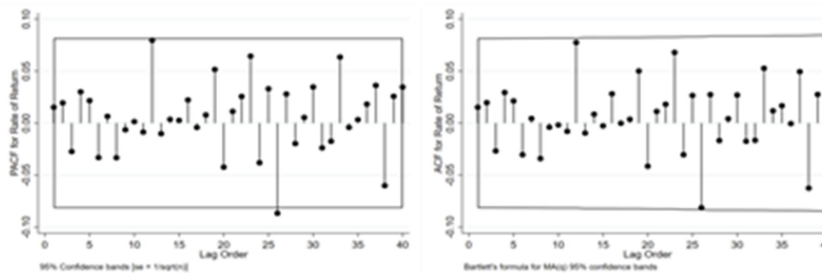


Figure3: PACF and ACF, Consumption index yield.

From the estimation results of the variance equation of ARMA-GARCH model, the ARCH terms of the two models are significant, indicating that there is significant conditional heteroscedasticity in the return rate of the consumption index. From the estimation results of exogenous variables, the coefficient of global and Chinese new additions is 0.001 and significant at 1% level.

Despite being statistically positive, the coefficient indicates that a 1% increase in the quantity of confirmed instances causes a 0.001 rise in the return volatility of the consumer sector index. However, the value of the coefficient is very small, that is, the change in the number of confirmed cases has little impact on the fluctuation of the return rate of the consumption index, and the economic significance is not significant.

These findings imply that COVID-19's long-term influence on the volatility of consumer yields is similarly relatively minimal.

Table3: ARMA-GARCH estimation results, variance equation.

Variables	(1)		(2)	
	Coef.	Std. err	Coef.	Std. err
	New confirmed cases			
The global China	0.0010***	0.0006	0.0010***	0.0006
	GARCH			
ARCH (-1)	0.0780*	0.0340	0.0778*	0.0352
GARCH (-1)	0.8358	0.0734	0.8322	0.0794
Constant	-10.2098	0.9645	-10.5993	0.5892

4. Discussion

Most of the existing articles only analyzed the short-term impact of the number of confirmed COVID-19 cases on consumption. They held that the abrupt COVID-19 outbreak had a significant negative influence on social and economic functioning, resulting in a significant drop in household spending at this time [2]. However, they did not use the long-term impact of daily new diagnoses on the returns of consumer-sector indices. Through the research of this paper, it can be found that the newly confirmed COVID-19 cases in China and the world will have a certain impact on the return rate of the consumption index in the short term. However, over time, the return on the consumer sector index will fluctuate less and less as a result of new COVID-19 diagnoses. As a result, the impact of new COVID-19 diagnoses on the return of the consumer sector index is minimal in the long run.

Overall, the impact of new COVID-19 diagnoses on consumption is only temporary and will diminish over time. For policymakers, it is important to put in place appropriate policies to prevent COVID-19 from having a big impact on consumption in the short term. And introduce some economic recovery policies to ensure the long-term and stable development of consumption. Future studies can focus on the long run to determine the best ways to reduce COVID-19's detrimental effects on consumption and get the world economy back to normal.

Consumption has not been fully negatively impacted by COVID-19. With the spread of COVID-19 around the world, e-commerce is developing better, and COVID-19 has brought development opportunities for cross-border e-commerce [12]. E-commerce is playing a positive role in the recovery of global consumption, which is the way forward in the long run. For investors, this is a development opportunity that cannot be lost.

5. Conclusion

Consequently, the COVID-19 epidemic has impacted economies all across the world, with consumption being the first to be impacted. Different industries have been influenced in different ways. The effect of the new COVID-19 diagnoses on the return rate and volatility of the consumer index is the main topic of this article. The COVID-19 epidemic will likely have some short-term effects on consumption, both in China and internationally, according to the methodology used to develop VAR and Arma-GARCH models. The COVID-19 pandemic's detrimental effects on consumption are not immediately apparent, albeit, in the long run.

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