



Study on the Impact of Major Public Health Emergencies on Chinese Tourism Industry

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Abstract. Because of its own nature, the tourism industry is less resistant to risk, highly sensitive to major public health emergencies. Based on the theoretical framework of tourism background trend line model and the data of Chinese tourists from 2000 to 2022, taking the SARS, H1N1, H7N9 and COVID-19 in the new century as reference, this paper analyzes the impact of major public health emergencies on Chinese tourism industry. The results show that all major public health emergencies have adverse impact on Chinese tourism industry, but there are differences in the degree of impact and recovery time. In addition, the domestic tourism market is more stable and recovers faster than the inbound tourism market.

Keywords: Public Health Emergency · Tourism Industry · Background Trend Line

1 Introduction

Since the beginning of 2020, Corona Virus Disease 2019 (COVID-19) has broken out in many countries around the world. The epidemic has spread rapidly, affected widely and lasted long, causing a huge impact on the economy, society and people's lives. The number of tourists in China has dropped sharply and the tourism industry has been hit heavily. Looking back on the Severe Acute Respiratory Syndrome Corona Virus (SARS), Influenza A Virus H1N1 (H1N1) and Influenza A Virus Subtype H7N9 (H7N9) that occurred in the past two decades, we could find that the impact of major emergencies on tourism will be phased and Chinese tourism industry has good resilience to recover quickly after the event. Studying past experience can provide some reference for coping with COVID-19. Therefore, based on the data of Chinese tourists from 2000 to 2022, this paper uses the background trend line to research the degree and regularity of the impact of major public health emergencies on Chinese tourism industry and then puts forward some strategies to enhance the confidence of tourism supply and demand, expecting a steady recovery and sustainable healthy development of tourism industry after COVID-19.

2 Literature Review

For evaluating the impact of unexpected events on tourism, one of the most widely used methods by foreign scholars is the “Comparison method of adjacent years”, which is relatively simple and compares the data of the year when the incident occurred with the previous year to obtain the impact of the incident on the tourism industry. Nevertheless, this method is not enough to reflect the natural trend of tourism development. Since the 21st century, foreign scholars have focused on the characteristics and follow-up effects of tourism crisis, consumer psychology and decision-making. The representative researches are as follows: BLAKE A & Sinclair T. M.’s study of 9·11 event concluded that the most effective way to restore tourism is through tax cuts and subsidies [1], Frisby.E’s analysis of 9·11 event and foot-and-mouth disease [2] and so on.

At the end of the 20th century, Chinese scholars have increasingly studied the impact of emergencies on tourism, with representative studies as follows: The “tourism background trend line” theory proposed by Sun Gennian in 1998 reflects the development trend of tourism under normal circumstances and provides a reference system for tourism crisis studying [3]. In 2012, Sun Gennian made a more comprehensive amendment to the above theory by introducing the concept of “baseline anomaly” [4] and conducted in-depth studies on the impact of some major events on tourism with other scholars [5–9]. Therefore, more and more scholars carry out researches which based on the theory of “tourism background trend line” [10–15]. Since the outbreak of COVID-19 in 2020, there are still few studies on the impact of this event on tourism. Liu Shufang et al. analyzed the impact of SARS, H1N1 and H7N9 on tourism among China, Japan and South Korea and estimated the impact of COVID-19 on tourism in each country [16].

On the basis of previous studies and the tourism background trend line theory, this paper selects the tourists data of China from 2000 to 2022 and uses nonlinear regression model to research the specific impact of four major public health emergencies, namely SARS, H1N1, H7N9 and COVID-19, on the tourists number of China to provide a reference system for the study of emergencies. Different from previous studies, this paper compared the impact degree and recovery time of the four emergencies, in the hope that the relevant research results can provide practical and effective empirical countermeasures to deal with the epidemic.

3 Research Design

3.1 Introduction of the Model

The background trend line of tourism refers to the normal development trend of the tourism industry under normal circumstances without the interference of accidental events. It is stable, while the tourism statistical line is volatile and the statistical value will fluctuate up and down around the background value under the influence of the outside world [3]. Based on the basic expression form of time series model, referring the multi-scale time domain combination model and the decomposition idea of time series, this paper divides the tourism development of a region into four basic change forms, namely: $Y(t) = T(t) + C(t) + S(t) + E(t)$. Among them, $\{Y(t), t = 1, 2, 3, \dots, n\}$ is the long-term sequence of tourism statistics, $T(t)$ is the long-term trend term, $C(t)$

is the fluctuation cycle term, $S(t)$ is the seasonal variation term and $E(t)$ is the event impact term. After modeling the first three terms respectively, they are combined to obtain the tourism background trend line. The difference between the statistics value and the background value is called “tourism anomaly value” [7], which is the amount of change caused by event, reflecting the impact degree of emergencies on tourism intuitively. The anomalous values in different periods have two forms: “concave valley” or “convex peak”. The crisis events impact forms “concave valley” and passenger flow loss = background value-statistical value, while the impact of celebration event forms a “convex peak” and the tourism gain value = statistical value-background value. The specific construction method is as follows:

Using the Linear Interpolation Method to Preprocess the Original Statistical Data

According to the research object of event, this paper selects the appropriate interpolation interval and then use linear interpolation equation to amend the statistics data of tourist in abnormal years. The equation is $X_N = X_A + (N - N_A) * D$. Among them, N represents the year to be revised, X_N represents the revised value of the number of tourists in the N th year, X_A represents the actual statistical value of tourists at the starting point of interpolation, N_A represents the year at the starting point of interpolation, D represents the tolerance value of the linear interpolation method, which calculation formula is $D = (X_B - X_A) / (N_B - N_A)$.

Fitting Model to Construct the Tourism Background Trend Line Equation

The independent variable is time, while the dependent variable is the data of tourists modified by interpolation method. This paper uses the least square method to fit model, and then according to the solution results, the equation which fitting best is selected as the tourism background trend line equation.

Drawing the Tourism Background Trend Line and Statistical Line and Calculating the Tourism Anomaly

According to the obtained data, the specific impacts of emergencies on tourism are evaluated.

3.2 Data Sources and Description

Data Sources

The data should be long-term that can reflect the development trend of tourism. Therefore, this paper selects domestic tourists and inbound tourists from 2000 to 2022, getting the total number of tourists by adding the two. The all data from 2000 to 2020 and domestic tourists in 2021 come from the National Bureau of Statistics. Since the data of inbound tourists in 2021 and domestic tourists and inbound tourists in 2022 have not been released, the forecast data of China Tourism Academy are adopted.

Data Preprocessing

By analyzing the changing trend of domestic tourists, inbound tourists and total tourists in China during 23 years, the interpolation interval of each event was determined. In the column “Object” of Table 1, D, I and T represent domestic, inbound and total tourists respectively (the same as Table 3).

Table 1. Data preprocessing results

Name	Interpolate section	Object	Tolerance	Revised value	
			Million people		
SARS	2002–2005			2003	2004
		D	1.113	9.893	11.007
		I	0.075	1.054	1.128
		T	1.188	10.947	12.135
H1N1	2008–2011			2009	2010
		D	3.097	20.217	23.313
		I	0.019	1.318	1.3362
		T	3.115	21.535	24.650
H7N9	2012–2015			2013	2014
		D	3.443	33.013	36.457
		I	0.005	1.329	1.334
		T	3.448	34.342	37.790
COVID-19	2019–2022			2020	2021
		D	−6.753	53.307	46.553
		I	−0.356	1.097	0.7402
		T	−7.110	54.403	47.294

4 The Empirical Analysis

4.1 Model Building

This paper adopts the composite tourism background trend line model of polynomial-logic-trigonometric function, whose basic form is shown in (1).

$$Y_t = at^3 + bt^2 + ct + d + \theta \sin(\omega t + \varphi) + \frac{k}{1 + \exp(\alpha - \beta t)} \tag{1}$$

With the help of SPSS24.0 and Eviews7.0, this paper uses the nonlinear least square estimation of model parameters to establish the background trend line model of Chinese tourists from 2000 to 2022, as shown in Table 2. Y1, Y2 and Y3 represent domestic, inbound and total tourists respectively.

4.2 Analysis of Model Results

Comparison of the Degree of Loss

The loss rate of tourist caused by four major public health emergencies is shown in Table 3. It is not hard to see that the H1N1 in 2009 had the least impact on tourism

Table 2. Background trend line models of the number of tourists in China 2000–2022

Background trend line equation
$Y_1 = 3.047\sin(-5.412t + 16.039) - 0.019t^3 + 0.693t^2 - 4.654t + 16.753$
$Y_2 = -0.001t^3 + 0.029t^2 - 0.116t + 1.038 + 0.111\cos(0.808t - 41.335) - \frac{1.089}{e^{10.451-t}}$
$Y_3 = 3.131\cos(-17.978t + 158.974) - 0.019t^3 + 0.703t^2 - 4.673t + 17.732$

both in absolute and relative terms. According to the relative amounts, the unfinished COVID-19 brought the largest impact on the tourism. Due to the rapid speed, large range and frequent recurrence of epidemic, the presence of the mutation, the long time and great energy needing by research and development of vaccine, the COVID-19 has not been control effectively. On account of national strict control of population mobility, the number of inbound tourists lost over three-quarters. Domestic residents strictly comply with the relevant policies and reduce the frequency of travel, resulting in the loss rate of domestic, inbound and tourist numbers as high as 43.89%, 75.58% and 44.46% respectively, which has a very obvious impact on the whole tourism market in China. The second was SARS in 2003, when science, technology and transportation had not been developed, which greatly reduced the flow of tourists. The overall impact of the other two epidemics on tourism was relatively small because that the viruses mainly transmitted between animals and people's health awareness was increasing.

Table 3. The impact of four health emergencies on tourism

Name	Object	Statistics	Background	Anomaly	Loss rate (%)
		Million people			
SARS	D	8.700	9.931	1.231	12.39
	I	0.917	1.078	0.161	14.94
	T	9.617	10.997	1.380	12.55
H1N1	D	19.020	19.619	0.599	3.05
	I	1.265	1.342	0.077	5.72
	T	20.285	20.903	0.6178	2.96
H7N9	D	32.620	36.002	3.382	9.39
	I	1.291	1.3380	0.047	3.53
	T	33.911	37.459	3.548	9.47
COVID-19	D	28.790	51.313	22.523	43.89
	I	0.275	1.125	0.850	75.58
	T	29.065	52.333	23.268	44.46

Comparison of Impact Duration and Recovery Speed

According to the established background trend line model and the statistical data of tourism development from 2000 to 2022, Fig. 1 is drawn for comparative analysis.

As shown in Fig. 1, the SARS in 2003 dealt a huge blow to both the domestic and inbound markets of Chinese tourism industry. However, the domestic market basically recovered one year later, and the inbound market also recovered to its original level two years later. The H1N1 in 2009 had a relatively small impact on the domestic and inbound tourism market, but the overall recovery time was longer than that of SARS. The H7N9 in 2013 had a greater impact on domestic tourism than inbound tourism because that the domestic development of the influenza was more serious. However, its recovery speed was faster, and it was generally back to the right track after the end of the influenza. At present, COVID-19 in 2020 has the biggest influence on tourism public health emergencies, leading to the number of domestic tourists falling off a cliff. While the duration of the disease for more than two years is not completely over, domestic tourism market in China has a certain stability due to the huge number of visitors. The impact of emergencies can be flexibly absorbed within a certain limit, and the number of domestic tourists is steadily rising, although such absorption may have a certain lag. And it may be because that foreign tourists have more closed sources of information and more diverse choices of tourist destinations, coupled with the tarnished image of Chinese tourism, the inbound market is more susceptible to the effects of public health emergencies.

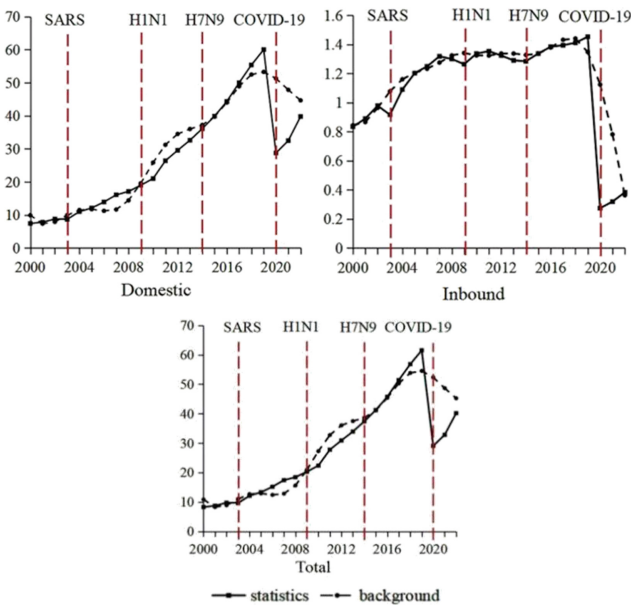


Fig. 1. Tourism statistics line and background trend line in China 2000–2022

5 Conclusion

Based on the number of tourists in China from 2000 to 2022 and relevant theories, this paper studies the influence degree and rule of major public health emergencies on Chinese tourism industry by constructing the tourism background trend line model. The main conclusions are as follows: First, major public health emergencies have greatly reduced the number of tourists in China, bringing significant negative impacts to tourism industry. But different events have different degrees of impact, and the stability of the inbound tourism market is much poorer. Second, major public health emergencies have a lasting influence on Chinese tourism industry. The decrease in the number of tourists leads to the destruction of the balance between supply and demand, thus affecting all aspects of the tourism market. Third, Chinese tourism industry is extremely resilient with increasing risk resistance. The recovery speed gradually increases with the cessation of events, until it returns to the original level and even rebounds.

References

1. Adam Blake, and M.Thea Sinclair.“TOURISM CRISIS MANAGEMENT.” *Annals of Tourism Research* 30.4(2003).
2. Elliott Frisby.“Communicating in a crisis: The British Tourist Authority’s responses to the foot-and-mouth outbreak and 11th September, 2001.” *Journal of Vacation Marketing* 9.1(2003).
3. SUN Gennian.“FOUNDATION AND SIGNIFICANCE OF BACKGROUND TREND LINE OF TOURISTS FROM ABROAD IN CHINA.” *SCIENTIA GEOGRAPHICA SINICA* .05(1998).
4. ZHANG Tiesheng,SUN Gennian,and MA Lijun.“An Assessment on Influences of Crises on Zhangjiajie Tourism: Analysis Based on the Tourism Background Trend Line in High Time Resolution.” *Economic Geography*. 32.10(2012):145–151.
5. SUN Gennian,and MA Lijun.“Post-evaluation of Impact of SARS in 2003 on Railway Passenger Traffic Volumes.” *Journal of the China Railway Society* .06(2006):28-34.
6. “Forecast on the tourist-generating market of Beijing Olympic Games in 2008 based on tourism background trend line.” *Geographical Research* .01(2008):65-74.
7. SUN Gennian,SHU Jingjing,MA Lijun,and WANG Jiejie.“Influences of Five Crises on US Inbound and Outbound Tourism:Analysis Based on the Tourism Background Trend Line in High Time Resolution.” *Progress in Geography*. 29.08(2010):987–996.
8. XIE Xuemei, SUN Gennin,and HAN Chunxian.“Impact of event tourism on tourism industry of Xinjiang.” *Arid Land Geography* 33.03(2010):487–492.
9. LI Zhongjian, LUO Fang,and SUN Gennian.“Impact of “3. 01” Terrorist Incidents on Kunming’s Inbound Tourism.” *Resource Development & Market* 34.10(2018):1466–1469+1443.
10. ZHU Biying,et al.“A study on the effect of the SARS epidemic on the international tourist arrivals in China.” *Geographical Research* .05(2003):551–559.
11. WEN Jiang,and XIONG Heigang.“The spatial difference of Xinjiang international tourism in different regions influenced by major events.” *Journal of Arid Land Resources and Environment* 28.01(2014):163–168.
12. TANG Chengcai, GUO Hua, YUAN Haihong,and ZOU Tongqian.“Impact of financial crisis on the tourism industry in Beijing.” *Journal of Arid Land Resources and Environment* 30.05(2016):191–196.

13. YAN Youbing, and ZHANG Jin. "Impact of Smog Weather on the Amount of Inbound Tourists of China Based on the Natural Trend Curve." *Economic Geography* 36.12(2016):183–188.
14. WANG Shu. "Analysis of the impact of crisis events on China-South Korea tourism interaction: Using background trend line method." *New West* .33(2019):65–66.
15. LV Ning, HAN Yuwen, and ZHAO Yaru. "The impact of new century emergency on cross-strait tourism interaction." *Statistics and Management* .01(2019):3–9.
16. LIU Shufang, and YANG Huta. "Research on the impact of COVID-19 on tourism in Chi-na, Japan and South Korea." *Asia-pacific Economic Review* .02(2020):21–29.

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