Expanded Study on the accumulation effect of tourism under the constraint of structure

1 Introduction

Many regions take the tourism industry as the leading sector of the economy for its characteristics like covering a broad range of areas and low threshold. It is expected to promote the overall development of the social economy in the whole region by supporting the development of tourism. From the results in practice, this approach is effective. But there have been problems at the same time, such as abnormal growth of tourism and other issues. A basic reason for these problems is that the mutual constraint relationship between structure and growth is ignored [1–5]. When it breaks away from the restriction of the existing economic structure, it is impossible for a single tourism sector to develop indefinitely. With regard to the relationship between the structure of existing departments and the accumulation and growth of the tourism industry, Li Jingyi conducted a more in-depth analysis in the paper "Research on tourism growth based on structural constraints". Different from the typical input-output model, Li Jingyi did not pay attention to the overall relationship between growth and accumulation, but it established a new industry association model by extending the two-categories model. It reveals the interdependent relationship between different sectors which is the mutual restriction relationship between the accumulation and growth of a sector and other sectors. Accordingly, some conclusions are proposed to guide the development of other industries based on the tourism industry.

Keywords: intermediate product; final product; accumulation; growth; structure

PACS: 89.20.Bb, 89.65.Gh, 89.65.Lm
of the data needed by the trichotomy model still lack statistical support, and many data are difficult to obtain. Therefore, how to simplify the industrial connection model and make it become more practical is a question in need of discussion. This paper attempts to simplify the relevant industry association model based on the dichotomy of value in order to stimulate and promote the research work in this area.

2 Industry association model based on the dichotomy

Is tourism not an industry? Can we form a relatively independent department? This is the first question we need to answer when building a departmental association model. On this issue, Li Jingyi pointed out that tourism can become an independent sector, which can become a part of the industrial structure together with other departments based on product use and transaction nature. This paper accepts this conclusion, and starts with this model.

2.1 Division of product value composition

According to different standards and requirements, product value can be divided into different components. There are two kinds of typical decomposition methods: (1) the product value is divided into two parts which include the intermediate product value and the final product value; (2) the product value is divided into three parts: constant capital value, labor input cost value, and surplus value. Research on department relationships according to the input-output model is generally considered from the value of the dichotomy [7–9]. Research on structure relations and economic growth through the two major categories model [10–12] is usually based on the trichotomy. According to the traditional reproduction theory, Li’s paper considered that any department product can be divided into three basic parts from the perspective of value regardless of its specific form: capital value $K$, labor cost value $L$ of intermediate consumption, and surplus value $M$. From the continuous process of reproduction, the value of these products will form the purchase of all society department products or services. Therefore, any department, including the tourism sector, has the same logical process from the perspective of reproduction. According to the consistency of this kind of logic process, Li Jingyi proposed in his paper that the social influence of tourism industry in the process of reproduction can be studied through the general department correlation model.

The value is divided into three parts which are based on the value of the production logic. Accordingly, the production first needs to consume the constant capital value, and secondly, the labor cost value and surplus value which is formed by labor will be consumed. Secondly, these values will not only be reproduced in the process of social expansion and regrowth, but also increase the total amount of the social economy. So, it is reasonable in logic to research the relationship between different departments based on the value trichotomy. Different from the general research, the industrial association model that Li Jingyi established changed the corresponding relationship between the general value division and the department division. Research on the relationship between multiple departments usually uses the value dichotomy, the study based on two major categories often uses the value trichotomy. However, in the paper, the model was combined with the value trichotomy and multiple departments, and it made a meaningful discussion on the basis.

If we look at the use of products, we can also divide the product value into two basic components, the intermediate consumption value $K$ and new production value $Y$. Among them, the intermediate consumption value $K$ is the constant capital value part of the production process. It is equivalent to the total amount of investment or consumption of the constant capital while the issue of depreciation is not considered. The new production value $Y$ is the new value of labor elements needed to be put into production when producing a certain number of products. It is equal to the sum of the labor cost value $L$ and the surplus value $M$ that consume while producing a certain number of products in Li’s paper. Under the premise of ignoring depreciation, the value of the new production is equivalent to the value of the final product. In this way, we can divide all the products which produced in a certain period and certain sectors into the intermediate consumption value $Y$ and new production value $K$ from the value. That is, the sum of the value of the intermediate and final products. That is a certain amount of product value equal to K$+$Y. In the process of social production, the value of all the products $X_i$ produced by any department during a certain period of is equal to Ki+Yi; The product value of all sectors of the whole society can be expressed by:

$$
\begin{align*}
X_1 &= K_1 + Y_1 \\
X_2 &= K_2 + Y_2 \\
&\vdots \\
X_i &= K_i + Y_i 
\end{align*}
$$

(1)
By decomposing the product value into two parts, the intermediate product value and the final product value, which is a relatively simple division method, we can not only simplify the industrial connection model proposed by Li Jingyi, but also can get support from the existing statistical work. Although our value decomposition method simplifies the problem of multiple depreciation of capital, it is essentially consistent with the product value decomposition method used in the input-output model. So it is easier to incorporate the licensing scope of the existing work. Discussion about the detailed statistics of value components is beyond the scope of this study, so we will not repeat them.

2.2 General model of the relationship between structure and growth

According to Formula (1) we can see that the product value of each department in a certain period can be decomposed into two parts from the use of the product, intermediate product value and final product value. If there is no consideration of the difference between the fixed capital and the current capital, it can be assumed that all capital consumption is compensated by the intermediate product value, and the final product value is all used for consumption. From the point of view of the process of reproduction, the value of intermediate products and the final product will form a demand for each department, and then the product value of the whole society can be written as:

\[
\begin{align*}
    x_{11} + x_{12} + \cdots + x_{1n} + y_{11} + y_{12} + \cdots + y_{1n} &= X_1 \\
    x_{21} + x_{22} + \cdots + x_{2n} + y_{21} + y_{22} + \cdots + y_{2n} &= X_2 \\
    \vdots \\
    x_{n1} + x_{n2} + \cdots + x_{nn} + y_{n1} + y_{n2} + \cdots + y_{nn} &= X_n
\end{align*}
\]

(2)

From the horizontal point of view, the left side of the formula is the demand which is formed in the process of specific sectors using different value income to buy their products from all sectors of the community. From the longitudinal perspective, it is the product supply provided by different departments to meet the needs of the society. In the case of simple reproduction, making the total supply = total demand, there must be:

\[
\begin{align*}
    (x_{11} + x_{12} + \cdots + x_{1n}) + (y_{11} + y_{12} + \cdots + y_{1n}) &= (x_{11} + x_{21} + \cdots + x_{n1}) + (y_{11} + y_{21} + \cdots + y_{n1}) \\
    (x_{21} + x_{22} + \cdots + x_{2n}) + (y_{21} + y_{22} + \cdots + y_{2n}) &= (x_{21} + x_{22} + \cdots + x_{n1}) + (y_{21} + y_{22} + \cdots + y_{n1}) \\
    \cdots \\
    (x_{n1} + x_{n2} + \cdots + x_{nn}) + (y_{n1} + y_{n2} + \cdots + y_{nn}) &= (x_{n1} + x_{n2} + \cdots + x_{nn}) + (y_{n1} + y_{n2} + \cdots + y_{nn}) \tag{3}
\end{align*}
\]

Assume:

\[a_{ij} = x_{ij}/X_i \text{ shows that the } i \text{ department needs to consume } x_{ij} \text{ products of the } j \text{ department while producing a certain amount of products } X_i\text{. It can be called the production consumption coefficient;}
\]

\[b_{ij} = y_{ij}/Y_i \text{ shows the average consumption for the } j \text{ sector product when the final product revenue of the } i \text{ sector is certain, and it can be called the average propensity to consume.} \]

\[Y_i \text{ is the disposable income that the } i \text{ department can be used for consumption and } y_{ij} \text{ represents the value of purchasing the products of the } j \text{ department. Under normal circumstances, if we assume that the value is constant, then the average propensity to consume is equal to the marginal propensity.}
\]

The above formula can be written as follows while integrating the parameters into Eq. (3):

\[
\begin{align*}
    \sum_{i=1}^{n} a_{11} X_1 - \sum_{i=1}^{n} a_{1j} Y_i X_1 - \sum_{i=1}^{n} a_{1i} Y_i - \sum_{i=1}^{n} a_{1i} r_i Y_1 &= 0 \\
    \sum_{i=1}^{n} a_{12} X_2 - \sum_{i=1}^{n} a_{1j} Y_i X_2 - \sum_{i=1}^{n} a_{1i} Y_i - \sum_{i=1}^{n} a_{1i} r_i Y_2 &= 0 \\
    \cdots \\
    \sum_{i=1}^{n} a_{1n} X_n - \sum_{i=1}^{n} a_{1j} Y_i X_n - \sum_{i=1}^{n} a_{1i} Y_i - \sum_{i=1}^{n} a_{1i} r_i Y_n &= 0 \tag{4}
\end{align*}
\]

The formula can be written as the follows when combining the same items of \(X_i\) and \(Y_i\):

\[
\begin{align*}
    \sum_{i=1}^{n} a_{11} X_1 - \sum_{i=1}^{n} a_{1j} Y_i X_1 - \sum_{i=1}^{n} a_{1i} Y_i - \sum_{i=1}^{n} a_{1i} r_i Y_1 &= 0 \\
    \sum_{i=1}^{n} a_{12} X_2 - \sum_{i=1}^{n} a_{1j} Y_i X_2 - \sum_{i=1}^{n} a_{1i} Y_i - \sum_{i=1}^{n} a_{1i} r_i Y_2 &= 0 \\
    \cdots \\
    \sum_{i=1}^{n} a_{1n} X_n - \sum_{i=1}^{n} a_{1j} Y_i X_n - \sum_{i=1}^{n} a_{1i} Y_i - \sum_{i=1}^{n} a_{1i} r_i Y_n &= 0 \tag{5}
\end{align*}
\]

The matrix form is as follows:

\[\begin{bmatrix}
    a_{11} - \sum_{i=1}^{n} a_{1j} & a_{12} & \cdots & a_{1n} \\
    a_{21} & a_{22} - \sum_{j=1}^{n} a_{2j} & \cdots & a_{2n} \\
    \vdots & \vdots & \ddots & \vdots \\
    a_{n1} & a_{n2} & \cdots & a_{nn} - \sum_{j=1}^{n} a_{nj}
\end{bmatrix}
\begin{bmatrix}
    X_1 \\
    X_2 \\
    \vdots \\
    X_n
\end{bmatrix} = 0 \tag{6}
\]
The following feature can be found when examining the coefficient matrix: any \(n-1\) row adding to the \(n\) row will make the \(n\) line equal to zero. According to this feature, we can reveal the inherent correlation between the accumulation and growth of different departments in the process of expanded reproduction. Society needs to accumulate in order to realize the expanded reproduction. In general, the accumulation can only be deducted from the final product and only the balance after deducting the accumulated can be eventually consumed. The last consumption amount of society is \(Y - \Delta Y\).

Assuming \(r\) is the accumulation rate and \(\Delta Y\) is the accumulation amount, then there are: \(r = \Delta Y/Y, Y - \Delta Y = Y - rY\). We assume that the accumulation of the final products are all used to increase the purchase of intermediate products. As to the labor demand which is accompanied by the accumulation of capital, in order to simplify the problem we assume it is implicit in the need which is formed by the residual final products. Contrasting Li Jingyi's previous research \([6]\), we can know that this assumption does not affect our analysis about the substance of the problem. Assuming the consumption coefficient of production and consumption trend are constant before and after accumulation, then through social accumulation, the composition of the product value of the whole society can be written as:

\[
\begin{align*}
\sum_{i=1}^{n} a_{i1}X_1 + \sum_{i=1}^{n} a_{i1}r_1Y_1 + \sum_{i=1}^{n} b_{i1}Y_1 - \sum_{i=1}^{n} b_{i1}r_1Y_1 &= X_1 \\
\sum_{i=1}^{n} a_{i2}X_2 + \sum_{i=1}^{n} a_{i2}r_2Y_2 + \sum_{i=1}^{n} b_{i2}Y_2 - \sum_{i=1}^{n} b_{i2}r_2Y_2 &= X_2 \\
\vdots \\
\sum_{i=1}^{n} a_{in}X_n + \sum_{i=1}^{n} a_{in}r_nY_n + \sum_{i=1}^{n} b_{in}Y_n - \sum_{i=1}^{n} b_{in}r_nY_n &= X_n
\end{align*}
\]

(7)

When the supply and demand are balanced:

\[
\begin{align*}
\sum_{i=1}^{n} a_{i1}X_1 + \sum_{i=1}^{n} a_{i1}r_1Y_1 + \sum_{i=1}^{n} b_{i1}Y_1 - \sum_{i=1}^{n} b_{i1}r_1Y_1 &= 0 \\
\sum_{i=1}^{n} a_{i2}X_2 + \sum_{i=1}^{n} a_{i2}r_2Y_2 + \sum_{i=1}^{n} b_{i2}Y_2 - \sum_{i=1}^{n} b_{i2}r_2Y_2 &= 0 \\
\vdots \\
\sum_{i=1}^{n} a_{in}X_n + \sum_{i=1}^{n} a_{in}r_nY_n + \sum_{i=1}^{n} b_{in}Y_n - \sum_{i=1}^{n} b_{in}r_nY_n &= 0
\end{align*}
\]

(8)

The formula can be written as follows after moving the right items to the left side and putting forward the common factors:

\[
\begin{align*}
\sum_{i=1}^{n} a_{i1}X_1 - \sum_{a} 1jX_1 + \sum_{i=1}^{n} a_{i1}r_1Y_1 - \sum_{a} 1jr_1Y_1 &= 0 \\
\sum_{i=1}^{n} b_{11}Y_1 - \sum_{b} 1jY_1 - \sum_{i=1}^{n} b_{11}r_1Y_1 - \sum_{b} 1jr_1Y_1 &= 0 \\
\sum_{i=1}^{n} a_{i2}X_2 - \sum_{a} 2jX_2 + \sum_{i=1}^{n} a_{i2}r_2Y_2 - \sum_{a} 2jr_2Y_2 &= 0 \\
\sum_{i=1}^{n} b_{12}Y_2 - \sum_{b} 2jY_2 - \sum_{i=1}^{n} b_{12}r_2Y_2 - \sum_{b} 2jr_2Y_2 &= 0 \\
\vdots \\
\sum_{i=1}^{n} a_{in}X_n - \sum_{a} njX_n + \sum_{i=1}^{n} a_{in}r_nY_n - \sum_{a} njr_nY_n &= 0 \\
\sum_{i=1}^{n} b_{in}Y_n - \sum_{b} njY_n - \sum_{i=1}^{n} b_{in}r_nY_n - \sum_{b} njr_nY_n &= 0
\end{align*}
\]

(9)

By moving the \(n\)th in square brackets to the right side and writing it in matrix form, the formula becomes Eq. (10):

\[
\begin{align*}
\begin{bmatrix}
a_{11} - \sum a_{1j} & a_{21} & \cdots & a_{n-1} & a_{n-1} \\
a_{12} & a_{22} - \sum a_{2j} & \cdots & a_{n-2} & a_{n-2} \\
\vdots & \vdots & \ddots & \vdots & \vdots \\
a_{1n-1} & a_{2n-1} & \cdots & a_{n-1} - \sum a_{n-1j} & a_{n-1j}
\end{bmatrix} \\
\begin{bmatrix}
X_1 \\
X_2 \\
\vdots \\
X_n - 1
\end{bmatrix}
\end{align*}
\]

(10)
\[
\begin{align*}
\text{(11)} & \quad A = \begin{bmatrix}
    a_{11} - \sum a_{1j} & a_{21} & \cdots & a_{n-11} \\
    a_{12} & a_{22} - \sum a_{2j} & \cdots & a_{n-12} \\
    \vdots & \vdots & \ddots & \vdots \\
    a_{1n-1} & a_{2n-1} & \cdots & a_{n-1n-1} - \sum a_{n-1j}
\end{bmatrix} \\
\end{align*}
\]

Let
\[
\begin{align*}
\text{(12)} & \quad X = \begin{bmatrix} X_1 \\ X_2 \\ \vdots \\ X_{n-1} \end{bmatrix} \\
\end{align*}
\]

\[
\begin{align*}
\text{(13)} & \quad R = \begin{bmatrix}
    r_1 & 0 & \cdots & 0 \\
    0 & r_2 & \cdots & 0 \\
    \vdots & \vdots & \ddots & \vdots \\
    0 & 0 & \cdots & a_{n-1n-1} - r_{n-1}
\end{bmatrix} \\
\end{align*}
\]

\[
\begin{align*}
\text{(14)} & \quad B = \begin{bmatrix}
    b_{11} - \sum b_{1j} & b_{21} & \cdots & b_{n-11} \\
    b_{12} & b_{22} - \sum b_{2j} & \cdots & b_{n-12} \\
    \vdots & \vdots & \ddots & \vdots \\
    b_{1n-1} & b_{2n-1} & \cdots & b_{n-1n-1} - \sum b_{n-1j}
\end{bmatrix} \\
\end{align*}
\]

The above formula can be written as:
\[
\begin{align*}
AX + ARY + BY &= BRY \\
&\quad - A_1 xn - A_2 rn - B_1 y_n + B_2 r_n \\
AX + ARY + BY &= (B_2 - A_2) r_n - (A_1 xn + B_1 y_n)
\end{align*}
\]

As can be seen from the above, the level of the accumulation of each department is interrelated in all sectors of society. One of the department's accumulation rate can be used as a free variable, which determines the extent of the accumulation of other n-1 departments.

### 3 Further description of the model contrast and industry association

Compared with the industry association model in Li's article, the model proposed in this paper is simpler and requires fewer statistics, so it has more practical value. This difference as well as the correlation between the accumulation and growth of the department can be further illustrated with the two-sector model. In the two-sector conditions, the value of social products is per Formula (21) based
on the value dichotomy:

\[
\begin{align*}
(X_{11} + X_{12}) + (Y_{11} + Y_{12}) &= X_1 \\
(X_{21} + X_{22}) + (Y_{21} + Y_{22}) &= X_2
\end{align*}
\]  

The formula for the aggregate supply and demand under the extended reproduction condition is as follows:

\[
\begin{align*}
(a_{11}X_1 + a_{12}X_2) + (a_{11}Y_1 + a_{12}Y_1) + (b_{11}Y_1 + b_{12}Y_1) = (a_{11}X_1 + a_{21}X_2) + (a_{11}Y_1 + b_{21}Y_1) \\
(a_{11}X_1 + a_{12}X_2) + (a_{11}Y_1 + a_{21}X_1) + (b_{11}Y_1 + b_{21}Y_1) = (a_{11}X_1 + a_{21}X_2) + (a_{11}Y_1 + b_{21}Y_1) \\
(a_{12}X_1 + a_{22}X_2) + (a_{12}Y_1 + a_{22}Y_1) + (b_{12}Y_1 + b_{22}Y_1) = (a_{12}X_1 + a_{22}X_2) + (a_{12}Y_1 + b_{22}Y_1) \\
(a_{12}X_1 + a_{22}X_2) + (a_{12}Y_1 + a_{22}Y_1) + (b_{12}Y_1 + b_{22}Y_1) = (a_{12}X_1 + a_{22}X_2) + (a_{12}Y_1 + b_{22}Y_1)
\end{align*}
\]  

Collecting terms one more time the result is:

\[
\begin{align*}
&\left[(a_{12}X_1 - a_{21}X_2 + b_{12}Y_1 - b_{21}Y_2)/(b_{12} - a_{12})Y_1 \right] \\
&\left[(b_{21} - a_{21})Y_2/(b_{12} - a_{12})Y_1 \right] r_2
\end{align*}
\]  

Let:

\[
\begin{align*}
(a_{12}X_1 - a_{21}X_2 + b_{12}Y_1 - b_{21}Y_2)/(b_{12} - a_{12})Y_1 &= A \\
(b_{21} - a_{21})Y_2/(b_{12} - a_{12})Y_1 &= B
\end{align*}
\]  

The above formula can be written as per Formula (28):

\[
r_1 = A + Br_2
\]  

It shows that the first sector’s rate of accumulation \(r_1\) is a function of the rate \(r_2\) in the second sector. As the consumption coefficient, the final product value, and the amount of the total product value are uncertain, the linear equation is an indefinite one. That is to say the two axis intercepts and slope of the linear equation in the coordinate system are uncertain. This determines when the society is in the expansion of reproduction, the levels of accumulation for both sectors that can be chosen are not only related to each other and limited, but also uncertain.

Theoretically speaking, the possible accumulation space of each sector is from zero to a certain threshold limit of \(K_i \leq Y_i\). But in the accumulation space, it is not always possible to see the accumulation from the perspective of trade balance. From the Formula above we can know that the social accumulation can be truly carried out only in the interval where accumulation equation and potential accumulation intersects. However, the feasible accumulation space of the society or the various departments is determined by the specific correlation between the accumulation equation and the possible accumulation space. In Formula (28) we can see that the possible cumulative range of first sector is from 0 to \(K_1\). But from the perspective of the balance of transactions, the first sector can only be accumulated from \(L_1\) to \(L_2\); In Formula (28) we can see that it is the possible cumulative range of first sector from 0 to \(K_2\). But from the perspective of the balance of transactions, the second sector can only be accumulated from \(F_1\) to \(F_2\). When the first sector accumulates to a certain value, the second department can only select a corresponding value and cannot arbitrarily select the feasible level of accumulation that the department desires in order to ensure the balance of the transaction. It can be seen that the accumulation level of different sectors of society is not only related, but also limited. In addition, due to the uncertainty...
of the equation \( r_1 = A + Br_2 \), not only the feasible accumulation interval of each department is uncertain, but also the relationship of accumulation rate between different departments is uncertain. It may be positively related and may also be negatively related. Readers who are interested in further study about the correlation between two departments on the accumulation and growth can refer to the achievements of Yan Zheng [13], Yang Yaqin [14], Li Jingyi [15], Han Liping [16], Tao Weiqun [17] and other scholars’ achievements.

### 4 Accumulation elasticity and growth elasticity

#### 4.1 Accumulation elasticity and growth elasticity

According to the industry association model, Li Jingyi put forward an important concept which is called the relevant change rate of accumulation \( dr_j/dr_i \). That is, in the process of social reproduction, with a certain change of the accumulation rate of department \( i \), the variation degree of accumulation rate of the \( j \) department changes under the condition of balanced reproduction. Since the accumulation relative rate of change is the ratio of two relative number accumulation rates, it can also be called accumulation elasticity. Under the assumptions of the two-sector model, the accumulation elasticity in Li’s paper is as follows:

\[
\frac{dr_2}{dr_1} = \frac{(c_{12} + d_{12} - g_{12})m_1}{(c_{21} + d_{21} - g_{21})m_2} \tag{29}
\]

Under the premise that the product value is decomposed into intermediate products and final products, according to the correlative discussion in the third part of this paper, the accumulation elasticity deduced for the two-sector model is

\[
\frac{dr_2}{dr_1} = \frac{(b_{12} - a_{12})Y_1}{(b_{21} - a_{21})Y_2} \tag{30}
\]

or

\[
\frac{dr_2}{dr_1} = \frac{(a_{12} - b_{12})Y_1}{(a_{21} - b_{21})Y_2} \tag{31}
\]

If we assume the tourism industry is the first sector, it can be known through the accumulation elasticity that how the accumulation or growth of the tourism industry will impact other sectors of the community is uncertain. A positive accumulation elasticity shows that when the accumulation rate of tourism industry is increasing, the other social sector’s accumulation rate also needs to increase in order to ensure the social expanded reproduction balance. A negative accumulation elasticity shows that when the accumulation rate of tourism industry is increasing, the other social sector’s accumulation rate must decrease under the condition of balanced reproduction. If the accumulation elasticity is greater than 1, it indicates that the accumulation rate of the other economic sector is higher than the accumulation rate of the tourism industry in the process of social expanded reproduction. If the accumulation elasticity is less than 1, it indicates that the accumulation rate of the other economic sector is lower than the accumulation rate of the tourism industry in the process of social expanded reproduction. It needs to be explained that a negative accumulation elasticity only shows that with the increase of a department’s accumulation rate, it will lead to a reduction in the rate of the other sector. This change does not mean that the accumulation of the sector will absolutely reduce, or even enter negative accumulation.

As the accumulation is the basis of growth, the accumulation elasticity is essentially the growth elasticity. Although there are some differences in the specific values between the growth elasticity and the accumulation elasticity, but in the basic nature of the two are the same. The accumulation elasticity shows the mutual influence between different sectors, and also means that there is a correlation between the different sectors in the growth. It indicates that with the change of the growth rate of a certain sector, other corresponding sectors’ growth rates will change under the premise of balanced reproduction. Therefore, people can also study the various economic relations between the industries based on growth elasticity in reality: Gao Liying studied the relationship between employment elasticity and GDP growth [18]; Wang Hao used the employment elasticity to analyze the relationship between economic growth and the development of the services sector [19]; Based on the panel data, Ding Ke analyzed the relationship between regional economic growth and employment elasticity [20]; Zhang Dan and Feng Xiaobing used the Panel-Data model to analyze the tourism economic growth and the scale of the star hotels [21]; and Zeng WeiYong studied the problem of the dynamic inefficiency of China’s economic growth and the adjustment elasticity [22]. Based on the concept of relevant change rate of accumulation or the accumulation elasticity, we can define the accumulation relevant change rate or growth elasticity as follows: in the process of social reproduction, with the change of the growth rate of \( i \) sector, the degree that the growth rate of the corresponding \( j \) sector changes. If we use \( R \) to show the growth rate of different sectors, then growth elasticity can be expressed as: \( dR_j/dr_i \). We can study the growth relationship between different sectors through using the growth elasticity.
4.2 An Empirical Study on the growth elasticity

Based on the above discussion, we made data analysis to the growth relationship of Sichuan Aba for nearly ten years, verified some ideas presented in this paper, and put forward some opinions about the development of the tourism industry according to the actual situation.

4.2.1 Reasons for selecting Aba as the research object

Selecting Aba as the main research object is mainly based on two considerations: First, tourism is a major industry in Aba Prefecture in Sichuan Province and the development of the tourism industry has an important influence on the development of local economy; Second, due to the constraints of history, transportation and development level and other factors, the relation between the other industries and the outside world is relatively weak in addition to tourism. So Aba is relatively closed and industries have strong internal links with each other.

4.2.2 Data analysis of Aba in recent ten years

According to statistics, tourism industry over the past ten years in Sichuan province Aba and the first, second, third and the condition of the whole economic development in the region are shown in Table 1:

<table>
<thead>
<tr>
<th>Year</th>
<th>Tourism Revenue (million)</th>
<th>Primary Industry (million)</th>
<th>Secondary Industry (million)</th>
<th>Tertiary Industry (million)</th>
<th>Total Region (million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>478000</td>
<td>148260</td>
<td>306848</td>
<td>306964</td>
<td>762072</td>
</tr>
<tr>
<td>2006</td>
<td>618100</td>
<td>157522</td>
<td>368269</td>
<td>357258</td>
<td>883009</td>
</tr>
<tr>
<td>2007</td>
<td>743800</td>
<td>195503</td>
<td>453948</td>
<td>419097</td>
<td>1068548</td>
</tr>
<tr>
<td>2008</td>
<td>174200</td>
<td>205013</td>
<td>234385</td>
<td>365231</td>
<td>804629</td>
</tr>
<tr>
<td>2009</td>
<td>406800</td>
<td>229714</td>
<td>432122</td>
<td>434090</td>
<td>1095926</td>
</tr>
<tr>
<td>2010</td>
<td>737800</td>
<td>251267</td>
<td>585272</td>
<td>491091</td>
<td>1327630</td>
</tr>
<tr>
<td>2011</td>
<td>1239252</td>
<td>278594</td>
<td>796565</td>
<td>609551</td>
<td>1684801</td>
</tr>
<tr>
<td>2012</td>
<td>1810340</td>
<td>315741</td>
<td>1021247</td>
<td>700403</td>
<td>2037391</td>
</tr>
<tr>
<td>2013</td>
<td>1956700</td>
<td>350353</td>
<td>1208405</td>
<td>781167</td>
<td>2339925</td>
</tr>
<tr>
<td>2014</td>
<td>2427400</td>
<td>372535</td>
<td>1253072</td>
<td>852322</td>
<td>2477929</td>
</tr>
<tr>
<td>2015</td>
<td>2850900</td>
<td>408393</td>
<td>1300244</td>
<td>941795</td>
<td>2650432</td>
</tr>
</tbody>
</table>

Note: Data are obtained from Aba Bureau of Statistics

As growth is mainly related to increment and growth rate, we mainly study the correlation between them and then build the growth elasticity that tourism industry brings for other industries.

According to Tables 2 and 3, we can calculate the correlation coefficient of economic growth and growth rate in the tourism industry and the first, second, third industry and the whole area, such as Table 4:

<table>
<thead>
<tr>
<th>Year</th>
<th>Tourism Revenue (million)</th>
<th>Primary Industry (million)</th>
<th>Secondary Industry (million)</th>
<th>Tertiary Industry (million)</th>
<th>Total Region (million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>140100</td>
<td>9262</td>
<td>61381</td>
<td>50294</td>
<td>120937</td>
</tr>
<tr>
<td>2006</td>
<td>125700</td>
<td>37981</td>
<td>85719</td>
<td>61821</td>
<td>185539</td>
</tr>
<tr>
<td>2007</td>
<td>-569600</td>
<td>9510</td>
<td>-</td>
<td>53866</td>
<td>-</td>
</tr>
<tr>
<td>2008</td>
<td>232600</td>
<td>24701</td>
<td>197737</td>
<td>68859</td>
<td>291297</td>
</tr>
<tr>
<td>2009</td>
<td>331000</td>
<td>21553</td>
<td>153150</td>
<td>57001</td>
<td>231704</td>
</tr>
<tr>
<td>2010</td>
<td>501452</td>
<td>27327</td>
<td>211384</td>
<td>118460</td>
<td>357171</td>
</tr>
<tr>
<td>2011</td>
<td>146360</td>
<td>34612</td>
<td>187158</td>
<td>80764</td>
<td>302534</td>
</tr>
<tr>
<td>2012</td>
<td>470700</td>
<td>22182</td>
<td>44667</td>
<td>71155</td>
<td>138004</td>
</tr>
<tr>
<td>2013</td>
<td>423500</td>
<td>35858</td>
<td>47172</td>
<td>89473</td>
<td>172503</td>
</tr>
</tbody>
</table>

As can be seen from Table 4, although to the tourism industry and the primary industry is relatively low in correlation of the growth rate, the rest of the correlations are relatively high. This shows that there is very strong interaction relationship among tourism growth in Aba and other industries’ growth and the economic growth of the whole region. The growth elasticity based on the calculating of the growth rate is rational in theory and practice.

It can also be seen from the correlation coefficient list that the primary industry’s correlation coefficient is lower than tourism either in increment or growth rate. They are respectively 0.719 and 0.4886. It indicates that the development of relationship between the first industry and the
Accumulation effect of tourism under the constraint of structure

Table 4: Correlation coefficients of increment and growth rate between tourism and other industries

<table>
<thead>
<tr>
<th>Sequence number</th>
<th>Industrial Relations</th>
<th>Correlation coefficient of increment</th>
<th>Correlation coefficient of growth rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tourism and the primary industry</td>
<td>0.719</td>
<td>0.4886</td>
</tr>
<tr>
<td>2</td>
<td>Tourism and the secondary industry</td>
<td>0.8673</td>
<td>0.94599</td>
</tr>
<tr>
<td>3</td>
<td>Tourism and the tertiary industry</td>
<td>0.9298</td>
<td>0.7824</td>
</tr>
<tr>
<td>4</td>
<td>Tourism and region</td>
<td>0.9535</td>
<td>0.8891</td>
</tr>
<tr>
<td>5</td>
<td>Max/Min</td>
<td>0.9535/0.719</td>
<td>0.94599/0.4886</td>
</tr>
</tbody>
</table>

Tourism industry is relatively weak. But in accordance with the general standard, the data also show that the tourism industry and the first industry have a strong correlation and moderate correlation. It is the statistical basis to construct the growth elasticity of the two industries.

Table 4 also shows that the correlation between tourism and other industries does not have the characteristics of corresponding to each other. From the perspective of growth, the correlation coefficient of tourism and the whole area is the highest at 0.9535. But from the perspective of growth rate, the correlation coefficient of tourism and the secondary industry is the highest at 0.94599. It means that the related degree between the tourism industry and other industries may be different from a different point of view.

The correlation coefficient between tourism industry and other industries is substantially higher than 0.8. It shows that there is a strong relationship between the growth of the tourism industry and other industries. So we can construct the growth elasticity between tourism and other industries according to the real growth rate, as shown in Table 5:

Table 5: Growth elasticity of tourism and other industries

<table>
<thead>
<tr>
<th>Year</th>
<th>1/L</th>
<th>2/L</th>
<th>3/L</th>
<th>D/L</th>
<th>Max</th>
<th>Min</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>0.213</td>
<td>0.682</td>
<td>0.559</td>
<td>0.541</td>
<td>0.682</td>
<td>0.213</td>
</tr>
<tr>
<td>2006</td>
<td>1.185</td>
<td>1.145</td>
<td>0.851</td>
<td>1.033</td>
<td>1.185</td>
<td>0.851</td>
</tr>
<tr>
<td>2007</td>
<td>-0.063</td>
<td>0.630</td>
<td>0.168</td>
<td>0.323</td>
<td>0.630</td>
<td>-0.063</td>
</tr>
<tr>
<td>2008</td>
<td>0.090</td>
<td>0.632</td>
<td>0.1412</td>
<td>0.271</td>
<td>0.632</td>
<td>0.0902</td>
</tr>
<tr>
<td>2009</td>
<td>0.115</td>
<td>0.436</td>
<td>0.161</td>
<td>0.260</td>
<td>0.436</td>
<td>0.1153</td>
</tr>
<tr>
<td>2010</td>
<td>0.160</td>
<td>0.531</td>
<td>0.3552</td>
<td>0.396</td>
<td>0.531</td>
<td>0.16</td>
</tr>
<tr>
<td>2011</td>
<td>0.936</td>
<td>1.980</td>
<td>1.0467</td>
<td>1.470</td>
<td>1.980</td>
<td>0.936</td>
</tr>
<tr>
<td>2012</td>
<td>1.357</td>
<td>2.268</td>
<td>1.4271</td>
<td>1.838</td>
<td>2.268</td>
<td>1.357</td>
</tr>
<tr>
<td>2013</td>
<td>0.263</td>
<td>0.154</td>
<td>0.3787</td>
<td>0.2407</td>
<td>0.380</td>
<td>0.154</td>
</tr>
<tr>
<td>2014</td>
<td>0.551</td>
<td>0.216</td>
<td>0.602</td>
<td>0.399</td>
<td>0.602</td>
<td>0.216</td>
</tr>
<tr>
<td>Mean</td>
<td>0.481</td>
<td>0.867</td>
<td>0.569</td>
<td>0.677</td>
<td>0.531</td>
<td>0.16</td>
</tr>
</tbody>
</table>

Note: 1/L, growth elasticity of tourism to the primary industry; 2/L, growth elasticity of tourism to the secondary industry; 3/L, growth elasticity of tourism to the tertiary industry; D/L, growth elasticity of tourism to the region’s whole industry.

From the statistical results we can see that there is negative growth elasticity between the tourism industry and the primary industry. In 2007, it was −0.06346. It shows that when the tourism growth rate increases by one percentage point, the primary industry growth rate will reduce by 0.06346 percentage points. It indicates the current industrial structure constraints of the coordinated development of overall economy in Aba. Higher development of tourism depends on reducing the development of the primary industry;

In most years, the growth elasticities between tourism and other industries is less than 1. It shows that balance of social reproduction in Aba needs the fast development of
tourism in these years. In some years, such as 2006, 2011 and 2012, the growth elasticities between the tourism industry and other industries are more than 1, which indicates that the balance of social reproduction in these years needs to reduce the development speed of tourism appropriately.

4.2.3 The basic views of the Aba state tourism development

First, the development of tourism should be appropriate. For example, in the years when the elasticity is negative or more than one, the development speed of tourism should be controlled appropriately to ensure the coordinated development of the whole area.

Second, attention needs to be paid to the cooperation of industries. Table 4–5 shows that the elasticity between the tourism industry and the secondary industry is greatest, which indicates the close relationship between them in balanced growth. So special attention needs to be paid to the secondary industry while promoting the development of the tourism industry, otherwise it will lead to the tourism industry fighting alone.

Third, the growth elasticity value between the tourism industry and the whole region is also relatively large, which shows that the tourism industry cannot leave the economic environment of the whole region and develop in isolation. It needs to maintain a certain coordination with the environment.

5 Basic conclusions and recommendations

5.1 Basic conclusions

From the previous discussion we can see that the intrinsic correlation of economic growth is not related to the value division of social products. Whether the value of social products is divided into two parts or three parts, we can draw the conclusion that economic growth has intrinsic correlation. This correlation is manifested that the accumulation degree of any n-1 sectors is a function of the accumulation degree of the n sector. In addition, the correlation of economic growth is not related to the division of sector, namely whether the social economy is divided into n sectors or 2 sectors, the accumulation rate of a sector can be used as a free variable that affects the accumulation degree of other sectors. Just based on this, we can take the tourism industry as the leading industry of economic development of a region. Through the management to the development of tourism indirectly regulates the social economic development of the whole region.

In addition, the model also verifies that some of the conclusions in Li’s paper are still applicable in the condition of dichotomy. These conclusions mainly include:

1. The conclusion of limited accumulation space. Whether an economic entity is divided into 2 sectors or n sectors its growth space is limited from the perspective of balance.
2. The determinants of growth space. That is, the economic growth space not only depends on the actual production structure, but also depends on the actual consumption structure and other factors.
3. Uncertainty of accumulation correlation. The constraint relationship of the accumulation rate between different sectors is uncertain. And the accumulation rate of any two departments may be positively correlated, may also be negatively correlated, and also may not be independent of each other.
4. The conclusion of balanced growth conditions. The balanced growth of a real economy entity may not be achieved under certain conditions. From the industrial correlation model we can see that the conditions of balanced growth are very strict. As a sectors feasible accumulation interval disappearing, the expansion of reproduction will not be realized.

5.2 Suggestions for tourism development

According to what has been discussed above, we put forward the following suggestions about the development of tourism:

1. The problem of leading industry. Now many areas put the tourism industry as the leading industry and hope through developing tourism to drive economic development of the whole area. Wang Shouchu studied the relationship between tourism industry and leading industry [23], Qiu Jianying [24], Li Baoji, and Wu Ying [25] researched the strategy and model of developing tourism as leading industry. In practice, Liupanshui hoped to achieve the goal of poverty alleviation through the development of the leading tourism industry [26]. According to our analysis of the industry association, the predecessors’ research conclusion is confirmed. It is feasible to take the tourism industry as the leading industry in theory. According to the industry associ-
ation model, we can regard the accumulation rate of tourism as a free variable. Through changing the value of the variable artificially and using the intrinsic correlation of the sector accumulation rate impacts the development of the overall social economy. However, in practice, it is also needed to consider the stage of tourism development. When the tourism development is in primary stage, the market demand is strong and the guiding role of production is obvious. Only at this time taking the tourism as the leading industry will have a better driving effect. But if a regional tourism development has been relatively mature and the market demand is already saturated, it may backfire that hoping tourism play the role of leading industry continuously.

2. The degree of development of tourism. According to the industry association model, the accumulation and growth of any sector are limited under certain structural conditions. The tourism industry is no exception. The degree under which using tourism to guide the development of social economy objectively has boundaries. The economy can only be developed in an unbalanced state while it is beyond a certain structural constraint. Exaggerating the driving effect of the tourism sector blindly and expecting to use it to drive development of the social economy in a long-term is often “haste makes waste” and it is also harmful in practice. Based on the research of the structure and growth, Yan Zheng [27], Yang Yaqin [28] and Li Jingyi [16] all emphasized this point.

3. Change of consumption coefficients. The above research is based on constant consumption coefficients. Strictly speaking, all kinds of consumption coefficients are variable. In the long run, economic growth is mainly dependent on the progress of technology [29]. With the continuous progress of technology, all kinds of coefficients are likely to change, especially the consumption coefficient. Although it can be assumed that it has a certain stability from the macroscopic view, it still has a large variability compared with the production coefficient. So the formation conditions of the various consumption coefficients, the factors of influence, and the rule of change should be an important part of our further study on the relationship between structure and growth.

In our model, although the decision factors of the production consumption coefficient, consumption coefficient, and the other factors that appears due to the model expansion are different. But the previous research results can provide useful reference for our discussion. The problems of various coefficients need to be further studied in the future.

4. The emphases and methods of government management. Government can effectively improve the method of managing the economy through using the relations which are revealed in the industry association model.

Firstly, the model can be used to coordinate the economic aggregate and the structure.

As early as 1949, Kuznets pointed out that the growth of national income and industrial structure were related to each other [30–32]. Therefore, the adjustment for the national economy needs to be carried out from the two aspects of the total amount and structure. The above model shows the unified relationship between the total amount and structure. Therefore, it can be used to adjust the total amount and structure of the economy. For example, when the total supply is less than demand and there are some sectors supply is greater than demand, on the one hand, we can reduce the total demand or increase the total supply or both; On the other hand, we can increase the total demand in some sectors or reduce the total supply or both. So as to achieve the unity of the total amount and structure adjustment and making the total amount and structure reach balance at the same time.

In the real economy, taking into account the impact of government, import and export, tax and other aspects, the aggregate social product can be further divided in value composition. Thus, it can coordinate the operation of the national economy in a wider range.

Secondly, it is helpful to improve the methods of government managing the economy.

Economic growth has an intrinsic correlation, that is, the growth rate of the n-1 sectors is a function of the n sectors growth degree which is a free variable. This provides a theoretical basis for the government to promote and coordinate the growth of the whole national economy through the leading sectors such as tourism. According to the inherent correlation of social economic growth, the government can manage the big and liberate the small, and lead and regulate the development of the whole economy through the growth of the leading sector.

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