Research Article

Correlation Analysis between Tourism and Economic Growth Based on Computable General Equilibrium Model (CGE)

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The current tourism industry has the problems of low service efficiency, poor coordinated development, and slow economic growth in terms of service volume and economic growth. This paper is based on computable general equilibrium (CGE) model. Firstly, a CGE data analysis model based on bee colony intensive breakthrough algorithm is established to store and analyze the data in the whole chain of tourism. Then, combined with the comparative analysis of tourism economic data over the years, it is fed back to the CGE model for error analysis. Finally, relevant experiments are designed to analyze the relationship between tourism and economic growth. The correlation degree of local economic growth is analyzed. The results show that, compared with the traditional research method of tourism economic growth based on module data analysis, this CGE model can realize the correlation analysis of the data involved in the process of tourism economic growth and analyze the factors affecting the speed of economic growth, which has the advantages of good reliability and strong pertinence.

1. Introduction

With the advent of the industrial 4.0 era and the rapid development of Internet data technology, tourism also presents great changes in service mode and business processing [1]. In recent years, with the rapid development of blockchain technology and the emergence and application of big data economic analysis model and CGE model, tourism is also facing an important transformation of digital development [2]. Therefore, data diversification and intelligence have become the necessary conditions for the future development potential of tourism [3]. On the other hand, although there are many tourism economic growth analysis models, there are still many problems [4]. For example, in the analysis of the development potential of tourism, the current analysis model generally does not have large-scale applicability, and its suggestions and conclusions are quite different from those in the actual implementation process [5]. Based on this background, this paper studies the correlation analysis system between tourism and economic growth and puts forward a computable general equilibrium model, which can quantitatively analyze and characterize the internal correlation between tourism and economic growth.

Aiming at the problems of poor coordinated development, slow economic growth, and low service efficiency in the process of market-oriented economic operation of the existing tourism industry, this paper studies the application of CGE model based on bee colony intensive breakthrough algorithm in tourism economic growth, which is mainly divided into four parts. Chapter 1 introduces the background, overall framework, and innovation of this study. Chapter 2 introduces the evaluation methods of tourism economic growth in different regions at home and abroad and the research status of data mining methods in tourism. Chapter 3 constructs the CGE model based on the bee colony intensive breakthrough algorithm and constructs the evaluation system of the correlation between tourism and economic growth by using the Laplace hyperbolic equation method. Chapter 4 tests the relevance evaluation system between tourism and economic growth, analyzes the results, and draws a conclusion.

The current mainstream analysis model of tourism economic growth (mainly based on the quantitative correlation analysis model based on neural network strategy algorithm or particle swarm optimization iterative optimization strategy algorithm) there is a disadvantage that it is necessary to set
known parameters and gradient interval. The innovation of this paper is to construct the correlation analysis method between tourism and economic growth through the bee colony intensive breakthrough algorithm, combined with the CGE model in the field of artificial intelligence and image recognition technology. On this basis, the model can not only record and store the data between tourism and economic growth in multiple regions but also make full use of the differential information of economic growth between each tourism area to analyze its correlation through CGE model. On the other hand, using Laplace factor quantitative index to complete the correlation analysis between tourism and economic growth can reduce the evaluation error.

2. Related Work

The existing tourism industry has the problems of poor coordinated development, slow economic growth, and low service efficiency in the process of market-oriented economic operation. Most scholars have analyzed the correlation between tourism and economic growth and tried to solve the above problems [6]. In order to solve the problem of transition analysis in the development of tourism, Rockicki other scholars put forward a comprehensive evaluation model of tourism growth and economic analysis based on the characteristics of regional development, so as to strengthen the analysis and weaken the management of the internal relevance of tourism [7]. According to the differential characteristics of different tourism industries in development, Zhao et al. put forward a development analysis strategy evaluation method based on CNN network. Experiments show that tourism can play a key role in economic growth [8]. Aiming at the problem of high cost in the process of user growth in tourism, Lin and other scholars used the convolution neural network algorithm of second-order least square method to analyze the correlation degree of factors affecting economic development and found that there is a strong correlation between cost and user growth strategy [9]. Aiming at the problem of low data utilization in the development of tourism, Cao and other scholars put forward an economic growth model combined with local economic development through experimental verification [10]. According to the traditional model theory and practical experience of tourism development, Peng and other scholars found that there are large differences in cross-regional tourists’ habits in the current local tourism areas in the process of economic growth. Therefore, they proposed an adaptive comprehensive evaluation method based on machine vision algorithm [11]. Hoffmann put forward a new scenic spot economic growth method based on Tourism Group trajectory analysis, which uses the deformed footprint map sequence to characterize the economic development of the tourism area on a large scale and realizes the determination of the optimal scheme in the process of tourism economic evaluation [12]. Through quantitative analysis of different scenic spots, Siddig and other scholars have made the regional tourism resources reach a state of near infinite saturation in the process of development. Experiments show that this strategy analysis and evaluation method have the advantages of fast comprehensive evaluation speed and obvious effect, but it is necessary to set the known data gradient interval [13]. In order to further study the influencing factors in the process of tourism economic development, scholars such as Gilliland et al. proposed a variable step economic data analysis method combined with the idea of computable general equilibrium model. This method can effectively improve the income of tourism, but it is necessary to set known parameters and data gradient interval [14]. Rui and other scholars put forward a new tourism economic growth analysis method based on K-means image recognition strategy according to the macroeconomic theory in economy and established a multifactor coupling analysis model. The model also needs to set known parameters and gradient interval [15]. Aiming at many unreasonable problems in the process of tourism economic development, Paroussos and other scholars put forward a feature recognition and analysis strategy based on neural network. After practical verification, the results show that the economic evaluation method based on image recognition and analysis strategy has good evaluation effect and is suitable for the comprehensive evaluation of the development of characteristic scenic spots in tourism [16]. Feuerbacher and other scholars have made a comprehensive evaluation from the aspects of the selection of evaluation forms for the economic development of tourism, the classification of evaluation scenic spots, and the management ability of regions. Experimental experiments are carried out in different regions. The results show that it can improve the profitability of scenic spots [17].

Based on the above research results, we can know that in the current research on tourism and economic growth, in the mainstream analysis models of tourism economic growth (mainly based on neural network algorithm or particle swarm optimization algorithm), most of them need to set the known data gradient interval as a priori information [18–20]. On the other hand, in the quantitative evaluation of tourism economic development, most economic development analysis models need to summarize the industrial data of different ranges first and then conduct unified analysis and processing, which leads to the overall analysis efficiency becoming very low [21, 22]. Therefore, it is of great significance to study the correlation analysis method between tourism and economic growth based on computable general equilibrium model.

3. Methodology

3.1. Application of Computable General Equilibrium Model Based on Bee Colony Dense Breakthrough Algorithm in Economic Growth Analysis. Bee colony dense breakthrough algorithm is one of the commonly used algorithms in data mining. This method solves the calculation problems with high dimension and large amount of data by simulating the idea of cooperative movement of bee colony in the process of group survival and realizes the sampling solution of complex problems. The computable general equilibrium model (CGE) includes three salient features. The first is “general.” That is, it makes an external setting for the behavior of economic subjects. In this model, one of the representative features is the pursuit of utility maximization. Manufacturers follow the decision-making principle of cost minimization and also include economic subjects such as government, trade organizations, importers, and exporters, which respond to
price changes [23]. Secondly, it is "equilibrium," which means that it includes two aspects of demand and supply. Many prices in the model are determined by both supply and demand, and price changes finally make the market realize equilibrium [24]. Finally, it is "computable." This is because the model reflects actual data and actual economic problems, which is closer to reality, involving industrial policy, income distribution, environmental policy, employment, etc. [25]. Therefore, the CGE model combined with bee colony intensive breakthrough algorithm can well solve the problem of correlation analysis between tourism and economic growth. The data correlation analysis process of tourism and economic growth based on CGE model is shown in Figure 1.

3.2. Data Analysis Process of CGE Model in Tourism Economic Growth. The tourism policy means concerned by the tourism CGE model are also divided into two categories: the first category is various tourism related laws, regulations, standards, and orders formulated by administrative means. The other is market-based and various economic means represented by tax, including direct tourism tax and indirect taxes such as hotel tax, gambling tax, and sales tax. In view of the above two types of policies, CGE model mainly discusses the impact of tourism industry policies on production (mainly including cost and productivity) and consumption (focusing on macro income and tourist welfare) in economic activities.

In order to better study the correlation between tourism and economic growth and conduct quantitative evaluation, after establishing the CGE model, it is necessary to quantitatively discuss the data analysis process of CGE model in tourism economic growth. According to the necessary conditions of macroeconomic model, it is necessary to design the operation threshold, termination condition, and evaluation standard of CGE model. Therefore, the economic growth operation threshold function $Q(x)$, the termination condition function $W(x)$, and the preliminary quantitative evaluation function $E(x)$ are set as follows:

$$Q(x) = \frac{\sqrt{\sum_{k=1}^{p} x_k^2 x_{k+1}/k x_p}}{\sum_{k=1}^{p} k x_p},$$

(1)

$$W(x) = \frac{p!}{1 + \bar{x}_p} \sqrt{\frac{x_1 + x_k + x_p}{x_{k+1}}},$$

(2)

$$E(x) = \sqrt{\sum_{k=1}^{p} (x_k - \bar{x}_k)^2 + \sum_{k=1}^{p} (x_k + \bar{x}_p)^2} / (k + 1)x_p.$$  

(3)

$x_k$ is the daily operation data of tourism, $p$ is the total number of users of tourism, $k$ is the service type of tourism, and $\bar{x}_p$ is the average data of quarterly economic growth.

After normalizing the above three functions, the corresponding expression is as follows:

$$Q'(x) = 1 + \frac{\sqrt{\sum_{k=1}^{p} x_k^2 x_{k+1}/k x_{p+1}}}{k \sum_{k=1}^{p} (x + \bar{x}_p/1 + \bar{x}_p)^2},$$

(4)

$$W'(x) = \frac{(p + 1)!}{p + x} \sqrt{\frac{x_1 + x_k + x_p}{x_{p+1}}}$$

(5)

$$E'(x) = \sqrt{\frac{2 + \sum_{k=1}^{p} (x_k + \bar{x}_p)^2}{1 + k \sum_{k=1}^{p} (x + \bar{x}_p/1 + \bar{x}_p)^2}}.$$

(6)

Through the statistics of tourism economic growth data in different regions, it is divided into regions according to the growth rate, and different types of economic growth data are distinguished in high dimensions to form multiple data envelopment analysis centers, and their data center groups are input into this CGE model. The simulation analysis results of these data groups on the correlation degree of tourism economic development are shown in Figure 2.

It can be seen from Figure 2 that the change trends of the three groups of databases are similar and are within a relatively stable change range, and the association analysis accuracy of the second group of databases is the highest. This is because after setting the operation threshold, and it is also necessary to quantitatively sort the relevant data affecting economic growth according to the utilization rate and carry out variable weight analysis. The module length analysis function $A(x)$, the economic growth solution function $S(x)$, and the nondisturbing error function $D(x)$ used in the vector comparison process in the above simulation analysis stage are as follows:

$$A(x) = \frac{\sqrt{|x|^2 + m|x| + \sqrt{|x|}}}{\sqrt{|k| + m|x|} + 2 + \sqrt{k}}.$$  

(7)

$$S(x) = \frac{\sqrt{m^2 + m|x| + \sqrt{|x|}}}{3mk + \sqrt{m + kx}},$$

(8)

$$D(x) = \frac{kS(x)^2 + mA(x)}{kS(x) + mx} \sqrt{(1 + A(x))}. $$

(9)

$|x|$ is the module length of tourism economic data vector, and $m$ and $k$ are the quantitative value and change type in the process of tourism economic growth, respectively. After fuzzifying the above three functions, the corresponding expression is as follows:

$$A'(x) = \frac{\sum_{k=1}^{m} |x|^2 + m|x| + \sqrt{|x|}|k|x| + m|x|^2 + k}{m + k},$$

(10)

$$S'(x) = m \sum_{k=1}^{m} |x|^2 + m|x| + \sqrt{|x|m|x|} + k|x|^2 + mk \sqrt{m|x| + k|x|^2 + mk},$$

(11)

$$D'(x) = \sum_{k=1}^{m} \frac{D'(x)}{mA(kx) + kS(kx)}.$$  

(12)
\(|x|\) is the module length of industrial economic data vector, and \(m\) and \(k\) are the number and type of tourism industry, respectively. In this stage, the economic growth simulation analysis results of CGE model on two types of random tourism economic data are shown in Figure 3.

It can be seen from Figure 3 that under the CGE model based on the bee colony dense breakthrough algorithm, with the increase of the number of simulation analysis, the correlation index of economic growth data in the two types of data shows different trends, and there are four intersections, because in general, due to the problem of computer programming, at present, the economic growth data analysis method in the tourism information data management system cannot reach the level of artificial intelligence. There is inconsistency in the information analysis and data feature extraction between the economic data content of tourism in different regions and the economic information value of tourism stored in the cloud.

3.3. Simulation Verification Process of Quantitative Analysis of Economic Growth Combined with CGE Model. Based on the above analysis results, in order to further improve the accuracy of the analysis process of the correlation between tourism and economic growth, this part makes an accurate comparative analysis of a number of economic data within the tourism industry. The analysis process is shown in Figure 4.

For the known tourism economic development data, the corresponding identification error rate and correlation evaluation results are different, because for the calculation and identification of similarity, it can be corrected, compensated, and classified through the computable general equilibrium model according to the difference and similarity of data information in the tourism economic process. The simulation analysis results after correction are shown in Figure 5.

It can be seen from Figure 5 that the repair amount of tourism data under the CGE model is different, and the difference is obvious. This is because although the disturbance amount of the CGE model analysis method is very small, the data itself will have some differences, so there will be less data information reflected in the final analysis process. Finally, in the process of analysis, the high self-adaptive evaluation function \(Z(x)\) and similarity function \(X(x)\) based on bee colony dense breakthrough algorithm are introduced, and their mathematical expressions are as follows:
where \(\bar{x}\) represents different economic growth data processing samples, \(k\) and \(j\) represent different numbers, and \(p\) represents the maximum number. In the process of error reduction of CGE model and result correction of overall operation function, it is necessary to normalize the sample data. The function set determined by the central data used in this process is as follows:

\[
Z(x) = 1 + \sqrt{\frac{\sum_{j=1}^{p} \left(jx_{j}^2 + x^2\right)}{1 + \sum_{k=1}^{p} (kx_{k}^2 - \bar{x}^2)^2}},
\]

\[
W(x) = x \cdot \sqrt{\frac{1 + \sum_{k=1}^{p} (kx_{k}^2 - \bar{x}^2)^2}{1 + px}},
\]

where \(x\) represents the tourism economic growth function with certain rules, \(x\) represents different processing samples, and \(l\) and \(r\) represent different economic growth analysis rules.

### 4. Result Analysis and Discussion

#### 4.1. Confirmatory Test of Correlation Analysis between Tourism and Economic Growth Based on CGE Model

After constructing the tourism and economic growth evaluation system based on CGE model, it is necessary to verify and analyze its practicability and scientficity. Therefore, this study combines the tourism economic data of Beijing in recent 5 years as the experimental data to verify. The preliminary analysis results of three groups of experimental data during the experiment are shown in Figure 6, in which the horizontal axis represents the number of experiments and the vertical axis represents the standardized correlation evaluation value based on CGE model.

As can be seen from Figure 6, under the bee colony dense breakthrough algorithm, with the increase of the number of
experiments, the number of consistent data shows a trend of decreasing first and then stable. Compared with the data group without correction factor, the tourism data group with correction factor has more standardized correlation and economic growth data. This is because the operation method adopted this time is the improved tourism economic correlation analysis model combined with the CGE model of bee colony intensive breakthrough algorithm, and the threshold parameters of three data envelopment sets are set to characterize the correlation between tourism and economic growth. In addition, the CGE model will be based on the tourism user group data of Beijing, China, in recent 5 years. Through the comparative analysis of different parameters, it ensures the equal weight of each data in the process of correlation analysis, so as to reduce the data analysis error in the experimental process and improve the objective accuracy and persuasion of the experimental process.

4.2. Experimental Results and Analysis. In the process of analyzing the experimental results, this study is based on the revenue and expenditure data disclosed by all scenic spots in Beijing in recent 5 years. The experimental group adopts CGE model, and the control group adopts the analysis model of conventional method (modular data analysis). The analysis results are shown in Figure 7.

Through the analysis of the results in Figure 7, it can be found that under the CGE model, the error of data correlation analysis is getting lower and lower, and the evaluation accuracy of the control group in the process of analyzing
the economic cycle of tourism is lower and lower. Therefore, in the process of actual tourism revenue creation, it is necessary to set different types of threshold management in combination with the economic characteristics of tourism in different regions, so as to realize the efficient coordination of the relationship between tourism and regional economic growth.

5. Conclusion

At present, the tourism industry has the problems of low service efficiency, poor coordinated development, and slow economic growth in terms of service volume and economic growth. Compared with the disadvantages of setting known data gradient interval in the current mainstream tourism economic growth analysis model (mainly based on genetic control strategy algorithm or particle swarm optimization iterative optimization strategy algorithm), this paper studies the analysis model based on computable general equilibrium (CGE) model. Firstly, a CGE data analysis model based on bee colony intensive breakthrough algorithm is established to store and analyze the data in the whole tourism chain. Then, combined with the comparative analysis of tourism economic data in previous years, it is fed back to the CGE model for error analysis. Finally, relevant experiments are designed to analyze the relationship between tourism and economic growth. The correlation degree of local economic growth is analyzed. The results show that, compared with the traditional research method of tourism economic growth based on module data analysis, this CGE model can realize the correlation analysis of the data involved in the process of tourism economic growth and analyze the factors affecting the speed of economic growth, which has the advantages of good reliability and strong pertinence. This paper still has some limitations: the error analysis content of data correlation analysis is too short. It is necessary to discuss the economic characteristics of tourism in different regions. Not detailed enough in terms of protecting multiple security of data, therefore, this paper makes an in-depth study on the enhancement of tourism security and regional economic growth in different regions.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare no conflicts of interest.

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