

The Empirical test on the impacts of crisis variables on tourism based on a demand model with the inbound data to China

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Abstract—This study highlights the importance of crisis variables in tourism, where a demand model is computed to some significant changes in tourists when crises or disaster hit in 1999-2018, to examine the negative impacts of crisis variables caused by weather or epidemic diseases on tourism. The results show that the correlation between tourism income, tourism price and the number of inbound tourists is usually an important factor affecting the number of tourists. More importantly, crisis variables such as climate, safety and health-related crises have had a heavily negative impact on tourism. And health valuable is the first factor of tourism consideration, which has a great impact. Therefore, it is proposed to improve the level of government management, consolidate the tourism industry, improve the quality of practitioners, optimize the quality of service, and actively guide the tourism industry to the development of ecological tourism, health tourism and safety tourism.

Keywords—impacts, demand model, crisis variables, correlation

I. INTRODUCTION

With the rising of people's material lives and spiritual needs, the demand for tourism is increasing day by day. Tourism has become more and more important in many countries and gradually become a pillar industry. There were reports in the Organization for Economic Cooperation and Development (2018) that the contribution of tourism directly accounts for 4.2% of GDP and 6.9% of employment in member countries [1]. More and more foreign tourists have been attracted to China due to the rapid development, time-honored cultural and unique natural resources. Since 2004, more than 100 million tourists (including those from Hong Kong, Macao and Taiwan) have visited China every year. In 2018, the added value of tourism and related industries in China was 4.14 trillion yuan, accounting for 4.51 percent of GDP. In 2019, the total tourism revenue was 6.63 trillion yuan, accounting for 11.05% of the total GDP, among which 6.01 billion were domestic tourists, up 8.4% year on year, domestic tourism revenue was 5.7 trillion yuan, up 11.7% year on year, the number of inbound tourists reached 14,500, including 31.88 million foreigners, and the international tourism revenue reached US \$131.3 billion. The number of outbound trips was 160 million, up 4.5% year-on-year (see China's Bureau of Statistics). With the development of China's economy, domestic tourism ranks first in the world, outbound tourism ranks second, and inbound tourism ranks fourth. As an important economic pillar of the country,

tourism not only contributes 11.05% of GDP, but also directly employs 28.25 million people and 79.87 million people, accounting for 10.31% of the total employed population in China.

Tourism industry has a strong sensitivity, because not only strong seasonality, but also vulnerability is very strong, so that crisis arises from time to time, forming a normal state. In the past 40 years, China's tourism development has experienced ten impacts, among which four were international factors, four were domestic factors and two era comprehensive impacts. There are three main aspects: first, the influence of terrorism always exists, second, the common occurrence of natural disasters and diseases; third, the financial crisis. All those seriously affect the development of world tourism, and those different types could have different impacts on tourism safety and tourist confidence. There is usually agreed that, as a result of the vulnerability of tourism, many variable crises have a great impact on tourism, such as natural disasters and health-related crises, which will make most people stop traveling, and the tourism industry has suffered huge losses. Safety has always been the primary consideration for tourists when they choose to travel [2-4]. This has been found in previous studies that tourism could be affected negatively by disasters [5-7], and health-related crises. In Novelli Burgess et al.'s studies about the impact of Ebola virus on the Gambia, tourism in the Gambia was developing smoothly before the outbreak of Ebola virus in 2013, however, after that, the number of tourists went down by 60%, causing great damages to tourism in the Gambia [8]. Kuo et al. studied the impact of SARS crisis on Asian tourism, and similarly, this strong negative impact was also very significant [9].

In this study, the tourism demand of Chinese inbound tourists is taken as the object and the key factors affecting the tourism demand are determined. Usually, price and income are important variables in the economy, which affect people's travel demand, but safety is the first consideration when choosing tourists. Different from other studies, this examines the impact of crisis events on the number of tourists and finds that the impact is significant. The lagged variables of tourist arrivals, such as income and price, also need to be included in the tourism demand model. Through the proportion of foreigners in inbound tourism income in China is small and the impact on the domestic tourism is

small, the epidemic outbreak of the globalization makes the biggest influence on entry and exit of tourism, leading to greatly negative impact of the practitioners after 2020 performance expectations of domestic tourism market, Inbound tourism can reflect the trend of international tourism development. The comprehensive and substantial recovery of tourism needs a process, and the results could also provide information for decision makers to optimize tourism crisis management and minimize negative impacts.

II. METHODS AND DATA

A. Data

Disasters related to health or safety may have different spiritual and psychological effects on humans, therefore, and on their interest in going out to travel. The first major pandemic disaster was SARS that begun in the second quarter of 2003, which lasted a half of year. The second most serious geological disaster was the Wenchuan earthquake in Sichuan Province on May 12, 2008. As a result, tourist arrivals during the SARS outbreak and in the year or two after the earthquake hit record lows amid China's steady rise.

The data in this paper were acquired from China Statistical Yearbook (2000-2019). It includes passenger arrivals (TA), the consumer price index (CPI), GDP by expenditure, the ratio of current prices (GDP) to the exchange rate (EX). The number of tourist arrivals is acted as a proxy for tourism demand [5]. The ratio of GDP and CPI of tourist generating country is used as the index of tourism income, the ratio of CPI of tourist destination and

CPI of tourist generating country is taken as the proxy of tourism price, and the exchange rate is the point exchange rate between the currency of destination country and the currency of tourist source country [10-11]. The problem of seasonality in tourist arrivals may be periodically extended to the number of inbound passengers in a particular season in some researches [5]. The significance of dummy variables can be also affected when these particular seasonal events occur. In order to solve the problem of seasonality, this paper applied X-12-ARIMA technology to quantify TA series by importing the tourism demand model. For simplicity, TA was the adjusted number of visitors.

Due to the large number of inbound tourists to China, this paper takes the continent as the statistical unit. Table 1 shows that the first two break dates of inbound tourists by continent are very close to SARS and Wenchuan earthquake. The year of 2008 is a special time point. August of 2008 is the first time in the history of the Olympic Games to be held in China. Originally, tourists from all over the world are bound to surge, which is the best opportunity to let more world tourists know about China. Unfortunately, there have been major events both at home and abroad. In May, China suffered extremely serious losses in Wenchuan earthquake, and the international subprime mortgage crisis in the United States but spread to the world, as well as the global H1N1 flu, these several negative factors make the number of inbound tourists in 2008 and 2009 sharply reduced. The impact on tourism has both economic crisis and non-economic crisis factors.

Table 1. Inbound Tourists by Continent (10000)

Year	Total	Asia	Africa	Europe	Latin America	North America	Oceania	Others
2018	3054.29	1912.07	67.41	604.43	45.37	333.48	91.31	0.22
2017	2916.53	1818.47	62.91	591.17	42.65	311.9	89.22	0.22
2016	2815.12	1803.7	58.9	547.2	39	299.1	82.6	0.2
2015	2598.54	1659.47	58.02	491.67	34.98	276.56	77.64	0.21
2014	2636.08	1633.13	59.69	551.43	34.62	276.03	81.01	0.18
2013	2629.03	1606.01	55.27	568.81	35.43	276.95	86.34	0.21
2012	2719.16	1662.22	52.49	594.82	35.31	282.64	91.49	0.19
2011	2711.2	1662.32	48.88	593.78	33.69	286.42	85.93	0.19
2010	2612.69	1617.86	46.36	569.79	30.05	269.49	78.93	0.21
2009	2193.75	1377.93	40.12	459.11	23.1	226.01	67.24	0.22
2008	2432.53	1455.1	37.84	612.33	26.03	232.12	68.88	0.23
2007	2610.97	1606.12	37.91	621.68	24.26	256.15	72.85	0.31
2006	2221.03	1358.82	29.38	527.96	19.58	221	63.86	0.43
2005	2025.51	1249.99	23.8	479.14	16.05	198.53	57.36	0.65
2004	1693.25	1073.66	17.34	377.57	13.25	165.67	45.21	0.52
2003	1140.29	726.5	10.42	259.76	8.01	105.28	30.01	0.3
2002	1343.95	864.38	9.85	282.58	9.71	141.25	35.37	0.81
2001	1122.64	686.42	7.32	268.38	7.45	120.31	30.97	1.79
2000	1016.04	610.15	6.56	248.9	8.29	113.28	28.18	0.68
1999	843.23	499.27	5.21	211.27	7.59	95.01	24.38	0.5

Data: China Statistical Yearbook, 2000-2019

Table 2. Statistics of China's tourism development

Year	International tourism revenue (\$100 million)	Inbound tourist arrivals (10,000)	Inbound overnight tourists (100 million)	Expenditure GDP (¥ 100 million)	Number of Domestic tourists (100 million)	Domestic tourism revenue (¥ 100 million)	Total consumption (¥ 100 million)	CPI
2018	1271.03	14119.8	6289.57	884426	55.39	51278.29	51278.3	102.1
2017	1234.17	13948.2	6073.84	815620	50.01	45660.77	45660.8	101.6
2016	1200.00	13844.38	5926.73	745632	44.40	39390.00	39390.0	102.0
2015	1136.50	13382.04	5688.57	699109	40.00	34195.05	34195.1	101.4
2014	569.13	12849.83	5562.20	647182	36.11	30311.86	30311.9	102.0
2013	516.64	12907.78	5568.59	596963	32.62	26276.12	26276.1	102.6
2012	500.28	13240.53	5772.49	540989	29.57	22706.22	22706.1	102.6
2011	484.61	13542.35	5758.07	486038	26.41	19305.39	19305.4	105.4
2010	458.14	13376.22	5566.45	410708	21.03	12579.77	12579.8	103.3
2009	396.75	12647.59	5087.52	349883	19.02	10183.69	10193.7	99.3
2008	408.43	13002.74	5304.92	319936	17.12	8749.30	8749.3	105.9
2007	419.19	13187.33	5471.98	271699	16.10	7770.62	7770.6	104.8
2006	339.49	12494.21	4991.34	221207	13.94	6229.74	6229.7	101.5
2005	292.96	12029.23	4680.90	189190	12.12	5285.86	5285.9	101.8
2004	257.39	10903.82	4176.14	162742	11.02	4710.71	4710.7	103.9
2003	174.06	9166.21	3297.05	138315	8.70	3442.27	3442.3	101.2
2002	203.85	9790.83	3680.26	122292	8.78	3878.36	3878.4	99.2
2001	177.92	8901.29	3316.67	111250	784	3522.36	3522.4	100.7
2000	162.24	8344.39	3123.60	100577	7.44	3175.54	3175.5	100.4
1999	140.99	7279.56	2704.66	90824	7.19	2831.92	2831.9	98.6

Data: China Statistical Yearbook, 2000-2019

B. Tourism demand model and crisis

In the tourism demand model, it is assumed that the log change in the number of inbound tourists ($\Delta \ln TA_t$) is determined by these factors of travelers: the change in income ($\Delta \ln IC_t$), the price of tourism ($\Delta \ln PR_t$), the exchange rate ($\Delta \ln EX_t$), the number of past tourists ($\Delta \ln TA_{t-1}$) and the dummy variables ($DI_t, D03_t, D08_t$). Before these dummy variables were added into the tourism demand model, the parameter instability test of Hansen is used to verify the stability. Since this test is used for time series data, we apply it to the model with visitor data. [12] The results show that there are some breakpoints in the model. In addition, a fixed-sample *LM* unit root test with level and trend changes is for estimation of unknown mutations in the sample period.

In addition, the model of Sio-Chong U and Yuk-Chow So [13] is used to further detect the two structural breakpoints in 2003 and 2008. In the inbound tourism demand model, in terms of the number of inbound tourists, The F-statistics are 35.7, 4.59 and 0.12, respectively, and the critical value is 2.03. Overall, the results suggest that the structural damage from SARS and the earthquake (or the subprime crisis) is clear. Therefore, the dummy variable for SARS, earthquake (or subprime mortgage crisis) is necessary in the model.

$$\begin{aligned} \Delta \ln TA_{i,t} = & \alpha + \sum_{j=0}^{n_1} \beta_{1,j} \Delta \ln C_{i,t-j} \\ & + \sum_{j=0}^{n_2} \beta_{2,j} \Delta \ln PR_{i,t-j} + \sum_{j=0}^{n_3} \beta_{3,j} \Delta \ln EX_{i,t-j} \\ & + \sum_{j=1}^{n_4} \beta_{4,j} \Delta \ln TA_{i,t-j} + \beta_5 DI_t + \beta_6 D03_t + \beta_7 D08_t + \varepsilon_{i,t} \end{aligned} \quad (1)$$

As mentioned before, in the model, we use $i = 1, \dots, N$ (number of regions), $t = 1, \dots, t$ (annual quantity) is taken as fixed sample data, Δ is the first difference operator, and the numbers from n_1 to n_2 is the optimal lag quantity based on AIC criterion. Because of the different optimal lag times of variables in different countries, this paper picks up the modes of different countries. Where, the values of $\Delta \ln IC$, $\Delta \ln PR$ and $\Delta \ln EX$ from the optimal lag are 4, 2 and 0, respectively. DI_t is a dummy variable to measure the tourism income. The value is 1 after 2014 (inclusive), otherwise, the value is 0. It is a dummy variable during the SARS crisis, with a value of 1 in 2003 and otherwise it is 0. $D03_t$ is a dummy variable for the earthquake (or subprime mortgage crisis), where the value is 1 in 2008-09 and otherwise it is 0.

Since the lagged number of arriving tourists ($\Delta \ln TA_{i,t-1}$) is included in the model, the application of Hayakawa(2009) can easily and efficiently solve the endogenous problem of auxiliary variable estimation. This method has good consistency in the case of fixed N and large T, and is suitable for this model. We believe that this way could lift the efficiency of the estimation of auxiliary variables by using the instruments that deviate from the past mean as auxiliary variables. Suppose, then $y_{i,t} = \Delta \ln TA_{i,t}$, $y_{i,t}$ will be replaced by its previous orthogonality bias of $y_{i,t}^* = c_t [y_{i,t} - (y_{i,t+1} + \dots + y_{i,T}) / (T - t)]$, in this case of $c_t = \sqrt{(T-t)/(T-t+1)}$, again, the independent variable $\ln TA_{i,t-j}$ will be replaced by $y_{i,t-j}^*$. The auxiliary variable of $y_{i,t-j}^*$ is the previous mean value deviated from $z_{i,t}^j$, as shown in Equation (2):

$$z_{i,t}^j = c_t \left[y_{i,t-j} - \frac{y_{i,t-j} + \dots + y_{i,t-j+n_4+1}}{t+n_4-1-j} \right] \quad (2)$$

Thus equation (1) can be transformed into Equation (3):

$$y_{i,t}^n = \alpha + \sum_{j=0}^{n_1} \beta_{1,j} \Delta \ln C_{i,t-j} + \sum_{j=0}^{n_2} \beta_{2,j} \Delta \ln PR_{i,t-j} + \sum_{j=0}^{n_3} \beta_{3,j} \Delta \ln EX_{i,t-j} + \sum_{j=1}^{n_4} \beta_{4,j} y_{i,t-j}^n + \beta_5 D1_{i,t} \Delta \ln C_{i,t} + \beta_6 D03_t + \beta_7 D08_t + \varepsilon_{i,t} \quad (3)$$

Here the auxiliary variable of $z_{i,t}^j, j = 1 \dots n_4$.

Because this paper uses the forward orthogonal deviation and reverse deviation from the past mean, the observed value T will be reduced by 2. To get the optimal numbers of lags in $\Delta \ln TA$, the partial autocorrelation function (PACF) of inbound tourists was compared, in which the influence of autocorrelation appeared six lag, whether it would be alleviated. Although the forward orthogonality deviation is used for the conversion to $\Delta \ln TA$, the notation of $\Delta \ln TA$ will always be used for simplicity.

Wang tested the long-term correlation of explanatory variables of $\Delta \ln TA$ with the ARDL model. [14] This error correlation term is not included in the model. Instead, in this paper, PACF is to find the optimal lag and the autoregressive effects are captured using the auxiliary variable valuation. This operation is easier to handle than including error dependent terms in a fixed sample of data. Charfeddine and Goaid [5] applied Markov transformation model to discover the different structural changes of breakpoints. However, it is not for fixed sample data, only for time series data but. Finally, the parameters in the tourism demand model are estimated by using the fixed effects model of auxiliary variable valuation.

III. EMPIRICAL RESULTS AND ANALYSIS

A. The importance of dummy variables

Table 1 shows the seasonally adjusted pre-and post-tourist arrivals in China's statistical yearbook, from unadjusted arrivals, noting that there are periodic fluctuations in tourist arrivals. Therefore, the seasonally adjusted number of tourists is a reliable to compute the impact of different crises on tourism activities. In particular, the SARS crisis occurred in the second quarter of 2003, and the Novel coronavirus outbreak (COVID-19) in 2020-2022 began to spread in the first quarter.

Among the vast majority of tourists to China, Asian tourists are the main part, accounting for about one third of the total tourists, not including those from Hong Kong, Macao and Taiwan to the mainland. Generally, it is reflected that geographical proximity is a critical factor affecting the choice of tourist destination, which is related to the consumption of time and transportation cost of traveling from the country of origin to the destination, because transportation, cost and time are the three most important objective conditions in determining travel.

Table 2 shows the parameter estimation of the tourism demand model. The relationship between tourism income, tourism price and the number of inbound tourists is usually an important factor affecting the number of tourists. Comparing the tourism demand model with and without dummy variables, it is found that when the variable rises from 0.47 to 0.86, it turns significant statistically after adding dummy variables, which also indicates that it is necessary to capture the structural changes in the model.

B. The impact of the crisis

To verify the effect of crisis on the inbound passengers, it is found that the coefficients of D03 and D08 are negative respectively and both have significant statistically. D03 is the largest in the three disasters. highly contagious SARS can be spread by respiratory droplets, which has a fatal rate of about 15%. Safety is the first for tourists, who were scared being infected. Therefore, SARS had the greatest effects on tourism, and then H1N1, the earthquake (or the subprime crisis), when the income fell and even more people were unemployed in many countries. As a result, less people are willing to travel, so that a great loss was evident in the tourism industry due to multiple factors.

To sum up, there have been three major crises affecting China's inbound tourism in recent decades. These include the climate crisis, the economic crisis and health-related crises, all of which have had a negative impact on tourism. Overall, health-related crises have the greatest negative impact, as safety comes first for tourists. The climate crisis may also be linked to the safety of tourist destinations. For the tourism industry, it is of importance for tourism crisis management, where a complete system should be included into the governments' work, such as crisis prevention and planning, strategy implementation, resolution, evaluation and feedback

[8]. Because they are crucial to restore tourists' confidence during and after the crisis.

IV. CONCLUSIONS

Taking the impact of crisis events China's inbound tourism on the tourism industry as the object, this study analyzes the effects of crisis events such as SARS crisis, Wenchuan Earthquake, H1N1 influenza and novel coronavirus epidemic (*COVID-19*) on the number of tourists through the tourism statistical data of the 20 years from 1999 to 2018.

Tourist income, tourist price and lagged tourist number have positive significance on China's inbound tourism. By estimating the parameters in the tourism demand model, comparing the tourism demand model with and without the dummy variables, it is found that the dummy variables have positive significance, so the dummy variables, tourist income, tourism price and the number of lagged tourists have a significant impact on China's inbound tourism demand.

Non-economic variables crisis (*SARS*, *H1N1*, earthquake) have negative significance on China's inbound tourism demand. Through the model analysis, it is found that *SARS*, *H1N1*, earthquake and other non-economic variables are respectively negative, the number of arrivals has a statistically significant impact, the coefficient of dummy variable in *SARS* is the most. When tourists plan their trip, safety comes first. *SARS* is a highly infectious disease that has the greatest impact on tourist numbers and is one of the three major crises in the number of arrivals.

Therefore, it is essential to study the effects of the crisis on tourism in the future, especially for emerging countries. China has started to use tourism to promote economic development to improve employment and reduce to recover their development poverty, such as efficient policies and strategies, however, the comprehensive and substantial recovery of tourism needs a process

V. DISCUSSIONS

Vulnerability characteristics of tourism impact on the development of tourism industry, but how to turn "crisis" as the "machine", to promote the tourism industry to accelerate development, improve the quality of development, based on the guest's needs and willingness to preferences, tourism enterprises in-depth reflection and precipitation, to be prepared for the market recovery is very necessary and timely and effective, the toughness of China tourism, or, to turn the crisis into an opportunity for It is expected to usher in the improvement of "quality" and "quantity". In view of the above research, the following countermeasures are proposed:

A. Promote the transition from the pursuit of cost-effective tourism products to the pursuit of quality and safety

Tourism service is also a new demand in the era of consumption upgrading. After the outbreak of tourism health security is the main focus of tourists, tourists generally

destination enterprises and hope can do a good job, enough health security and provide more detailed travel destination country or region's safety and health information in tourism economic growth figures released at the same time, regularly publish tourism economy system risk sensitive index, so as to provide policy basis for risk prevention and control of regional tourism economic system. Strengthen the construction of "smart" tourism scenic spots, promote the comprehensive improvement of the hard and soft power of the operation of scenic spots, optimize the service quality of scenic spots, and improve the satisfaction and safety of tourists under the general background of epidemic prevention and control requirements.

B. Stimulate the tourism consumption in a healthier direction

It is key to stimulate the tourism industry and adjust people's needs. The competition of the proportion of tourists' external consumption has gradually transformed to the competition of consumers' consumption choice of tourism products provided by the market. The pursuit of healthy leisure vacation and other natural tourism, such as forest health and rural leisure tourism, must be a great opportunity in the future. Forest health vacation is people's life needs, is the domestic and foreign health care community general knowledge, but also the society has been advocated and advocated the best concrete practice of health mode. Rural leisure tourism should focus on the development of rural leisure life, the development of small groups of life of leisure vacation, is also a direction worth looking forward to in the future. In addition, from the perspective of tourism operation mode, it is imperative to change the traditional crowded tourism mode of huge passenger flow, and the development of more healthy and small groups, decentralized, leisure life and vacation tourism is the choice of the future.

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