Tourism Prosperity Index of Macau Via Principal Component Analysis

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Abstract. This paper argues for a more robust and flexible framework to develop the Tourism Prosperity Index (TPI), one which is able to forecast supply and demand for a destination. However, the adoption of indicators and cycle selection address challenge when researchers attempt to include them in the forecasting model. In this paper, the principal component analysis is used to construct and evaluate TPI in Macau from 2006 to 2015 and predicts its future development. The prediction results were coincident with the realistic development situation.

Keywords: Tourism Prosperity Index (TPI); Macau.

1. Introduction

Currently, tourism consumption has been the most dynamic sector of Macau consumption structure. However, this industry is easily impacted by emergencies. TPI is an effective industry survey tool. With the rise of Macau position in tourist destinations in the world, it's very urgent to undertake researches on tourism prosperity indexes.

As for researches on TPI, business circle, clarifying various methods are used to predict the number of international tourists [1]. Multiple regression analysis [2] and external impact detection TRAMO/SEATS model [3] are taken up with calculating the number of China's inbound tourists. Moreover, researchers empower the indicators by coefficient of variation [4] and entropy weight method [5]. On the basis of which, the indicator of exchange rate and per capita income in the country of source is introduced, Tuner provides for future development of the Australian tourism industry by employing the composite index [6]. Ni Xiaoning has also calculated China's tourism market prosperity indexes with composite index method [7]. Dai Bin finding the travel agency industry prosperity index in China [4]. Tang Chengcai establishes the model with the TPI of heritage site [8].

In general, between the research results, there is a logical disorder of the subordinate in the selection of indicators. In the establishment of weight, there is the absence of effective integration of diverse methods.

The organization of this paper is as follows: Section 2 weight indexes and introduces the principal component analysis method; Section 3 describes the data and presents the results of preliminary data analysis. Finally, Section 4 examines the findings and draws conclusions.

2. Methodology

2.1 TPI System

The TPI system explores 3 groups of indicators, i.e., leading coincident and lagging indexes. Leading index refers to peak or valley indicators appearing in advance before economic indicates get to peak or valley, which reflects income and consumption level of the tourist market of the year; coincident indicator is those whose peak or valley time and economic cycle fluctuation is approximately similar to the benchmark time, which indicates the prosperity of the tourist market of the year; lagging indicate is defined as those turning points appear later than the benchmark turning

points of economic cycle fluctuations, which reveals the investment heat of the tourist market of the year. Referring to China macro-economic prosperity index developed by National Information Center Economic Prosperity Analysis Research Group, this paper constructs a composite index that consists of leading, coincident and lagging indicators. The TPI construction process is seen in Fig. 1. To demonstrate the tourism prosperity, this paper utilizes consists of leading, coincident and lagging indicators to constructs a composite index.

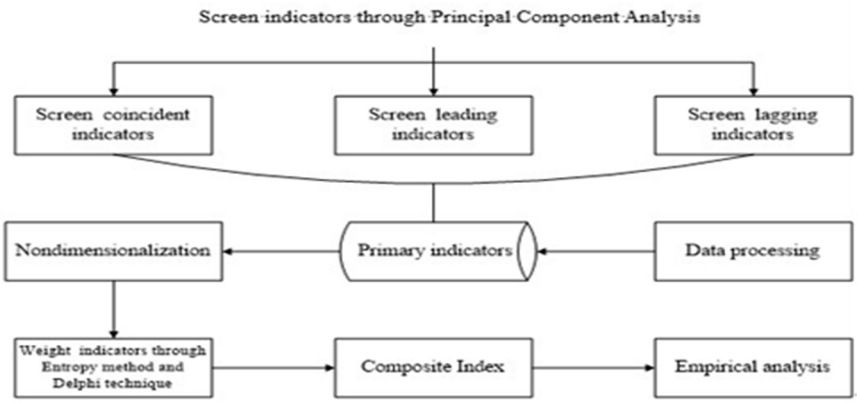

Fig. 1 TPI construction process

First, we selected 64 primary indicators from statistical data of China's tourism development. Then we exclude some relevant indicators by correlation analysis. Finally, we obtained 4 leading indicators, 6 coincident indicators and 6 lagging indicators, as listed in Table 1.

Table 1. The Index System and Weight of Tpi in Macau

Classification	Index	Weight
Leading indicator	Macau GDP	0.5028
	PGP of local residents in Macau	0.5005
	Total per capita income of Macao per capita	0.4958
	Consumption expenditure of local residents in Macau	0.5010
Coincident indicator	Number of employees in Macau tourism-related industry	0.4276
	Macau tourism-related industries and places	0.4106
	Macau tourism-related industries revenue	0.4297
	Macau tourism-related industry total value added	0.4307
	Number of visitors arriving in Macau	0.3874
	Macau Per Capita Consumption	0.3583
Lagging indicator	Fixed capital formation	0.3616
	Money supply	0. 4740
	Fiscal Expenditure	0. 4266
	Total foreign direct investment	0.4750
	Total import and export trade in goods	0.4480
	Exchange rate	-0.1905

2.2 Tourism Prosperity Composite Index

The internationally agreed prosperity indexes associate with Diffusion Index (DI) and Composite Index (CI). DI is a measure of the move in any of the business cycle indicators, showing how many of an indicator component are moving together with the overall indicator index, it lacks essential ability to describe the extent. Hence, CI is used to forecast prosperity index [9]. These steps can be described as follows.

Step 1: Symmetrical Change Rate and Standard of Single Index

Calculating the formula of symmetrical change rate:

$$C_{it} = \frac{d_{it} - d_{it-1}}{\left(d_{it} + d_{it-1}\right)/2} \times 100 \quad (1)$$

$$A_i = \sum_{t=2}^{N} \frac{|C_{it}|}{N-1} \tag{2}$$

$$S_{it} = C_{it} - A_i \tag{3}$$

where, C_{it} is the symmetric change rate of the ith indictor in the tth year; d_{it} is the actual indicator value of the ith indictor in the tth year; A_i is ordinal average of C_{it} sequence and N is the standardized number of periods; S_{it} is the standardized value of the ith indictor's C_{it} in the tth year.

Step 2: Determining weighted average of standardized multi-index symmetric change rate

$$R_t = \sum_{i=1}^{k} S_{it} * \left(\frac{W_i}{\sum_{j=1}^{k} W_j} \right) \tag{4}$$

where, R_t is the value of the composite average symmetrical change rate of the leading indicator or lagging indicator in the tth period; W_i is the weight of the ith indictor, i=1, 2, …, k refers to the number of indicators.

Step 3: Standardizing the average change rate by the synchronization index

The standardization factor F can be obtained as follows:

$$F = \left[\sum_{t=2}^{N} \frac{|R_t|}{N-1} \right] \Big/ \left[\sum_{t=2}^{N} \frac{|P_t|}{N-1} \right] \tag{5}$$

$$r_t = \frac{R_t}{F} \tag{6}$$

where P_t is the value of the composite average symmetrical change rate of the coincident indicator in the tth period of the time sequence; r_t is the average change rate of the synchronic index standardization t=2, 3…, N refers to the number of period.

Step 4: calculating the CI

First, calculating the original chain index. with I_1=100, the calculation formula is:

$$I_t = \frac{I_{t-1} * (200 + r_t)}{200 - r_t} \tag{7}$$

$$CI_t = \frac{I_t}{I_0} \times 100 \tag{8}$$

where, I_0 is the average value of the chosen benchmark year and CI_t is the CI.

3. Result and Analysis

According to the CI construction method, the statistical software, MATLAB R2016a, is employed. The benchmark year is 2005. The TPI of the tourism industry in Macau shows a trend of sustained growth on the whole. The composite index of rose from 100.25 in 2006 to 100.79 in 2015.

The composite prosperity index of Macau tourism industry pointed out that from 2006 to 2015, the composite prosperity index of Macau tourism industry had maintained a stable development tendency. Due to the impact of global financial crisis, there was a significant decline in 2007. Until 2015 did it drop slightly, some emergencies like exchange rate fluctuation, policy adjustments, US subprime mortgage the composite prosperity index of Macau tourism industry pointed out that from 2006 to 2015, the composite prosperity index of Macau tourism industry had maintained a stable

development tendency. Due to the impact of global financial crisis, there was a significant decline in 2007. Until 2015 did it drop slightly, some emergencies like exchange rate fluctuation, policy adjustments, US subprime mortgage crisis and H1N1 flue did not generate a huge impact on Macau tourism development. Its tourist economy still maintained a generally gradual increase trend.

Fig. 2 Composite prosperity index (2006-2015)

4. Conclusion

After the explosion depended on the gaming industry, the development of tourism industry in Macau embraced a more rational growth. It was a period of great and profound change for Macau tourism market. To strengthen control over emergencies, enhance resilience against risk, diversify its tourist industries and extend tourism-related industry chain is accumulated vast experience in promoting stable and healthy development of Macau tourism economy.

Research on Macau TPI is still at the initial stage, which requires more in-depth and long-term exploration. Owing to a lack of quarterly data and monthly data, the paper yielded the TPI based on the study of annual data. It makes an elementary description about the prosperity of tourism, but the sensitivity is insufficient. Some short-term slight fluctuations may not be detected. Moreover, construction of Macau TPI will be further perfected along with the statistical data unceasing development and thoroughly research.

Acknowledgments

This research was supported by the Ten-Thousand Tourism Talents Program of Ministry of Culture and Tourism of China (Grant No. WMYC20184-131), all support is gratefully acknowledged.

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