Analyzing the Impact of COVID-19 in China's Restaurants Industry: Revenue from Meals and Revenue from Meals above Designated

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Abstract. COVID-19 has a significant impact on the world's economy, which includes China's restaurants industry. Thus, in this paper, it shows the fluctuations of Revenue from Meals and Revenue from Meals above Designated after the start of COVID-19. The study uses the data before COVID-19 to forecast through ARIMA model. Examining the disparity between the actual and the predicted data, the result will display the practical impact on China's restaurants industry. The difference between the actual values of revenue and the forecasted values is decreasing at first, but increasing gradually after March 2020. This paper proves that restaurants above designated have less impact than all restaurants. The results from the study can explain that the restaurants industry is easily affected by public health problems. The developing trend of restaurants industry is not to be underestimated. Policy makers need to have corresponding preparatory strategies to reduce the loss of the sudden public health crisis. Restaurants' leaders can develop various operating models as well.

Keywords: China, Restaurants Industry, COVID-19, ARIMA model.

1 INTRODUCTION

In late 2019, a new coronavirus appeared in China and started spreading to the whole country. Afterwards, the World Health Organization (WHO) named it as COVID-19. The sudden COVID-19 has a great impact on almost every industry in the world. It causes many industries to stop operating normally. In the first three months of 2020, China's economy contracted 6.8% compared with a year earlier [1]. Specifically, China Cuisine Association (CCA), a national catering industry association, implemented a quarantine policy at the beginning of the epidemic. The policy refuses any activities of gathering or wedding banquets [2]. Thus, people are not allowed to go out and have meals in the restaurants. According to Xiaoou Liu et al., revenue from Beijing restaurant chains which are influenced by stay-at-home orders decreased by 17 percent [3]. In addition, people themselves are afraid of the spread of coronavirus, and they are unwilling to choose restaurant food. Many restaurants close at the begin

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ning of the COVID-19. In April 2022, Revenue from Meals decreased by 22.7% compared with a year earlier [4]. There is some harm to this industry due to this public health problems.

Prior to this epidemic, this industry developed rapidly. Judging from the catering business area of chain catering enterprises, the catering industry has a rapid expansion trend from 2006 to 2012 [5]. However, restaurant industry is relatively vulnerable when the health-related crisis arises because of its small-scale, low liquidity, and some other reasons [6]. In the Bartik's sample, 43 percentage of business temporarily shut down [7]. Bartik thinks that small businesses in restaurants are financially fragile [7]. Compared with large businesses, small businesses are more affected by policies formulated due to the epidemic. Therefore, the change of revenue from meals will be different from the change of revenue from meals above designated.

Studying the effect on the catering industry can provide some information so that the government is able to make policy to recover the economy. According to Guidelines for the prevention and control of new coronavirus pneumonia in hospitality enterprises, CCA suggests that restaurants should have diversification of business models. [8] For example, restaurants can develop takeaway food service, or they can set more sales windows. Jaewook et al. propose that restaurants can run more different business models so that it can reduce the influence of COVID-19 [9]. All these strategies balance the decline of the revenue from meals and are helpful for the industry recovery as well. Warwick McKibbin and Roshen Fernando assert that some countries, which include China, adopted uncertain policies at the beginning of the epidemic [10]. Thus, they have higher economic forecasts in Warwick and Roshen's research [10]. The policy can effectively prevent continued decreases in China's domestic trade.

The study analyzes the changing of Revenue from Meals in China and Revenue from Meals above Designated and concludes the effect of the COVID-19 on the catering industry. This research introduces the data source from the National Bureau of Statistics and the model used to analyze this data. The empirical results and analysis will be discussed by the ARIMA model. The data is separated by two time periods. Analysis is based on comparing the forecast data by the data before COVID-19 and the actual data after COVID-19. Ultimately, it concludes the research briefly.

2 RESEARCH DESIGN

2.1 Data Source

The source of data is the National Bureau of Statistics, which is a database responsible for national statistics and economic accounting work. Revenue from Meals (RFM) and Revenue from Meals above Designated (RFMDS) are used to observe the changing of all businesses and the changing of median to large businesses. In this study, it selects the data before the COVID-19 to forecast. Because the data before is definitely not affected by the COVID-19. The starting month of COVID-19 is set as t0. Using Stata data analysis software, RFM and RFMDS are used to generate logarithmic revenue value, and the first order difference is used to generate logarithmic return series.

Afterwards, the values before COVID-19 are used to construct the ARIMA model by Stata and analyze the output value. After obtaining the forecasted data, using actual data after COVID-19 compared to it and verify the impact of COVID-19 in China's restaurant industry.

2.2 Unit Root Test

It is first necessary to do a unit root test in order to observe whether the series is stationary. It defines the null hypothesis (H0) of the presence of unit root. The original hypothesis (H0) is that the series is not stationary. From Table 1, it shows that the logarithmic return values are 0.00. It is smaller than 0.1. Hence, the output should disprove the original hypothesis that these models are stationary.

Table 1. Weak stationarity test.

	t	p
Total Retail Sales of Consumer Goods, Revenue From Meals (RFM)		
Ln value	-7.660	0.0000
1st order difference	-7.392	0.0000
Total Retail Sales of Consumer Goods, Revenue From Meals above Designated Size (RFMDS)		
Ln value	-4.481	0.0016
1st order difference	-6.042	0.0000

2.3 ARIMA Model

The whole name of ARIMA model is the Autoregressive Differential Moving Average model. The ARIMA model predicts the future using past time series. The model includes three components: Autoregressive model (AR), Differential process (I), and moving average model (MA). The Autoregressive describes using the value of the previous periods in the model. The AR(p) model's mathematical form is as follows:

$$x_t = \emptyset_0 + \emptyset_1 x_{t-1} + \cdots + \emptyset_p x_{t-p} + a_1 \quad (1)$$

The MA model describes past white noise error terms. The relation between current value and historical white noise error is linear. Thus, the MA model is continuous stationary. The MA(q) mode's mathematical form is as follows:

$$x_t = c_0 + a_t - \theta_1 a_{t-1} - \cdots - \theta_q a_{t-q} \quad (2)$$

Differential process (I) occurs when the result of a unit root test is non-stationary. After the differential process, time series become stationary, and it can use the ARMA model to forecast.

The AR model utilizes the logarithmic return of RFM and RFMDS before the start of COVID-19, while using error terms from MA model to forecast the future.

3 EMPIRICAL RESULTS AND ANALYSIS

3.1 Order of ARIMA Model

After unit root test, the first step is doing order determination for RFM and RFMDS separately. Figure 1 below shows the results of two data series.

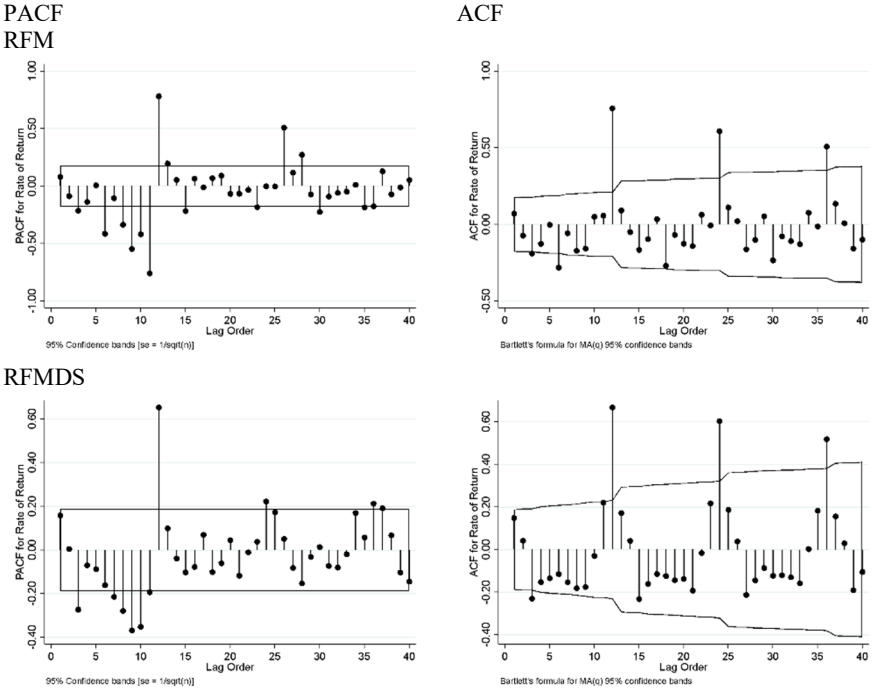

Fig. 1. ARMA (p, q) identification.

Photo credit: Original

There are upper and lower confidence intervals in the ACF and PACF graphs. Some lags are significantly exceeding the confidence intervals in Figure 1. As shown in the above PACF and ACF plot in the Figure 1, it is obvious that the first lag beyond the confidence interval is 10 and 6 respectively. Hence, the RFM finally determines ARIMA(10,1,6) as their model. In PACF and ACF plot of RFMDS, the first lag exceeding the confidence intercal is 10 and 3 respectively. Therefore, the RFMDS decides ARIMA(10,1,3) as their model. After determining the exact order, the residual test is shown below:

Table 2. Residual test.

Model	Portmanteau (Q) statistic	Prob > chi2
RFM - ARIMA(10,1,6)	141.7450	0.0000
RFMDS - ARIMA(10,1,3)	209.0698	0.0000

According to Table 2, it shows that these data series are not white noise, because the p-value is smaller than 0.05. The series is stationary and can be used to predict the next step. After order determination and residual test, the data can be forecasted by the Stata program for the period after COVID-19.

3.2 Forecast Results and Interpretation

Figure 2 is the chart from forecasted value and actual value of RFM, and Figure 3 is chart of the difference between two values. Figure 4 is the chart which use RFMDS actual data and predicted value in the period after COVID, and Figure 5 is the difference between two values as well.

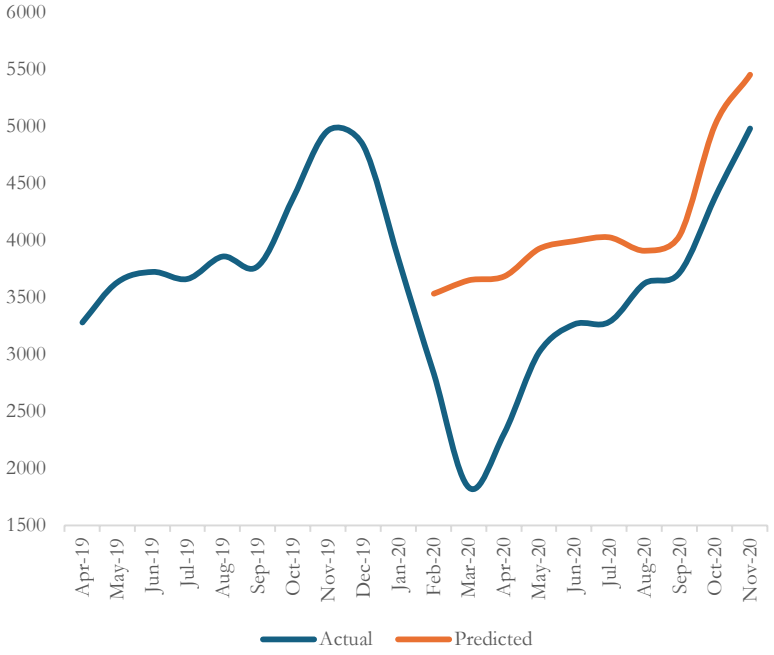

Fig. 2. RFM before and after Covid-19.

Photo credit: Original

In the Figure 2, it is obvious that the forecasted data is completely higher than the actual data at the start point of the pandemic. There is a significant decreasing from January to March 2020. In the Figure 3, the difference value percentage is negative 20% at the beginning point. From January to March 2020, the difference of percentage decline. However, the percentage begins increasing after March, and it doesn't have dramatic fluctuate after June 2020. The empirical result indicates that COVID-19 has a negative influence on restaurants industry.

Fig. 3. The difference percentage of two values on RFM.

Photo credit: Original

In the Figure 4, the actual value of RFMDS is still higher than the forecasted value from January to September 2020. There is a dramatic decreasing at the beginning of the epidemic as well. In the Figure 5, the difference percentage is minus 25.93% at the start point of COVID-19. It fluctuated up and down by 20% in the early stages of the epidemic. Therefore, it means that the effect of COVID-19 is the same with its in RFM, but it is different when the COVID-19 comes to an end. After March, the difference is gradually smaller and even becomes positive after September 2020.

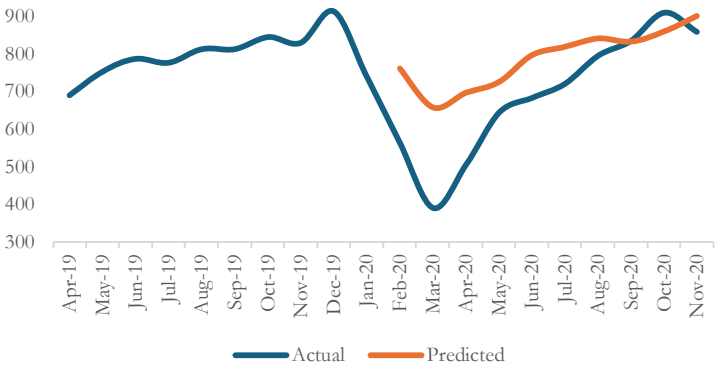

Fig. 4. RFMDS before and after Covid-19.

Photo credit: Original

Revenue from Meals above designated only includes enterprises operating catering activities with annual operating income above 2 million RMB. The differences between the differences percentage of the start point and the first minimum in RFM and RFMDS are 29.93% and 14.79% respectively. The average of differences in RFM and RFMDS are around -20.26% and -13.57% separately. Compare the restaurants with annual revenue of more than 2 million RMB and those with less than 2 million RMB, restaurants above designated are less effected by COVID-19. In addition, the difference of RFMDS after September represents that the enterprises above designated have stronger resilience.

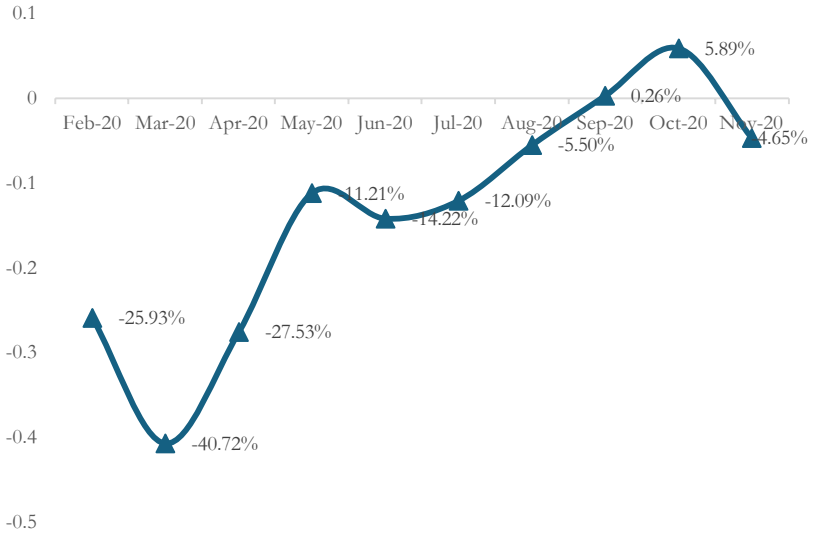

Fig. 5. The difference percentage of two values on RFMDS.

Photo credit: Original

COVID-19 first has a significantly negative effect on restaurant industry, but then the impact gradually declines. Compare RFM and RFMDS, the effect is relatively smaller in RFMDS.

4 CONCLUSION

The influence of COVID-19 on the entire catering industry is the primary subject of the paper, which specifically includes the research on restaurants above designated. In this study, the ARIMA model is the main research method. Two data series divide into two periods respectively, the period before the epidemic and the period after the epidemic. Stata use the ARIMA model to obtain log returns of RFM and RFMDS before COVID-19, while using error terms from MA component to forecast the future value.

From two research charts, the actual value is smaller than the predicted value. Result of comparison of actual value and predicted value concludes that the effect of this public health problem on the entire catering industry first increased from January to March, and then decreased after March. The impact on Revenue from Meals above Designated is smaller. Enterprises above 2 million RMB have economic reserves to deal with the sudden epidemic. According to the decreasing difference at the later stage of COVID-19, enterprises have strong resilience.

Based on these observations, there are several future suggestions. Small businesses can develop various operating models. For example, in this case, restaurants can make takeaway food. They can develop contactless food delivery for consumers, which will reduce the risk of spreading the coronavirus. Furthermore, catering enterprises are supposed to prepare sufficient reserves to cope with various unexpected health crises. In conclusion, it is expected that advance preparation is helpful for all catering enterprises and can provide stability for the entire industry.

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