

# Research on the Dynamic Relationship Between Tourism and Regional Economic Development Based on VAR Model A Case Study of Chongqing

Han Wang<sup>1</sup> Zhu Ye<sup>2</sup>

<sup>1,2</sup> School of Economics and Management, Tibet University, Lhasa, Tibet 85000, China

<sup>2</sup> Corresponding author.

## ABSTRACT

Based on analysis methods such as cointegration theory, error correction model, and impulse response analysis, this paper establishes a VAR model composed of the number of tourists, tourism income, and regional total value in Chongqing, and conducts an empirical study on the dynamic impact of Chongqing's tourism and regional economic development in recent years using Chongqing's tourism data from 2000 to 2021. The empirical research results show that there is a long-term stable equilibrium relationship among the number of tourists, tourism income, and regional economic development in Chongqing. In the short term, the promotion effect of tourism on the economic development of Chongqing is still relatively limited, and the economic development has a significant pulling effect on the tourism industry. In the long run, there is a long-term balanced cointegration relationship between tourism development and GDP in Chongqing. The impact of local economic development on tourism is significant and steadily increasing, but the impact of the number of tourists and tourism income in Chongqing on GDP is relatively small.

**Keywords:** Regional economic link, VAR model, Tourism economy, Regional effect.

## 1. INTRODUCTION

Since the reform and opening up, tourism has become a pillar industry of the national economy, playing a significant role in promoting the overall economic development of China. As a labor intensive industry, the development of tourism plays a positive role in stimulating domestic demand, increasing employment, enhancing cultural transmission, and promoting the development of transportation. As an important component of the modern service industry, tourism has become a strategic pillar industry of the national economy, helping to promote the stable development of the regional economy.[1] During the "13th Five-Year Plan" period, the national tourism development plan explicitly proposed that tourism should be the main driving force for economic development, in order to promote the smooth transition of China's economy from high-speed development to high-quality development. In

this context, the empirical analysis of the quantitative relationship between tourism and regional economic growth can provide a scientific basis for formulating relevant policies.

Chongqing has a long history, rich natural resources, and unique regional culture. It is the birthplace of Bayu culture and an important transportation hub in the Yangtze River Basin. With the formation of the "Chengdu-Chongqing Economic Circle", Chongqing, as one of the two major central cities in the Chengdu-Chongqing Economic Circle, has significant geographical advantages in developing tourism, which helps drive the economic development of the western region and stimulate strategic cooperation between the Yangtze River Economic Belt and the Silk Road. In recent years, the tourism industry in Chongqing has developed rapidly, and the year of 2021 was the beginning year of the "14th Five-Year Plan", which was also a year for the cultural and tourism industry to overcome the impact of the

overall environment and accelerate the recovery and revitalization, and the tourism industry in the whole city generally showed a good trend of constantly enriching the business form system and making the main body of the tourism market more sound. Chongqing received 88.3486 million overnight tourists, a year-on-year increase of 37.2%. The tourism industry achieved an added value of 107.609 billion yuan, a growth rate of 9.9%, accounting for 3.9% of the city's GDP. Therefore, this article will take Chongqing as an example and mainly use the vector auto-regression (VAR) model in time series analysis to study the dynamic impact relationship between Chongqing's tourism industry and regional economic development.

## 2. LITERATURE REVIEW

Through referring to relevant literature, it can be seen that in recent years, domestic and foreign scholars have conducted a large amount of empirical analysis on the correlation between tourism and regional economic development, and most studies have shown that economic growth can promote the development of the tourism industry. However, there are some differences in the academic community's conclusions regarding whether tourism will promote economic development based on different research objects and methods. The literature involved in this article mainly focuses on the following two aspects.

The first is the literature study on the dynamic relationship between tourism and regional economic development. Zhang Guanghai (2015) [2] measured the correlation between tourism income and regional GDP in Qufu based on the variance decomposition method, conducted a quantitative study of the relationship between tourism income and economic development, and believed that the contribution of tourism development to the regional economy was greater than the back-feeding effect of economic growth on the tourism industry. Sharif (2017) [3] believed that economic growth drives tourism development in the short term, while tourism drives economic growth in the long term. Paramati (2017) [4] concluded that tourism has a significant positive impact on economic growth in both developed and developing economies, but the degree of impact varies. Based on the three systems of tourism, regional economy, and ecological environment, Li Yongping (2020) [5] constructed a coupling model for coordinated development of industries, analyzed the coordinated development of industries, and concluded that the development

of tourism needs to improve quality and enhance efficiency, and although the regional economy of Shanxi Province has significant growth, the growth is slow. Based on the theory of economic growth, Mao Lijuan (2021) [6] analyzed the impact of China's tourism industry on economic development using the difference gmm method, and on this basis, compared the regional economic effects of coastal developed areas and inland areas, concluding that the impact of tourism scale on regional economic growth shows an inverted U shape, and at the initial stage of tourism development, it can promote regional economic growth, but the marginal effect will gradually weaken and eventually have a negative impact.

The second is the literature study on the differences in empirical methods for studying the correlation between tourism and regional economy. Based on the growth decomposition method, Habibi (2018) [7] concluded that Iran's tourism industry has a positive impact on regional economic growth. Based on the perspective of system dynamics, Jing Xiuli (2020) [8] constructed a dynamic model for the interactive development of Shenzhen's tourism industry and regional economy. The research shows that within the allowable range of regional economic level, the growth of tourism investment can promote the rapid development of regional economy, while economic growth further feeds back the healthy development of tourism quality. Zhang Shuwen (2020) [9] established a Spatial Dubin Model based on spatial autocorrelation analysis to explore the impact of tourism industry agglomeration on regional economic growth. The results show that China's tourism industry agglomeration generally presents a fluctuating growth trend, with regional differences gradually decreasing, and its economic growth has a strong spatial correlation. Li Zhu (2022) [10] explored the transmission mechanism of the impact of tourism industry dependency on economic growth rate in the Yangtze River Economic Belt based on a regression model, and concluded that the overall tourism industry dependency in the Yangtze River Economic Belt has a robust N-shaped curve relationship with economic growth rate.

In addition, a small number of scholars have applied the VAR model to the dynamic development of tourism and economy, but it still needs to be deeply explored. Although there is a basic consensus on the balanced development between tourism and regional economy in relevant domestic and foreign literature, there are significant differences among provinces or cities due to

different regions, which requires further empirical research. Therefore, this article uses the relevant data of tourism and regional economic development in Chongqing from 2000 to 2021 to conduct a quantitative analysis of its stability and cointegration relationship, and uses VAR model to derive its impulse response function, obtaining the explanatory power of the interaction between the two.

### 3. VARIABLE SELECTION, DATA PROCESSING, AND INDEX CONSTRUCTION

The data used in this article mainly comes from the Chongqing Statistical Yearbook, with a data time range of 2000-2021. Using cointegration theory and VAR model, it analyzes the factors that affect the regional economy of Chongqing's tourism industry, and then uses impulse response to test the degree of impact between the two variables, thereby predicting future trends and providing reference for proposing corresponding policy measures.

#### 3.1 Variable Selection

In order to better examine the dynamic relationship between tourism industry and regional economic development, as well as the impact of relevant factors on it, Eviews.11 software is used to use Chongqing's regional gross domestic product as the dependent variable Y, and factors related to the development of tourism industry as the explanatory variable X. The data processing is as follows:

##### 3.1.1 Explanatory Variables

The tourism industry is influenced by both domestic and foreign tourists, but considering the influence of uncontrollable factors such as foreign exchange and politics, the development of the tourism market has undergone significant fluctuations in the past few years. Therefore, this article doesn't separately list and analyze the income and passenger turnover times brought by domestic and foreign tourists to the tourism industry, but takes the overall tourism development of Chongqing as the research object. When selecting a representative index for Chongqing's tourism development, it uses Chongqing's tourism industry income (X1) and the number of tourists (X2).

##### 3.1.2 Explained Variables

When evaluating the degree of economic development of a region, it is usually chosen to express it by GDP growth (Y).

### 3.2 Data Processing and Index Construction

It requires preliminary processing of the collected data to eliminate errors caused by different units and orders of magnitude, for example: nondimensionalization, linear transformation, aggregation and generalization, weighted approach, etc. Here, only the dynamic relationship between Chongqing's tourism industry and regional economic development is studied, assuming that other factors affecting GDP change smoothly. In order to remove the heteroscedasticity between units and variables, the data is logarithmized, the tourism index X is synthesized, and an equation model is established (m represents the year)

$$\ln x_{mn} = a \times \ln x_{m1} + b \times \ln x_{m2} \quad (1)$$

Based on the data of Chongqing's GDP (Y), tourism income (X1), and the number of tourists (X2), it constructs a VAR model and performs impulse response analysis, thereby determining the corresponding coefficient and weight coefficient  $W_i$ .

The weight model is:

$$W_i = \frac{|u_i|}{\sum_1^n |u_i|} \quad (2)$$

To eliminate the impact of different units and avoid heteroscedasticity, it first performs logarithmic processing on Y, X1, and X2, respectively, obtaining  $\ln y$ ,  $\ln x_1$ , and  $\ln x_2$ .  $W_i$  is the weight coefficient. Then it uses  $\ln y$ ,  $\ln x_1$ , and  $\ln x_2$  to establish VAR models and perform impulse response to obtain corresponding coefficients, as shown in "Table 1".

Table 1. Index and coefficient table

index	$u_1$	$u_2$
Coefficient	1.4418	1.1917

Combining the data from "Table 1", it then calculates the weight coefficients of  $\ln x_1$  and  $\ln x_2$  according to Formula (2) and retains 2 decimal places, as shown in "Table 2".

Table 2. Weight coefficient table

Index	$w_1$	$w_2$
Coefficient	0.55	0.45

It logarithmizes the data of relevant indexes, calculates the weights of each factor, and then assigns values to obtain the final constructed indexes. The weight coefficients of each factor are substituted into formula (1) to obtain the equation model:

$$\ln x_{mn} = 0.55 \times \ln x_{m1} + 0.45 \times \ln x_{m2} \quad (3)$$

#### 4. EMPIRICAL RESULTS AND ANALYSIS

Before conducting Johansen cointegration test analysis, it tests the unit root of variables to determine whether the time series is stable. On the premise of ensuring that the time series is stable, it then performs a cointegration analysis.

#### 4.1 Unit Root Test

This article decides to use the ADF unit root test to test the stability of the selected time series. On the one hand, it determines whether the series has a unit root, and on the other hand, it determines whether the series is stable.

First, it performs ADF unit root tests on variables  $\ln y$  and  $\ln x$ , and the results are shown in "Table 3". Obviously, when tested at significant levels of 1%, 5%, and 10%, the test results are all non-stationary series. After first order difference processing, the unit root test results of  $d\ln y$  and  $d\ln x$  indicate that  $\ln y$  is unstable at the first order and  $\ln x$  is stable at the first order. It then processes  $\ln y$  through a second order difference ( $d^2\ln y$ ), with P values of 0.0001 and 0.000, both less than 0.05. It can be concluded that the tourism industry  $\ln x$  and regional economy  $\ln y$  variables are both second-order integrated series.

Table 3. Unit root test results

Variable	ADF value	Critical value			P value	Conclusion
		10%	5%	1%		
$\ln y$	-1.9679	-2.6461	-3.0124	-3.7880	0.2975	Unstable
$d\ln y$	-2.4811	-2.6504	-3.0207	-3.8085	0.1345	Unstable
$d^2\ln y$	-5.9939	-2.6606	-3.0404	-3.8573	0.0001	Stable
$\ln x$	-0.6867	-3.8085	-3.0207	-2.6504	0.9885	Unstable
$d\ln x$	-9.8977	-3.8085	-3.0207	-2.6504	0.0000	Stable
$d^2\ln x$	-13.6442	-3.0299	-3.0810	-3.8315	0.0000	Stable

#### 4.2 Johansen Cointegration Test

This article uses Johansen's test to study whether there is a cointegration relationship between the two time series  $d^2\ln x$  and  $d^2\ln y$ . As shown in "Table 4", the p value is less than 0.05

when tested at a significant level of 5%, rejecting the original hypothesis, and there is a long-term and stable cointegration relationship between Chongqing's tourism industry and regional GDP, that is, tourism and regional economic development promote each other.

Table 4. Johansen cointegration test results

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.8131	52.4121	15.4947	0.0000
At most 1 *	0.7091	22.2268	3.8415	0.0000

#### 4.3 Dynamic Characteristics of VAR Model

By conducting stationarity tests, feature root tests, and impulse response functions, it is aimed to

explore the interrelationships between variables in detail.

### 4.3.1 Stationary Test

Before establishing a vector autoregressive (VAR) model, it is necessary to test its stationarity.

The test results are shown in "Table 5". According to the values of the five indexes LR, FPE, AIC, SC, and HQ, when the lag order is 2, the model is stable.

Table 5. Test table for the lag order of VAR model of Chongqing's tourism industry and regional GDP

Lag	LogL	LR	FPE	AIC	SC	HQ
0	28.75038	NA	0.000121	-3.343798	-3.247224	-3.338853
1	37.35914	13.98923	6.86e-05	-3.919893	-3.630172	-3.905057
2	45.16683	10.73557*	4.41e-05*	-4.395854*	-3.912986*	-4.371127*
3	46.06524	1.010716	7.07e-05	-4.008155	-3.332140	-3.973538
4	50.26239	3.672501	8.17e-05	-4.032798	-3.163636	-3.988290

### 4.3.2 AR Polynomial Characteristic Root Test

The application of VAR model requires the stability of each parameter. Firstly, the element root test is performed on each parameter to verify its stability. The model analysis shows that the element roots of each element root are less than 1, that is, each element root is inside the element circle, and the model fitting is stable. As shown in "Figure 1", the values of the characteristic roots of AR polynomials are all less than 1, indicating that the VAR model is stable.

regional economy. It can analyze the dynamic impact on the system when an error term changes, and can also vividly depict the path changes between variables, as shown in "Figure 2".

Inverse Roots of AR Characteristic Polynomial

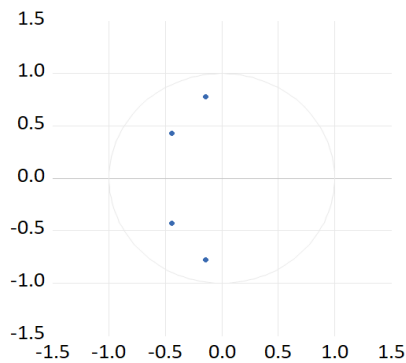


Figure 1 Inverse root graph of AR polynomial characteristic root of VAR model.

### 4.3.3 Impulse Response Analysis

This paper uses a VAR model based on Chongqing tourism  $d^2lnx$  and local economy  $d^2lny$  to study the dynamic characteristics of tourism and

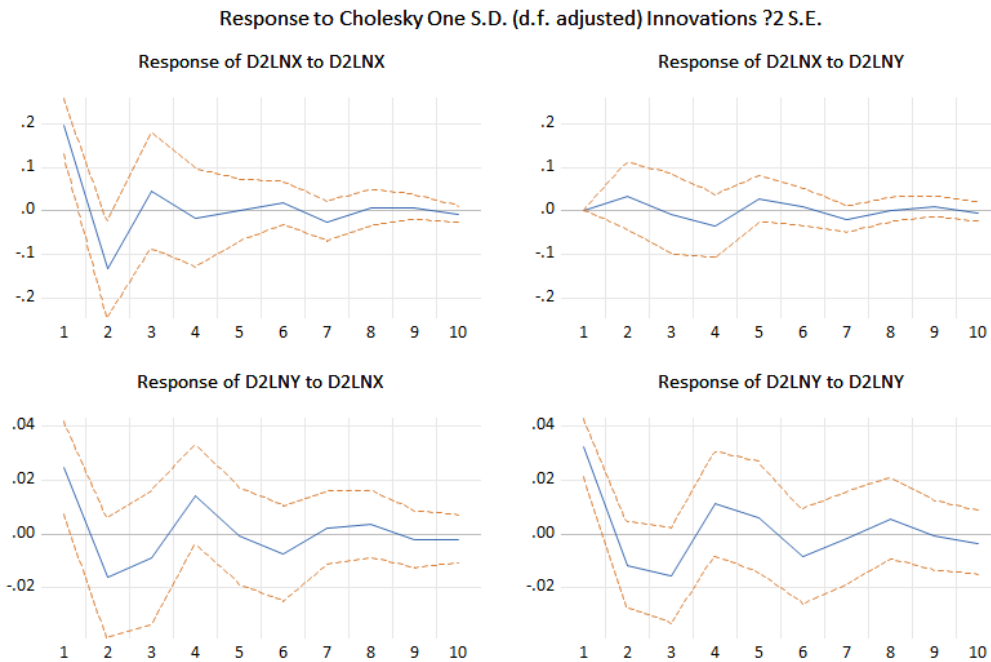


Figure 2 Impulse response results.

In "Figure 2", the horizontal axis represents the number of lag periods (years), and the vertical axis represents the degree of impact between Chongqing's tourism development and regional GDP. The full line is the analysis result of the impulse response function, and the upper and lower dotted lines represent a positive and negative double standard deviation band.

As shown in the figure, Chongqing's tourism industry has a positive external impact on the regional economy during the first to second periods of its impact on GDP. The positive impact in the first period is the largest, and then it gradually decreases, turning into a negative impact. In the fourth period, the negative impact reaches its highest level, after which, the negative impact decreases and turns to a positive impact in the fifth period. Then, the impact of Chongqing's tourism industry on the regional economy fluctuates slightly back and forth, and finally tends to flatten out, with the impact amplitude approaching zero.

In the impact of regional economic development on the tourism industry, the positive impact brought by economic growth in the first period reaches its peak, but the degree of impact turns negative in the second period, and then maintains a positive impact in the fourth and fifth periods. Among them, the second, the fourth, and the sixth periods are corresponding impact turning

points, and the degree of impact gradually decreases from the peak.

In the short term, Chongqing's tourism industry has a positive and sustained impact on regional GDP. However, in the long run, the impact of tourism on regional economic development is mostly positive, but the degree is relatively small. In contrast, regional economic development has a greater impact on the tourism industry.

## 5. CONCLUSION AND PROSPECT

This paper establishes a VAR model, uses cointegration test and impulse response function to conduct an empirical analysis of the dynamic impact of Chongqing's tourism industry on regional economy, examines the interactive relationship between time series data from 2000 to 2021.

### 5.1 Main Conclusions

From the empirical results, it can be seen that Chongqing's tourism industry impact factors have a driving effect on regional economic growth, and the two promote each other, and from the perspective of the degree of impact, regional economic development has made a significant contribution to the tourism industry. The specific conclusions are as follows:

First, the unit root test results show that in the long run, there is a long-term balanced cointegration relationship between Chongqing's tourism industry and GDP growth, which is basically consistent with the research results of domestic and foreign scholars. This indicates that the development of Chongqing's tourism industry and its derivative industries are complementary and mutually reinforcing.

Second, after establishing a VAR model and analyzing time series data with the help of impulse response functions, its results show that in the short term, Chongqing's tourism industry mainly has a positive impact on the regional economy, with a strong overall impact, and there is also a small negative impact over time. And compared to the former, the promotion effect of regional economic development on tourism is more significant. However, in the long term, the positive impact of tourism on the economy in Chongqing will gradually decrease and eventually stabilize. Besides, the development of Chongqing's tourism industry has a positive impact on itself, but the impact gradually weakens over time. The response time of tourism development to economic growth is longer, but its degree of impact is not high. This shows that in the process of regional economic development, economic growth has a more obvious driving effect on the tourism industry. Therefore, the investment in Chongqing's tourism industry should be concentrated in the initial stage, and over time, the investment in Chongqing's tourism industry should also decrease.

## 5.2 Implications and Suggestions

First, there is a strong co-integration between Chongqing's tourism industry and regional economic development, so it is necessary to promote the overall coordinated development of tourism and regional economy. The government should promote the economic transformation of local industries, focus on the tertiary industry, and strengthen supervision. While developing the tourism industry, it should also maintain the ecological environment and protect regional characteristics, so as to make contributions to promoting employment, improving infrastructure construction, and promoting the optimization of industrial structure.

Second, regional economy can promote the development of tourism to a certain extent, and it is an inevitable trend to coordinate the development of tourism and related industries. Therefore, it is

necessary to continuously adjust and optimize the industrial structure to promote the simultaneous development of catering, accommodation, culture and entertainment, and transportation. This will help improve the overall industrial level of Chongqing, promote local tourism development, increase the number of tourism employees, and improve the regional ecological environment and the quality of life of residents.

Third, due to the imperfect development of Chongqing's tourism industry, which has a limited role in promoting the regional economy and can't exert the maximum multiplier effect, it is necessary to vigorously develop the tourism industry to maximize the effectiveness of regional characteristic industries and explore new paths for the development of the regional economy. Specifically, on the one hand, it is necessary to develop tourism resources in Chongqing, improve the tourism industry chain, and create diversified tourism brands; on the other hand, it needs to provide tourists with a comprehensive range of characteristic tourism services to enhance the core competitiveness and enhance tourists' willingness to revisit.

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