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A fair distribution and transfer mechanism of forest tourism benefits in China

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ABSTRACT

This study establishes a theoretical model of forest tourism benefit allocation. Empirical testing was carried out based on China's inter-provincial panel data from 2000 to 2016, following the principle of fair allocation, and using an iterative algorithm to distribute forest tourism benefits among different economic entities and regions fairly. The empirical results show that urban residents get more than 40% of these benefits, while rural residents get less than half of that of urban residents. After the tax reform, the distribution ratios of the government and enterprises decreased due to an increase in the distribution ratio of urban residents. The transfer of forest tourism benefits among regions is highly unstable, and the central and western regions obtain more benefits than the eastern regions. Therefore, when constructing forest tourism infrastructure, the central and local governments should consider the transfer ratio of these benefits, which will help optimize the structure and use of capital investments, and continue to strengthen the backward-feeding of the economy from the eastern regions to the central and western regions.

1. Introduction

As the natural carrier of ecological resources and the spatial carrier of economic activities, a forest offers economic, social, and ecological benefits (Yue et al., 2020). Additionally, in recent years, the pace of urbanization in China has been increasing, and people are becoming increasingly aware of the importance of a healthy lifestyle (Miao et al., 2019). These factors are contributing to the gradual development of ecotourism. Under the influence of ecotourism, forest tourism came into being with the theme of “returning to nature” (Wu et al., 2020). There are different forms of forest tourism, and the main form comprises of forest parks (Kent et al., 1991). Forest parks contribute to the conservation of water and soil resources, air purification, and biodiversity protection (Lejeune and Kettunen, 2017; Wu et al., 2019). The tourism income and tax revenue of forest parks could not only fund the development, maintenance, and staff salaries of forest parks but could also become an additional revenue source for local governments. Therefore, forest parks can generate profits and positive externalities. The government, enterprises, and residents constitute the three major economic subjects who receive benefits from forest tourism (Cassidy et al., 1971). Forest tourism benefits include two main aspects. (1) The economic income obtained from forest tourism. (2) The non-economic value obtained from forest tourism, such as ecological benefits and physical and mental relaxation. For the government, the forest tourism benefit involves the tax revenue received by the

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government. For enterprises, more attention is paid to the profits brought by forest tourism. For residents, as consumers, more attention is paid to the leisure entertainment brought about by forest tourism. However, as owners of the forests, residents pay more attention to the income brought by forests and the environmental problems of forests. In addition, since the distribution of forest resources has obvious regional features, local areas are also considered as units in the distribution of these benefits.

First, from the perspective of the distribution of benefits among the government, enterprises, and residents, both the government and enterprises enjoy the economic benefits of forest tourism, while residents enjoy the leisure-time benefits that accrue from forest tourism (Terleckyj, 1970). As forests are public goods, to avoid the "tragedy of the commons" (Hardin, 1968) phenomenon, the government must play a "first-come" role in the development and construction of the infrastructure for forest tourism by becoming the main investor. Second, with respect to the regional distribution of benefits, it must be noted that there are significant geographical differences in relation to China's forest tourism resources and its economic conditions. The eastern region lacks forest resources but has a developed economy. The central and western regions are rich in forest resources, and 40% of China's total forest park area is in the western region. However, the economy in the area is underdeveloped, which has led to investment in forest parks in the western region, constituting only about 25% of the total capital investment (Miao et al., 2018). This is a challenge for the development of infrastructure for forest parks in the western region.

For a long time, there have been many unsolvable problems in economics, and the fairness of distribution has always been one of the major problems, which is also the focus of many economists. Hence, this study primarily considers how to distribute forest tourism benefits fairly among economic subjects. It should be noted that the transfer of forest tourism benefits represents "fair benefits," and the transfer amount is the difference between the actual benefits obtained from a region and the "fair benefits." That is, a region obtains forest tourism benefits generated by the social development of other regions. Considering the differences in resource endowment, how should forest tourism benefits be fairly distributed among different regions? How much is the "fair benefit" that each region should receive? How is forest tourism benefit transferred among regions? Is the actual forest tourism benefit obtained by each region higher or lower than the level of "fair benefit"? How can the proportion of transfers be measured? To answer these questions, in this study, based on the income distribution model, a theoretical model of the benefit distribution among the three aforementioned subjects is set up to analyze the configuration status of benefits in China. Additionally, Chinese provincial panel data are used for an empirical analysis to quantify the distribution and transfer of forest tourism benefits among different subjects and regions. The aim here is to provide a fundamental basis for the distribution of benefits and references for optimizing the structure of the financing of forest park construction and the tax collection of the central and local governments.

The remainder of this study is structured as follows. Section 2 reviews the relevant literature and summarizes the relationship between the benefits of forest tourism, economic subjects, and regions. Section 3 introduces the model for distributing the benefits of forest tourism. A panel data model with a constrained interaction effect is developed. Section 4 conducts an empirical test of the model by using sample data to distribute the benefits of forest tourism fairly. Section 5 concludes by clarifying the significance of the research results and stating the avenues for future research.

2. Literature review

2.1. Relationship between resources and economic growth

Existing studies have discussed the relationship between resources and economic growth. The resource curse, which states that high availability of resources hinders economic growth, has become the focus of scholarly discussions (Dong et al., 2019). For example, Gerelmaa and Kotani (2016), Zhang and Brouwer (2020), and Asif et al. (2020) proved the existence of the resource curse hypothesis through an empirical analysis. Frynas et al. (2017) pointed out that resource-rich countries had experienced the resource curse and hypothesized that an increasing number of countries would suffer from the vicious impact of the resource curse in the future. Badeeb et al. (2017) also found that resource-wealth was linked to slow economic growth and that its negative impact was greater in developing countries. Similarly, Dauvin and Guerreiro (2017) empirically tested the impact of resources on economic growth and found that developing countries were more likely to suffer from the resource curse. However, they also found that its negative effect would disappear if certain conditions were met. Desierto (2018) pointed out that improper distribution of resources and competition for political power in the government would lead to a political resource curse. Shahbaz et al. (2019) empirically tested the relative effects of resource abundance and the resource dependence of a country on economic growth and concluded that resource abundance promotes economic growth, while resource dependence hinders economic activities. Lu et al. (2019) chose a small area for close examination. They proved the existence of the resource curse effect—resource development did not promote economic development, but, to a certain extent, inhibited and often affected economic growth in a variety of negative ways, such as causing the Dutch Disease effect, the extrusion effect, and the institutional weakening effect.

With an increase in environmental pollution, research on the characteristics of natural resources, especially of forest resources, the economy, and the environment, is increasing. Rasche and Tatom (1977) pointed out that abundant natural resources had significant positive effects on the economic growth of a region. Havranek et al. (2016) argued that there were two relationships between natural resources and economic growth. On the one hand, natural resources promote economic growth, and, on the other hand, they indirectly hinder economic growth through a transmission mechanism. Marcouiller (1998) examined the importance of using forest resources for ecotourism, and he believed that environmental resources were the main potential production factors of tourism. Chen et al. (2017) conducted an empirical analysis of the role of forest resources in the development of the green economy. They found that there was no significant efficiency difference across the economic regions in China, except the northeast region, and that the state-owned forestry structure had a significant negative impact on China's forestry production efficiency. Hao et al. (2019) studied the

relationship between forest resources and economic growth based on the hypothesis of the environmental Kuznets curve and the use of China's provincial panel data.

The above studies mainly examined the relationship between resources and the economy. The availability of forest tourism resources gives these areas a comparative advantage in the market (Angalakudati et al., 2014). The central and western regions utilize substantial amounts of forest resources as a form of capital to obtain benefits and realize sustained economic growth. In terms of the distribution of the benefits of forest tourism among economic subjects, the above studies focus on the relationship between the compensation pricing of forest tourism and some specific economic subject. The relationship between two or more economic subjects is rarely considered, nor is the distribution of benefits among all economic subjects. The distribution of benefits is also not quantified.

2.2. Forest tourism benefits of economic subjects

Considering the distribution of benefits among the government, enterprises, and residents, this study explains the internal relationship between an economic subject and forest tourism benefits. From the government's perspective, the basic consensus is that forest tourism resources belong to the state, and the state can exercise the ownership of forests and enjoy the right of revenue on behalf of the residents (Weintraub and Navon, 1976). Hughes (1995) found that ecotourism could increase taxes and provide employment opportunities for the government. White and Martin (2002) identified that the ownership relationship and management mode of forests were closely related to the economic benefits of forests. Nikolaeva et al. (2015) analyzed the current situation and the challenges of ecotourism development in Russia, discussed the major regions and countries with a high level of ecotourism development, and considered the policy models of some countries in the field of ecotourism. Luo et al. (2016) emphasized the roles of the state, capital, and society in the construction of forest parks, pointing out that future research should focus on the role of institutions in creating space for local forest parks and tourism. Wu and Tsai (2016) suggested that local support and capacity building, which could enable ecotourism, required the participation of local communities, and the development and protection of tourism cannot be facilitated without the support of government agencies. Arshad et al. (2017) argued that tourism was closely related to other industries in the national economy, and its development would increase the main indirect incomes, foreign investment, trade opportunities, private investment, local development, and public infrastructure.

Existing studies mainly examine the relationship between the development of forest tourism and the costs and benefits of enterprises and their mutual influences. Kerkvliet and Nowell (2000) note that, while tourists enjoy forest park tourism, they cause serious ecological damage to the land they enjoy. To maintain the integrity of the ecosystem, park managers must make tourism development and management an important part of their work. Essex (2001) found that the experience of ecotourism and leisure landscape largely depended on the conservation of woodland, and pointed out that the effective management of forest tourism can provide additional income, thereby offsetting a part of the costs. Lister (2011) illustrated the importance of enterprises' participation in forest management by considering forests in Canada, the United States of America, and Sweden as examples. Matilainen and Lähdesmaki (2014) identified that, in many countries, ecotourism mainly focused on private forests, and enterprises benefited from a sustainable cooperation strategy with private forest owners. Iranah et al. (2018) studied the direct and indirect use values of forest landscapes and conducted an in-depth analysis of the willingness of forest users (such as tourism entrepreneurs) to pay fees, thus achieving the purpose of protecting landscape value and biodiversity.

Collectively, the above studies explain the relationship between forest tourism benefits and the subjects of government and enterprise. From the perspective of residents, it can be said that they obtain some economic benefits of forest tourism. However, they also experience the main negative effects of forest tourism, such as the environmental pollution, without receiving any corresponding economic compensation. Scheyvens (1999) argued that local community residents were not only deprived of several benefits of ecotourism, but they were also the main bearers of the social, cultural, and environmental costs of ecotourism development, and they were not duly compensated. Similarly, Ioras et al. (2001) identified that unsustainable forestry and tourism management had seriously threatened the ecological security of national forest parks. On this basis, it was argued that appropriate compensation should be provided to local residents to reduce the antipathy between residents and parks, achieve resource protection, and provide the necessary guarantee for the sustainable development of society.

In related research, Gossling (1999) and Kiss (2004) both purported that ecotourism could not replace traditional economic activities (such as farming and fishing) to provide residents with an economic income source. Kuvan and Akan (2005) studied the attitudes of residents toward the impacts of tourism on forests. By taking the small resort town of Belleek on the Mediterranean coast of Turkey as an example, they concluded that residents held a positive attitude toward tourism development in this region, and observed the negative effects of tourism, especially on forests. Ostrom (1999) reasoned that, since forest resources are public goods, residents should increase their participation in local common resources, including in the management of forest resources and the design of management policies. Habesland et al. (2016) pointed out that forests could mitigate climate change, and Norwegian forest owners had a strong interest in participating in forest management. Bernard et al. (2016) focused on the role of ecotourism in improving the adaptability and resilience of local communities and proposed that the expansion of protected areas was a prerequisite for increasing ecotourism activities. Dejouhanet (2017) analyzed the equal and unequal characteristics of income generated from forest tourism and discussed the role that local residents played in the development of forest tourism.

2.3. Regional forest tourism benefits

The distribution pattern of the benefits of forest tourism is not strictly related to the capital invested in forest tourism. In existing studies, stakeholders are given consideration during the distribution of benefits in different regions. It should be noted that, according

to the above definitions of the transfer of forest tourism benefits and the transfer of forest tourism revenue, existing studies mainly discuss forest tourism revenue. Existing studies mainly focus on the development, management, and profit distribution of regional forests and compare the distribution and management of tourism investments in different countries, especially in developed and less-developed countries. Research on regional forests by Reddy and Chakravarty (1999) found that although forests did not contribute significantly to reducing regional income inequality, they were conducive to reducing poverty and extreme poverty in the region. Mamo et al. (2007) studied the degree of dependence of regional rural households on forest resources and the income-balancing effect they have. It was concluded that forest resources had the potential to balance income in the regions. Furthermore, it was argued that reducing the use of forest resources would affect the welfare of the rural population and increase wealth disparities among rural households.

Brohman (1996) argued that, despite the vigorous development of tourism, developing countries still faced many challenges emerging from export-oriented development strategies, such as excessive dependence on foreign countries and serious environmental damage. Hence, countries and residents should be encouraged to actively participate in tourism planning to get a fairer share of benefits and meet the need for local development. Hamin (2001) studied forest parks in western countries and found that their main investment subjects are over-concentrated. It was also noted that most of the development funds were invested by the government and jointly managed by residents. Adams and Infield (2003) pointed out that, in African countries, governments were the main investors and managers of forest parks. However, the investment of government and donors in central Africa could only reach 30% of the required amount. Additionally, the authors revealed that the development of forest parks depended on the government's distribution of tourism revenue. Baviskar (2004) confirmed that, in developing countries, the development of forest parks could be regarded as the government's investment to achieve two goals—protecting biodiversity and reducing poverty, which was a political need. Miller-Rushing et al. (2016) identified that both developed and developing countries had structural flaws in their schemes for the construction of forest parks, particularly in the allocation of funds, which weakened their ability to achieve their stated mission. Vargas (2018) analyzed world heritage sites and discussed the impacts of tourism on local social and economic development. This research included an analysis of the responses of managers and residents to the government's investment in tourism infrastructure.

To sum up, the government, enterprises, and residents are the main stakeholders in the distribution of the benefits of forest tourism. The government, as the main investor in forest tourism resources, enjoys the ownership of forest resources and mainly obtains the economic benefits of forest tourism. As the manager of forest tourism resources, enterprises, while investing in forest resources, manage forest resources, and enjoy the economic benefits of forest tourism. The residents, on the one hand, enjoy the benefits provided by forest resources as consumers of forest tourism resources; on the other hand, they participate in the management of forest tourism resources together with the government and enterprises. The fair distribution of the benefits of forest tourism among all stakeholders, the optimization of the investment structure for constructing forest tourism infrastructure, and the adjustment of structural imbalance are all conducive to improving residents' enthusiasm in participating in forest tourism management. Irrespective of whether the distribution of benefits among different economic subjects or regions is being examined, it is always a question of the distribution of benefits among stakeholders.

2.4. The data-driven algorithm

There are many limitations or weaknesses in previous studies on the distribution of the benefits of forest tourism. Matilainen and Lähdesmaki (2014) explored the distribution of forest tourism among tourism entrepreneurs and private forest owners. They found an asymmetrical cooperative relationship between the two sides and proposed four strategies for stakeholder management. However, no optimization techniques were employed in their analysis. The same applies to Bernard et al. (2016), Wu and Tsai (2016), Vargas (2018), and other researchers who employed relatively formal econometric models. Kerkvliet and Nowell (2000) used the travel cost model and the mixed logit model, which is used to examine discrete choice, to examine the effects of recreational management on forest tourism. Iranah et al. (2018) adopted a stepwise regression model to survey tourists' willingness to pay for the conservation of forests. However, the models used in this analysis did not consider the unobservable common factors and factor loads. Data-driven and iterative algorithms were not employed. Hence, these methods leave significant room for improvement.

Regarding the distribution and transfer of forest tourism benefits, the previous study does not exploit the potential value of data. It focuses on data description, which makes it difficult to examine the rule in detail. Recently, numerous studies and models have been established with a focus on the data-driven perspective. Data-driven perspective involves collecting large amounts of comprehensive and real-time data through internet technology, organizing the data to form an information flow, and in the process of making decisions, extracting and summarizing effective information from the information flow according to different needs, and based on simulation training, forming an automated decision model. When new data are entered, the system can use the previously established model to make decisions. Making decisions based on data and algorithms avoids artificial subjective factors and makes decisions more objective. In addition, the decision-making process requires continuous input of new data, the established model is continuously revised according to the decision results and actual data, and decision-making is also constantly improved. Provost and Fawcett (2013) discussed the data-driven perspectives of data science and decision theory. They underline that data-driven decision-making refers to the practice of decision-making based on the analysis of data, rather than being based on intuition. Brynjolfsson et al. (2011) constructed a data-driven indicator to measure the extent to which companies rely on data for decision-making. Their analysis shows that the more data-driven the companies tend to be, the higher is their productivity. To analyze the roles of principals, teachers, students, and district personnel, Levin and Datnow (2012) developed a data-driven decision-making model using case study data. Their analysis deepened the understanding of the educational reform process.

These studies show the significant impact of the data-driven perspective and its prominent role in breaking the information

barriers between various fields. The relevant techniques of the data-driven perspective are also widely used in forest management research. Coops et al. (1998) evaluated forest productivity in Australia and New Zealand by using a data-driven model, in which weather and satellite data are incorporated. Battles et al. (2008) adopted a data-driven model to study the effects of climate change on forest productivity and health in California. They found that, in an extreme case, climate change would reduce forest productivity by 2100 by 19%. Leiterer et al. (2015) explored the forest canopy-structure characterization, which is an indicator of a variety of biophysical variables. Their study revealed that the characterization affected the energy fluxes between the atmosphere and vegetation. Despite the extensive use of data-driven technology in forest management, so far, there is no relevant research in the field of the benefit distribution of forest tourism. This study would fill this gap by applying the idea of the data-driven perspective and studying the factors influencing the distribution of forest tourism benefits.

3. A novel model for distributing the benefits of forest tourism

The traditional panel data model assumes that common factors have the same effect on different individuals, which may not necessarily be so. As far as this study is concerned, we believe that the effects of technological and institutional factors on individuals are often different. Therefore, to reflect the different effects of common factors on different individuals, it is necessary to introduce the interaction effect into the panel interception model. Research that applies panel data models with interactive effects is one of the main recent developments of econometrics. These models have special estimation methods and asymptotic distribution forms. By analyzing the interaction effect model and its performance, we can put forward a more suitable model form to meet the needs of real economic problems.

Considering the economic differences and different levels of development between different regions in China, we use provincial panel data for our analysis to more accurately measure the impact of technological and institutional changes on the development of forest tourism and the spatial differences involved. We propose a novel approach based on the model of Bai (2009). It is developed based on the following theoretical model, which depicts the relationship between the benefits of forest tourism and forest area:

$$ftr_{it} = L_{it} fpa_{it} \tag{1}$$

where $fpa_{it}$is the area of forest tourism resources; $L_{it}$is a random variable that represents the unobservable technical and institutional factors between the benefits of forest tourism and forest tourism's resource area of province$i$at time t, which changes with individual and time. Formula (1) captures the idea that the benefits of forest tourism cannot be directly reflected by statistical data and that these benefits are closely related to the forest area. When building a model for distributing the benefits of forest tourism, the benefits are decomposed into three parts—government benefit, enterprise benefit, and resident benefit. Based on the idea of data-driven modeling, the classical model of the income distribution, and, with reference to Venieris and Gupta (1986) and Yang and Xu (2016), the C-D production function with constraints is used. Considering the distribution of forest tourism benefits among the government, enterprises, and residents, the constraint conditions are given as$\alpha + \beta + \gamma = 1$ in which α, β, and γ, represent the proportion of forest tourism benefits obtained by the government, enterprises, and residents, respectively.

$$ftr_{it} = (h \cdot gov_{it})^{\alpha}(j \cdot ent_{it})^{\beta}(k \cdot res_{it})^{\gamma},\ i = 1, 2, \cdots, N;\ t = 1, 2, \cdots, T \tag{2}$$

where h, j, and k are proportional constants, $i$refers to province; ftr_{it}represents the area of forest tourism resource; gov_{it} is the government benefit; ent_{it} is the enterprise benefit, $res_{it}$is the resident benefit, and $t$refers to time. Then, the following formula is obtained:

$$fpa_{it} = (H_{it} \cdot gov_{it}^{\alpha})(J_{it} \cdot ent_{it}^{\beta})(K_{it} \cdot res_{it}^{\gamma}) \tag{3}$$

where $H_{it} = h^{\alpha}/L_{it}$, $J_{it} = j^{\beta}/L_{it}$ and $K_{it} = k^{\gamma}/L_{it}$ refer to the transitional effects of technology and institutions, and these variables are unobservable. Model (2) measures the overlapping elements of the dynamic change between each economic entity benefit and forest tourism benefits. That is, it measures the elements with covariant characteristics. Under the constraint condition $\alpha + \beta + \gamma = 1$, parameters$\alpha$,$\beta$, and $\gamma$of the forest tourism benefit distribution formula in model (3) are estimated to obtain the distribution proportions of the benefits of forest tourism among economic subjects.

China is now in a dual economic structure. This means that the development of China's urban economy is characterized by modern industrial production, while the rural economy is based on traditional agricultural production. There are obvious differences between these two forms of the economy. In the distribution of forest tourism benefits among residents, there may be significant differences in the proportions of benefits obtained by urban and rural residents. To reveal such differences, residents are divided into the following two categories: urban residentsurb and rural residentsrur. Then, model (3) can be changed to:

$$fpa_{it} = \varphi_{it} gov_{it}^{\alpha} ent_{it}^{\beta} urb_{it}^{\theta} rur_{it}^{\delta} \tag{4}$$

where $\varphi_{it} = H_{it} \cdot J_{it} \cdot K_{it}$ is an unobservable parameter, rur_{it} represents the benefit acquired by rural residents, and urb_{it} refers to the benefit acquired by urban residents. Currently, $\alpha + \beta + \theta + \delta = 1$. For the convenience of parameter estimation, model (4) is transferred to a logarithm model to obtain a linear regression equation, as shown below:

$$\ln fpa_{it} = \alpha \ln gov_{it} + \beta \ln ent_{it} + \theta \ln urb_{it} + \delta \ln rur_{it} + v_{it} \tag{5}$$

Where α,β,θ, and δ refer to the distribution proportion of the benefits of forest tourism to each economic subject, namely the government, enterprises, urban residents, and rural residents, respectively. $v_{it} = \ln \varphi_{it}$ refers to the change in technology and institutions. Different individuals generate different technology and institution effects at different times. To reflect this transition of

effects, $v_{it}$is split, and the following model is obtained:

$$\ln fpa_{it} = \alpha \ln gov_{it} + \beta \ln ent_{it} + \theta \ln urb_{it} + \delta \ln rur_{it} + \mu_i + f_t + u_{it} \quad (6)$$

where u_{it}represents a pure random factor, μ_i refers to the individual effect, andf_t refers to the time effect.

However, there is an implicit condition in model (6) that is contrary to reality. That is, for different individuals, changes in the common factor f_t remain the same, which means that the influence of changes in technology and institution on individuals are the same. For example, there are differences in natural conditions, resource structure, and economic conditions between different regions. If a new policy is implemented in a certain region, then the effect of the policy may be positive for that region, but in other regions, the effect may not be the same or may even be negative. Similarly, it is possible that the new policy may have a noticeable effect within a very short time in one region, while the same effect may be delayed, or may even never eventuate in other regions. Therefore, Bai (2009) creatively introduced the interaction effect between time and each person in the form of a product in the panel data model, revealing the different responses of different individuals to the common influencing factors. Thus, the model is transformed into:

$$\ln fpa_{it} = \alpha \ln gov_{it} + \beta \ln ent_{it} + \theta \ln urb_{it} + \delta \ln rur_{it} + \mu_i + \lambda_i f_t + u_{it} \quad (7)$$

where λ_i refers to the responses of different individuals to the common factor f_t. Similarly, $\alpha + \beta + \theta + \delta = 1$.

Model (7) is the distribution equation for the benefits of forest tourism, which can reflect the distribution proportions of benefits among different economic subjects and the transfer proportions among different regions simultaneously. Based on the parameter estimation results of the model, the fair forest tourism benefits that each region should obtain are calculated. Meanwhile, this study measures whether there is a benefit transfer by comparing the actual benefit with fair benefits, which reflects the transfer mechanism of benefits in practice. From the perspective of transfer, if the actual benefits of all regions are exactly equal to the fair benefits, then the distribution of benefits among regions will not lead to a transfer of benefits. If the actual benefits of a region are not equal to the fair benefits, then the distribution of benefits among regions will lead to a transfer. This study aims to quantify this transfer. Therefore, the proportion of benefits distributed to each economic subject is the estimated value of the parameters in the equation. That is, $\alpha$is the proportion of benefits obtained by the government, $\beta$is the proportion of benefits obtained by enterprises, and $\theta$and$\delta$are the proportions of benefits obtained by urban and rural residents, respectively. The distribution proportions of benefits among regions can also be estimated through this equation.

The fitted value ln$fpa_{it}$of $\ln fpa_{it}'$can be obtained by introducing the sample data into the model and by carrying out a consistent estimation of parameters in model (7).

$$\ln fpa_{it}' = \hat{\alpha} \ln gov_{it} + \hat{\beta} \ln ent_{it} + \hat{\theta} \ln urb_{it} + \hat{\delta} \ln rur_{it} + \overline{\mu}_i + \overline{\hat{\lambda}}_i \hat{f}_i \quad (8)$$

where $\ln fpa_{it}'$ refers to the fitted value of lnfpa_{it}. Three conditions can be obtained by comparing actual values with fitted values. When $\ln fpa_{it} - \ln fpa_{it}' > 0$, it means that benefits are transferred to the regions; that is, the partial benefits of other regions are obtained by this region, making the actual benefits of this region higher than the fair benefits. When $\ln fpa_{it} - \ln fpa_{it}' < 0$, it means that benefits are transferred out of the region; that is, the partial benefits of this region are obtained by other regions, making the actual benefits of this region lower than that of the fair benefits. When $\ln fpa_{it} - \ln fpa_{it}' = 0$, it means that the inward and outward transfers of benefits are the same or there are no inward or outward transfers; that is, the actual benefits of this region are equal to the fair benefits. If the benefits obtained by a region are less than the benefits generated by the corresponding forest tourism development level, it indicates that the benefits have been obtained by other regions and transferred externally. Conversely, if the benefits obtained by a region are greater than those generated by the corresponding forest tourism development level, it indicates that the benefits in other regions are being obtained by this region, and the forest tourism benefits are transferred internally.

Model (7) can be transformed into a model without constraint from the panel data model with the constrained interactive effect by transforming the constraint condition. $\alpha + \beta + \theta + \delta = 1$ to $\delta = 1 - \alpha - \beta - \theta$ in model (7) and let $y_{it} = \ln fpa_{it} - \ln rur_{it}$, $x_{1it} = \ln gov_{it} - \ln rur_{it}$, $x_{2it} = \ln ent_{it} - \ln rur_{it}$, and$x_{3it} = \ln urb_{it} - \ln rur_{it}$.

$$y_{it} = \alpha x_{1it} + \beta x_{2it} + \theta x_{3it} + \lambda_i f_t + \mu_i + u_{it} \quad (9)$$

Based on the iterative algorithm, Bai (2009) built a consistent estimator by transforming the interactive effect panel data model, like model (9), into a constrained static panel model and factor model, which solved the problem of parameter estimation in the model. The steps of model estimation are as follows. Model (9) is tranformed. If the common factor f_t and loading coefficientλ_i are known, then, in essence, the panel data model with the unconstrained interactive effect has been converted into the panel data model with the constrained static effect. At this time, parameters α,β, and θin the model can be estimated by using the least-squares dummy variable method. By contrast, if the known quantities are parameter coefficients α,β, and θ in the model, then the panel data model (9) with the unconstrained interactive effect has been transformed into a factor model. Additionally, the principal component analysis method can be used for estimating the common factor $f_t$and its loading coefficient λ_i. Therefore, by setting an initial value to the model and utilizing the constrained static panel and factor models, a consistent estimation can be achieved for each parameter in model (9).

4. An empirical test for the distribution of forest tourism benefits

4.1. Sample data

Data are collected from three avenues, namely government, enterprises, and residents. Additionally, the complexity of the real economy is considered. The availability of data and the measurement error of data are also considered. The sample data used in this study are provincial panel data for China from 2000 to 2016 (excluding Tibet and Chongqing), collected from the China Compendium of Statistics 1949–2008, the China Statistical Yearbook, and the China Forestry Statistical Yearbook. This study uses the area of forest parks in each province in each year to measure forest tourism benefits and the local final financial accounts to measure the level of government benefit. Ticket income, board and lodging income, entertainment income, and other incomes of forest park tourism[1] are used to measure enterprise benefits. Since the statistical unit of these incomes is CNY10000, the total income is selected to reflect the enterprise benefit. To estimate the benefits for urban residents, with reference to the practice of Yang and Xu (2016), the sum of residents' income is used, that is, the product of the per capita disposable income of residents and the population. Concerning the benefits for rural residents, statistics before 2013 capture the per capita net income, whereas after 2013, statistics capture the per capita disposable income. Thus, to maintain the integrity of the data, the benefits for rural residents before 2013 are measured by the product of the per capita net income of rural residents and the rural population, and those after 2013 are measured by the product of the per capita disposable income of rural residents and the rural population.

To maintain data comparability and to eliminate the influence of inflation, the data on the benefits for the government and enterprises are deflated based on the consumer price index. Additionally, the data on the benefits for urban and rural residents are deflated, based on urban and rural resident's consumer price indexes, respectively,. Consumer prices are based on the fixed base index of the year 2000 = 100. Descriptive statistics for all data are shown in Table 1.

4.2. Stationary test

The stationarity of all relevant variables in the model is tested by using a unit root test. To enhance the robustness of the test results, the Levin–Lin–Chu (LLC) test and augmented Dickey–Fuller (ADF) test are used to test the stability of the variables. The results (Table 2) show that variables lnfpa, lngov, lnent, lnurb, andlnrur all pass the test and are stable. Hence, the equation does not need to consider the problem of pseudo-regression. On this basis, the parameter estimation of the forest tourism benefits distribution equation is carried out.

4.3. Model analysis

Estimating model (7), the values ofα, β, θ, and δ are found to be 0.4287, 0.1026, 0.3008, and 0.1679, respectively (Table 2). The estimated results show that the government gains most from forest tourism. According to the calculation results of the eigenvalues, the contribution of the first common factor to the common component is 91.15%. Therefore, the number of common factors is set to one to obtain the estimated results of common factors, as shown in Fig. 1 (solid line). Fig. 1 shows that the fluctuation of common factors showed a flat trend from 2000 to 2003 and a stable downward trend after 2003. The rate of decline fluctuated around 2009. In general, the common factors showed a significant downward trend. Therefore, technological and institutional changes played a positive role in forest park development. However, structural mutations may exist in technological and institutional changes around 2009, resulting in changes in the rate of the common factor curve.[2]

4.4. Consider tax reform

In view of the actual situation, China implemented the reform of value-added tax transformation in 2009, the pilot reform of resource tax in 2010, and the pilot collection of environmental tax in 2011. Before the resource tax reform, the principle of levying based on quantity was implemented, whereas, after the resource tax reform, the tax was linked to the change in resource price. Before the collection of environmental tax, enterprises did not have to bear the costs of environmental pollution. However, after the collection of environmental tax, the tax burden of enterprises changed, along with their costs and incomes. This impacted their economic decisions.

As the reform of the distribution mechanism is affected by the reform of the tax system, the reform of resource and environmental taxes may affect the distribution result. Consequently, the distribution equation of forest tourism benefits changed in structure around 2009. Based on the estimation results of common factors and considering the actual situation of resource tax and environmental tax reforms, a dummy variable is introduced into the model to analyze the possible structural mutation of the benefits' distribution equation around 2009. After considering the impact of the tax reform, the dummy variable D (the year 2000 to 2008 = 0, the year 2009 to 2016 = 1) is introduced, and the forest tourism benefits distribution equation is expressed as:

[1] Other incomes mainly refer to those directly related to tourism, such as farming, agricultural, sideline product processing, and handicraft production.

[2] The dynamic change of common factors reflects the transitional effects of technology and institutions. Its value has no direct economic meaning.

Table 1
Descriptive statistics.

Year	Variable	Number of samples	Mean value	Standard error	Maximum value	Minimum value
2000–2008	ln*fpa*	493	2.8336	1.9433	5.5062	−2.5823
	ln*gov*	493	11.2511	0.9636	13.2429	9.1590
	ln*ent*	493	5.4173	1.8357	9.6538	0.4055
	ln*urb*	493	12.5002	0.7885	14.245	10.6770
	ln*rur*	493	11.1950	1.0427	12.8455	6.2178
2009–2016	ln*fpa*	493	3.4632	0.9428	5.1246	0.5589
	ln*gov*	493	10.4870	1.2737	13.5371	7.4146
	ln*ent*	493	5.0235	1.7639	8.2029	−0.9787
	ln*urb*	493	11.8261	1.2041	14.5584	9.0847
	ln*rur*	493	10.9607	1.0998	12.8154	8.5217
2000–2016	ln*fpa*	493	3.1299	1.5849	5.5062	−2.5823
	ln*gov*	493	10.8915	1.1824	13.5371	7.4146
	ln*ent*	493	5.2320	1.8112	9.6538	−0.9787
	ln*urb*	493	12.1830	1.0560	14.5584	9.0847
	ln*rur*	493	11.0847	1.0753	12.8455	6.2178

Note: Data were collected from the *China Compendium of Statistics 1949–2008*, the *China Statistical Yearbook,* and *China Forestry Statistical Yearbook*. Values in parentheses are P values.

Table 2
Results of the panel unit root test.

Year	Methods	ln*fpa*	ln*gov*	ln*ent*	ln*urb*	ln*rur*
2000–2008	LLC	−21.1113	−29.6235	−28.3398	−24.6091	−15.2787
		(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
	ADF	168.8378	272.2591	183.0685	236.5321	212.9103
		(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
2009–2016	LLC	−14.3642	−23.0688	−15.5306	−20.9611	−49.3816
		(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
	ADF	116.6187	222.1283	188.8773	194.5988	156.3116
		(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
2000–2016	LLC	−24.7528	−19.4600	−20.0925	−18.2782	−17.7580
		(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
	ADF	324.4112	506.7592	366.4702	462.4559	365.1481
		(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)

Note: Data were calculated from Stata 14.0. Values in parentheses are *P* values.

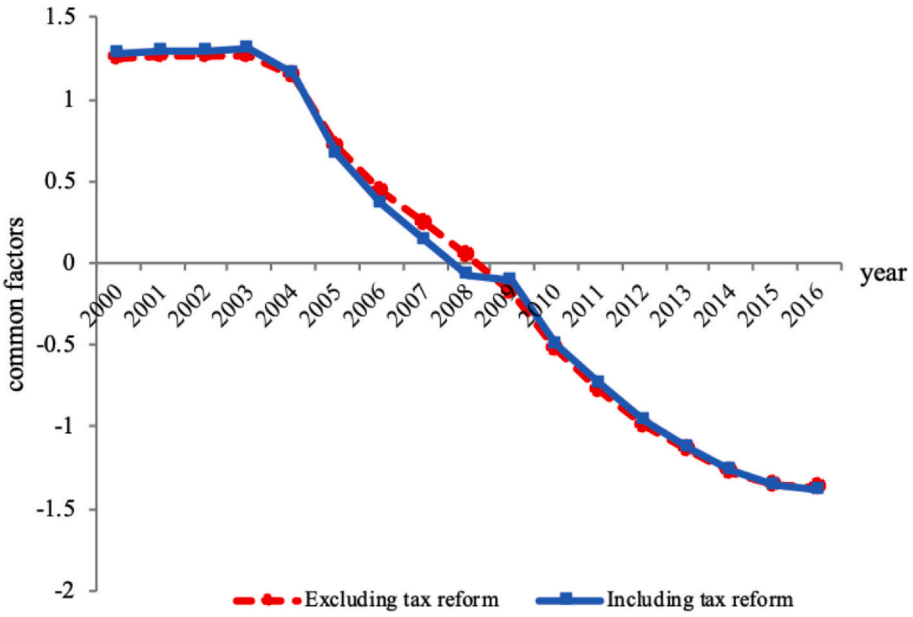

Fig. 1. Effects of technology and institutional changes reflected by common factors.

Table 3
Distribution of benefits to each economic subject.

Sample period	α	β	θ	δ
Year 2000 to 2008	0.4858(5.5133)	0.1082(6.9180)	0.2350(2.7423)	0.1711(1.8611)
Variation	−0.1383	−0.0507	0.1670	0.0219
Year 2009 to 2016	0.3475(−1.4136)	0.0575(−2.1083)	0.4020(1.2146)	0.1930(0.1719)
Year 2000 to 2016	0.4287(6.2155)	0.1026(6.9957)	0.3008(6.4081)	0.1679(2.2598)

Note: Data were collected from the *China Compendium of Statistics 1949–2008*, the *China Statistical Yearbook,* and *China Forestry Statistical Yearbook*. Values in parentheses are *t* values.

$$\ln fpa_{it} = \alpha_1 \ln gov_{it} + \beta_1 \ln ent_{it} + \theta_1 \ln urb_{it} + \delta_1 \ln rur + D(\alpha_2 \ln gov_{it} + \beta_2 \ln ent_{it} + \theta_2 \ln urb_{it} + \delta_2 \ln rur + \tau) + \mu_i + \lambda_i f_t + u_{it} \quad (10)$$

where the constraint condition before 2009 was $\alpha_1 + \beta_1 + \theta_1 + \delta_1 = 1$. $\alpha_1, \beta_1, \theta_1$, and δ_1 refers to the proportion of the benefits to be distributed to each economic subject, as above. The constraint condition after 2009 was $\alpha_2 + \beta_2 + \theta_2 + \delta_2 = 0$, among which $\alpha_1 + \alpha_2, \beta_1 + \beta_2, \theta_1 + \theta_2$, and $\delta_1 + \delta_2$ refer to the proportion to be distributed to the government, enterprises, urban residents, and rural residents, respectively. τD refers to the change in the equation intercept in which $\hat{\tau}$ = -0.6037 (t = - 2.7442).

4.5. Analysis of the results

We estimate model (10), and the method is similar to that of model (7). The estimation results (Table 3) indicate that the distribution status of benefits changed significantly around 2009. The test results of the parameters in the model show that the change in the enterprise distribution proportion is most significant, while the change in rural residents' proportion is not statistically significant, reflecting the fact that the tax reform has no obvious effect on the distribution of benefits to rural residents. However, Fig. 1 shows that, after considering the resource and environmental tax reforms, the effects of technological and institutional changes on forest tourism development are very notable (dotted line in Fig. 1). This is because, when compared to the reduced rate of the common factors before the reform, the decline rate after the reform is more stable, which also indirectly reflects the positive impacts of technological and institutional changes on forest tourism.

4.5.1. Distribution among economic subjects

Table 3 presents the estimated results of the benefit distribution equation to better compare the distribution patterns of forest tourism benefits among economic subjects before and after the reform of resource and environmental taxes. The estimated results, without considering the tax reform, are also listed in Table 3 in the line “Year 2000 to 2016.”

Before 2009, 48.58%, 10.82%, 23.50%, and 17.11% of the forest tourism benefits were distributed to the government, enterprises, urban residents, and rural residents, respectively. After 2009, 34.75%, 5.75%, 40.20%, and 19.30% of the forest tourism benefits were distributed to the government, enterprises, urban residents, and rural residents, respectively.

Estimation results show that more than 40% of the benefits were acquired by the government. Since the reform and opening up of the Chinese economy, the development of forest tourism relied heavily on governmental construction of tourism infrastructure, which laid a solid foundation for the development of forest tourism and made forest tourism revenue the government's main source of income in remote regions. In recent years, China has actively invested funds in developing forest tourism, especially in areas with rich forest tourism resources but a less-developed economy. However, investments in the early stages of forest tourism construction are large and have long cycles, which mean the partial distribution of benefits to the government as these investments need to be repaid over time. However, since 2009, there has been a significant change in the distribution of benefits; the government's proportion decreased by 14%. This shows that the government's reform of resource and environmental taxes did not increase their benefits. This may be attributed to the government's compensation for residents' interests, which were damaged by forest tourism.

The analysis result shows that urban residents enjoy more benefits from forest tourism than rural residents. This is because forest tourism resources are mostly distributed in remote rural areas. When the forest ecological carrying capacity is fixed, the increase in the number of tourists will inevitably cause certain damage to the forest's ecological environment. Forest tourism involving urban residents brings economic benefits to rural residents but destroys the ecological benefits. Rural residents must use their economic benefits to repair the damaged ecological environment. Therefore, the overall share of benefits is relatively low for rural residents. After 2009, the proportions of benefits obtained by urban and rural residents changed significantly. Compared to the situation before 2009, the proportion of benefits obtained by rural residents increased by about 2%, while the proportion of benefits obtained by urban residents increased by about 17%, which is much higher than that of rural residents. It is inferred that the reason for this change may be the implementation of China's new urbanization strategy, which makes the rural population gradually move to cities and towns.

Compared to the government and residents, enterprises' proportion of forest tourism benefits is relatively low; before 2009, it was only 10.82%. After 2009, enterprises' share of benefits stands at only 5.75%. This can be attributed to the development process of forest tourism in China. Forest tourism emerged late in China, and forest resources are concentrated in underdeveloped areas. The construction of infrastructure for forest tourism is mainly carried out by the government at the early stage, while enterprises only play the role of operators in the development process of forest tourism, with a low amount of capital input. Hence, forest tourism benefits

Table 4
Regional fair benefits from forest tourism from 2000 to 2016.

Region	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Beijing	2.88	3.09	3.14	3.43	3.57	3.48	3.50	3.59	3.62	3.59	3.52	3.52	3.50	3.53	3.55	3.61	3.65
Tianjin	1.97	2.14	2.21	2.39	2.35	2.31	2.42	2.50	2.54	2.70	2.68	2.72	2.75	2.74	2.79	2.83	2.87
Hebei	3.27	3.33	3.40	3.58	3.64	3.56	3.64	3.65	3.64	3.69	3.64	3.66	3.68	3.68	3.72	3.78	3.83
Liaoning	3.15	3.33	3.42	3.52	3.73	3.66	3.69	3.75	3.80	3.73	3.68	3.71	3.71	3.71	3.67	3.53	3.54
Shanghai	2.70	2.85	2.87	2.98	3.04	3.64	3.62	3.67	3.67	3.70	3.61	3.58	3.55	3.55	3.56	3.64	3.69
Jiangsu	3.86	4.02	4.21	4.41	4.47	4.43	4.44	4.52	4.54	4.50	4.44	4.46	4.45	4.45	4.45	4.49	4.53
Zhejiang	3.82	4.10	4.23	4.37	4.38	4.36	4.45	4.51	4.51	4.39	4.33	4.33	4.30	4.31	4.31	4.39	4.44
Fujian	3.10	3.29	3.32	3.44	3.41	3.38	3.41	3.43	3.44	3.54	3.47	3.50	3.52	3.53	3.55	3.58	3.61
Shandong	3.93	4.09	4.14	4.31	4.34	4.32	4.33	4.36	4.35	4.34	4.29	4.31	4.33	4.33	4.35	4.39	4.43
Guangdong	4.22	4.58	4.67	4.83	4.82	4.73	4.71	4.74	4.74	4.77	4.71	4.71	4.70	4.66	4.68	4.73	4.79
Hainan	1.41	1.52	1.62	1.62	1.70	1.61	1.64	1.72	1.75	1.77	1.76	1.83	1.85	1.89	1.92	1.97	1.98
Shanxi	2.39	2.55	2.63	2.87	3.12	3.37	3.26	3.18	3.19	3.12	3.07	3.09	3.15	3.18	3.19	3.16	3.16
Neimenggu	2.08	2.21	2.38	2.51	2.70	2.80	2.85	2.96	3.03	3.03	2.88	2.90	2.90	2.92	2.93	2.95	2.99
Jilin	2.52	2.60	2.69	3.02	2.87	2.94	2.93	2.97	3.04	2.97	2.90	2.95	2.98	2.97	2.95	2.95	2.98
Heilongjiang	2.68	2.83	3.06	3.29	3.11	3.14	3.17	3.15	3.21	3.18	2.99	3.06	3.07	3.09	3.08	3.04	3.04
Anhui	2.92	3.03	3.06	3.20	3.29	3.20	3.28	3.34	3.41	3.49	3.44	3.49	3.53	3.57	3.58	3.62	3.68
Jiangxi	2.70	2.81	2.90	3.10	3.25	3.16	3.25	3.34	3.38	3.33	3.30	3.35	3.40	3.43	3.47	3.55	3.59
Henan	3.28	3.39	3.51	3.66	3.77	3.70	3.75	3.78	3.76	3.82	3.74	3.76	3.79	3.81	3.84	3.89	3.92
Hubei	3.19	3.26	3.30	3.36	3.41	3.36	3.37	3.37	3.37	3.45	3.40	3.51	3.54	3.60	3.64	3.71	3.74
Hunan	3.24	3.39	3.48	3.61	3.65	3.53	3.53	3.55	3.56	3.61	3.56	3.63	3.65	3.71	3.74	3.79	3.84
Guangxi	2.88	3.02	3.11	3.20	3.23	3.10	3.10	3.13	3.16	3.24	3.15	3.14	3.16	3.20	3.26	3.29	3.32
Sichuan	3.32	3.33	3.51	3.73	3.79	3.71	3.72	3.81	3.84	3.78	3.72	3.76	3.79	3.83	3.85	3.89	3.93
Guizhou	2.10	2.40	2.48	2.58	2.66	2.63	2.62	2.64	2.69	2.71	2.68	2.78	2.89	2.96	3.01	3.06	3.12
Yunnan	2.52	2.64	2.87	2.98	3.03	2.93	2.99	2.95	3.02	3.03	2.97	3.03	3.07	3.12	3.13	3.16	3.19
Shaanxi	2.52	2.67	2.74	2.91	2.98	2.92	2.99	3.03	3.04	3.02	2.98	3.07	3.05	3.10	3.12	3.17	3.17
Gansu	1.90	2.01	2.13	2.29	2.34	2.19	2.15	2.17	2.21	2.24	2.17	2.17	2.19	2.26	2.29	2.34	2.39
Qinghai	0.27	0.41	0.46	0.68	0.60	0.88	1.01	0.96	1.00	0.98	0.91	0.98	1.02	1.08	1.08	1.09	1.07
Ningxia	0.68	0.87	0.98	1.09	1.19	1.08	1.11	1.16	1.13	1.15	1.12	1.17	1.23	1.31	1.32	1.40	1.43
Xinjiang	1.95	2.05	2.23	2.33	2.38	2.27	2.43	2.48	2.42	2.45	2.42	2.49	2.54	2.54	2.58	2.63	2.66

Note: Data were collected from the *China Compendium of Statistics 1949–2008*, the *China Statistical Yearbook,* and *China Forestry Statistical Yearbook.*

accruing to enterprises are relatively low.

It is notable that, before 2009, the benefits enjoyed jointly by urban and rural residents were lower than that of the government. However, after 2009, the decline in the proportions of benefits shared between the government and enterprises directly led to an increase in residents' proportion. This increased the proportion of forest tourism benefits enjoyed by residents to approximately 60%. It also reflects that the distribution of benefits is close to the fair distribution, and residents are appropriately compensated. The change in the distribution proportions of benefits among the government, enterprises, and residents illustrates the regulating role of the market. Since forest tourism resources are considered as public goods, the fair distribution of benefits depends not only on the government's fair distribution but also on the compensation mechanism of enterprises. Overall, the distribution of benefits among economic subjects is relatively fair. Furthermore, the results of the empirical test verify the rationality of the theoretical model established in this study for the fair distribution of forest tourism benefits among economic subjects.

4.5.2. Distribution among regions

Table 4 presents the annual forest tourism benefits that should be obtained by each region from 2000 to 2016 according to the distribution equation of forest tourism benefits, that is, the fair benefits. The overall pattern of fair benefits obtained by regions did not change much from 2000 to 2016. Compared to the central and western regions, the eastern region obtained more forest tourism benefits, while the western region obtained the least. As the distribution of forest tourism benefits follows the principle of fair distribution, there may be a transfer in the actual distribution situation of benefits among regions.

To analyze the transfer mechanism of benefits among regions, the transfer proportion of forest tourism benefits in each region during 2000 and 2016 is calculated. When there is a transfer of benefits to a region, the actual benefit level in this region exceeds the fair level, and the transfer proportion of benefits is positive. When there is a transfer of benefits outside a region, the actual benefit level in this region falls below the fair level, and the transfer proportion of benefits is negative.

Figs. 2 and 3 depict the transfer rates of forest tourism benefits in various regions from 2000 to 2016. Overall, from 2000 to 2008, areas with the highest rates of outward transfer of forest tourism benefits are mainly located in the eastern region, such as Shanghai, Tianjin, Jiangsu, Beijing, Shandong, Zhejiang, and Fujian. Areas with the highest inward transfer are mainly located in the central and western regions, including Qinghai, Jilin, Xinjiang, Gansu, Inner Mongolia, Heilongjiang, Hainan, and Shanxi. From 2009 to 2016, the eastern region, mainly including Shanghai, Tianjin, Jiangsu, Beijing, Anhui, Shandong, Zhejiang, and Liaoning, continued to witness the highest outward transfer rates of benefits. The central and western regions continued to record the highest inward transfer rates, including Qinghai, Jilin, Xinjiang, Gansu, Inner Mongolia, Heilongjiang, and Shanxi. Before and after the tax reforms, although the benefits of the eastern, central, and western regions changed, the central and western regions continued to receive higher forest tourism benefits than the eastern region.

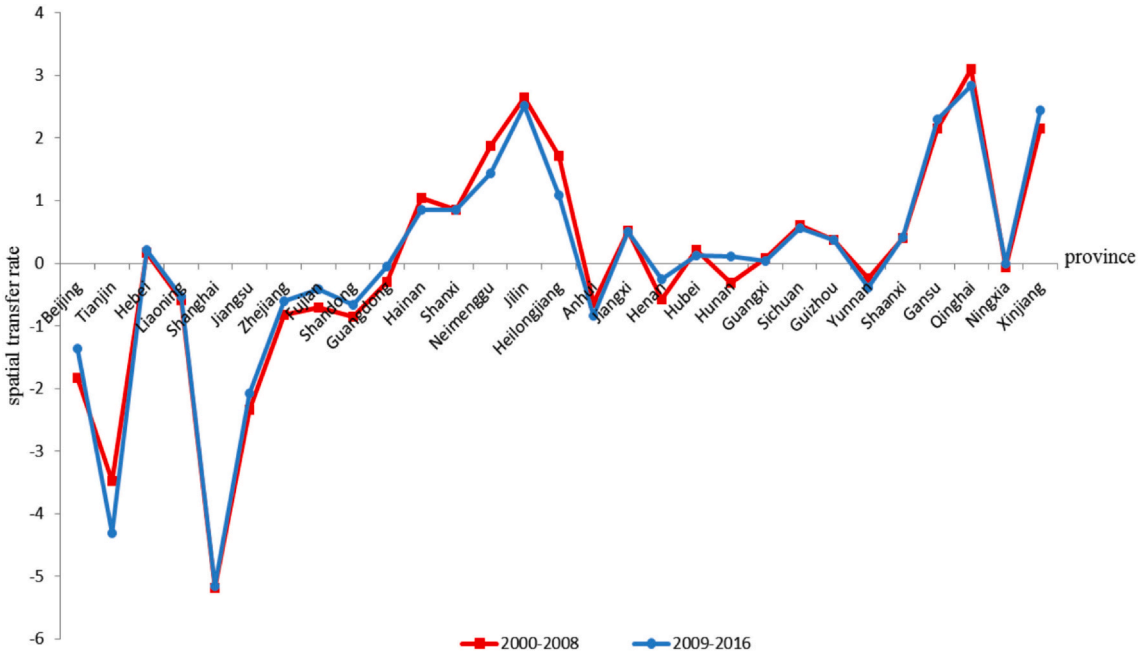

Fig. 2. Spatial transfer rates of forest tourism benefits.

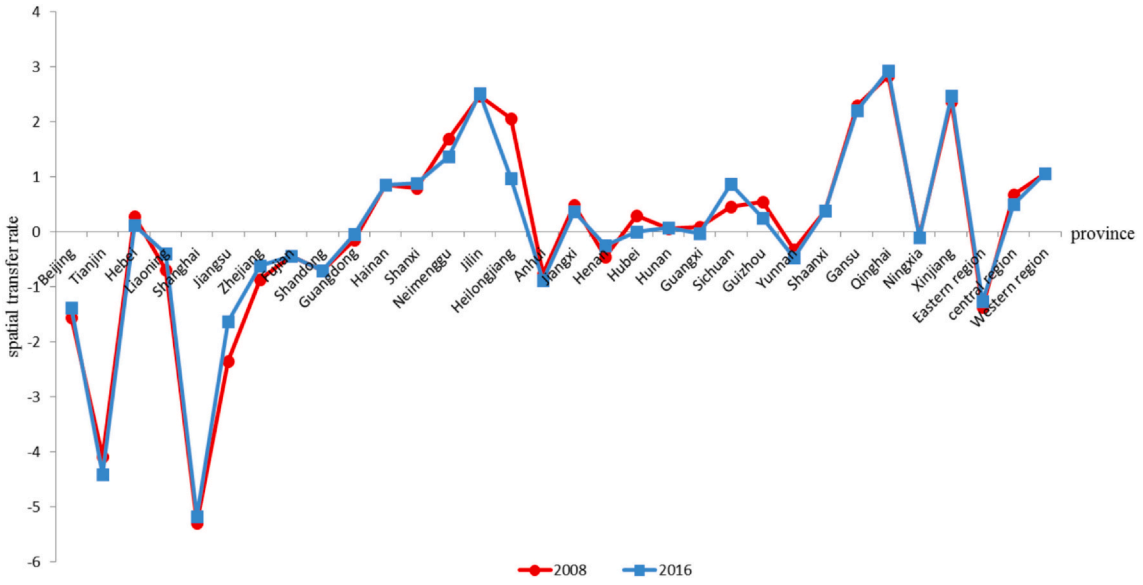

Fig. 3. Spatial transfer rates of forest tourism benefits.

Specifically, forest tourism benefits in Heilongjiang, Jiangsu, Sichuan, Tianjin, and Inner Mongolia underwent significant dynamic changes. Judging from the changes before and after the tax reforms (2008 and 2016), there was an inward transfer of benefits in Hubei and Guangxi in 2008, but it changed to an outward transfer thereafter. Additionally, the transfer rate in 2016 was closer to the fair benefits level. Meanwhile, the rate of outward transfer of benefits in Beijing and Guangdong also declined. Other changes in the transfer rate are reflected in the eastern coastal areas, such as Jiangsu and Zhejiang. Unlike Beijing and Guangdong, the rates of the outward transfer of benefits in Tianjin and Anhui increased—the rate in Tianjin increased from 409.1% to 442.0%, and the rate in Anhui increased from 77.0% to 88.5%. Corresponding to those areas with an outward transfer of benefits, the transfer in Hebei, Inner Mongolia, and Shanxi were all inward transfers. The largest decline in the inward transfer of benefits occurred in Heilongjiang, from 204.7% in 2008 to 96.6% in 2016. Conversely, in the same period, the transfer rates of forest tourism benefits in Qinghai and Sichuan increased.

Overall, the distribution of benefits among different regions is not in accordance with fair benefits. The distribution of benefits is

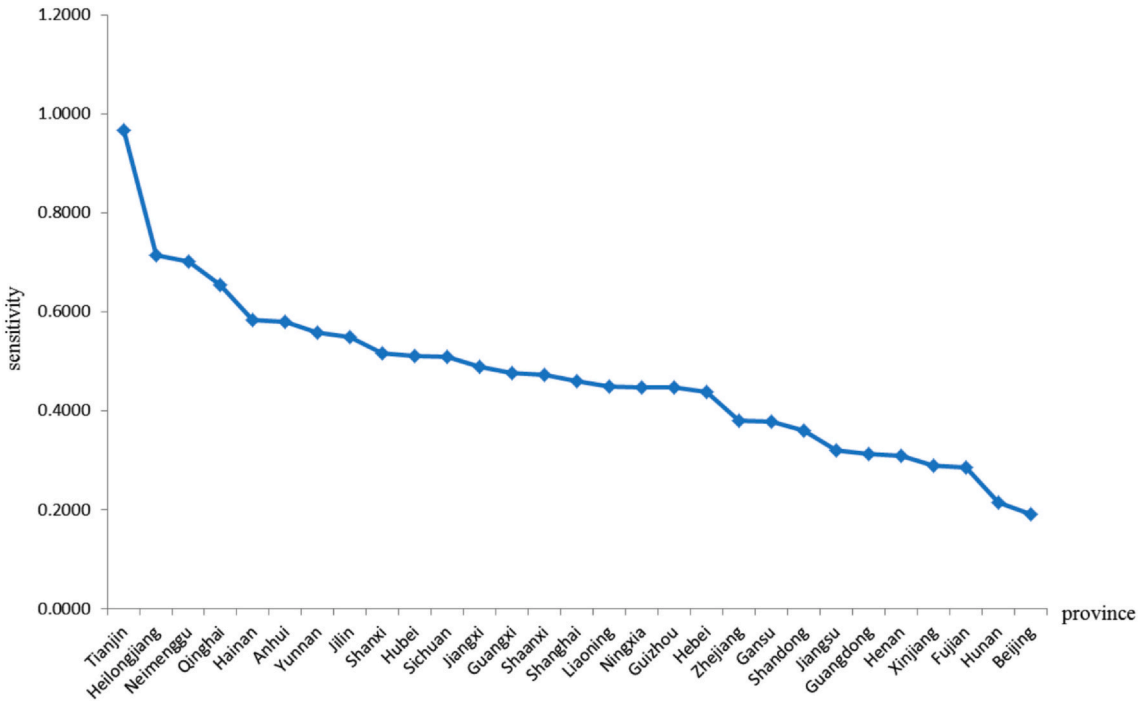

Fig. 4. Sensitivity of regional benefits to technological and institutional changes.

subject to transfer, and changes in the transfer of benefits are significant, which can be highly unstable. Compared to the economically developed eastern areas, although the economy in the central and western regions is relatively backward, the transfer of benefits ensures that the benefits of forest tourism are distributed in a manner that reduces the wide economic gap between regions. Additionally, the transfer has not only significantly changed the distribution pattern among regions, but also helped to balance the structure of the regional forest resource capital input and further strengthened the economic support provided by the eastern region to the central and western regions. Therefore the distribution of forest tourism benefits among regions is also relatively fair. Though the distribution of benefits does not follow the calculated fair distribution of benefits, the transfer of benefits among regions and the level of development of the regional economy are complementary. The benefits that are transferred to the central and western regions, to some extent, compensate for their less-developed economy. Overall, the results of the empirical test validate the rationality of the model established in this study. Additionally, the quantification of the distribution of forest tourism benefits provides a practical insight into the structural optimization of forest tourism capital inputs by central and local governments.

4.5.3. Sensitivity to technological and institutional changes

As mentioned above, to reveal the influence of technology, institutions, and other factors on forest tourism benefits, the interaction effect ($\lambda_i f_t$) between the load coefficient and the common factor is introduced into the model. As mentioned earlier, the common factor f_t exemplifies a declining trend, indicating that technology and institutional factors play a positive role in the construction of the infrastructure for forest tourism. Fig. 4 shows the sensitivity of the technological progress and institutional change to the distribution of benefits in different regions, that is, the estimated results ofλ_i. Fig. 4 shows that load coefficients vary in different regions, indicating the different effects on the common factor in different regions. Some areas are relatively sensitive to technological and institutional changes, such as Tianjin, Heilongjiang, Inner Mongolia, Qinghai, and Hainan, while others are relatively insensitive to technological and institutional changes, such as Beijing, Hunan, Fujian, Xinjiang, and Henan.

5. Conclusions

To facilitate a fair distribution of benefits of forest tourism among different regions and economic subjects, this study establishes a theoretical model of the distribution of benefits by building on the income distribution model and by introducing constraint conditions, which are data-driven. Chinese provincial panel data are used for the empirical analysis, and the iterative algorithm is adopted to solve the model and thus, to quantify the distribution of benefits. This analysis leads to the following conclusions.

First, urban residents and the government enjoy large shares of the benefits from forest tourism, while enterprises enjoy a smaller share. On the one hand, as urban residents are the main consumers of forest tourism, they obtain more than 40% of the forest tourism benefits. On the other hand, forest tourism emerged late in China, and hence, its development mainly depends on the government's infrastructure construction and capital input. Hence, as the government strongly supports the development of forest tourism and owns the resources, it obtains more than 30% of the benefits. Enterprises only receive 5.75% of the total of the benefits of forest

tourism.

Second, after tax reforms, the proportion of benefits received by the government decreased from 48.58% to 34.75%. Enterprises also witnessed a decrease in their share of benefits. Residents witnessed an increase in their share of benefits. Forest tourism inevitably leads to the destruction of the environment, which will ultimately be paid for by residents. Therefore, the government must transfer its own benefits to residents as compensation. The fact that this occurred suggests that the established model for the distribution of forest tourism benefits is fair.

Third, the forest tourism benefits of rural residents are lower than those of urban residents. The main cause of this is that forest resources are concentrated in rural and mountainous areas, and, with the continuous increase in urbanization, an increasing number of urban residents enjoy forest tourism. Forests are restricted by their ecological carrying capacity, and the ecological damage caused to rural residents by tourists should be compensated by benefits. However, due to the implementation of the new urbanization strategy in China, the rural population keeps migrating to cities, which increases the gap in the distribution proportions of forest tourism benefits between rural and urban residents.

Fourth, by comparing the overall distribution proportions of benefits in different regions, we find that there is no obvious change in the pattern. Forest tourism benefits are transferred out of the eastern region and into the central and western regions. From a vertical perspective, the transfer of benefits among regions is highly unstable; that is, it does not exhibit a gradual change from east to west. Irrespective of whether it is before or after the tax reforms, the central and western regions gain more benefits than the eastern region. However, the transfer of benefits has narrowed the economic gap between regions. The eastern region supports the less-developed central and western regions and improves the capital input structure of forest resources.

6. Discussion

Due to the policies on forest tourism implemented by the government in 2009, the distribution of forest tourism benefits is no longer tilted toward the government and enterprises; it is now more inclined to the residents. Therefore, considering the public nature of forest resources, the empirical results of this study verify that the distribution of benefits among economic subjects is fair. This provides evidence for the pricing of environmental compensation for forest tourism resources. The model is conducive to motivating residents to participate in forest resource management. At present, the central and local governments attach great importance to tourism, especially forest tourism, and constantly increase the inputs necessary to construct the infrastructure for forest tourism. However, the input structure is not reasonable as the transfer mechanism of benefits among regions is not fully considered. When investing in the construction of infrastructure for local forest tourism, the economic conditions should be taken as the basis to ensure that the economically underdeveloped areas can obtain more forest tourism benefits and carry out the construction of infrastructure for forest tourism in the future. This would improve the rationality of the forest tourism input structure.

The theoretical model established in this study provides a reference for the fair distribution of benefits during the development of forest tourism in a new era. The construction of infrastructure for forest tourism cannot be separated from the financial support of the government and the active participation of the residents. In different development stages, the stakeholders of forest tourism are different, and the key to the fair distribution of benefits is to distinguish the major stakeholders from the secondary stakeholders. The issue of forest tourism benefits distribution should be analyzed from the perspective of stakeholders to provide theoretical support for fair distribution to each stakeholder. This perspective is essential for providing a scientific decision-making reference to governments to ensure that they can enact appropriate forest tourism development strategies. This includes quantifying the ecological compensation mechanism according to the subjects and regions. Analyzing the transfer mechanism of benefits among different regions and optimizing the input structure of forest tourism construction funds in each area are conducive to establishing an ecological compensation mechanism among the regions. This will stimulate social subjects to appropriately utilize resources, protect the environment, and push forward forest tourism development.

Due to data limitations, this study mainly focuses on the distribution of benefits among the government, enterprises, urban residents, rural residents, and regions. There are several other direct and indirect stakeholders that require attention. Future research should further refine the sample regions, expand the economic subjects of benefits distribution based on the data of China's prefecture-level cities, and conduct an in-depth analysis of the tourism benefits of forest parks at different stages and levels of development. Finally, it should be mentioned that due to the lack of statistical data, the theoretical model of the distribution of benefits established in this study has its limitations. The distribution involves only three sectors; the model is not fully applicable to the distribution among multiple departments. The multi-sectoral fair distribution of benefits can be further improved based on the theoretical model built in this study, which is also a problem and hence, must be examined in the future. Additionally, different sample data obtained by empirical analysis or different indexes used may lead to different results concerning the distribution of the benefits of forest tourism. In this study, a theoretical model of distribution is constructed and solved by using the iterative algorithm to quantify the distribution result of the benefits of forest tourism. Based on theoretical and empirical analyses, a new research perspective is provided for the government to analyze the distribution of forest tourism benefits.

Declaration of interests

None.

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