Analysis on Seasonality of Accommodation Demand for Tourist Hotels

Yin-Ju Chang, Shieh-Liang Chen, Tzong-Shyuan Che, and Jui-Yuan Chu

***Abstract*—Seasonality is an important feature of the tourism industry, and one of the greatest disturbing factors affecting related business operation in the industry. This study used the structural time series model to analyze the seasonality of the accommodation demand for tourist hotels, and this method can test the stochasticity of seasonality and observe the seasonal pattern changes, which makes itself a very good way to explore the seasonality of tourism. The empirical results show that the accommodation demands for tourist hotels in all 7 areas are all obviously seasonal and stochastic. The seasonal pattern of tourist hotel accommodation demand of Taipei area, and Taoyuan, Hsinchu, and Miaoli area are similar; the pattern of Kaohsiung area and Taichung area are also similar to each other; and Hualien area, scenic area and other areas are similar in their seasonal pattern, mainly due to the difference in the structure of tourist sources. Faced with the seasonal changes, hoteliers can adopt the strategy of price differentiation, cooperate with other industries and hold events, conferences and exhibitions with the local government to expand the tourist source and increase the room occupancy rate.**

***Index Terms*—Tourist hotel, seasonality, structural time series model.**

I. Introduction

The hotel industry is the core of the tourism industry, and an important indicator of the development of the tourism industry. Since the government allowed mainland Chinese tourists to visit Taiwan for sightseeing in July, 2008 and the implementation of "Sightseeing top-notch pilot scheme", the inbound tourism of Taiwan has been effectively developed and the operation performance of tourist hotels has also been greatly improved. According to the data of Tourism Bureau, the average room occupancy rate of all tourist hotels in 2001 was 61.6% and the number jumped to 66.4% in 2016. The average room rate grew from NTD2,951 to NTD3,831, up by 29.8% during the 15 years. Meanwhile, the operation income of tourist hotels soared from NTD34.16 billion to NTD58.92 billion. The number of tourists to Taiwan grows fast and promotes the development of tourist hotels. In addition to pursuing the growing in the total number, how to balance the tourist number of different seasons of the year and maintain the stable growth of tourist hotels and the accommodation market is a topic of concern. Seasonality has been recognised as one of the greatest features of the tourism industry for a long time [1] affecting the operation and development of the industry. The tourist number and accommodation number gap between the months of the peak seasons and the months of the off-peak seasons can affect the hotelier's human resource management, facility utilisation and service quality maintenance. This highlights that handling, analyzing seasonality and planning relevant measures are vital to the development of tourism. Few past studies have studied the seasonality of tourism in Taiwan. Is a foreign scholar who firstly conducted comprehensive research on the seasonality of tourism by using the static measuring method to analyse the seasonal pattern of 16 source countries of inbound tourists [2]. [3] questioned the traditional practice of identifying the seasonal changes as either deterministic or constant when building the model and who pointed out that the seasonal pattern of tourism demand usually changes with the time based on their empirical proofs [4]. This means that the seasonality of tourism is stochastic rather than constant.

Seasonality is an important feature of the tourism industry and one of the greatest disturbing factors affecting related business operation in the industry. According to past research findings on seasonality of tourism, they mostly explored seasonality by static methods and neglected that seasonality of tourism might change with time through the alternation of recreational resources, promotion of leisure travel policy, change of travel consumer behavior and political, economic and social emergencies. Thus, it becomes extremely important to validate time dynamics of seasonality by appropriate quantitative method. Based on above, through structural time series model (STSM) proposed by [5], this study validates dynamic characteristics of seasonality of the accommodation demand in tourist hotels of Taiwan and analyzes seasonal pattern and seasonal change of the accommodation demand. Research findings aim to serve as reference for related units to develop tourism development policy.

II. Literature Review

Seasonality widely exists in different industries. Either in agriculture, industry or service industry, it is possible for seasonality to exist due to factors such as the production feature of the industry, customer decision making, nature and policies. [6] believed that seasonality is the fluctuation within a year and a product of systematicness, not necessarily with laws. Climate change, calendar effect, decision making timing and the producer's and the consumer's decision making in the

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economic system are all factors influencing the appearance of seasonality. These decisions are affected by the resource endowment, estimate, preference and available production technology in the economic environment. [7] defined the seasonality of tourism as the temporal imbalance phenomenon of sightseeing time and it is represented by the tourist number, tourist expenditure, transport flow, employee number and admission of tourist spots, etc.

In past studies on the seasonality of tourism, three major methods, namely descriptive statistics, regression and time series, are used to measure seasonality. Descriptive statistics includes seasonality ratio, coefficient of seasonality variation and coefficient of Gini. [8] used seasonality ratio and coefficient of seasonality variation to analyse the seasonality of tourism of Sri Lanka from 1967 to 1979. In his study, seasonality was measured at three levels of national, regional and sectoral and the empirical results showed that coefficient of seasonality variation was a better way to measure seasonality.

Coefficient of Gini is one of the common way used to measure seasonality of the tourism industry [9]-[11] used coefficient of Gini to analyse seasonality of the tourism industry of Spain from 1952 to 1975 and divided seasonal changes into two categories of pure change and pattern change, leading to a deeper discussion on seasonal changes of tourism. [12] discussed the seasonal concentration of the accommodation demand for hotels at Costa Del Sol from 1989 to 1994 by means of coefficient of Gini. The study disassembled the coefficient of Gini by different tourist source country of accommodation to explore the contribution of different tourist source country to the seasonal concentration and the marginal effect produced by accommodation changes.

Regression is a method to measure seasonality and test the significance of seasonality by embedding dummy variable into equations. [13] analysed the seasonal variation of Canadian tourism industry from 1986 to 1997 by means of regression. They used 113 national tourism indicators and analysed seasonal variation from five aspects, namely tourism demand in Canada, tourism domestic demand in Canada, tourism export demand in Canada, supply of tourism commodities and employment generated by tourism. Results of the study showed that there was little seasonality in the employment generated by tourism, but much more seasonality in the third quarter in the other aspects of tourism demand in Canada, tourism domestic demand in Canada, tourism export demand in Canada and supply of tourism commodities. [14] analysed the seasonal changes in New Zealand's largest inbound market by using regression.

Based on the time series data, the time series method, consisting of 4 components, namely trend, cycle, seasonal and irregular, can be used to estimate the seasonality factors and analyse the changes in seasonal pattern by means of traditional difference approach [15], [16], X12-ARIMA [17], [18], ARIMA [19] and structural time series model [20].

Ref. [21] used Danish data on hotel nights of 324 months from 1970 to 1996, categorised them into 15 countries and 12 nationalities, and examined stochasticity of seasonality on hotel nights by unit root. The empirical results proved that a varying and changing seasonal pattern was common, either modelling seasonality on hotel nights by county or by nationality using time series data. In other words, the seasonality on hotel nights was more stochastic and less deterministic. [22] analysed the relation between tourism seasonality and climate change by means of STSM and the study suggested that climate played a dominant role in shaping the seasonal patterns of visitation for two national parks, Denali and the Everglades, in the US. Moreover, [23] built a pattern to forecast tourist arrivals to Hong Kong by using the time-varying parameter (TVP)-STSM model, and the empirical results showed that the TVP-STSM outperforms all other competitors.

In addition to the three major methods of measuring seasonality, there are some statistical techniques used to analyse seasonality of tourism, such as cluster analysis, principal component analysis [24] and portfolio theory [25].

Recent studies on seasonality suggested that the trend of seasonal pattern of tourism changing with the time is becoming increasingly obvious [26]-[28]. It means that the seasonality of tourism is more stochastic rather than deterministic. Therefore, it may be difficult to handle the dynamics of seasonality by using only descriptive statistics or regression. Hence, by structural time series model, this study probes into seasonal dynamics of the accommodation demand in tourist hotels and analyzes seasonal pattern and seasonal change of the accommodation demand.

III. Empirical Model Set-up and Analysis

A. Description of Data

The study aimed to discuss the seasonality of accommodation demand for tourist hotels in Taiwan. The accommodation demand was measured by the accommodation number at hotels based on the empirical data of Data on Tourist Hotel Operations published by the Tourism Bureau monthly for 7 areas, namely Taipei area, Kaohsiung area, Taichung area, Hualien area, scenic area, Taoyuan, Hsinchu, Miaoli area and other areas. The materials consist data of 192 months from January 2001 to December 2016.

In 2016, in Taiwan, there were a total of 119 tourist hotels. 43 of them were in Taipei area and there were 9 tourist hotels in Kaohsiung, 7 tourist hotels in Taichung area, 5 hotels in Hualien area, 17 tourist hotels in scenic area, 13 tourist hotels in Taoyuan, Hsinchu and Miaoli area and 25 tourist hotels in other area. In 2016 of Taiwan, accommodation number of people in tourist hotels was 11,929,000 person-time.

B. Model Set-up

Structural time series model is the model which directly presents non-observable factors such as trend, cycle, seasonal and irregular characteristic in economic time series. In the recent decade, many major issues happened in the world, including the 911 Attacks in the US in 2001, SARS outbreak in 2003, Southeast Asian tsunamis in 2004, bird flu outbreak in Hong Kong in 2007 and the financial crisis in 2008. Such emergencies can cause a sudden drop in the accommodation number at tourist hotels and the appearance of outliers. In Taiwan, tourism policies were put forward one after another, including Taiwan tourism development program, plan for the doubling of tourist arrivals, sightseeing top-notch pilot scheme and allowing mainland Chinese tourists to visit Taiwan for sightseeing, etc., and these policies can lead to a sudden increase in the accommodation number at tourist hotels. Thus,

this paper used the intervention analysis at the same time of building STSM of the accommodation demand of hotels to handle the influence of emergencies or policies on tourist hotels. The empirical STSM is set up as follows:

$$LnHD_{it} = \mu_{it} + \gamma_{it} + \sum_{j=1}^{h} \lambda_{ij} d_{ijt} + \varepsilon_{it} \quad (1.1)$$
$$, t = 1,2 \dots \dots \dots T$$

$$\mu_{it=}\mu_{it-1} + \beta_{it-1} + \eta_{it} \quad (1.2)$$

$$\beta_{it=}\beta_{it-1} + \xi_{it} \quad (1.3)$$

$$\gamma_t = \sum_{j=1}^{[s/2]} \gamma_{j,t} \quad (1.4)$$

In Eq. (1.4), $\gamma_{j,t}$ is derived from the following:

$$\gamma_{jt} = \gamma_{j,t-1} \cos \lambda_j + \gamma^*_{j,t-1} \sin \lambda_j + \omega_{jt} \quad (1.5)$$
$$\gamma^*_{jt} = -\gamma_{j,t-1} \sin \lambda_j + \gamma^*_{j,t-1} \cos \lambda_j + \omega^*_{jt},$$
$$for\ j=1,\dots,[s/2] \quad (1.6)$$

In Eq. (1.1), $LnHD_{it}$ is the logarithm of accommodation number of people in tourist hotels of different areas *i*, $\varepsilon_{it} \sim \mathrm{NID}(0, \sigma^2_{\varepsilon})$ ◦ μ_{it} means level of trend, β_{it}means slope of trend, $\eta_{it}$and ξ_{it} respectively refer to factors which influence trend level and slope. $\eta_{it}$and ξ_{it} are blank and they are not related. Mean is 0 and variates are$\sigma^2_{i\eta}$ and$\sigma^2_{i\xi}$. Random or certain trend factors depend on hyperparameter $q^2_{i\eta} = \sigma^2_{i\eta}/\sigma^2_{i\varepsilon}$ and $q^2_{i\xi} = \sigma^2_{i\xi}/\sigma^2_{i\varepsilon}$.When any of hyperparameter is zero, it means the corresponding factor is certain. In Eq. (1.5) and Eq. (1.6), ω_{ijt} and ω^*_{ijt} is white noise, mean is zero, Covariance $\sigma^2_{i\omega}$. ω_{ijt} and ω^*_{ijt} are not related. $\lambda_{ij} = 2\pi_{ij}/s$, *j*=1, 2…, [*s*/2]. $\sigma^2_{i\omega}$ the estimates determines randomness or certainty of seasonal factors. d_{ijt} intervening variable and λ_{ij} is corresponding parameter of intervening.

TABLE I: TAIWAN TOURIST HOTEL ACCOMMODATION DEMAND STRUCTURAL TIME SERIES MODEL PARAMETER ESTIMATION RESULT

	Taipei area	Kaohsiung area	Taichung area	Hualien area	scenic area	Taoyuan, Hsinchu and Miaoli area	Other area
Hyperparameters							
Level	0.00033	0.00199	0.00223	0.00183	0.00112	0.00154	0.00248
Slope							
Seasonal	2.13E+06	1.30E-06	1.62E-06	7.40E-05	2.86E-06	1.28E-05	1.64E-06
Irregular	0.00122	0.00226	0.00148	0.00790	0.00300	0.00132	0.00307
Coefficients							
Level	12.720*	11.186*	10.812*	10.346*	11.607*	11.046*	10.608*
Slope							
Seasonal chi2 test	119.058*	67.765*	76.280*	141.240*	68.080*	34.029*	110.744*
Pulse dummy							
D2001(2)						-0.295*	
D2001(8)							0.423*
D2001(9)					-0.263*		
D2003(2)				0.508*			0.406*
D2003(4)			-0.288*				
D2003(5)	-0.575*	-0.435*	-0.674*	-0.598*		-0.470*	-0.472*
D2003(8)			0.236*				
D2007(1)				-0.332*	-0.225*		-0.248*
D2009(2)		-0.256*	-0.278*				-0.303*
D2009(6)	-0.168*					-0.235*	
D2009(10))				-0.301*			
D2009(11)			0.186*				
Shift dummy							
L2001(2)	0.179*						
L2001(8)	-0.142*						
L2001(12)							0.396*
L2002(6)							0.250*
L2003(4)	-0.828*					-0.675*	
L2003(6)					0.350*		
L2003(7)	0.533*	0.400*	0.300*	0.457*		0.637*	0.431*
L2003(8)	0.299*						
L2004(2)					-0.244*		
L2004(5)	0.141*						
L2004(8)							0.279*
L2006(7)					0.227*		
L2009(4)						0.274*	
L2009(6)			-0.310*				
L2009(8)					-0.239*	0.234*	
Seasonaleffects							
1	-0.056*	-0.077*	-0.115*	-0.246*	-0.120*	0.015	-0.127*
2	-0.013	0.005	-0.058*	-0.039	0.005	0.009	-0.019
3	0.069*	-0.046	0.015	-0.144*	-0.078*	0.114*	-0.101*
4	-0.026	-0.019	0.026	0.002	0.004	0.054	0.023
5	-0.065*	-0.021	-0.058*	-0.066	-0.014	-0.035	-0.009
6	-0.079*	-0.051*	-0.077*	0.065	-0.020	-0.126*	-0.013
7	-0.045*	0.086*	0.063*	0.390*	0.149*	-0.024	0.191*
8	0.044*	0.030	0.055*	0.287*	0.094*	-0.002	0.140*
9	-0.095*	-0.095*	-0.043	-0.149*	-0.095	-0.138*	-0.101*
10	0.056*	0.060*	0.043	0.035	0.034	0.036	0.020
11	0.065*	0.053*	0.073*	-0.047	-0.016	0.031	-0.039
12	0.147*	0.074*	0.074*	-0.088	0.058*	0.064	0.036
Diagnostics							
Normality	1.809	3.114	1.078	5.534	2.505	5.875	3.652
H	0.549	0.750	0.845	0.610	0.710	0.767	0.371
DW	1.901	2.002	1.870	1.810	1.915	1.777	1.948
r(1)	0.033	-0.008	0.060	0.093	0.025	0.099	0.001
r(24)	0.010	0.069	0.063	0.073	0.012	0.018	0.163
Q	15.896	15.003	22.928	30.748	21.397	20.755	27.174
$\bar{R}^2$	0.806	0.413	0.588	0.457	0.486	0.637	0.578

Empirical Results and Analysis

Eq. [29] is estimated by using the statistical software, STAMP, and the empirical results are summarised in Table I. Firstly in terms of diagnostic checking, the STSMs of the tourist hotels in 7 areas all perform well. Testing statistic by Bowman-Shenton on normal distribution of residual terms

shows that the residual of STSM of 7 areas fulfils the requirement of normal distribution and is without heterogeneity. As for serial correlation, Q-statistic test of Box-Ljung is used, and the residual terms of STSM of Taipei area, Kaohsiung area, Taichung area, Hualien area, scenic area, Taoyuan, Hsinchu, and Miaoli area and other area show no serial correlation. Regarding seasonality, according to results of the χ^2-test, the seasonal component of 7 areas are all significantly different from zero, showing that there is much seasonality in the accommodation demand of tourist hotels. For hyperparameter, the level value of time component and the estimate value of seasonal component of 7 areas are both over 0 (Table I), representing that the time component and seasonal component of STSM of accommodation demand for tourist hotels in 7 areas are stochastic rather than deterministic. In the intervention analysis, the intervening dummy variable of the accommodation demand for tourist hotels in all areas shows that the accommodation demand is significantly affected by the SARS outbreak in 2003 and the financial crisis in 2008.

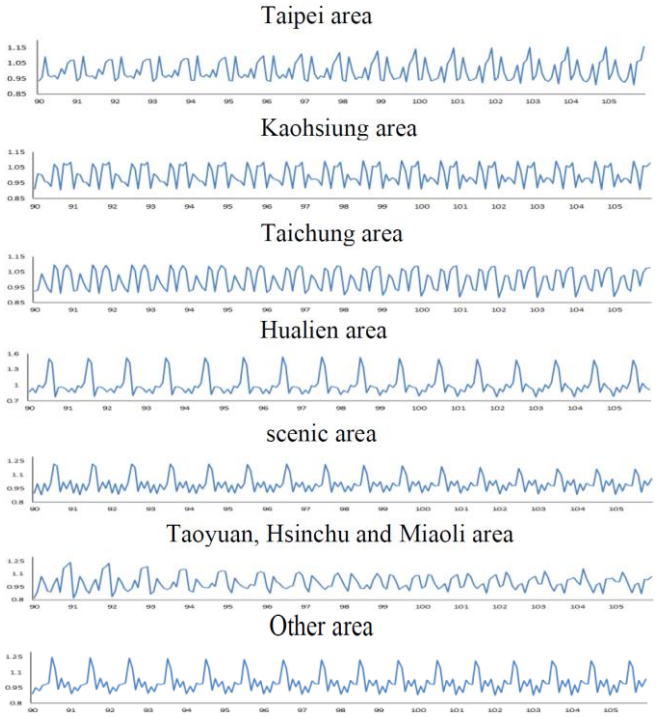

Fig. 1. Taiwan tourist hotel accommodation demand STSM season factor estimation results.

According to seasonal effect coefficients in Table I, in 7 areas, regarding seasonality of the accommodation demand in tourist hotels, except for May and September which are low seasonality and October is high seasonality, seasons of the accommodation demand of tourist hotels in different areas are different. It might be caused by different customer structures in different areas. In Taipei area, the accommodation demand of tourist hotels shows five months with significant high and low seasons. In Taichung area, high and low seasons are respectively 4 months. In Kaohsiung area, 4 months are significantly high season and 3 months are significantly low season. In the accommodation demand of tourist hotels in Taoyuan, Hsinchu and Miaoli area, significantly high season is only one month and significantly low season are two months.

According to seasonal change of the accommodation demand in tourist hotels of Taipei area in Fig. 1, seasonal pattern successively changes from double to single peak. After 2005, amplitude of seasonal index gradually expanded. It shows that gap of accommodation number in high and low seasons significantly increased. In Kaohsiung area, as to the accommodation demand in tourist hotels, July and October are high peaks of seasonality. Seasonal pattern change of the accommodation demand does not change significantly. As to seasonal index of the accommodation demand of tourist hotels in Taichung area, after 2008, amplitude gradually increased. Seasonal pattern changed significantly. In Hualien area, scenic area and other tourist hotels, seasonal pattern of the accommodation demand is single peak. Amplitude of seasonal index successfully lowered after 2008 and seasonal pattern change was insignificant. In Taoyuan, Hsinchu and Miaoli area, amplitude of seasonal index of the accommodation demand in tourist hotels after 2004 lowered and seasonal pattern changed significantly.

Seasonality widely exists in every industry, and the seasonality of the tourism industry is more complicated and harder to be handled than other industries because tourism is constrained by natural environment, the tourism decision making behaviour and the characteristics of tourism resources. The above empirical analysis proves that the stochasticity of seasonality generally exists in the accommodation demand for tourist hotels in Taiwan, which is consistent with the research findings of [30]. Additionally, allowing mainland Chinese tourists to visit Taiwan for sightseeing does have an obvious impact on the seasonality of the accommodation demand for tourist hotels in Taiwan.

IV. Conclusion

The tourism industry is a global industry which plays an important role in creating economic benefits and employment for a country. In recent years, the implementation of Plan for the Doubling of Tourist Arrivals and Sightseeing Top-notch Pilot Scheme have promoted the fast growing of the inbound tourist market and become a great help for the development of the hotel industry. As seasonality is an important feature of the tourism industry, it also affects the development of the industry to some extent. Therefore, handling the seasonality and formulating relevant strategies are vital to the development of the tourism industry.

After reviewing the relevant literature on the seasonality of tourism, this paper discovers that most studies discuss the topic by means of static descriptive statistics or regression, and the dynamic feature of the seasonality of tourism is less discussed or analysed. This study uses the structural time series model to analyse the seasonality of accommodation demand for tourist hotels in Taiwan, and this method can test the stochasticity of seasonality and observe the seasonal pattern changes, which makes itself a very good way to explore the seasonality of tourism. The statistical software STAMP is used for the model parameter estimation and the diagnostic checking results show that the structural time series model of tourist hotels in 7 areas all perform well.

The accommodation demands for tourist hotels in all 7 areas are all obviously seasonal and stochastic. The seasonal pattern of tourist hotel accommodation demand of Taipei area, Taoyuan, Hsinchu, and Miaoli are similar; the pattern of

Kaohsiung area and Taichung area are also similar to each other; and Hualien area, scenic area and other areas are similar in their seasonal pattern, mainly due to the difference in the structure of tourist sources of hotels. The major tourist sources of hotel of Taipei area, Taoyuan, Hsinchu and Miaoli are inbound tourists; in Kaohsiung area and Taichung area the major tourist sources include both domestic tourists and inbound tourists; while in Hualien area, scenic area and other areas the major tourist source is domestic tourists.

When facing the seasons with low accommodation demand, tourist hotels in all areas of Taiwan can adopt the strategy of price differentiation, cooperate with other industries, promote rooms at off-peak seasons by providing lower prices at tourism exhibitions or online booking platforms and hold events, conferences and exhibitions with the local government to expand the tourist source and increase the room occupancy rate. Seasonality is an important topic for the tourism industry, but relevant discussion or analysis on this aspect of Taiwan was rather insufficient in the past. This study used a dynamic STSM to analyse the seasonality of accommodation demand for tourist hotels and explore the seasonal pattern changes. We hope that the findings of this study can provide reference to relevant organisations for formulating tourism development policies.

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