International Journal of Computer Information Systems and Industrial Management Applications
ISSN 2150-7988 Volume 17 (2025) pp. 1-15
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https://doi.org/10.70917/ijcisim-2025-0265
Article

The impact of tourism flows on the local economy: an empirical study based on time series analysis

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Abstract: Accompanied by the impulsive interpretation of investment-driven growth in the process of industrialization, the trajectory of the rising contribution rate of consumption to economic growth has received more and more attention. Based on the VAR model, the article selects the relevant data of a region from 2005 to 2024 to make an empirical research on the relationship between tourism flow and local economy, and analyzes the current situation of tourism industry and economic development in the region, and finally proposes the relevant strategies according to the empirical results. The empirical results show that there is a mutual positive influence between tourism flow and local economy, and the positive effect of tourism flow on local economic growth is more significant, and its contribution can be up to 45% in the 10th period, while the local economy's contribution to tourism flow is stable at about 15%~20%, compared with the more limited role of economic development on tourism flow. The causal relationship provides a theoretical basis and foundation for the development of regional tourism policy.

Keywords: time series; vector autoregressive model; tourism flow; economic development

1. Introduction

Under the background of profound changes in the global economic pattern and the continuous promotion of economic double-cycle strategy, consumption has become the core engine of high-quality economic development [1-2]. As a comprehensive consumption field, the development trend of tourism consumption not only reflects the degree of improvement of residents' quality of life, but also reflects the structural changes of the entire consumer market [3-4]. 2025 “May Day” holiday, the tourism market achieved a double breakthrough in passenger flow and consumption, with an average daily tourism revenue of 20.24 billion yuan, and the volume of cross-regional people flow reached 1.42 billion, a record high. The regional flow of people amounted to 1.42 billion person-times, a record high. With the transformation of social supply and demand structure, the development of tourism is no longer the development mode of “circling the mountains and water to collect admission fees, and eating the dividends of the sea of people”, but rather towards improving the quality of service, promoting technological and cultural innovations, accelerating the realization of high-quality development of tourism, and promoting the development of the tourism economy [5-8].

The contribution of tourism to national economic development is multifaceted, according to the theory of tourism economy, the development of tourism can increase national income, earn foreign exchange, expand employment, drive the development of related industries, and promote the development of social and economic development and the improvement of ecological environment [9-12]. As a result, tourism and economic growth have formed an economic industrial chain: the development of tourism has led to the prosperity of the tourism economy, and the continuous growth of the tourism economy has led to the chain reaction of the regional economy through its income effect, foreign exchange earning effect, employment effect, and industrial correlation effect, which ultimately promotes the overall rapid growth and development of the economy [13-17]. However, affected by multiple factors such as national legal holidays, natural factors, government support, transportation

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facilities, etc., the seasonality, nonlinear characteristics, and popular concentration characteristics of tourism flow in the three dimensions of time, space, and flow become more and more obvious [18-20]. The spatial and temporal distribution characteristics of tourism flows correspond to different local economic patterns, and the high-quality development of regional tourism and local economy is promoted by exploring the dynamic association between tourism flows and local economy [21-23].

Based on the spatial analysis perspective, literature [24] evaluated the economic benefits of tourism in the case of high tourism flows in Italy, and found that excessive tourism flows are not conducive to the growth of local per capita income, and also affect the GDP growth of neighboring regions. Literature [25] used exploratory spatial data analysis to explore the spatial and temporal evolution characteristics of tourism mobility in China, and combined with a panel data model based on econometric modeling and log-averaged Diels-Alder indexing methodology, it was pointed out that tourism mobility positively promotes the growth of the tourism economy, but there is a negative effect on the surrounding areas. Literature [26], under the calculation of spatial econometric model, found that tourism mobility has spatial correlation, while the economic base, neighboring markets, transportation facilities, and attractions are positive factors affecting tourism mobility, and based on this result, the optimal spatial scale of regional cooperation was determined. Literature [27] developed a destination-source matrix of tourism flows to determine the coefficients of tourists' attractiveness in each region, and introduced a gravity model and a spatial autoregressive model to quantify the effects of factors influencing tourism flows, in which the level of local income is positively related to tourism flows.

Literature [28] pointed out that the spatial pattern of tourism flow network in Chengdu-Chongqing Economic Circle of China shows an inverted “U” shaped distribution, in which the effectiveness of the structural holes of local administrative units is positively proportional to the per capita gross domestic product and the construction of local infrastructures, and gave the tourism optimization strategy of Chengdu-Chongqing Economic Circle. Literature [29] obtains the interest area of inbound tourism traffic network through clustering algorithm, analyzes the spatio-temporal characteristics of Shanghai inbound tourism traffic network by combining with the complex network theory, and points out that the popular attractions in Shanghai are gathered in the city center, and the results of its spatio-temporal changes are conducive to the economic and cultural exchanges in Shanghai. Literature [30] used gravitational model, spatial Durbin model and fuzzy set qualitative comparative analysis to explore the correlation between tourism information flow and local tourism economic linkage, and the information flow of tourists presents a short-lived spillover effect on local tourism economic linkage. Literature [31] analyzed the impact of inbound tourism flows on local exports and pointed out that inbound tourism flows promote processed food exports in non-OECD regions, and exports are a channel to stimulate economic activities in tourist destinations. Currently, studies are mostly based on panel data and econometric models for exploring tourism flows and economic development, which are not only difficult to effectively capture the spatio-temporal correlation between tourism flows and local economy, but also difficult to analyze in depth the impact of tourism flows on local economic benefits. In contrast, time series analysis methods have been used to predict tourism flows and tourist flow analysis, which can be used to construct models to analyze the long-term dependence and short-term fluctuation characteristics of tourism flows and local economy [32-34].

The study takes tourism flow as the independent variable and regional economic development as the dependent variable, and selects the relevant data of a region from 2005 to 2024 as the research sample. After analyzing the current situation of tourism industry and economic growth in the region, the study constructs a VAR model through data smoothness test, cointegration test and Granger causality test, and carries out the model's variance decomposition and impulse response analysis to explore the influence role between tourism flow and local economy from the perspective of time series analysis. Finally, the development strategies of strengthening institutional construction and publicity, focusing on regional cooperation and building a green ecological development system are proposed. The empirical research using vector autoregressive model and econometric analysis in this paper can fully understand the influence mechanism and channels of tourism economic effects, and can point out the direction for the future tourism economic development of the region.

2. Research methodology and data selection

2.1. Variable selection and data processing

2.1.1. Selection of variables

In this paper, the number of tourists (NUM) and the gross regional product (GDP) of a region for the years 2005-2024 were collected from the Statistical Yearbook of the region. The former item is a measure of the level of tourism flows in the region and the latter is a measure of the level of economic development in the region.

2.1.2. Data processing

In this paper, all 2 variables are logarithmized into natural logarithms with e as the base. There are two main purposes of the logarization process. One is to eliminate the heteroskedasticity of the data. An important assumption of the classical linear regression model: the data contain the same variance. If this assumption precondition cannot be met, meaning that the random error terms in the data will have different variances, the linear regression model is said to have heteroskedasticity. If there is heteroskedasticity in the linear regression model, the parameter estimates obtained by estimating the model using the traditional least squares method are not valid estimates, or even further, the estimates obtained are not asymptotically valid, and at this point, when the valid estimates cannot be obtained, it is not possible to test the significance of the model parameters in relation to each other. Secondly, to make the data more linearized trend and eliminate the exponential trend that may exist in it. The variables after taking the natural logarithm are denoted as LNGDP, LNNUM, respectively. Since the VAR model has to be carried out on the basis of smoothness of the series of variables, it is necessary to test the smoothness of the variables.

2.2. Research methodology

This paper utilizes Eviews software and adopts the relevant research methods of econometrics to conduct an in-depth analysis and discussion on the relationship between economic growth and tourism flows in the region. The following is a brief introduction to the models and test methods used in the research process.

2.2.1. Vector autoregressive model

The VAR autovector regression model is an effective dynamic model that can effectively predict economic time series and can effectively analyze the effects of random perturbations on economic variables, so as to better understand the relationship between economic variables and effectively control and regulate economic variables. The most distinctive feature of the model is that it can replace the traditional econometric method, which can be based on actual economic data rather than relying solely on the theory of economics, thus better describing the dynamic changes of the economic system. However, the number of parameters required and the time span are more complicated when fitting with a VAR model.

In this study, a VAR model is constructed to determine the role of the relationship between tourism flows and the local economy using cointegration test, impulse response, variance decomposition, and Granger causality test. The VAR autovector regression model is used to analyze the time series and ensure that they are smooth and cointegrated.

The original setup of the VAR model is as follows:

$$Ay_t = F_1 y_{t-1} + \cdots + F_s y_{t-s} + u_t, t = s+1, \ldots, n \tag{1}$$

y_t is a $k \times 1$ -dimensional observed variable, $A, F_1, \ldots, F_s$ is a $k \times k$ -dimensional coefficient matrix, and u_t is a $k \times k$ -dimensional structural shock. The lower triangular matrix A is constructed by recursively identifying the contemporaneous relations of the specified structural shocks:

$$A = \begin{pmatrix} 1 & 0 & \cdots & 0 \\ a_{21} & \ddots & \ddots & \vdots \\ \vdots & \ddots & \ddots & 0 \\ a_{k1} & \cdots & a_{k,k-1} & 1 \end{pmatrix} \tag{2}$$

Both sides of Eq. (1) are multiplied simultaneously by the inverse matrix A^{-1} and the VAR model becomes:

$$y_t = B_1 y_{t-1} + \cdots + B_s y_{t-s} + A^{-1} \sum \varepsilon_t, \varepsilon_t \sim N\left(0, I_k\right) \tag{3}$$

where $B_i = A^{-1} F_i, i = 1, \ldots, s$, then:

$$\Sigma = \begin{pmatrix} \sigma_1 & 0 & \cdots & 0 \\ 0 & \ddots & \ddots & \vdots \\ \vdots & \ddots & \ddots & 0 \\ 0 & \cdots & 0 & \sigma_k \end{pmatrix} \tag{4}$$

The $\sigma_i (i = 1, \ldots, k)$ is the standard deviation of the structural shock. The $k^2 s \times 1$ -dimensional vector in the B_i matrix is labeled β, defining $X_t = I_k \otimes \left[y_{t-1}', \ldots, y_{t-k}' \right]$ and $\otimes$ is the Kronecker product.

The VAR model can be written in simplified form:

$$y_t = X_t \beta + A_t^{-1} \sum \varepsilon_t \tag{5}$$

The vector autoregressive model for the time-varying parameters is set up as follows:

$$y_t = X_t \beta_t + A_t^{-1} \sum_t \varepsilon_t, t = s+1, \ldots, n \tag{6}$$

where the correlation coefficient β_t and the parameters A_t and $\sum_t$ are time-varying. Let σ_t be the matrix of the diagonal elements in $\sum_t$, and α_t be the matrix of the non-zero and non-one elements of A_t, i.e., $\alpha_t = \left(\alpha_{21}, \alpha_{31}, \ldots, \alpha_{k,k-1} \right)'$, and let $h_t = \left(h_{1t}, h_{2t}, \ldots, h_{kt} \right)'$, and let $h_t = \log \sigma_{jt}^{\ 2}, (j = 1, \ldots, k, t = s+1, \ldots, n)$.

Assume that the parameters in Eq. (6) obey random wandering, i.e:

$$\begin{gathered} \beta_{t+1} = \beta_t + \mu_{\beta t} \\ \alpha_{t+1} = \alpha_t + \mu_{\alpha t} \\ h_{t+1} = h_t + \mu_{ht} \\ \begin{bmatrix} \varepsilon_t \\ \mu_{\beta t} \\ \mu_{\alpha t} \\ \mu_{ht} \end{bmatrix} \sim N \left[0, \begin{pmatrix} I & 0 & 0 & 0 \\ 0 & \Sigma_\beta & 0 & 0 \\ 0 & 0 & \Sigma_\alpha & 0 \\ 0 & 0 & 0 & \Sigma_h \end{pmatrix} \right] \end{gathered} \tag{7}$$

where $\beta_{s+1} \sim N\left(\mu_{\beta 0}, \Sigma_{\beta 0} \right), \alpha_{s+1} \sim N\left(\mu_{\alpha 0}, \Sigma_{\alpha 0} \right), h_{s+1} \sim N\left(\mu_{h0}, \Sigma_{h0} \right), t = s+1, \ldots, n$. with the following assumptions: the parameters β_t, a_t, h_t are uncorrelated, and $\sum_\beta, \sum_\alpha, \sum_h$ is a diagonal matrix to ensure recursive identification of the VAR model.

2.2.2. Stability tests

Time series is a class of random variables generated over time with non-repeatability, data that has been generated in the past cannot be reproduced, predicting future time series based on past time series is a research focus with continuity. In the research process, people are more expected to study the characteristics of the past time series, such as expectations, standard deviation, etc. can be inferred in the future, which requires the time series can be retained continuation of these characteristics, that is, smooth.

Smooth processes are generally categorized into strictly smooth and broadly smooth processes. For a time series $\left\{ X_1 \right\}$, with respect to any n values $t_1 < t_2 < \ldots < t_n$ at time t, the following equivalence relation is independent of the values of s:

$$F_{t_1, t_2, \ldots, t_n} \left(X_{t_1}, X_{t_2}, \ldots, X_{t_n} \right) = F_{t_1+s, t_2+s, \ldots, t_n+s} \left(X_{t_1+s}, X_{t_2+s}, \ldots, X_{t_n+s} \right) \tag{8}$$

then it is strictly smooth, and a time series is said to be broadly smooth if its second-order moments are finite and satisfy the following conditions:

$$\mu_t = E\left(X_t \right) = c \tag{9}$$

$$\gamma(t, s) = E\left(X_t - c \right)\left(X_s - c \right) = \gamma(t - s, 0) \tag{10}$$

The expression of the self-covariance function is given below:

$$\gamma(t,s)=E\left(X_t-c\right)\left(X_s-c\right) \tag{11}$$

And it has symmetry, $\gamma(t,s)=\gamma(s,t)$.

Smoothness analysis is an important issue in time series regression analysis and is one of the basic assumptions implemented in classical regression analysis. The methods of testing smoothness, subjective methods such as the trend graph of the data can be drawn to visualize whether the changes are smooth, and objective methods include unit root test, Person's method, and so on.

This paper studies the impact of tourism flow on the local economy, the entire research process of this paper's data for the time series, and the time series requires that the sample itself must be a smooth sequence, the subsequent Granger causality test and impulse response test also requires the sequence for the stability of the sequence. Generally speaking, if the research sample is a non-stationary series, the establishment of VAR model can also be studied on the data in the sample, but this is likely to cause the sample data "pseudo-regression", once the pseudo-regression occurs, the sample data to establish the VAR model is likely to have statistical bias. In this paper, the test of sample smoothness is taken as the ADF test, which is an extension of the DF test, and is used to test whether the series with a time trend is a smooth series. In general, the ADF test mainly tests the following three formulas, as long as one of the three formulas rejects the original hypothesis H_0, the series can be considered as a smooth series, and if none of the three formulas rejects the original hypothesis H_0 the time series under study is a non-smooth series. The collective formulas are shown below:

Model 1:

$$\Delta X_t=\delta X_{t-1}+\sum_{i=1}^{m}\beta_i\Delta X_{t-i}+\varepsilon_t \tag{12}$$

Model 2:

$$\Delta X_t=\alpha+\delta X_{t-1}+\sum_{i=1}^{m}\beta_i\Delta X_{t-i}+\phi_t \tag{13}$$

Model 3:

$$\Delta X_t=\alpha+\beta t+\delta X_{t-1}+\sum_{i=1}^{m}\beta_i\Delta X_{t-i}+\xi_t \tag{14}$$

For all three models above, the original assumptions are $H_0:\delta=0$

2.2.3. Granger causality test

Granger causality test is generally used to test whether there is a causal relationship between changes in two variables, according to the direction of the influence of the causal relationship between the variables, the results of Granger causality test can be categorized into unidirectional and bi-directional relationships. If the past changes in one variable affect the current changes in the other variable, it is a unidirectional relationship. If the changes that occurred in the past of both variables affect the other variable now occurring changes, then the two have a bidirectional Granger causality test relationship, that is, the current changes of both will affect each other's future data changes. Before conducting the Granger causality test on the variables, the variables must be tested for smoothness, so as to avoid "pseudo-regression" in the model.

The Granger causality test is accomplished with the help of the constrained F-test, and the formula for the Granger causality test is as follows:

$$Y_t=\sum_{i=1}^{m}\alpha_i X_{t-i}+\sum_{i=1}^{m}\beta_i Y_{t-i}+\mu_i \tag{15}$$

$$F=\frac{\left(RSS_R-RSS_U\right)/m}{RSS_U/(n-k)} \tag{16}$$

$$H_0:\alpha_1=\alpha_2=\alpha_3=L=\alpha_m=0 \tag{17}$$

where RSS represents the residual sum of squares, Eq. (16) represents the constrained F-test statistic, and Eq. (17) represents the original hypothesis of the Granger causality test. When the F statistic in Eq. (16) satisfies $F<F_\alpha(m,n-k)$, then the original hypothesis in Eq. (17) is not rejected, i.e., the

variable X in Eq. (15) is the Granger cause of the variable Y.

2.2.4. Johansen cointegration test

When using econometric theory modeling to analyze data and explore issues, the Granger causality test can only test a single variable and explain it, which makes the model less explanatory. In the case of multivariate variables, further analysis should be done using the Johansen cointegration test.

Johansen cointegration test is a multivariate cointegration test using trace statistic and maximum eigenvalue, etc. It is a kind of regression coefficient test based on the VAR model.The purpose of Johansen cointegration test is to verify whether the linear combination of non-stationary series has stable equilibrium relationship.

2.2.5. Impulse Response Function and Variance Decomposition

In the vector autoregressive model, in addition to the Granger causality test and the ADF test, there is one more important test - the impulse response test. The impulse response test detects the impact of the standard deviation change of a randomly disturbed term of a variable on the current and future values of other variables in the model by establishing an impulse response function. Shocks to the standard deviation of the randomly perturbed term are called “impulses”. Next, a set of binary models is used to illustrate the results of the impulse response function analysis:

$$Y_t = \sum_{i=1}^{m} \alpha_i Y_{t-i} + \sum_{i=1}^{m} \beta_i Y_{t-i} + \varepsilon_t \tag{18}$$

$$X_t = \sum_{i=1}^{m} \alpha_i X_{t-i} + \sum_{i=1}^{m} \beta_i Y_{t-i} + \varepsilon_t \tag{19}$$

Equation (18) and Equation (19) represent the relationship between two variables with correlation. The ε_t in the equation represents the random perturbation term, which is said to produce an impulse response if both Y and X change after a change in ε_t. The random perturbation term in the impulse response function can be either positive or negative in terms of the shock to the change in the variable, with a positive term indicating a positive push and a negative term indicating a negative inhibitory effect.

The variance decomposition method mainly focuses on analyzing the proportion of the standard deviation of the forecast residuals due to the shocks and impacts of different information, and then analyzing and exploring the contribution of each endogenous variable in the forecast variance realized.

3. Empirical research and analysis of results

3.1. Status of the tourism industry and economic growth

3.1.1. Tourism traffic development

Based on the collected data of the sample area, the passenger transportation volume and passenger transportation turnover of the area are analyzed from 2005 to 2024. The passenger transport volume and passenger transport turnover in the sample area are shown in Figures 1 and 2.From 2005 to 2024, the passenger transport volume and passenger transport turnover in the sample area showed an overall upward trend, and the data only declined from 2019 to 2022, and most of the tourists traveled by road transport. As shown by the statistical yearbook, the number of tourists received in the region in 2024 reached about 44,600,000, which is an improvement of nearly 9.58 percentage points from the previous year. And the overall passenger transportation turnover in the region in 2024 amounted to 5,647,800,000 kilometers, an improvement of 193.15 percentage points from 2005.

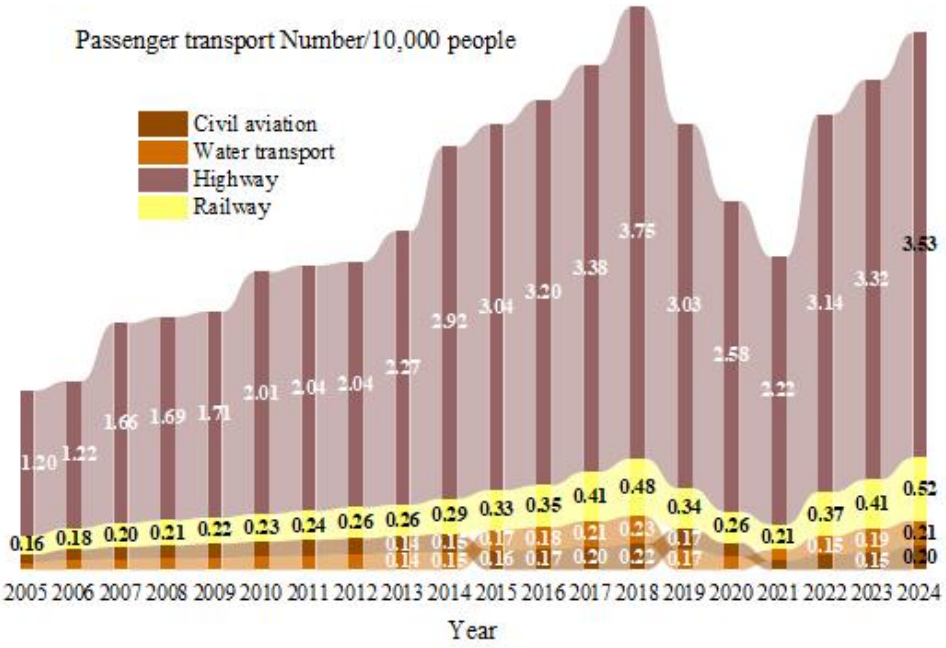

Figure 1. The number of passenger transport in the sample area

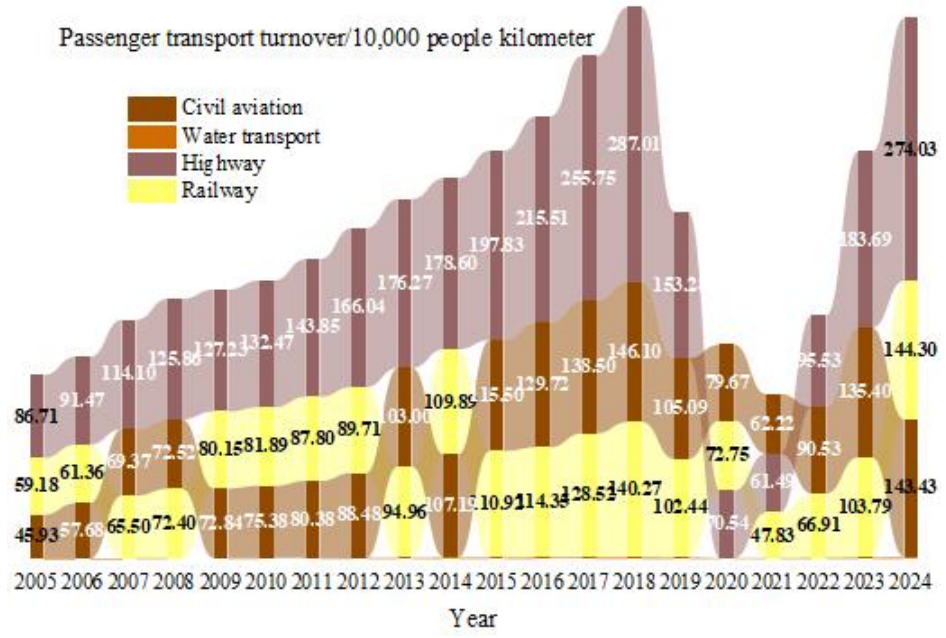

Figure 2. Passenger transport turnover in the sample area.

3.1.2. Tourism development leads to economic growth

With the development of tourism, all kinds of related industries have developed vigorously and emerged in response to the different needs of tourists, bringing business opportunities to many companies and individual households in related fields, such as travel agencies, savory snacks and so on. On the occasion of tourists visiting the scenery of each attraction, they unconsciously form a complete industrial chain, such as food, transportation, accommodation and several parts of enjoyment, which include stores, restaurants, hotels, transportation, retail and entertainment. First of all, the whole process of food, transportation, accommodation, excursions, shopping brings monetary expenses will increase the economic profits of enterprises and individual households in such areas, and these businesses are

linked to the scenic spots for marketing, and generally need to pay a certain amount of rent or other related fees, which indirectly also brings economic profits for the scenic spots. It can be seen that with the increase in the number of tourists in the tourist attractions, the various expenses incurred also increase, the entire scenic area of all the interests of the community's economic growth has a great role in promoting. Secondly, because the main purpose of tourists sightseeing and tourism is to realize the material and spiritual level of double enjoyment, so they have higher requirements for all levels of infrastructure and configuration, scenic spots in order to meet the needs of tourists, will inevitably be timely update, construction of related infrastructure, which also led to the development of this field of facilities, equipment manufacturing industry. Promote the industrial development of the whole region, to ensure the stable growth of the local economy.

The tourism and economic income of the region from 2005 to 2024 is shown in Figure 3, and the share of economic profit generated by tourism in different fields is shown in Figure 4. The economic profit generated by tourism in the sample area has increased by varying degrees each year during this 20-year period. The weighting parameter of tourism revenue in GDP has also increased to a great extent, increasing to 23.8 percentage points from the initial 2.6 percentage points, and in addition, the weighting parameter of the value added of the tertiary industry has also increased to a great extent, by about 42.2% from the initial level. The results show that the development of tourism in the sample area promotes the growth of local economic income, and the position of tourism in the economy of the sample area gradually increases.

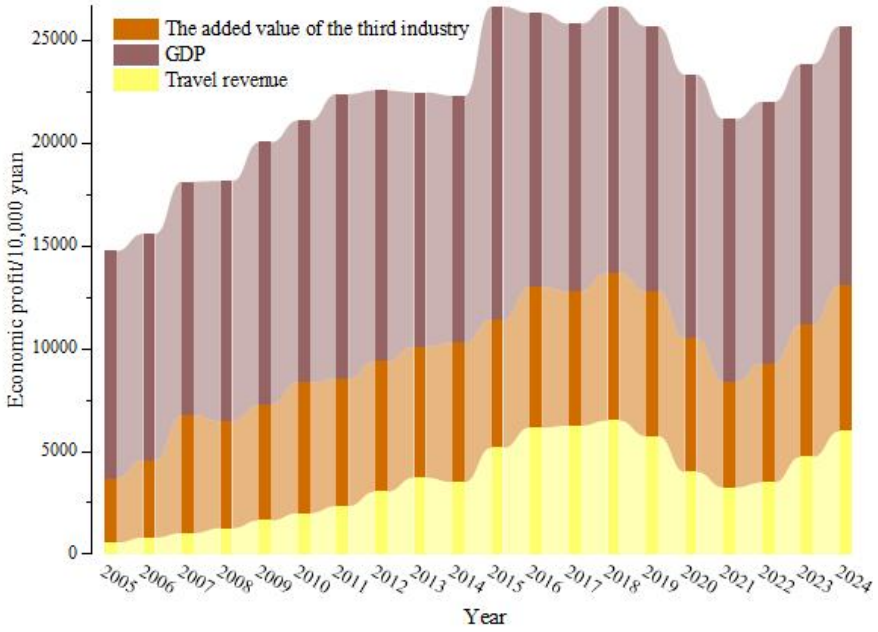

Figure 3. Tourism and economic income in the area.

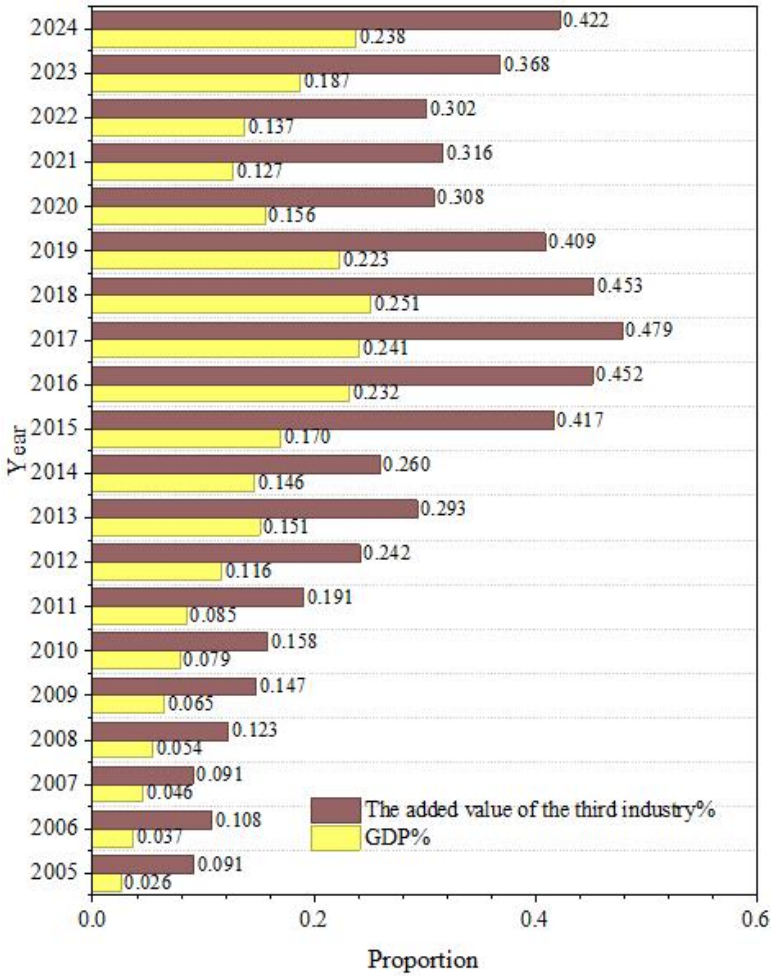

Figure 4. The proportion of tourism economic profits in different areas.

3.2. Contribution of tourism flows to the local economy

3.2.1. Data Smoothness Test

Image analysis of the 2 variables after logarithmization was performed, and the curve of logarithmized data over time is shown in Figure 5. It can be seen that there is a clear trend in the data of the 2 variables. Therefore the next step must be to test the smoothness of these data. In order to test whether the data are smooth, the ADF unit root test, which is more commonly used in statistical tests, is adopted.

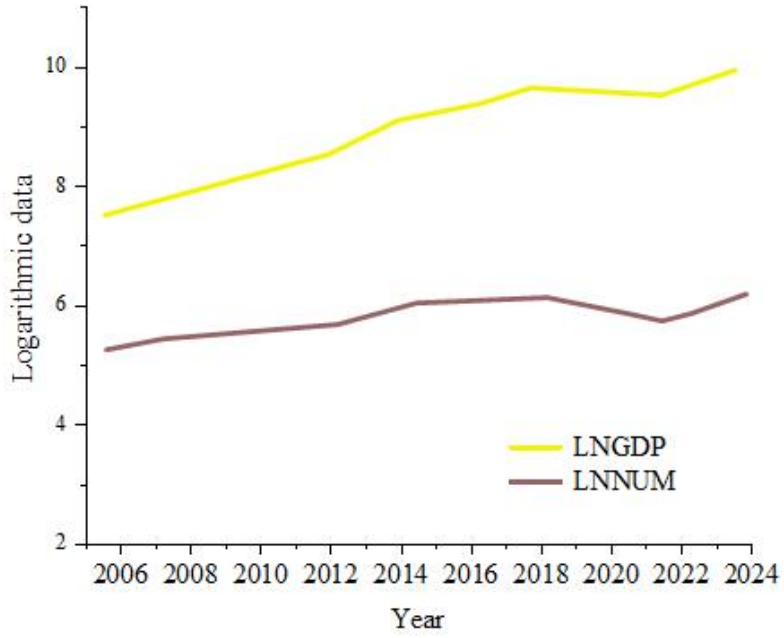

Figure 5. Logarithmic data change curve.

The results of the smoothness test of the data are shown in Table 1.The ADF statistics of the 2 logarithmized variables are -1.18679 and -2.44974 respectively, which are both greater than the ADF critical value (5% level of significance), which indicates that there is a unit root in the 2 variables, and that both of them are non-smooth series. Therefore, the first-order differencing is performed on the above 2 variables, and after testing, the ADF statistics of DLNGDP and DLNNUM are -3.83604 and -6.68811, which are both smaller than the ADF critical value (5% significance level), then it indicates that there is no unit root in the above 2 variables, and it can be called a first-order single-integrated series, and it can be used for the establishment of the VAR model and the correlation analysis.

Table 1. Data stability test results

Variables	ADF statistic	ADF threshold(5%Significance level)	Stability
LNGDP	-1.18679	-2.95772	No
LNNUM	-2.44974	-2.95236	No
DLNGDP	-3.83604	-2.92242	Yes
DLNNUM	-6.68811	-2.92242	Yes

3.2.2. Cointegration tests

Before building a VAR model, the lag order of the model needs to be determined. If the lag order is too small, then the residuals will be autocorrelated. If the lag order is too large, then the degrees of freedom of the relevant parameters of the VAR model will be too small. The LR statistic, AIC criterion, and SC criterion are chosen as the criteria for selecting the optimal lag order. The selection of lag order of GDP and tourism flow in the sample area is shown in Table 2. According to the minimum information criterion, the 1st order is chosen as the lag order of this VAR model, and the lag order of the cointegration test is 0. The results of the cointegration test are shown in Table 3, which contains 2 cointegration relationships at the 5% significance level, that is, there exists a stable long-run equilibrium relationship between the GDP of the sample area and the tourism flow.

Table 2. The lag order selection of GDP and travel flow in the sample area.

Lag	0	1	2	3
LogL	-72.4312	83.62447	86.65364	90.07269
LR	NA	288.49361*	2.26713	6.79278
FPE	2.44152	5.29-05*	6.43-05	6.58-05*
AIC	0.27443	-4.20964*	-3.83214	-3.86655

SC	2.59509	-3.42008*	-3.43452	-3.45053
HQ	6.66127	-3.99275*	-3.76482	-3.68075

Table 3. Cointegral test results.

There is no cointegral relationship	Eigenvalue	Trace statistics	5% threshold	P value
None	0.5169	37.1363	16.70054	0.000
At most 1	0.1569	7.0945	3.03867	0.016

3.2.3. Granger causality test

Granger causality test was performed on the VAR model and the results of the Granger causality test for the VAR model are shown in Table 4. The P-values are all less than 0.01, and the results are all rejecting the original hypothesis that LNGDP and LNNUM are Granger causes for each other, presenting a bi-directional Granger causality, which means that an increase in the GDP of the region will lead to an increase in the tourism flow, and an increase in the tourism flow will lead to an increase in the GDP of the region.

Table 4. Granger causality test results of VAR model.

Original hypothesis	P value	Result
LNGDP is not the granger of LNNUM	0.002	Rejected
LNNUM is not the granger of LNGDP	0.005	Rejected

3.2.4. VAR modeling

After the Granger causality test, in order to explore the specific two-way dynamic impact relationship between LNGDP and LNNUM in the region, the choice for the lag order in the previous section was 1st order. Therefore, a VAR model with 1st lag order is developed as follows:

$$LNGDP=0.924*LNGDP(-1)+0.100*LNNUM(-1)+0.022 \quad (20)$$

$$LNNUM=0.069*LNGDP(-1)+0.750*LNNUM(-1)+0.652 \quad (21)$$

As shown by Equation (20) (21), the region's LNGDP has a positive relationship with the LNGDP and LNNUM in the lagged period, but the coefficients are all relatively small and the effect is not significant, which shows that the region's tourism flow and gross regional product have a positive and promotional bi-directional effect but there is a certain degree of lagging.

Next, the model is tested for smoothness. The results of the unit root test of the model are shown in Figure 6, the inverse of the eigenvalues of this VAR model all fall within the unit circle, and the model is smooth. The analysis of variance decomposition and impulse response can be performed.

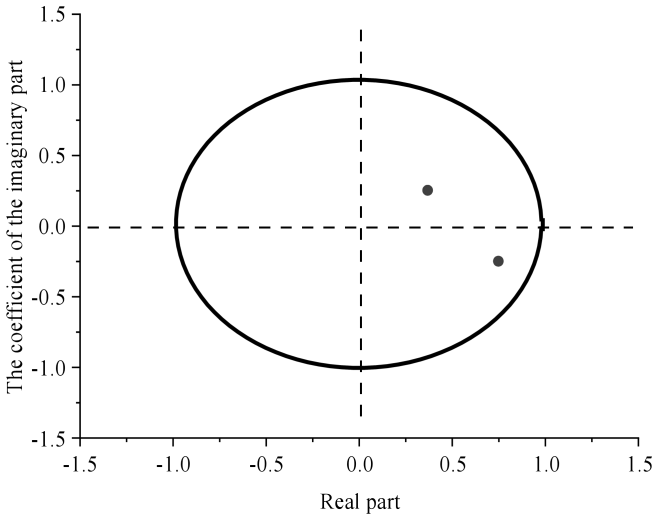

Figure 6. The unit root test results of the model.

3.2.5. Variance Decomposition and Impulse Response

The ANOVA decomposition of the VAR model shows the strength of the structural influence of changes in one endogenous variable by shocks to changes in other endogenous variables. The ANOVA decomposition of LNGDP and LNNUM for the sample region and the results of the ANOVA are shown in Figure 7.LNNUM has always had a large contributing role to LNGDP, which has been on an increasing trend from period 1-10, and the contribution reached 45% in period 10, i.e., for every 1% increase in the gross domestic product of the region, 45% of this increase is due to the increase in LNNUM. The LNGDP has been having a smooth contributing role to LNNUM, but the contribution is not significant, stabilizing at around 15% to 20%. That is, for every 1% increase in tourism flows in the region, 15% to 20% is due to an increase in LNGDP.

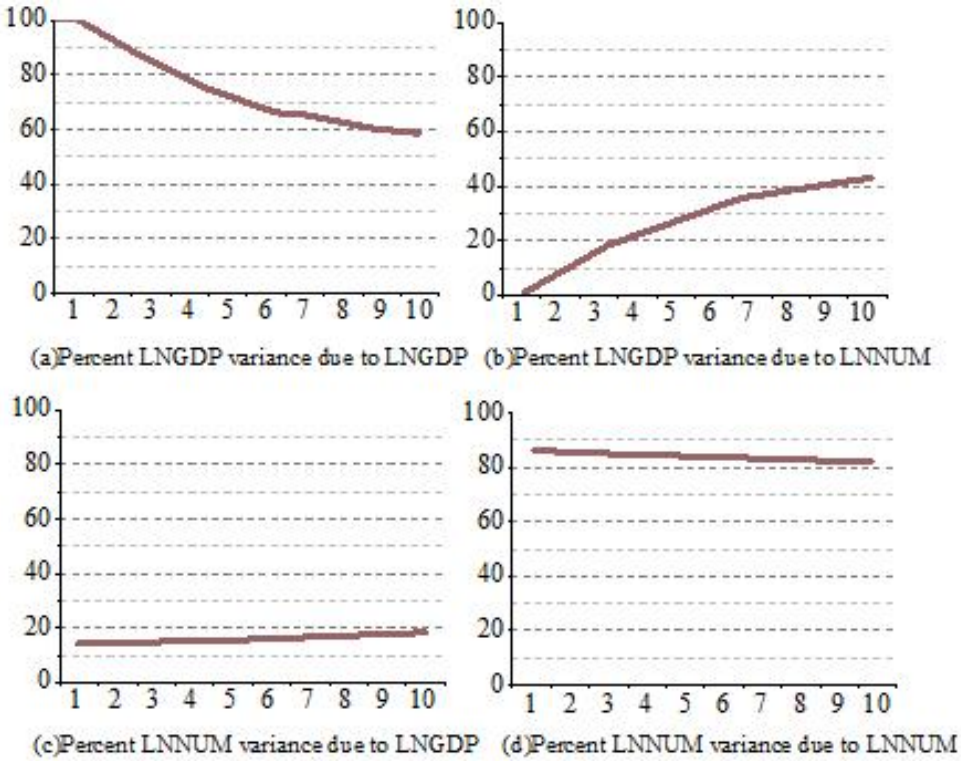

Figure 7. Analysis of variance analysis.

The impulse response function is shown in Fig. 8. The response path of LNNUM to the impact of LNGDP is positive, with 0 in the first period, then gradually increasing to 0.55 in the eighth period, and then stabilizing, which indicates that the elasticity of tourism flows to the growth of the sample area's GDP is first increasing and then decreasing. After 0.25, it tends to stabilize, which indicates that the elasticity of growth of GDP in the sample area for tourism flows in the area is gradually decreasing. On the whole, it shows that the tourism flow in the sample area can bring about the growth of the local economy, and at the same time, the growth of the GDP in the area can also bring about the increase of the tourism flow.

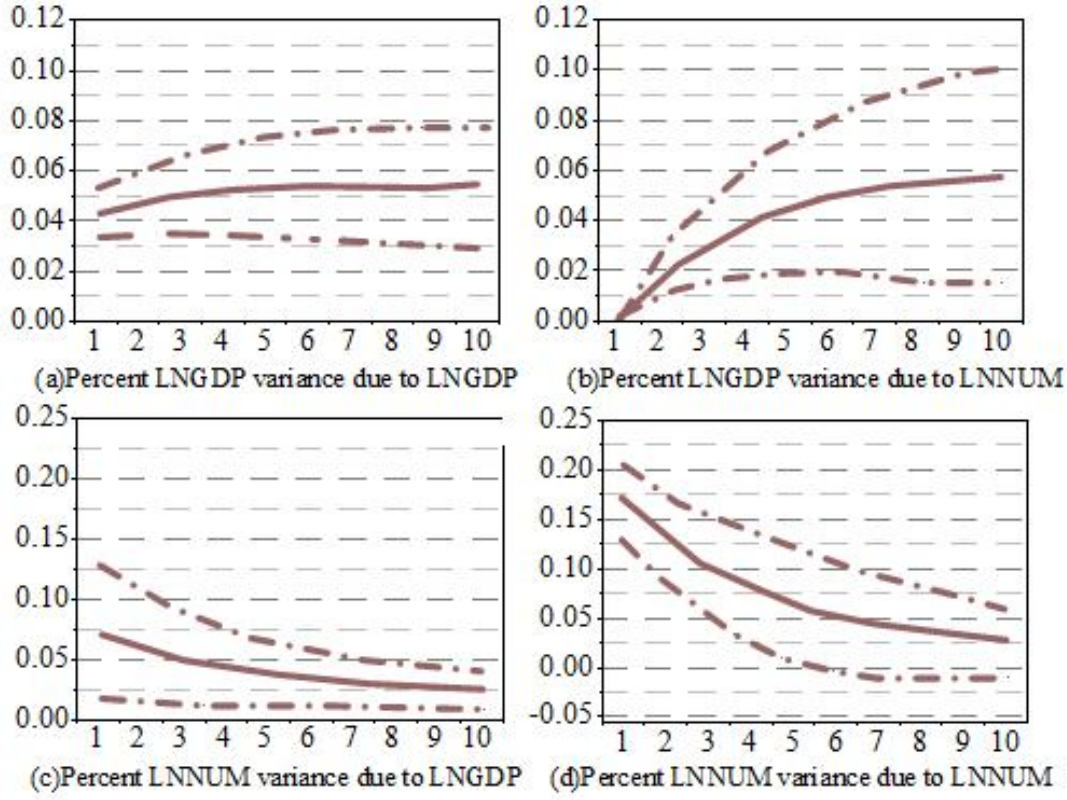

Figure 8. Pulse response function.

4. Effective strategies for developing tourism for economic development

4.1. Institutional strengthening and sensitization

In order to increase the standardization of the regional tourism industry, first of all, we should actively establish and improve the tourism industry's relevant systems, strictly regulate and supervise the tourism industry in the market, promote the overall level of the tourism industry as well as improve the quality of service, the first time to understand the real needs of tourists, and use the corresponding measures to make their needs satisfied, to ensure that the tourism industry can be the first time to take measures in the market under the change of effective response. Actively promote regional tourism, in the market for adequate research at the same time, the development of diversified promotional strategies, different tourists, have different needs, the development of innovative travel programs to attract the attention of tourists, promote the rapid development of the tourism industry, and thus contribute to the good development of the economy.

4.2. Focus on interregional cooperation in tourism

Combined with the existing regional situation, the special and advantageous tourism resources of each place should be integrated, and the development of a part of it should be utilized to promote the benign development of the region as a whole. The development of regional tourism should synthesize the region's good ecology, unique culture and special superior natural environment. Transportation conditions, geographical and other factors have a certain impact on the tourism industry, in the process of developing tourism should be treated equally, can not be formed by the phenomenon of short board, should provide the same opportunities for all regions.

4.3. Building a green ecological development system

Regional tourism development and gross domestic product (GDP) are complementary and closely linked, and in the long term, the best option is to follow the path of sustainable development, which is extremely beneficial to the rapid growth of the regional economy. In the development of tourism, the sustainable development strategy is a general trend, the ultimate goal is to make around the tourists generated by a variety of tourism needs to be satisfied, which need to actively improve the social living

environment and continue to protect the ecological nature to achieve. In terms of economic development, although quantitative growth is important, it is also important to pay close attention to overall efficiency and quality. From the perspective of social development, the goal is to promote social progress, but the improvement of people's living standards is also the goal of its best efforts to achieve. Based on the cultural point of view, to ensure the scientific and rational development and utilization is the general trend, but also pay attention to the protection and inheritance of local cultural heritage and special customs. Following the principle that ecological, economic and social benefits are complementary and mutually reinforcing, the goal of sustainable development of the tourism industry and the regional economy can be successfully achieved.

5. Conclusion

In order to study the influence mechanism between tourism flow and local economy, relevant indicators are selected, and a vector autoregressive (VAR) model is used to conduct an empirical study with panel data of a region from 2005 to 2024. The study shows that the short-term positive interaction between tourism flows and the local economy can be generated. The analysis of tourism flow in the sample area shows that the overall trend of passenger transportation and passenger transportation turnover is upward, and the number of tourists received in the area has increased by 199.32% from 2005 to 2024, and the proportion of tourism revenue to GDP and value added of the tertiary industry has also been increased, which systematically demonstrates that the development of the local tourism has a driving effect on the economic growth. Through the variance decomposition and impulse response analysis, the positive effect of tourism flow on the local economic growth is obvious, and its contribution reaches 45% at the 10th period, while the local economic development plays a smaller role in tourism flow, and its contribution is stable at about 15%-20%. On the whole, there is a close link between tourism development and economic growth, and the interaction between the two is more effective in generating impacts on local economic growth than tourism flows.

The development of tourism plays an extremely important role in promoting and radiating economic and social development, therefore, the study proposes the following development strategies: to strengthen the institutional construction and publicity of the tourism industry, to strengthen the cooperation between regions, to focus on inter-regional tourism cooperation, to build a sustainable green ecological development system, and to enhance the balanced and coordinated progress of tourism and economic growth.

About the Author

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