

Research on the COVID-19 Epidemic's Impact on China's Catering Industry

Fuxin Tian*

Department of Statistics and Data Science, University of Santa Barbara, California, USA

*Corresponding author: fuxintian@ucsb.edu

Abstract. The catering industry is an important part of the basic needs of people's livelihood, with frequent foot traffic, a high concentration of people, and relatively closed space characteristics. The characteristics of the catering industry make it particularly vulnerable to the COVID-19 epidemic. This study examines quarterly data on the catering industry's GDP, electricity consumption, and epidemic indicators in China from 2016-March to 2022-June by using correlation analysis, Granger causality testing, vector auto-regression, and vector error correction models. Fruitful findings are derived. (1) Catering industry's GDP shows a significant positive correlation with electricity consumption, while there is a negative correlation with total cases, deaths, new cases, and deaths of the COVID-19 epidemic. (2) Catering industry's electricity consumption, total cases, and new deaths from COVID-19 are Granger causes of the catering industry's GDP. (3) The current COVID-19 outbreak will have a long-lasting negative impact on catering GDP for the next six months. Based on these findings, concrete policy recommendations are made to promote the catering industry, which should assist the industry in recovering from the outbreak of COVID-19.

Keywords: COVID-19; Catering industry; VAR and VEC; Policy suggestions.

1. Introduction

1.1 Research background

There is no doubt that the catering industry plays a major role in the tertiary industry, as it is closely related to people's livelihoods and acts as a catalyst for stimulating consumption potential and expanding the market demand for the industry [1]. A phase of rapid development has begun in China's catering industry, with revenue rising from 323.1 billion yuan in 2015 to 4672.1 billion yuan in 2019. The total retail sales of social consumer goods grew from 10.74% to 11.35%, contributing 1 percentage point to the growth of total retail sales of consumer goods. The contribution rate reached 13.1% [2].

The catering industry has a frequent flow of people, a high concentration of people, space is relatively closed, and the dining environment health requirements are high. However, it is also susceptible to public health emergencies, particularly infectious epidemics. When epidemics are on the rise, the production and operation activities of the catering industry are often the most direct, prominent, and long-lasting effects of these outbreaks. The COVID-19 epidemic in 2020 has seriously impacted China's economic development [3]. The epidemic was widespread and spread rapidly. Various regions took measures such as home quarantine and delaying the resumption of work and production to prevent the spread of the disease and reduce population movement; as a result, the consumer norm before the epidemic changed dramatically [4]. During the epidemic, the traditional catering industry was caught in a difficult business situation, facing numerous challenges such as high labor cost expenditures, the easy spread of the virus from dine-in meals, and obstruction of the purchase of imported cold-chain food raw materials. Affected by the COVID-19 epidemic, many catering companies suspended their operations, with a serious loss of corporate income, and the catering industry was greatly impacted [5].

According to China's National Bureau of Statistics, China's catering industry fell precipitously by 48.05% in the three months following the outbreak of the COVID-19 epidemic in late 2019. A times series plot of the quarterly GDP from the catering industry from Mar-16 to Jun-22 is given below to illustrate its dynamic changes. With the COVID-19 epidemic effectively under control, the catering

GDP rebounded, but its volatility was significantly stronger than before the epidemic. This phenomenon shows the negative impact of the COVID-19 epidemic not only on the revenue of the catering industry but also increases the risk of revenue and loss.

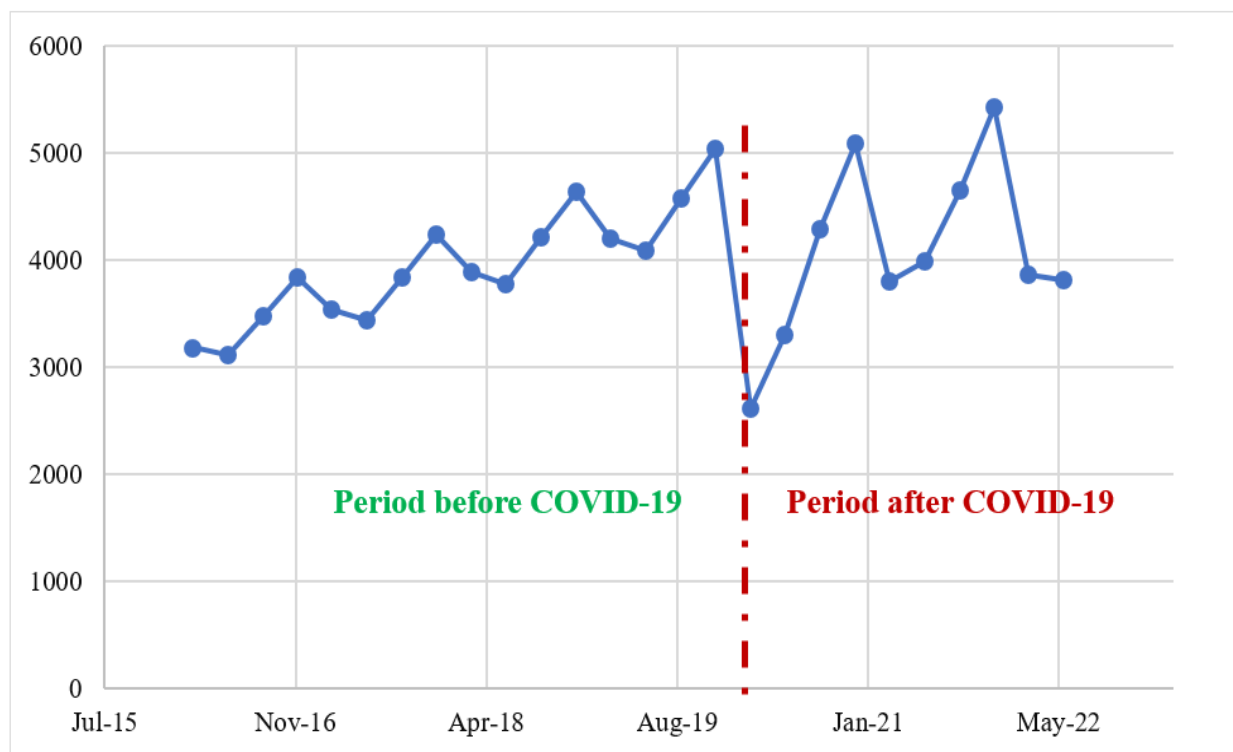


Fig 1. Times series of the quarterly GDP from the catering industry from Mar-16 to Jun-22.

1.2 Literature review

In recent years, scholars have conducted a lot of research on the development of the catering industry in the context of the COVID-19 epidemic. Foreign scholars such as Yost and Cheng (2021) analyzed the impact of the COVID-19 epidemic on restaurants by combining the affective decision-making framework, the motivational met theoretical model, and optimism bias theory and proposed a theoretical solution to address consumer motivation in the catering industry [6]. Kim and Lee (2021) investigated the effects of the perceived threat of COVID-19 and the salience of the virus on consumer preferences for private dining facilities. Combining theories from risk psychology and studies of preferences for private dining, they predicted that virus salience would systematically increase preferences for private dining facilities. Thus, the catering industry could mitigate the negative effects of the COVID-19 pandemic by increasing private dining facilities [7].

Domestic scholars such as Lv (2021) used a time series ARIMA intervention analysis model to forecast the turnover of the catering industry in Liaoning Province from January to June 2020 to measure the degree of impact of the epidemic on the catering industry. The results showed that the epidemic's impact on the catering industry was greater at the beginning, with an instantaneous reduction of 76,000 yuan in the average monthly turnover of catering enterprises in Liaoning. As the epidemic normalizes and becomes progressively more manageable, the impact will continue to accompany and diminish [8]. Zheng and Leng (2021) mainly analyzed the economic losses and difficulties faced by the catering industry in Hangzhou during the COVID-19 epidemic. Results showed that Hangzhou's catering revenue dropped 33.0% from January to March 2020 [2]. And since April, Hangzhou's catering revenue has shown steady growth. Wang et al. (2021) used the grey system theory model to forecast China's catering industry revenue from 2012 to 2020. It was found that the forecasted value of China's catering revenue from 2012-2019 was not significantly different from the actual value. However, the real value of China's catering revenue in 2020 dropped from the

forecasted value is 2020, which showed that the COVID-19 epidemic significantly impacted China's catering revenue [9].

Most scholars have focused on exploring the changes in catering revenues in a city before and after the outbreak, using the moment of the COVID-19 epidemic as the dividing line. The variables considered are only a single catering revenue, and the effects of other temporal variables on catering revenue cannot be considered in aggregate.

1.3 Research framework

This study will provide a new perspective on the impact of the COVID-19 epidemic on the catering industry in China based on multivariate time series of the number of people infected by the COVID-19 epidemic and the GDP of the catering industry. Since electricity is a valuable resource for economic development, sufficient and reliable electricity is an important guarantee for sustainable economic development [10]. Thus, this paper additionally considers the time series of electricity consumption in the catering industry. The catering industry's GDP and electricity consumption data are downloaded from the National Bureau of Statistics of China (Online website: <https://data.stats.gov.cn/>). And the COVID data was downloaded from Johns Hopkins University Center for Systems Science and Engineering COVID-19 data repository (Online website: <https://github.com/CSSEGISandData/COVID-19>). Pearson correlation analysis and the Granger causality test will first provide the overall correlation and causality between the time series. Further, the vector autoregressive model will model the multivariate time series to obtain the fitted relationships among the number of people infected by the COVID-19 epidemic, electricity consumption in the catering industry, and the GDP of the catering industry.

2. Methods

This study used multiple data analysis methods to investigate the number of people infected by the COVID-19 epidemic, electricity consumption in the catering industry, and the GDP of the catering industry, including correlation analysis, Granger causal analysis, and vector auto-regression.

2.1 Correlation analysis

The Pearson correlation is one of the most common methods to calculate the correlation between two variables. Here is the formula of coefficient in the Pearson correlation: [11]

$$r = \frac{cov(X,Y)}{\sigma(X)\sigma(Y)} = \frac{\sum_{i=1}^n (X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{\sum_{i=1}^n (X_i - \bar{X})^2} \sqrt{\sum_{i=1}^n (Y_i - \bar{Y})^2}} \quad (1)$$

This paper uses Pearson correlation coefficients to correlate the number of people infected by the COVID-19 epidemic, electricity consumption in the catering industry, and the GDP of the catering industry.

2.2 Granger causal analysis

Economists developed the Granger causality test to analyze the causality between variables. This test was pioneered by Clive Granger (1969), winner of the 2003 Nobel Prize in Economics, to analyze the causal relationships between economic variables [12]. This paper uses Granger's causal analysis to explore the causal relationship between the GDP of the catering industry and the people infected by the COVID-19 epidemic or electricity consumption in the catering industry.

2.3 Vector auto-regression

When analyzing multivariate value time series, the VAR model has become a popular model for analyzing multivalued time series data with cross-dependencies within an economic system and a key

tool in macroeconomic research since its introduction by Sims (1980) [13]. A general p -order VAR model is expressed as follows [14].

$$Y_t = A_1 Y_{t-1} + A_2 Y_{t-2} + \cdots + A_p Y_{t-p} + u_t \quad (2)$$

This paper takes the number of people infected by the COVID-19 epidemic, electricity consumption in the catering industry, and GDP of the catering industry as the three-time series considered in the VAR model. Y_t , Y_{t-1} ... Y_{t-p} are three-dimensional time series; u_t is a three-dimensional residual series; and A_1 , A_2 ... A_p are 3×3 coefficient matrix.

2.4 Vector error correction

When the time series data in the VAR model are non-stationary, these variables must pass a cointegration test and build a VEC model.

In contrast to the smoothness test, which describes the short-run equilibrium state, cointegration is a powerful concept. By analyzing cointegration, one can understand the long-run equilibrium state between variables. Furthermore, this is the basis for building and testing models based on a long-run steady state. As for the data itself, some time series data may temporarily deviate from the mean due to disturbances by some factors in the short run, but these variables will return to equilibrium over time. A cointegration relationship accounts for the data's short-term deviation and long-term steady-state characteristics [15].

It is commonly used to model non-stationary time series cointegration relationships with the VEC model. Using the VEC model, it is possible to analyze both short-run fluctuations and the long-run equilibrium between variables. The error correction term reflects the long-run equilibrium relationship between variables, and deviations from that equilibrium can be corrected through short-term adjustments. The model is based on the premise that cointegration applies, and the error correction term reflects the long-run equilibrium relationship between variables. The cointegration test in this paper uses the Johansen test, which can be referred to as Johansen (1991) [16].

3. Results

To begin with, descriptive statistics should be given to form an overall impression of the raw data. Descriptive statistics are various activities that characterize data using tabulation and classification of aggregated data, graphics, and calculation. Descriptive statistics are reported differently for different data types. For the three mainly discussed time series of the number of people infected by the COVID-19 epidemic (Unit: individual), GDP of the catering industry (Unit: Billion Yuan), and electricity consumption in the catering industry (Unit: kilowatt-hour), the descriptive statistics are given in Table 1 and Figure 2. In Figure 2, electricity consumption in the catering industry and COVID-19 cases correspond to the left-hand axis, and the GDP of the catering industry corresponds to the right-hand axis. It can be found that all three-time series have changed to different degrees over time and have fruitful information.

Table 1. Descriptive statistics of the catering industry's GDP, electricity consumption, and COVID-19 cases.

Indicator	N	Minimum	Maximum	Mean	Standard deviation
GDP	26	2614.600	5427.500	3995.862	649.758
Electricity	26	322621.000	871495.000	655601.182	127937.314
COVID-19 Cases	26	0.000	2134718.000	167758.654	483118.309

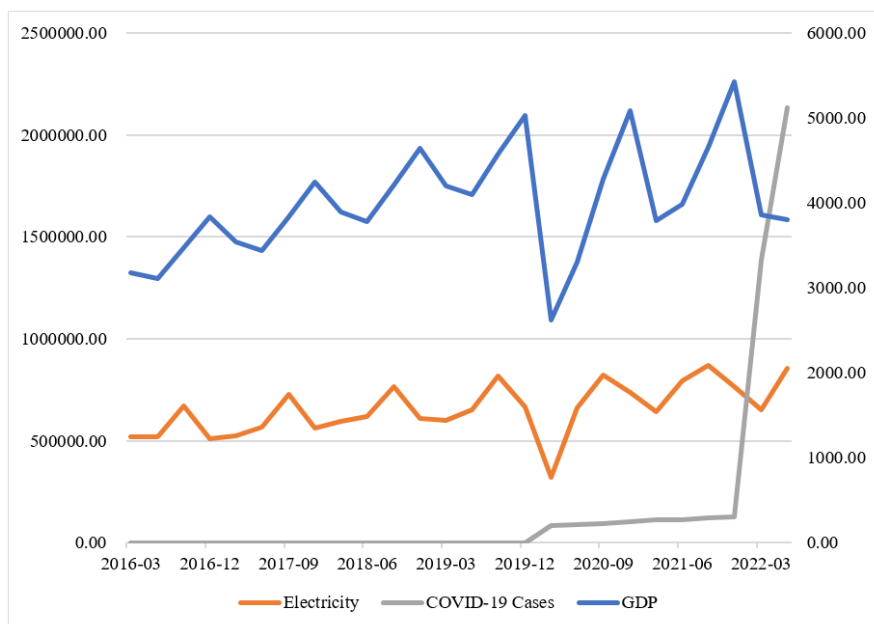


Fig 2. Time series plot of the catering industry's GDP, electricity consumption, and COVID-19 cases.

Next, the Pearson correlation coefficient measures the correlation between the GDP of the catering industry, electricity consumption in the catering industry, and COVID-19 indicators (including total cases, total deaths, new cases, and new deaths). The results are shown in Figure 2. Blue circles indicate positive correlations, and the red circles in the figure indicate negative ones. The larger the circle is, the stronger the correlation. It can be seen that the GDP of the catering industry shows a significant positive correlation with electricity consumption, whose Pearson correlation coefficient reached 0.56. In contrast, the GDP of the catering industry shows a negative correlation with total cases, deaths, new cases and new deaths in different degrees, with Pearson correlation coefficients of -0.18, -0.17, -0.21, and -0.43, respectively. This indicates that the intensification of the COVID-19 epidemic will have a significant negative impact on the revenue of the catering industry. Electricity consumption in the catering industry shows a relatively significant negative correlation with new deaths, with a Pearson coefficient of -0.28. While total cases, deaths, new cases, and new deaths all show a strong positive correlation between the two.

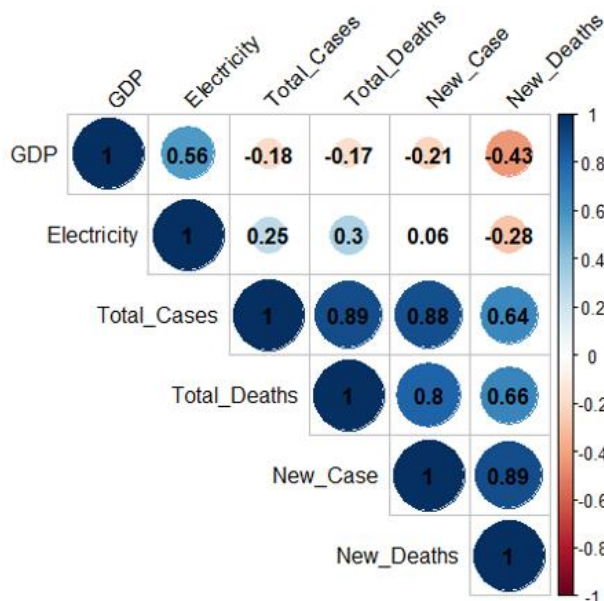


Fig 3. Pearson correlation plot between the catering industry's GDP, electricity consumption, and COVID-19 indicators.

Then, the Granger causality test is conducted to determine whether total cases, deaths, new cases and new deaths are Granger causes of the GDP of the catering industry. Results are listed in Table 2. At a significance level of 0.05, it can be assumed that the catering industry's electricity consumption, total cases, and new deaths from COVID-19 are Granger causes of the catering industry's GDP. If the significance level is relaxed to 0.10, then the total deaths and new cases of COVID-19 can also be reckoned as the Granger causes of the catering industry's GDP. Granger causality tests pointed out that the variables selected in this paper are important potential influences on the catering industry's GDP.

Table 2. Summary of Granger causality test.

Granger relationship	F statistics	P-value
GDP $\leftarrow$ Electricity consumption	4.728	0.033
GDP $\leftarrow$ Total cases	4.633	0.049
GDP $\leftarrow$ Total deaths	3.957	0.067
GDP $\leftarrow$ New cases	3.316	0.075
GDP $\leftarrow$ New deaths	6.172	0.026

Furthermore, the VAR model modeled the dynamic quantitative relationship between the numbers of people infected by the COVID-19 epidemic, the catering industry's GDP, and the catering industry's electricity consumption. To start with, the ADF unit root tests are conducted to check if the series is stable. The ADF test results are given in Table 3. As seen from the table above, the p-values of all three-time series are greater than 0.05 at the significance level of 0.05, and the original hypothesis that the series is not stable cannot be rejected, i.e., the time series of all variables is not stable. In this case, the regression can be performed using first-order differences (the differenced series tend to be stable). However, for the model to have a richer economic connotation, the original order series of all the variables will be analyzed empirically in this paper. And to perform empirical analysis on the non-stationary original order series, the variables must pass the cointegration test and build a VEC model.

Table 3. Summary of ADF unit root tests.

Time series	Dickey-Fuller	P-value
GDP	-2.973	0.202
Electricity	-2.567	0.356
COVID-19 Cases	-0.294	0.984

In order to build a VEC model, the Johansen test should be firstly conducted to determine whether there are cointegration relationships between variables. The results of the Johansen test are given in Table 4. According to the results, the original hypothesis that the number of cointegrating vectors is 0 ($25.49 > 21.07$) can be rejected at the significance level of 0.05, but the original hypothesis that the number of integer vectors is less than or equal to 1 ($8.35 < 14.90$) cannot be rejected. Therefore, it can be considered that there is a cointegration relationship between the three-time series of the number of people infected by the COVID-19 epidemic, the GDP of the catering industry, and electricity consumption in the catering industry.

Table 4. Summary of Johansen test.

Null hypothesis	Test	10pct	5pct	1pct
$r \leq 2$	2.72	6.50	8.18	11.65
$r \leq 1$	8.35	12.91	14.90	19.19
$r = 0$	25.49	18.90	21.07	25.75

After determining the cointegration relationship, the VEC model was developed. The VEC model was transformed into a horizontal VAR model to facilitate the interpretation of the coefficients. The formula of the established VAR model is given in Equation (3). It can be seen that both the first-order lags and second-order lags of the COVID-19 total cases have a negative effect on GDP in the current period, and the effect of second-order lags is stronger than that of first-order lags. Each additional person in the total COVID-19 cases would reduce the catering industry's GDP by 0.00047 billion Yuan after three months and the catering industry's GDP by 0.004647 billion Yuan after six months. First-order lagged electricity consumption positively affects the current catering industry's GDP (with a coefficient of 0.009), while second-order lagged electricity consumption weakly affects the current catering industry's GDP (with a coefficient of -0.0018). The above results illustrate that the impact of the COVID-19 outbreak on catering GDP is long-lasting and that the current COVID-19 outbreak will have a negative impact on catering GDP for all of the next six months.

$$\begin{bmatrix} \text{GDP}_t \\ \text{Electricity}_t \\ \text{COVID}_t \end{bmatrix} = \begin{bmatrix} -284.0 \\ 67232.3 \\ 208262.5 \end{bmatrix} + \begin{bmatrix} -0.612 & 0.009 & -0.00047 \\ -68.36 & 0.975 & -0.06466 \\ 487.07 & -2.097 & 1.624687 \end{bmatrix} \begin{bmatrix} \text{GDP}_{t-1} \\ \text{Electricity}_{t-1} \\ \text{COVID}_{t-1} \end{bmatrix} \\ + \begin{bmatrix} 0.649 & -0.0018 & -0.004647 \\ 222.36 & -1.0577 & 0.8825510 \\ -90.70 & -0.6897 & 1.4804866 \end{bmatrix} \begin{bmatrix} \text{GDP}_{t-2} \\ \text{Electricity}_{t-2} \\ \text{COVID}_{t-2} \end{bmatrix} \quad (3)$$

The paper considers the goodness-of-fit R-square and the Box-Ljung white noise test for the VAR model fit results. R-square is the percentage of variability in the dependent variable explained by the regression equation. The Box-Ljung white noise test checks whether the model residuals still have valid information for further modeling. The results of the R-square and Box-Ljung tests are given in Table 5. It can be seen that the model explains a satisfactory 42.5% and 44.5% of the variance of the catering industry's GDP and electricity consumption, respectively. For COVID-19 cases, the goodness-of-fit is slightly worse, at 17.3%. This is due to the absence of the COVID-19 epidemic from 2016 to 2019 within the time window selected for this paper. The results of the Box-Ljung test show that the original hypothesis that the three residual series are white noise cannot be rejected. It indicates that the model has effectively modeled the information in the original time series.

Table 5. Summary of model fitting effects.

Residuals	R-square	Box-Ljung	p-value
GDP	0.425	10.194	0.424
Electricity	0.445	8.474	0.583
COVID-19 Cases	0.173	1.835	0.998

Based on the modeling results of the VAR and VEC models, the values of the catering industry's GDP, electricity consumption, and COVID-19 cases can be predicted for the next three years. As can be seen, the model shows that the catering industry's GDP and COVID-19 cases will show a fluctuating increase, and the catering industry's electricity consumption will show a continuous increase.

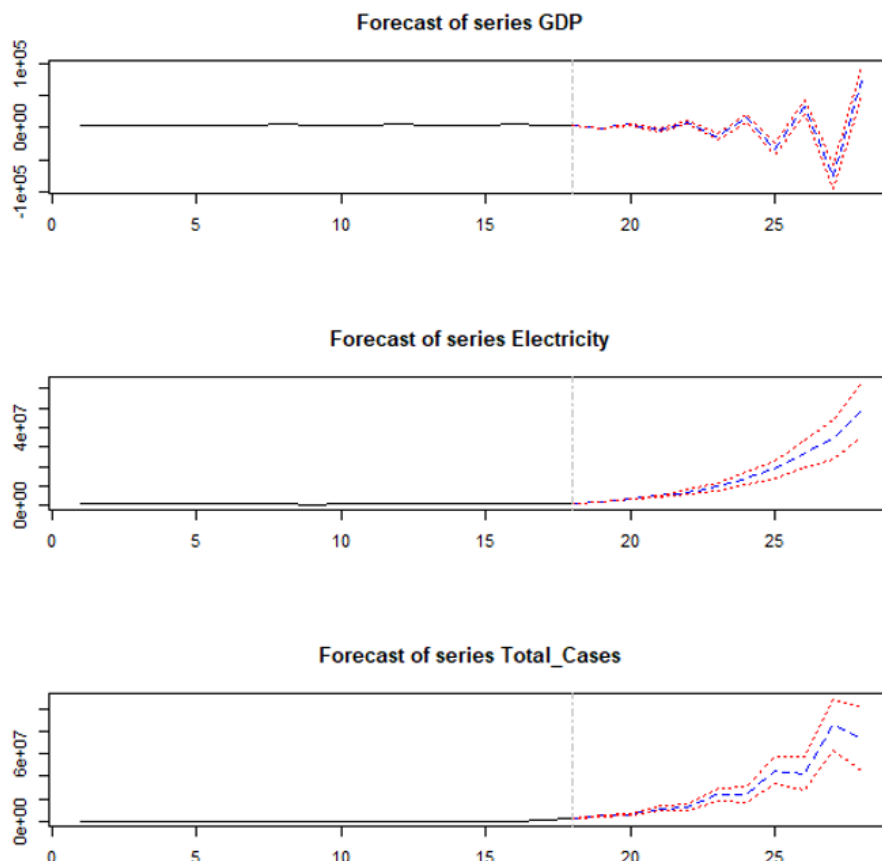


Fig 4. Forecast of the GDP, electricity consumption, and COVID-19 cases in the future 3 years.

4. Discussion

Based on the correlation analysis and Granger causality analysis, it was noted that the GDP of the catering industry is closely related to electricity consumption and the COVID-19 outbreak. The VAR and VEC models further indicated that the negative impact of COVID-19 on the GDP of the catering industry is long-lasting, and this impact will last up to six months. Based on the above analysis and results, the following recommendations are made for the later development of China's catering industry.

4.1 Environmental hygiene

Environmental hygiene is the basic condition for catering operations. Although the epidemic has seriously impacted the catering industry, it can increase customer traffic by improving consumer confidence. The key to the long-term development of the catering industry is ensuring food hygiene and safety. Enterprises should fully promote public spoons and chopsticks and do a good job of disinfection.

4.2 Develop an online take-out marketing model

The incubation period of the new crown pneumonia virus is long, and during the seriousness of the epidemic, many governments completely abolished dine-in food. And consumers will give priority to ordering take-out based on safety considerations for some time after resuming work and production. The network ordering and non-contact delivery effectively reduce the gathering of people due to dining out and meet the residents' basic needs for food. In order to ensure profits, caterers must convert to online marketing. Catering enterprises can promote in-store features and establish an active take-out marketing network through social platforms such as WeChat public numbers, WeChat small programs, Tik Tok, and Quick hand. The integration and development of the catering industry and the Internet can create new development models and ultimately achieve a win-win situation.

4.3 Promote the adoption of a dine-in meal sharing system in enterprises

Taking the opportunity of this new epidemic control, we will normalize the experience of sharing meals in dining rooms, setting up transparent windows for dining, setting up public spoons and chopsticks, maintaining a moderate dining distance, and reducing the density of dining staff. Gradually change the traditional round table dining habits and adopt the dine-in meal system to reduce the probability of cross-infection and improve food culture and dining efficiency.

4.4 Standardize the management of catering enterprises

If the catering industry wants to sustain development before the epidemic, it has to do a good job of epidemic prevention. To adhere to the disinfection of public places, disinfection records, open the doors and windows to ventilate diligently, and the customers who enter the store to consume real-time monitoring of epidemic prevention health code. Moreover, to truly cut off the source of the virus from the root, to protect the public's health and safety so that customers can consume confidently. We should strictly count the information of employees, actively provide personal protective equipment, and do a good job of educating and guiding employees. During the epidemic, we should strictly check the physical condition of the take-away workers and their families and check whether they have fever and cough. Moreover, increase the number of disinfections of take-away sites and delivery boxes, and keep records. In addition, carry out training on food safety and epidemic prevention and control knowledge for take-away workers to improve their awareness and ability.

4.5 Build a perfect supply chain system for the catering industry

Use information technology to build an emergency big data platform. Considering various aspects such as the state, government, and enterprises, an emergency supply chain system should be established; to ensure that emergencies such as the new crown pneumonia epidemic can be quickly matched to effective response strategies. Supply chain information sharing should be smooth and updated promptly to maintain efficient communication; to ensure that the best suppliers can be found promptly in emergencies.

4.6 Strengthen the training of practitioners and improve the level of catering services

Relying on industry associations to carry out induction training to comprehensively improve the professionalism and ethics of catering practitioners. At the same time, regularly organize food safety managers of catering units to carry out training and assessment of professional ethics, food service codes of practice, laws, regulations, etc., to improve the management of the catering industry. Health, disease control, and other departments in the health certificate for practitioners and other matters, synchronized assessment of public health and food safety, and other theoretical knowledge. Administrative licensing departments in the "food business license" new, renewal, change, and other matters, the appropriate increase in the legal representative / responsible for food safety and other aspects of the assessment content, to strengthen their awareness of the main responsibility for food safety. Market supervision departments should increase the training of practitioners, and enrich the form of training and education through short animation videos, audiobooks, typical case studies, etc., to improve the motivation of restaurant practitioners to learn on their own. Moreover, organize emergency drills and hands-on training to standardize food service behavior and enhance the response to public health events and the ability to respond to public health events. Vocational education management department to speed up the reform of the education system and focus on improving the culinary skills of academic education. In food higher education, provide additional practical courses such as catering and culinary management and public health management courses to train and deliver technical and comprehensive management personnel for the catering industry.

4.7 Increase policy support to boost confidence in the development of the catering industry

With the impact of the new crown pneumonia epidemic, the catering industry operators' confidence in the industry has been seriously set back. In this regard, government departments should increase policy support, optimize financial and credit services, and provide financial support for catering operators with the will to continue operating by introducing interest-free loans, lowering loan interest, or extending the repayment time frame to promote the recovery of the catering industry gradually. According to the actual situation, the deadline for reducing or extending social security contributions for catering employees. Optimize the catering license approval process for a single business variety, low-risk potential catering industry to implement a commitment to the record system. At the same time, the administrative licensing network platform is used to achieve the full process online, compress the approval time frame, and synchronize the issuance of electronic licenses to provide maximum support for the catering industry. Encourage scientific research and innovation in the field of catering and food-related products, increase the research and development of intelligent catering food processing machinery, intelligent distribution equipment, ordering and cashier management systems, etc., and promote the transformation of the catering business towards intelligent and "no contact" mode, to provide strong support for the catering industry to deal with the adverse effects of the epidemic

5. Conclusion

This study uses various data analysis techniques to examine quarterly data on the catering industry's GDP, electricity consumption, and epidemic indicators in China from 2016-March to 2022-June. Several interesting findings are derived.

(1) The correlation analysis pointed out that the catering industry's GDP significantly positively correlated with electricity consumption (Pearson correlation coefficient reached 0.56). While catering industry's GDP negatively correlates with total cases, deaths, new cases, and new deaths, with Pearson correlation coefficients of -0.18, -0.17, -0.21, and -0.43, respectively.

(2) Granger causality analysis shows that the catering industry's electricity consumption, total cases and new deaths of COVID-19 are Granger causes of the catering industry's GDP at a significance level of 0.05. If the significance level is relaxed to 0.10, the total deaths and new cases of COVID-19 can also be reckoned as the Granger causes of the catering industry's GDP.

(3) The ADF unit root test states that the number of people infected by the COVID-19 epidemic, the catering industry's GDP, and the catering industry's electricity consumption are not stable time series. And the Johansen test shows that there is a coin-integration relationship between the three variables.

(4) The modeling results of VAR and VEC models show that both the first-order lags and second-order lags of the COVID-19 total cases have a negative effect on GDP in the current period. Each additional person in the total COVID-19 cases would reduce the catering industry's GDP by 0.00047 billion Yuan after three months and the catering industry's GDP by 0.004647 billion Yuan after six months. The above results indicate that the impact of the COVID-19 outbreak on catering GDP is long-lasting and that the current COVID-19 outbreak will have a negative impact on catering GDP for all of the next six months.

(5) The forecast for the future three years based on VAR and VEC models indicates that the catering industry's GDP and COVID-19 cases will show a fluctuating increase, and the catering industry's electricity consumption will continuously increase.

Based on the above findings, concrete suggestions for promoting the catering industry are proposed, including (1) Environmental hygiene;(2) Developing an online take-out marketing model;(3) Promoting the adoption of a dine-in meal sharing system in enterprises;(4) Standardize the management of catering enterprises;(5) Build a perfect supply chain system for the catering industry;(6) Strengthen the training of practitioners and improve the level of catering services; and (7) Increase policy support to boost confidence in the development of the catering industry.

References

- [1] Medlick S, Airey D W. Profile of the hotel and catering industry [J]. Profile of the hotel and catering industry. 1981.
- [2] Zheng N, Leng S. Y. Analysis of the impact of the new crown pneumonia epidemic on the catering industry in Hangzhou [J]. Journal of Chuxiong Normal College, 2021, 36(05):147-155.
- [3] Altig, D., Baker, S., Barrero, J.M., Bloom, N., et al. 2020. Economic uncertainty before and during the COVID-19 pandemic. Journal of Public Economics, 191, 104274.
- [4] Deb, P., Furceri, D., Ostry, J.D., Tawk, N. 2020. The economic effects of Covid-19 containment measures.
- [5] Coibion O, Gorodnichenko Y, Weber M. Labor markets during the COVID-19 crisis: A preliminary view[R]. National Bureau of economic research, 2020.
- [6] Yost E, Cheng Y. Customers' risk perception and dine-out motivation during a pandemic: Insight for the restaurant industry [J]. International Journal of Hospitality Management, 2021, 95: 102889.
- [7] Kim J, Lee J C. Effects of COVID-19 on preferences for private dining facilities in restaurants [J]. Journal of Hospitality and Tourism Management, 2020, 45: 67-70.
- [8] Lv Qiufen. An empirical analysis of the impact of the new crown pneumonia epidemic on the catering industry--Liaoning Province as an example [J]. Journal of Party and Government Cadres, 2021(04):49-55.
- [9] Wang Shanshan, Wang Jingyi, Chang Tingyu, Li Jichuan, Zhang Xuefeng. Analysis of the impact of the new crown pneumonia epidemic on catering enterprises and countermeasures [J]. Shanxi Agricultural Economics, 2021(05):91-92.
- [10] Pan W, Xiong JW. An empirical analysis of electricity consumption, economic growth and CO₂ emissions--based on Chinese panel data [J]. China Management Science, 2018, 26(03): 152-159.
- [11] Benesty J, Chen J, Huang Y, et al. Pearson correlation coefficient[M]//Noise reduction in speech processing. Springer, Berlin, Heidelberg, 2009: 1-4.
- [12] Granger, Clive W. J. Investigating Causal Relations by Econometric Models and Cross-spectral Methods. Econometrica (The Econometric Society), 1969, 37 (3): 424-438.
- [13] Sims C A. Macroeconomics and reality [J]. Econometrica: journal of the Econometric Society, 1980: 1-48.
- [14] Johansen S. Statistical analysis of cointegration vectors [J]. Journal of economic dynamics and control, 1988, 12(2-3): 231-254.
- [15] Johansen S. Statistical analysis of cointegration vectors [J]. Journal of economic dynamics and control, 1988, 12(2-3): 231-254.
- [16] Johansen S. Estimation and hypothesis testing of cointegration vectors in Gaussian vector autoregressive models [J]. Econometrica: journal of the Econometric Society, 1991: 1551-1580.