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Article

A Study on the Nonlinear Impact of Tourism Flows on Local Business Economic Development Based on Time Series Modeling

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Abstract: Studying the relationship between tourism flow and local business economic development is of great significance to the sustainable development of regional tourism industry. Therefore, this paper collects the tourism and business economic development data of a region from 2013 to 2023, and constructs a time series model using Granger causality test, Johansen cointegration test and vector autoregressive model to explore the nonlinear impact of tourism flow on local business economic development. The results show that tourism flow in the study area plays a good role in promoting the development of local business economy, with a contribution degree of 0.702, which shows a more significant contribution relationship, and that tourism flow and local business economic development positively affect each other, and the fluctuating shocks of the development of local business economy gradually slow down the impact of tourism flow. The research in this paper provides certain ideas for the future development of regional tourism industry and the growth of business economy.

Keywords: time-series model; Granger causality test; vector autoregressive model; tourism flows

1. Introduction

Under the background of global economic integration and industrial structure transformation and upgrading, tourism, as an important part of modern service industry, has gradually become a new driving force for global economic growth by virtue of its strong relevance and low-carbon environmental protection characteristics [1]. Countries around the world have cultivated the tourism industry as a national strategic pillar industry, and promoted the rapid development of the tourism industry through policy support, capital investment and other measures. The Chinese government also attaches great importance to the development of tourism industry, incorporating it into the national development strategy system and putting forward the goal of building a strong tourism country [2-3]. During the “14th Five-Year Plan” period, the added value of tourism and related industries accounted for the proportion of China's gross domestic product to maintain the growth trend, and the comprehensive contribution of tourism to the national economy exceeded 10% [4]. In 2023, China's A-class tourist attractions will directly employ more than 10 million people, and tourism-led comprehensive employment will be nearly 8 million. In 2023, the direct employment of A-grade tourist attractions in China exceeded 10 million people, and the comprehensive employment driven by tourism was nearly 80 million people [5].In the first quarter of 2024, the total consumption of Chinese tourists amounted to 1.52 trillion yuan, a year-on-year increase of 17%, which plays an obvious role in promoting consumption and stimulating domestic demand, all of which is sufficient to show that tourism has become an indispensable part of people's daily life.

With the new normal of the economy and the deep adjustment of the global economy, the tourism industry is facing a new time of development [6]. The importance of the tourism industry is reflected in its comprehensive contribution to the national economy, including the number of direct and indirect employment, the contribution rate to GDP, and in the growth of tourism facilities and services. Behind this rapid growth, the optimization of the tourism supply structure and the diversification of tourism demand have played a key role, making the tourism industry an important force in promoting regional economic development [7-9]. Regions such as Chongqing and Guizhou have elevated the tourism industry to a strategic pillar industry for regional development, highlighting the importance of the tourism industry in promoting regional economic development [10]. Meanwhile, the government also actively promotes the coordinated development of regional economy and promotes economic ties and collaboration among different regions by implementing a series of regional development strategies, such as the Western Development and the development of the Yangtze River Economic Belt [11]. Nonetheless, the impact mechanism between the tourism industry and local economy has not yet received sufficient attention and research.

Tourism industry has a strong comprehensive and industrial relevance, and has a close connection with the local transportation, accommodation and other related business economy, with high relevance, high driving capacity and other characteristics, and the external comprehensive effect is obvious such as increasing employment opportunities, improving infrastructure, driving the development of related industries and promoting regional economic growth [12-13]. Laut et al. (2021) used a dynamic panel approach to empirically analyze the role of tourism on economic growth in Indonesia using time-series data from 2013-2018, and concluded that the development of tourism had a significant impact on regional income has a significant impact [14]. Calero and Turner (2020) conducted a systematic review of studies related to the relationship between the regional economy and tourism in an attempt to explain the mechanism of tourism's role in regional development and growth [15]. Dhungel (2015) studied and analyzed the relationship between tourism and economic growth in Nepal and concluded that the two are unidirectional causality and tourism has an extremely important impact on economic growth [16]. Raza et al. (2017) collected monthly data from January 1996 to March 2015 in the United States and fully utilized the wavelet transform analysis tool to study the impact of tourism industry on economic growth, and the results of the study showed that the tourism industry has a positive effect on economic growth and should pay attention to the cultivation of tourism demand [17]. Brida et al. (2020) used modeling methods such as minimum spanning tree and hierarchical tree, based on panel data from 80 countries, to analyze the 1995-2016 period economic growth dynamics as well as the spatio-temporal evolution characteristics of the tourism industry, and found that the tourism industry has a certain clustering effect on the regional economy, which has a tendency of diminishing marginal utility. The above literature shows that there is a strong and multidimensional link between the tourism industry and regional economic growth [18]. Studies have generally pointed out that the tourism industry occupies an important position in promoting regional economic development, which can not only increase foreign exchange earnings and enhance economic efficiency, but also effectively promote and drive the development of related businesses [19-21]. This view also lays a theoretical foundation for subsequent in-depth studies and leads scholars to further explore the specific role mechanisms between the two.

With the continuous progress of research methods, regression analysis, spatial econometric tools and other empirical research methods are widely used in the exploration of the relationship between the tourism industry and economic development. Using the correlation coefficient analysis, Snieška et al. (2014) confirmed that the development of rural tourism has a positive impact on the local development of average gross monthly income of residents, foreign direct investment, and government expenditures (correlation coefficients higher than 0.9) had a positive impact [22]. Tang and Tan (2015) collected time-series data from Malaysia over a 36-year period from 1975 to 2011, and utilized research tools such as Solow growth model and Granger causality test to empirically investigate the relationship between tourism industry and regional economic growth The results of the study showed that the tourism industry has had a positive effect on Malaysia's economic development in both the short and long term [23]. Seghir et al. (2015) used panel cointegration and panel Granger causality tests to analyze the relationship between consumption and economic development generated by tourism in 49 countries, and in doing so, proposed the need to optimize the allocation of tourism resources, formulate the correct development strategy, and strive to promote the tourism industry and economic development to reach the maximum and optimal. industry and economic development to achieve the maximum and optimal results [24]. Liu and Wu (2019) explored the transmission mechanism between tourism and economic growth using a Bayesian dynamic stochastic general equilibrium model under the assumption of diminishing marginal returns to capital and found that due to the externalities of physical capital, human capital, and public services, there is a spillover effect from tourism to spillovers among other business sectors [25]. Majeed and Mazhar (2021), using a fixed effects approach, found that in developing countries economic growth is affected by tourism and its fluctuations significantly, but this effect is less affected in developed countries [26]. Liu et al. (2022) explored the direct and spillover effects of tourism on regional economic growth using a dynamic spatial Durbin model (SDM) and found that tourism also plays an important role in stimulating local economic growth, and that this spatial spillover effect is limited to mainland tourists

[27]. Lee, H and Hlee (2021) utilized an input-output model and found that the development of tourism in the city of Seoul has provided a significant opportunity for local residents to increase income and employment opportunities, indicating that there is a positive impact of Seoul's tourism industry on economic development [28]. Cárdenas et al. (2024), comparing the results of panel causality analysis with those of homogeneous countries, found that there is a unidirectional causality of tourism on the economy in economically developed regions, while there is a unidirectional causality of the economy on tourism in economically less developed regions [29]. Existing literature has explored the complex relationship between regional economy and tourism industry through different empirical analysis methods, such as Granger causality test, vector error correction model, and linear regression analysis. However, there are still some shortcomings in the current research. Including relatively few discussions on the nonlinear impact, indirect impact, and long-term impact of regional economy on tourism industry, which need to be further studied in depth. In addition, the research perspective is relatively single, lack of research from multi-dimensional comprehensive analysis of the impact of the regional economy on the tourism industry, and the theoretical framework needs to be further improved.

Based on the sample data of a region from 2013 to 2023, this paper analyzes the tourism development of the study area in terms of tourism flow, the number of travel agencies and the number of A-class attractions. On this basis, the relationship between tourism flow and local business economic development was empirically analyzed by constructing a VAR model with local business economic development as the explanatory variable and tourism flow as the explanatory variable. Through ADF smoothness test, Johansen cointegration test, Granger causality test, as well as impulse response analysis and contribution measure, the nonlinear effect of tourism flow on local business economic development is explored. Based on the analysis of time series model, the study summarizes the logical relationship between the two, which is instructive for the future development of regional tourism industry.

2. Study area and its tourism development

2.1. Study area

This paper takes a certain region as the study area and focuses on 10 administrative division areas (denoted as R1~R10) in it. In recent years, the tourism industry in this place has been developing rapidly, and tourism has gradually become an important industry in the region, which plays an important role in promoting the economic growth of the region as well as the development of local business economy. At the same time, the development of tourism has a positive driving effect on the promotion of ecological environmental protection and the propagation of local excellent traditional culture. In view of the availability and uniformity of data, the number of tourist flows, the number of travel agencies, and the number of A-grade attractions in each district of the region from 2013 to 2023 were selected as the indicators to measure the current status of the development of the tourism industry, and the relevant data were obtained from the statistical yearbooks of the districts and from the “Statistical Yearbook of Tourism in China”, “Statistical Yearbook of Culture, Cultural Relics, and Tourism in China”, and the “Statistical Yearbook of China”. China Statistical Yearbook of Culture, Heritage and Tourism.

2.2. Tourism Development

2.2.1. Number of tourist flows

The trend change in the number of tourist traffic in the study area from 2013-2023 is shown in Fig. 1. The number of tourist traffic in all 10 regions of the place is in an upward trend from 2013-2019, and the number of tourist traffic in 2020-2022 declined sharply due to the impact of the epidemic, which led to the impact on the tourism industry in many places, and then in 2023 it resumed the upward trend.The average value of the number of tourist flow in the study area from 2013 to 2023 is at 30,925,000 person-times, and the development of the tourism industry in the 10 regions of the place roughly shows three gradients, with the average annual tourist flow of R1, R2, R5, and R9 below 30 million person-times, R3, R4, R6, R8, and R10 above 30 million person-times, and R7 with the average annual tourist flow is the highest at 40,569,100 trips. Except for 2020-2022, which was hit by the epidemic, the number of tourist receipts in the sample area has become a trend of increasing year by year, and the tourism industry is developing in a good direction.

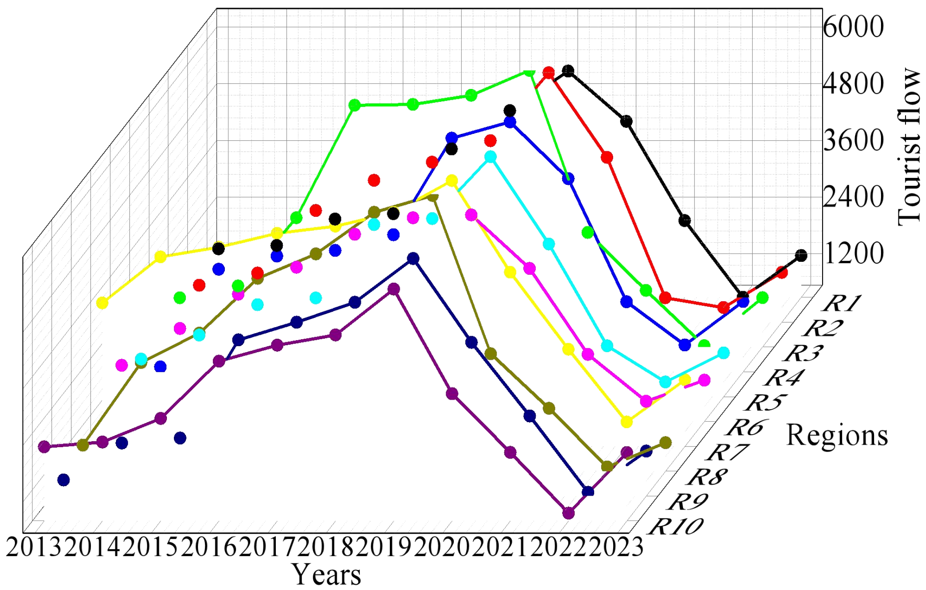

Figure 1. Trends in the travel flow number in the research area from 2013 to 2023.

2.2.2. Number of travel agencies

Trends in travel agents in the study area from 2013-2023 are shown in Figure 2. The growth in the number of travel agents in the 10 regions of the place was relatively flat until 2016, and the change in the number of travel agents was relatively small, although the growth in the number of travel agents in the 10 regions of the study area was relatively flat, the overall trend shows an upward growth. The number of travel agents in the 10 regions of the area began to show a more rapid growth after 2016 and a rapid decline after 2019. There is little difference in the number of travel agents in the regions, with the average number of travel agents between 2013-2023 ranging from 209.91 to 263.45.

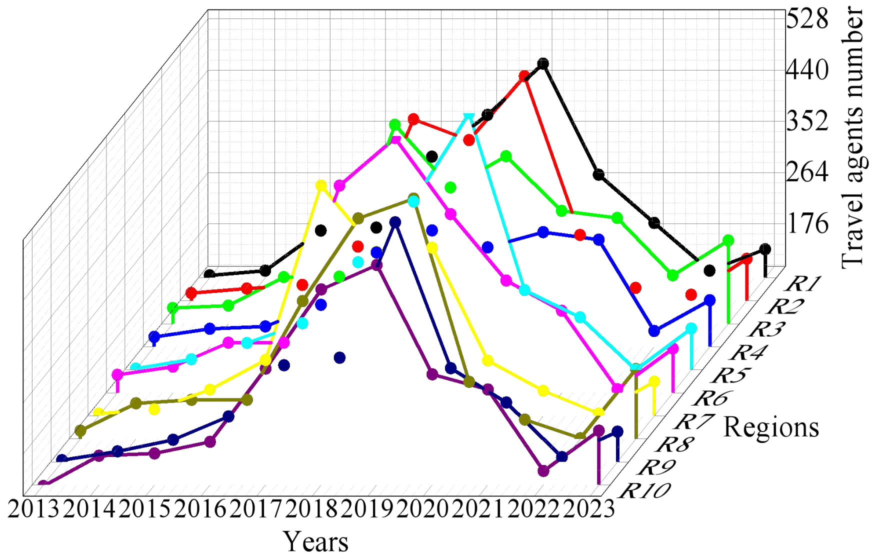

Figure 2. Trends in the travel agent number in the research area from 2013 to 2023.

2.2.3. Number of A-Rated attractions

Figure 3 shows the trend in the number of A-rated attractions in the study area from 2013-2023. The number of Class A attractions in the 10 regions of the site has increased year by year, and overall the number of Class A attractions in the region totaled 372 in 2013, and the total number of Class A tourist attractions will grow to 1,756 by 2023, and the development of Class A attractions and the increase in the number of Class A attractions provide the basis for the development of tourism in the local development, which accordingly contributes to the overall development of the tourism industry in the study area.

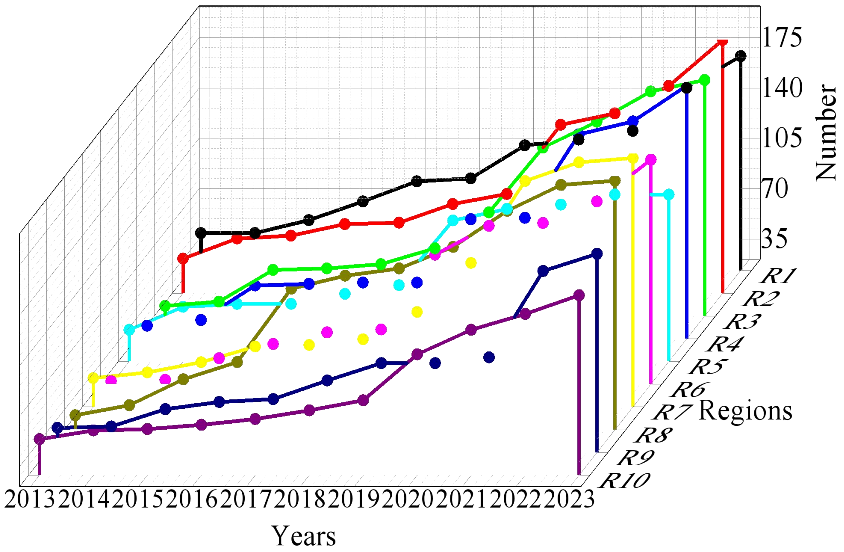

Figure 3. Trends in the A level scenic spot number in the research area from 2013 to 2023.

3. Research design

3.1. Variable Selection and Data Sources

3.1.1. Variable Selection

The purpose of this paper is to empirically investigate the non-linear impact of tourism flows on local business economic development in the sample area, with the explanatory variable being local business economic development (LBED), the explanatory variable being tourism flows (TF), and the control variables being the level of regional consumption (T) and government expenditures (E). The local business economic development is calculated by the value of local business GDP, and the tourism flow data is expressed by the number of tourism flow in the sample area. In order to make the research results of this paper more in line with reality, according to the theoretical indicator system, the corresponding explanatory variables are selected. Specifically, the other indicators in this paper select two control variables, mainly the regional consumption level (T), which is calculated by the total retail sales of social consumer goods, and the government expenditure (E), which is calculated by the government's budgeted expenditure.

3.1.2. Data sources

This paper uses the indicators of local business economic development, tourism flow, regional consumption level and government expenditure of a region in 2013-2023 to measure the relationship between tourism flow and local business economic development. The raw data of each major indicator are from the 2013-2023 urban statistical yearbook and statistical bulletin of the study area, and combined with the survey information of relevant departments and other public information on the Internet.

3.2. Timing model analysis methods

Vector autoregressive (VAR) model is based on the establishment of data statistics system, all variables in the model are endogenous variables, at the same time, each endogenous variable can be represented by a function of the lagged value of the other endogenous variables, which is usually used in the correlation of the time series system to predict the dynamic impacts of stochastic perturbations on the variable system, and then to analyze the interpretation of the economic shocks on the variable formation. In this paper, we focus on analyzing the nonlinear impact of tourism flows on local business and economic development, and the main modeling process of its time series model is smoothness test (ADF) and cointegration test (Johansen). In applying Granger's causality test (Granger) analysis method, it analyzes whether there is indeed such a long-term equilibrium causal relationship between variables.

Finally, the impulse response function is applied to study the effect of shocks between the analyzed variables.

3.2.1. Granger causality test model

The Granger causality test requires that the time series of the variable being tested is smooth, but many financial and economic time series are not flat and stable, so the time series of the variable must first be tested for smoothness. The ADF test is selected here, and the following three models exist:

$$\text{Model 1: } \Delta y_t = \sigma y_{t-1} + \sum_{j=1}^{p} \lambda_j \Delta y_{t-j} + u_t \quad (1)$$

$$\text{Model 2: } \Delta y_t = \mu + \sigma y_{t-1} + \sum_{j=1}^{p} \lambda_j \Delta y_{t-j} + u_t \quad (2)$$

$$\text{Model 3: } \Delta y_t = \mu + \beta t + \sigma y_{t-1} + \sum_{j=1}^{p} \lambda_j \Delta y_{t-j} + u_t \quad (3)$$

In this case, model 1 has no constant and trend terms and model 2 has only constant terms. Model 3 has constant and trend terms. In general, if the series fluctuates up and down around a mean of 0, model 1 is chosen. if the series has a non-zero mean with no time trend change, model 2 is chosen. if the series has a trend change over time, model 3 is chosen.

In order to overcome the emergence of pseudo-regression, when the variable being tested is a non-stationary time series, the variables being tested are differenced to make it a stationary time series, which results in a long term loss of stable relationship. Therefore, it is necessary to carry out cointegration test for two variables, which is realized in two steps by using the EG test method:

(1) Establish a cointegration regression of two time series, estimate the coefficients of each variable by the least squares method, and calculate the residual series.

(2) Perform the ADF test on the residual series. If the residual series are smooth, it indicates that the two variables are cointegrated. On the contrary, it is not a cointegration relationship.

The Granger causality test is modeled as follows:

$$y_t = c_1 + \sum_{j=1}^{q} \alpha_j x_{t-j} + \sum_{j=1}^{q} \beta_j y_{t-j} + u_{1t} \quad (4)$$

$$x_t = c_2 + \sum_{j=1}^{s} \lambda_j x_{t-j} + \sum_{j=1}^{s} \sigma_j y_{t-j} + u_{2t} \quad (5)$$

where u_{1t} and u_{2t} are assumed to be irrelevant.

If the lagged value of x can significantly improve the prediction of y when y is regressed on other variables, i.e., the change in x precedes the change in y, then the variable x is the Granger cause of the variable y, and similarly y is introduced as the Granger cause of x. Because the lag period of Granger causality test is arbitrarily selected, generally have to test a number of different lag periods of Granger causality test and the conclusion is the same, in order to draw the final conclusion.

3.2.2. Johansen cointegration test

There are two main test methods for testing the existence of cointegration between variables: one is the EG cointegration test. This method holds that if there is a smooth linear combination of a set of non-stationary time series (i.e., the combination does not have a random trend), then there is cointegration in this set of series, and this linear combination is called the cointegration equation. One of the disadvantages of the "EG cointegration test" is that it cannot deal with situations where there are multiple cointegration relationships (i.e., the cointegration rank is greater than 1) at the same time. The other is Johansen's great likelihood cointegration test, which is a method based on VAR and using great likelihood estimation to test the cointegration between variables, which is mostly applied to test whether there is a cointegration relationship between multiple variables.

Maximum Likelihood Estimation (MLE) is applied to estimate the following Vector Error Correction Model (VECM):

$$\Delta y_t = \alpha + \Gamma_0 y_{t-1} + \Gamma_1 \Delta y_{t-1} + \ldots + \Gamma_{p-1} \Delta y_{t-p+1} + \varepsilon_t \quad (6)$$

where, for simplicity of derivation, it is assumed that the time trend term is not included. Assuming a sample size of $T+p$, then the observed data are $\{y_{p-1}, y_{p-2}, \ldots, y_0, y_1, \ldots, y_T\}$. it can be found that the VECM model above holds only if there is cointegration in y_t . Otherwise, the left side of Eq. (6) is a smooth process, while the right side is a non-smooth process (due to the fact that $\Gamma_0 y_{t-1}$ is not smooth). Assuming that the cointegration rank is h , then the Δ -coefficient matrix Γ_0 must satisfy the constraint " $rank\ (\Gamma_0 = \mathrm{h})$ ". This is done by maximizing the log-likelihood function of $\{y_1, \ldots, y_T\}$ (i.e., conditional MLE) while satisfying " $\mathrm{rank}(\Gamma_0) = \mathrm{h}$ " with a given $\{y_{-p+1}, y_{-p+2}, \ldots, y_0\}$ condition.

Assume that the perturbation term is normally distributed in n dimensions, i.e., $\varepsilon_t \sim N(0, \Omega)$, and that $\{\varepsilon_t\}$ is independently and identically distributed. the joint density of the n -dimensional random vector ε_t is:

$$\frac{1}{2\pi^{n/2}\,|\,\Omega\,|^{1/2}} \exp\left\{-\frac{1}{2}\varepsilon_t'\Omega^{-1}\varepsilon_t\right\} \tag{7}$$

Taking the logarithm of equation (7) yields:

$$\frac{-n}{2}\ln 2\pi - \frac{1}{2}\ln|\,\Omega\,| - \frac{1}{2}\varepsilon_t'\Omega^{-1}\varepsilon_t \tag{8}$$

Noting $\Pi = (\alpha \Gamma_0 \Gamma_1 \cdots \Gamma_{p-1})$, $x_t = (y_{t-1} \Delta y_{t-1} \cdots \Delta y_{t-p+1})'$, then there are $\varepsilon_t = \Delta y_t - \Pi' x_t$, so the log conditional likelihood function corresponding to $\{\varepsilon_1, \varepsilon_2, \ldots, \varepsilon_T\}$ is:

$$\max \frac{-n}{2}\ln 2\pi - \frac{1}{2}\ln|\,\Omega\,| - \frac{1}{2}\sum_{t=1}^{T}\left[(\Delta y_t - \Pi' x_t)'\Omega^{-1}(\Delta y_t - \Pi' x_t)\right] \tag{9}$$

where n is the number of variables in the system and T is the sample size. In order to solve the above constrained extremum problem, it is necessary to determine the covariance rank h . When the covariance rank is h , the coefficient matrix Γ_0 has h free (linearly independent) column vectors. Therefore, the larger the covariance rank h is, the less constraints there are on matrix Γ_0 , and the larger the maximum value of its corresponding likelihood function should be. Therefore, the following likelihood ratio test can be performed:

$$H_0 : rank(\Gamma_0) = 0 \quad vs \quad H_1 : rank(\Gamma_0) > 0 \tag{10}$$

Since the rank of the matrix Γ_0 depends on the number of its non-zero eigenvalues, the test statistic is called the "trace statistic" and is denoted as λ_{trace} . Since the tracetest is a likelihood-ratio test, it is a one-sided right-hand side test, i.e., the larger λ_{trace} is (with the addition of the H constraint), the more the maximum value of the likelihood function falls. Because "tracetest" is a likelihood ratio test, it is a one-sided right-handed test, i.e., the larger h is (the more the maximum value of the likelihood function decreases after the H_0 constraint is added), the more the hypothesis will be rejected. If " $H_0 : rank(\Gamma_0) = 0$ " is accepted, then it is assumed that there is no cointegration. Instead, then continue to test for the existence of multiple cointegration relationships:

$$H_0 : rank(\Gamma_0) = 1 \quad vs \quad H_1 : rank(\Gamma_0) > 1 \tag{11}$$

The tests are repeated in this order until H_0 is accepted and the cointegration rank h is confirmed. After confirming the cointegration rank h , the conditional MLE can be used to estimate all parameters (both long-run and short-run parameters) in the VECM model.

3.2.3. Vector autoregressive model

Vector autoregressive (VAR) modeling refers to the regression of all current variables in the model on a number of lagged variables of all variables. Since the VAR model is primarily constructed by modeling each endogenous variable in the system under study as a function of the lagged values of all the endogenous variables in the system, the univariate autoregressive model is extended to a multivariate "vector autoregressive model". Specifically, a p -order unconstrained VAR model is expressed as:

$$Y_t = \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \ldots + \beta_p Y_{t-p} + \varepsilon_t, t = 1,2,\ldots T \tag{12}$$

In Eq. (12), Y_t denotes a K -dimensional vector, p is the vector autoregressive lag order, and ε_t is a K -dimensional perturbation vector and ε_t is uncorrelated with the variables in the $t-1$ period and before.

One very important issue for VAR models is the determination of the lag order. In order to satisfy both a sufficient number of lag terms and a sufficient number of degrees of freedom, this requires some methods for determining the optimal lag to be tested, such as the commonly used SC criterion ("Bayesian Schwarz Information Criterion") and AIC criterion (Akaike Information Criterion).

1) SC criterion:

$$\min_K BIC = \ln\left(e'e/n\right) + \frac{\ln n}{n} K \tag{13}$$

where k denotes the number of explanatory variables selected, $\ln\left(e'e/n\right)$ denotes the reward for good model fit (reduction in the residual sum of squares), and $\frac{\ln n}{n} K$ denotes the penalty for having too many explanatory variables. In addition, the principle for selecting the optimal lag (i.e., K value) is the one K value that makes the value of SC relatively small as the K value increases.

2) AIC guidelines:

$$\min_K AIC = \ln\left(e'e/n\right) + \frac{2}{n} K \tag{14}$$

where K denotes the choice of the number of explanatory variables and $\ln\left(e'e/n\right)$ denotes the reward for good model fit (reduction in the sum of squares of the residuals). $\frac{2}{n} K$ denotes the penalty for having too many explanatory variables (an increasing function of the number of explanatory variables K). Similarly, the principle for selecting the optimal lag (i.e., the value of K) is the value of K that makes the value of AIC relatively small as the value of K increases.

In summary, the SC criterion is relatively more severe in penalizing too many explanatory variables than the AIC criterion (i.e., the SC criterion places more emphasis on model simplicity).

4. Empirical analysis

4.1. ADF smoothness test

In this paper, the views10 software was used, and with the method of ADF, the variables were tested for smoothness, local business economic development (LnLBED), tourism flow (LnTF), regional consumption level (LnT), and government expenditures (LnE), and the results of the ADF test after differencing are shown in Table 1. Measurement results show that LnLBED, LnTF, LnT, LnE no matter at what significant level, the absolute value of the ADF statistic value is less than the absolute value of the critical value, the results fully show that the initial variables are unstable, if the initial variables are used in the linear model, it will produce a "pseudo-regression" problem. In this way, the unit root can be eliminated by differentiating the original data.

The following conclusions were obtained through the differential analysis: the absolute value of the ADF statistic of the first-order differential series D(LnLBED) and D(LnTF) of the local business economic development and tourism flow is greater than the absolute value of the critical value, which is 5.9108 and 6.2907, respectively, indicating that they are in a stable series under the first-order differential series at different degrees of significance. The first-order difference series of district consumption level and government expenditure, D(LnT) and D(LnE), also show stable series at 10% significance level. So LnLBED, LnTF, LnT, LnE can be viewed as smooth series after first-order differencing and can be tested for cointegration for each data series.

Table 1. ADF test results after difference.

Variables	D(LnLBED)	D(LnTF)	D(LnT)	D(LnE)
ADF statistic	-5.9108	-6.2907	-2.6535	-3.5908
1% threshold	-5.2862	-4.9771	-3.0762	-5.1032
5% threshold	-3.434	-3.7282	-2.3131	-3.6983
10% threshold	-2.1886	-4.2734	-1.2644	-3.2541
P value	0.0028	0.0072	0.0064	0.0086
Stability	Yes	Yes	Yes	Yes

4.2. Johansen cointegration test

In this paper, the Johansen method is applied to test the cointegration relationship, mainly to verify the specific equilibrium state between the variables, this paper adopts the method containing the truncated moment term without the trend term, and selects lag 1. The results of the verification of cointegration relationship between the variables are shown in Table 2. At 1% significance level, the trace statistic is less than the critical value, the hypothesis that the cointegration vector has at least 2 cannot be rejected, so there are 2 cointegration relationships in each series of LnLBED, LnTF, LnT, LnE, and it can be concluded that there is inevitably a long-run equilibrium between the variables, and vector autoregression can be measured.

Table 2. Test results of cointegration relationship between variables.

Original hypothesis	Characteristic root	Trace statistics	5% threshold	P value
None *	0.49095	22.56784	17.88617	0.0061
At most 1 *	0.38689	15.79496	14.73171	0.0022
At most 2 *	0.03525	2.84012	7.52527	0.0048

4.3. Granger causality test

The cointegration test verifies the equilibrium relationship between the variables, but it can't explain the specific causality between the variables, and it needs to be verified by the Granger test, which analyzes whether the development of the local business economy in the study area has a direct impact on the tourism flow at the significance level of 5%. The results of the Granger causality test are shown in Table 3. When the original hypothesis is "LnTF is not the Granger cause of LnLBED", the P value is less than 1% significance level, which means that the original hypothesis is rejected. When the original hypothesis condition is "LnLBED is not the cause of LnTF Granger", the P-value of 0.4571 is greater than the level of significance, then the original hypothesis is accepted. The study shows that there is a strong causal relationship between tourism flows and local business economic development in the study area, and conversely, the effect of local business economic development on tourism flows development in the study area is not very significant.

Table 3. Granger causality test.

Original hypothesis	F value	P value	Conclusion
LnTF is not a granger reason for LnLBED	8.35964	0.0035	Reject
LnLBED is not a granger reason for LnTF	1.24224	0.4571	Acceptance

4.4. VAR-based impulse response analysis

The above Granger causality mainly understands that the tourism flow in the study area has a certain degree of influence on the development of the local business economy, but whether this influence effect is positive or negative needs to be further verified, which needs to be analyzed by applying the impulse response function.

4.4.1. Model stability analysis

Figure 4 shows the smoothness test of the VAR model, it can be seen that the points representing the inverse values of the roots of the characteristic equations of the model, all fall within the unit circle, thus indicating that the model has a stable structure and the constructed model is valid, based on which the following dynamic analysis can be carried out.

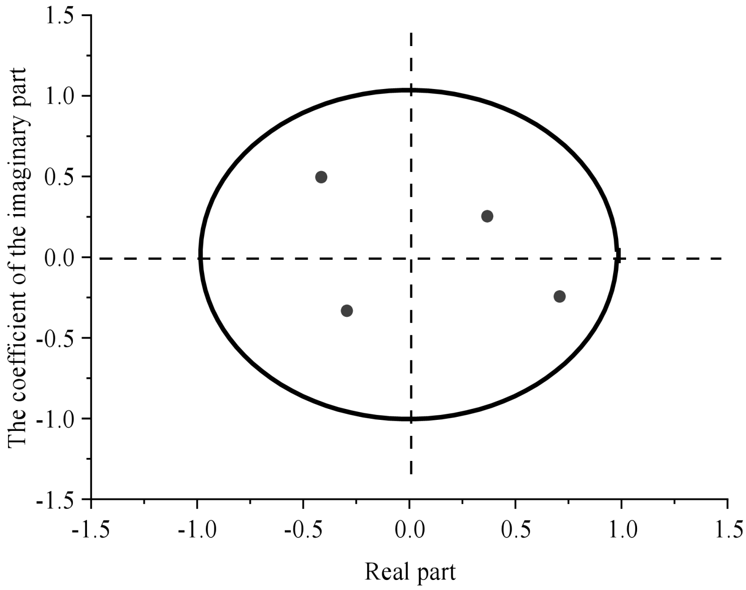

Figure 4. VAR model stability test.

4.4.2. Impulse Response Analysis

On the basis of vector autoregression, in order to further explore the long-term equilibrium relationship between LnLBED and LnTF, the established model is analyzed by applying the impulse response function, the impulse response function of tourism flow to local business economic development, and the impulse response function of local business economic development to tourism flow are shown in Fig. 5 and Fig. 6. The horizontal axis of the impulse response function plot indicates the number of lag periods for the effect of shocks, the vertical axis indicates the magnitude of the impulse response function, the upper and lower dashed lines indicate the positive and negative standard deviation bands, and the middle dashed line represents the trend of the impulse response function, which indicates how the explanatory variables change after one shock to the explanatory variables.

Figure 5 shows the impulse response function plot of TF on LBED: if given a shock to the current TF, LBED is always a positive response and an upward trend from the first period, and the cumulative effect from the first period to the 10th period improves by about 0.025%, which shows that the study area tourism flow has a positive impact on the development of the local business economy, and in the long run, the driving effect is more obvious. Figure 6 shows the impulse response function plot of LBED on TF: when a positive shock is given to the GDP of the current period, TF rises from the first period and reaches the highest value in the third period, and then the shock effect begins to decline, but the shock value is above the 0 line for a long time, which is a positive response, thus indicating that the local business economic development of the study area has a significant contribution to the tourism flow in the short term, and it is contributing to it in the long term , but its contribution to tourism flow will gradually slow down in the long run.

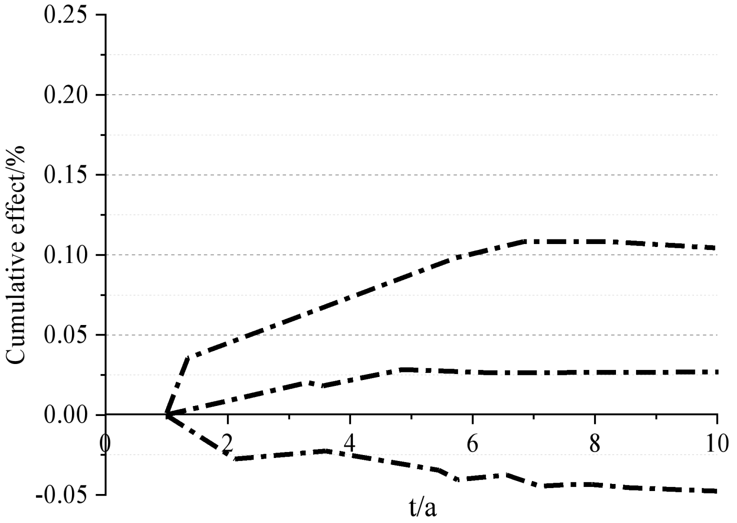

Figure 5. Impulse response function of the tourist flow to local business economic development.

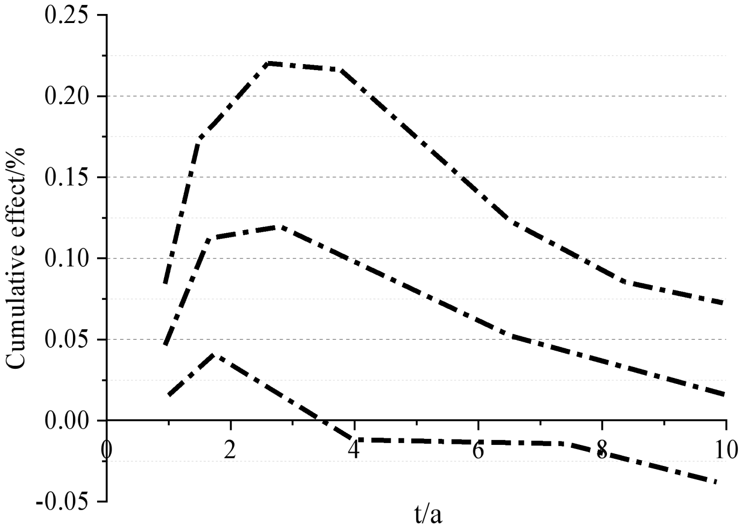

Figure 6. Impulse response function of the local business economic development to tourist flow.

4.5. Contribution Measurement

This paper applies the gray correlation model to measure the contribution degree of the research indicators, setting the local business economic development indicators as the reference indicators, tourism flow, government expenditure, regional consumption level and so on as the comparative indicators, first of all, we should carry out the standardization of the original data, and then carry out the calculation of the contribution coefficient. The results of contribution analysis are shown in Table 4. The gray correlation coefficients of local business economic development and indicators of tourism flow, regional consumption level and government expenditure in the study area are 0.702, 0.728 and 0.563, respectively. The results show that the contribution of tourism flow and regional consumption level to the economic growth is higher, 0.702 and 0.728, while the contribution of government expenditure to the economic growth is 0.563, which is presented as general contribution nature.

Table 4. Results of grey correlation analysis.

Contribution degree	Travel traffic	Government expenditure	Regional consumption level
Local business economic development	0.702	0.728	0.563

5. Conclusion

In order to analyze the degree of influence of tourism flows on local business economic development, this paper takes the sample data of a region from 2013 to 2023 as the research object, constructs a time series model, and explores the nonlinear influence of tourism flows on local business economic development. In general, tourism flow in the study area has a positive promoting effect on local business economic development, and the pulling effect of tourism flow in the study area on local business economic development in the long term is greater than the driving effect of local business economic development on tourism flow.

This paper analyzes the tourism development of the study area, and the tourism development of the place from 2013 to 2023 shows a trend of first increase, then decrease and then increase, with an average annual tourism flow of 30,925,000 person-times. In the empirical analysis, the local business economic development shows a positive response and rises after being hit by tourism flow in the first period, and the cumulative effect reaches about 0.025% in the 10th period, indicating that the local business economic development expands with the level of tourism flow. And the tourism flow shows a trend of rising and then falling after the impact of local business economic development, but the cumulative effect is always greater than 0, indicating that the impact of local business economic development on tourism flow in the study area has an obvious driving effect in the short term. In addition, tourism flow and local business economic development show a high contribution rate, and the contribution coefficient reaches 0.702 as measured by the model, and the development of tourism flow shows an obvious pulling effect on the growth of local business economy.

The empirical analysis of this paper is conducive to a more in-depth understanding of the relationship between tourism development and business economic development, which is of great significance in exploring suitable strategies for the development of the tourism industry and economic growth, and is of great practical significance in promoting the high-quality and integrated development of the regional tourism industry.

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