

The Relationship between Air Temperature and the Daily Number of Visitors at Jiuzhaigou National Park

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Abstract

Most tourists don't like to trip in either too hot or cold weather. Using the co-integration analysis approach, this article examines the relationship between air temperature and the daily number of visitors at Jiuzhaigou national park. The main results suggest that there is a long-term equilibrium relationship between air temperature and the daily number of visitors. It corrects the deviation of the number of visitors from the equilibrium. There is a positive response of the number of visitors to air temperature which rises with time.

Keywords

Air temperature; national park; visitor; co-integration analysis.

1. INTRODUCTION

The raise of temperature has a significant influence on our life, which attracts much attention of climate scientists. This is not an idle concern. In accordance with the statistic data, the global average temperature has an obvious increase in the recent 100 years. The raise of temperature in spring exceeds one degree centigrade. Tour is an important component of social activity, which is beneficial to release the pressure from life and work [1]. Tourists are sensitive to the temperature, and they always would like to choose the destination with appropriate temperature that makes them comfortable. Therefore, the raise of temperature probably influences the development of the scenic area from the choice of tourists. Research on the relationship between the temperature and the number of visitors contributes to enrich the literature of tourist choice to destination, and for the manager of scenic to actively cope with climate change.

After much attention is attracted into the debate, many empirical studies are conducted to examine the impacts of climate change on tourism activities [3-4]. Some of them indicate that the raise of temperature has gradual effects on the basic environment of destination such as changes the blooming florescence [5-6]. It indirectly impacts the number of visitors and tourism activities. There are many studies focusing on the impacts of air temperature on the number of visitors at country or province level, little attention being paid to the effects on the number in scenic area [2]. They construct an index composed by air temperature, wind speed and humidity to reflect the change of climate and adopt the regression or correlation analysis to examine the impacts on tourists. Although these studies give some insight in the impacts of climate change, there still need more empirical studies on the impact from the change of the single factor on the number of visitors in scenic area [7-8].

Therefore, the present study chooses Jiuzhaigou National Park as sample and based on the data of the daily number of visitors accepted as well as by the co-integration analysis and error correction model, examine the relationship between air temperature and the daily number of

visitors. The aim of this study is to fill the gap of literature and bring some enlighten on the mangers of scenic area.

2. METHODOLOGY AND DATA

2.1. Study Area

We choose Jiuzhaigou National Park as the sample, because it is a very famous scenic area in China, which is also the first nature reserve whose aim is to protect the natural scenery. It has several Tibetan villages, rolling mountains and curiously shaped lakes, accompanied with four distinct seasons. The average temperature is 0 degree centigrade in winter and 20 degree centigrade in summer. This wide change of temperature is also the reason we choose it as sample.

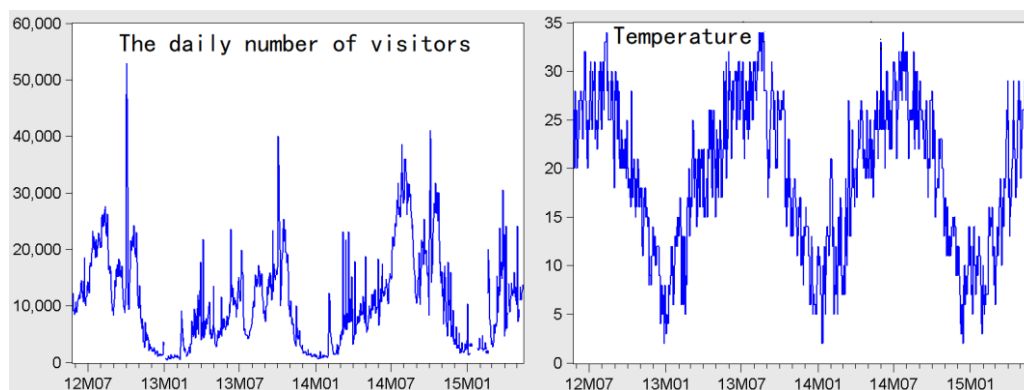


Fig 1. The daily number of visitors and the temperature

2.2. Data Source

We collect the daily number of visitor accepted by Jiuzhaigou National Park from May 2012 to May 2015. The data derived from the official website, which publishes the information about tourist amount every day. The results of descriptive statistics suggest that in this period, the most daily number of visitors is 52935, and the least is 382. The average daily number is 10781. On the other hand, the data of temperature in Jiuzhaigou National Park is from the weather website (<http://www.tianqi.com>). We choose the highest temperature each day to reflect the change. The data shows that the lowest temperature is 2 degree centigrade in 28/12/2012, and the highest temperature is 34 degree centigrade in 25/7/2014. The average temperature is 19.8 degree centigrade.

2.3. Methodology

From figure 1, we can find that the daily number of visitors has the same change tendency with the daily temperature. It suggests that there is a long and stable relationship between them. We define Q_t as the number of visitors in day t , and TE_t as the temperature. Taking the logarithm of variables Q_t , it becomes LNQ_t , and the equilibrium relationship can be expressed as

$$LNQ_t = \alpha_0 + \beta TE_t + \mu_t \quad (1)$$

Where α_0 is a constant term, μ_t is the error term, and β denotes a coefficient reflecting the long-term impact of the temperature on the daily number of visitors.

This co-integration function reveals the long-term relationship, but it can't describe the short term impacts of temperature on the number of visitors. Therefore, introducing vector error correction model is necessary to analysis the process of waves in short-term and figure out the

mechanics of adjustment under the long- term equilibrium relationship. Accordingly, the model structure is as follow:

$$\Delta LNQ_t = \alpha_1 + \gamma(LNQ_{t-1} - \alpha - \beta TE_{t-1}) + \sum_{i=1}^n \delta_i \Delta LNQ_{t-i} + \sum_{j=0}^n \theta_{j+1} \Delta TE_{t-j} + \varepsilon_t \quad (2)$$

Where γ is adjustment coefficient, δ_i and θ_{j+1} denote the coefficients of the difference terms, reflecting the impacts in short-term, α_1 is a constant term, and ε_t is error term.

3. EMPIRICAL RESULTS

Due to the same change tendency, the regression results probably suggest there is a significant relationship between the time series variables that are without any connections. For avoiding this problem, conducting a unit root test is necessary. The long-term equilibrium relationship requires the variables are integrated of same order. The results of the augmented dickey-fuller unit root test indicate that the two variables follow the first-order difference stationary process, meeting the requirement of the same order.

Table 1. Augmented dickey-fuller unit root test

Variables	Horizontal test			First-order difference		
	(C,T,L)	ADF value	P value	(C,T,L)	ADF value	P value
LNQt	(C,0,17)	-0.2206	0.1991	(0,0,16)	-8.5608***	0.0000
TEt	(C,0,12)	-2.2102	0.2028	(0,0,11)	-13.6611***	0.0000

Note: C is a constant term, T is time trend, and L is the lag order; Significance: ***1%; **5%.

Before testing whether the co-integration relationship exists, we need to confirm the best lag order. The statistics of SC, LR and AIC contribute to the choice. As showed in table 2, the results suggest that in the 5% significance level, four of them supports the best lag order is 8. Therefore, we follow the result.

Table 2. The judge of lag length

Lag	LR	FPE	AIC	SC	HQ
0	NA	28.1814	9.0144	9.0248	9.0184
1	3541.164	0.6131	5.1865	5.2178*	5.1984
7	22.3808	0.5692	5.1122	5.2687	5.1719
8	40.6845*	0.549*	5.0761*	5.2535	5.1438*
9	4.7281	0.5509	5.0795	5.2778	5.1552
10	3.8965	0.5533	5.0839	5.3030	5.1675

Note: Significance: *, 5%.

From figure 1, the two variables have no significant difference of tendency, so the structure of the co-integration equation is without the term of tendency but with the intercept term. The results of the Johansen co-integration test show that we should accept the hypotheses that the number of the co-integration function is greater than zero and it is less than or equals to one. Therefore, there is a co-integration relationship between the temperature and the number of visitors.

Table 3. Johansen cointegration test

HO	Eigenvalue	Trace	P value	Maximum Eigenvalue	P value
r=0	0.0284	31.3133**	0.0010	27.0154**	0.0006
r≤1	0.0046	4.298	0.3695	4.298	0.3695

Note: Significance: **, 1%; r: the number of the co-integration equation.

After confirming the structure and the number of the co-integration function, we estimate the parameters, and write as

$$LNQ_{t-1} = 6.443 + 0.1256TE_{t-1} + \mu_{t-1} \tag{3}$$

(0.0165) (0.3509)

Where the standard deviations are in the parentheses, and the likelihood ratio equals to -2344.039.

The estimate results suggest that there is a co-integration relationship between the two variables. In 1% significant level, temperature has a stably long-term equilibrium relation with the number of visitors. In the equation, the coefficient of temperature is significantly positive, showing that the raise of temperature leads to the increase of the number of visitors. Specifically, the value equals to 0.1256. It means that the 1 degree centigrade increase of temperature generates the 0.1256 percentage increase of the number of visitors.

The short-term impacts of temperature on the number of visitors also need much attention. Based on the co-integration function, we estimate the vector error correction model as

$$\begin{aligned} \Delta LNQ_t = & -0.0755(LNQ_{t-1} - 6.443 - 0.1256TE_{t-1}) - 0.1221\Delta LNQ_{t-1} - 0.1639\Delta LNQ_{t-2} \\ & [-4.9837] \qquad \qquad \qquad [-3.6636] \qquad \qquad \qquad [-4.925] \\ & -0.1026 * \Delta LNQ_{t-4} - 0.1174\Delta LNQ_{t-5} - 0.1126\Delta LNQ_{t-6} + 0.1825\Delta LNQ_{t-7} + \varepsilon_t \\ & [-3.0916] \qquad \qquad [-3.5539] \qquad \qquad [-3.368] \qquad \qquad [5.5] \\ R2=0.1632 \quad & Adj.R2=0.1487 \quad \quad AIC=0.2797 \quad \quad SC=0.3677 \end{aligned} \tag{4}$$

Figure 2 indicates that the vector error correction model has a good stability. The results of LM test show that LM1 equals to 1.4497,P equals to 0.8355, LM2 equals to 4.6135, and P equals to 0.3293, suggesting that there is no correlation between residual error.

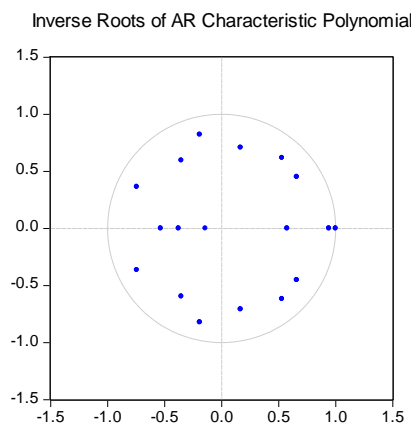


Fig 2. VEC stability condition check

The adjustment coefficient is significantly negative, suggesting that when the number of visitor deviates from the long-term equilibrium, the mechanism will correct the error. There are more lag terms, and most of them are negative. Taking into the estimate coefficients of ΔLNQ_t account, the number of visitors in short-term has a tendency to return to the normal. Compared with the adjustment coefficient, the impacts of short-term are greater than of long-term.

The results of the impulse response analysis showed in figure 3 indicate that a slight change of temperature lead to the positive impacts of the daily number of visitors. The impacts gradually increase with time, only having a decline in the lag period of 9. Then, the impacts tend to be stable. Giving a slight impulse to the daily number of visitors has the gradually decreasing impacts on itself, and the impacts also tend to be stable.

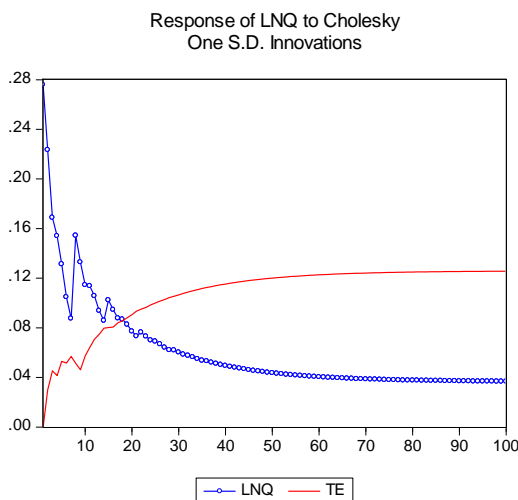


Fig 3. Response of LNQ to TE

Variance decomposition means that given the fluctuations of explanatory variables in a different period, the contribution of variance of other variables in VECM in the corresponding period is decomposed. As given in figure 4, the results of variance decomposition suggest that the forecast error of the daily number of visitors is influenced by itself in the earlier stage. Then, the percentage tends to be stable, after a quick decrease, finally reaching 15 percentage of total error. The contribution of temperature on the forecast error of the number of visitors also tends to be stable after a rapid increase. Finally, it reaches 85 percent.

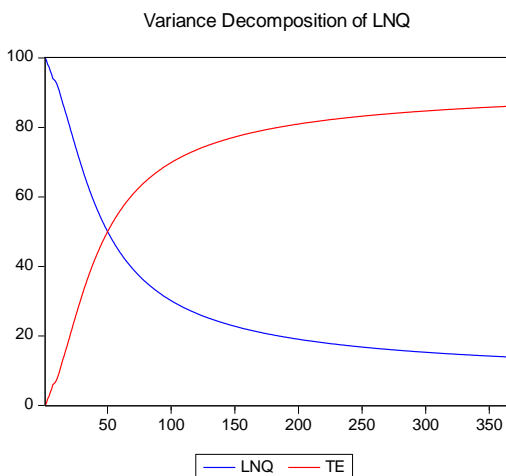


Fig 4. Variance decomposition of LNQ

4. CONCLUSION

This article choose Jiuzhaigou National Park as sample and based on the data of the daily number of visitors accepted as well as by the co-integration analysis and error correction model, examine the relationship between air temperature and the daily number of visitors. The conclusions are as follows.

In long-term, there is a stably equilibrium relationship between the temperature and the number of visitors. The raise of temperature has a positive improvement on the number of visitors. The estimate results of the vector error correction model indicate that when the daily number of visitors deviates from the long-term equilibrium, the mechanism of error correction will promote the number of visitors returning to the normal level. Moreover, the changes of temperature in the short-term have greater impacts than in the long-term. The results of the impulse response analysis indicate that give a slight impulse to temperature leads to the gradually increasing impacts on the daily number of visitors. The variance decomposition results indicate that the contribution of the number of visitors on the error variance decrease with time and the contribution of temperature increase gradually.

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