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A model of cross-border tourism competition

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Abstract

This paper analyzes the situation in which the citizens of two countries have the opportunity to travel domestically and cross the border of the other country. The governments of both countries are assumed to be attempting to maximize the social welfare of their respective countries by choosing the appropriate domestic tax rates. The domestic tax serves as the source of funding for the improvements to the infrastructure of domestic tourism, including the areas of security, public facilities, natural areas, and artificial scenic construction. In the process, both governments compete for the attention of tourists. Each country in this game has a tourism industry in place. The two competing industries set the prices of their services, including entrance fees, to maximize their profits and overtake each other. We consider two cases in the sequential game: the case in which the tourism industry is the leader and the case in which the government is the leader. We consider the factors that influence the tax rate and national income of both countries and identify a feasible strategy for their governments to maintain the attractiveness of their respective countries to tourists while remaining competitive. Although we derive the outcome of each sequential game, it is not easy to compare them in general cases. Hence, we assume several specific sets of parameters representing consumer preference, and then analyze the possible outcomes based on the strategic form where both agents choose the leadership or not. According to the results of the simulation, it is found that there are so many possible patterns. Especially, it is shown that the leadership of governments does not always guarantee better outcomes for consumers.

Key words: tourism, competition, sequential game, cross-border

1. Introduction

Tourism has long been part of the economy. Specifically, it serves as a kind of resource that performs an important role in national economies. With the rise of globalization, cross-border tourism has grown and induced intense competitive among counties. We define tourism as follows:

“Tourism is deemed to include any activity concerned with the temporary short-term movement of people to destinations outside the places where they normally live and work, and their activities during the stay at these destinations.” (Burkart and Medlik, 1974)

In our discussion of tourism, we also consider the term “tourism product.” We define it as a series of interrelated services, namely, services produced from various industries (economics), community services (social aspect), and natural services.

Mason (2000) formulated the following components of tourism products:

1. *Attractions: Natural, cultural, or man-made attractions such as festivals or performing arts.*
2. *Accessibility: The ease of obtaining or achieving organizational goals, such as those for tourism (travel agents)*
3. *Amenities: Facilities in place to deliver pleasure such as accommodation, cleanliness, and hospitality.*
4. *Networking: The network of cooperation related to the products offered locally, nationally, and internationally.*

Let us now consider the supply and demand from the perspective of tourism product. The following are the impacts of tourism on the economy:

- Income (value added) generation
- Employment generation
- Tax revenue generation
- Balance of payment effects
- Improvement of the economic structure of a region
- Encouragement of entrepreneurial activity
- Economic disadvantages

As for the economic impact of cross-border tourism, the foreign exchange reserves of the national economy increase, and regional industrial development improves. Cross-border tourism also contributes to the increase in employment and taxes.

"*Annual Report of China Outbound Tourism Development*" is the report from China Tourism Research Institute Annual, is the important data of the research of the economic effects of tourism.

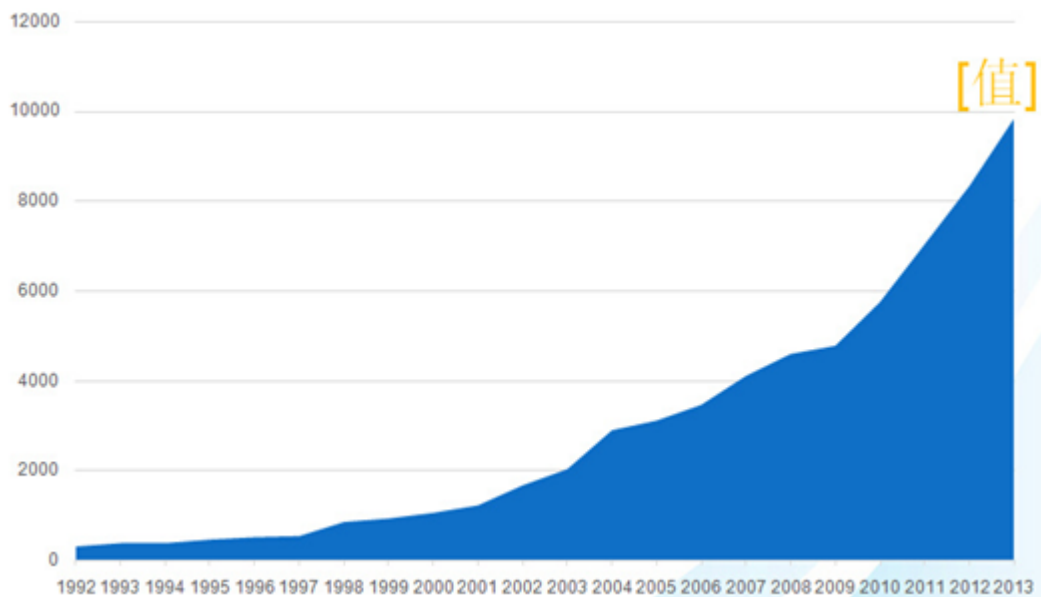


Figure 1. Chinese cross-border tourism longitudinal comparison of population growth from 1992 to 2013. (Unit: million passengers)

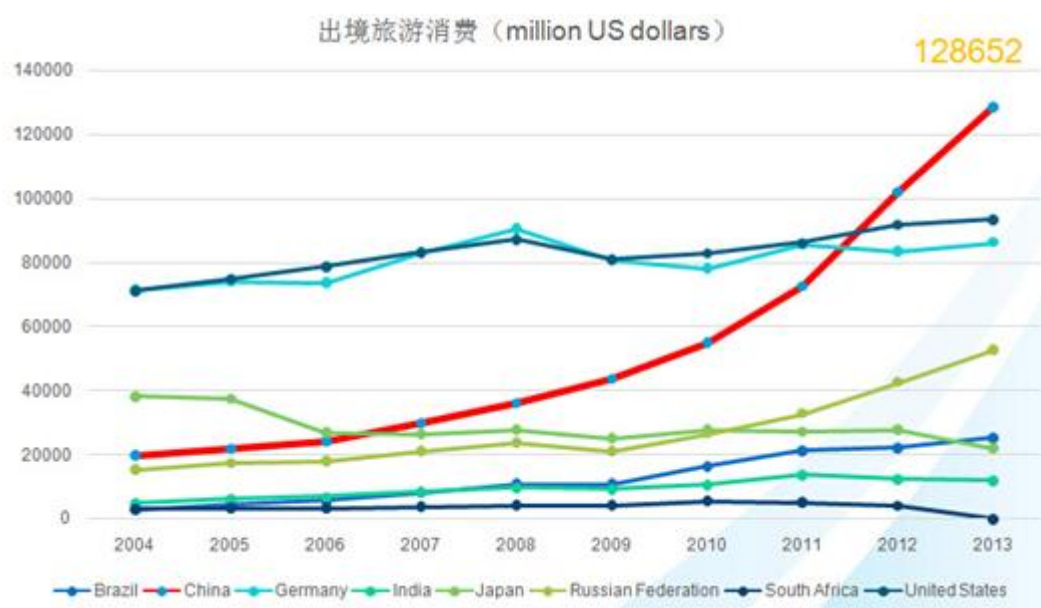


Figure 2. The comparison with other countries of Chinese tourists cross-border consumption. (Unit: million US dollars)

We can see from the report and the figure, cross-border tourism has become another form of international trade. The local consumption of tourists can be seen as another form of merchandise exports.

Obviously, in the limit range that can be supported cross-border tourism is the fruitful role of the national economy. To some extent, tourism is a shortcut to a rapid economic development, if public construction is completed. Bird (1991) explained the same in his book on tax policy and economic development.

However, cross-border tourism is very different from domestic tourism, especially because it comprises several other factors.

The factors of the host country:

Tourism resources are targets regardless of type. Consumer price index, inflation rate, and exchange rate of the host country are major impact factors.

Archer (1987) explored demand forecasting and estimation in travel, tourism, and hospitality. Artus (1970) focused on the effect of revaluation on the foreign travel balance of Germany. Chadee and Mieczkowski (1987) performed an empirical analysis of the effects of exchange rates on Canadian tourism.

Tourism resources are widely available all over the world. Given that they are alternatively distributed, they are indicative of the importance of the destination choices of tourists who seek cheap tourism products. Regardless of the development of tourism resources and the industry, high tourism prices that continue to increase yearly will cause the tourism demand to flow to other countries. Martin and Witt (1988) investigated substitute prices in models of tourism demand. Rosenweing (1988) expressed the same view on his paper about the elasticities of substitution in Caribbean tourism demand.

Impact factors such as security, hygiene, and climate are equally important to tourism. Walsh (1996) performed a demand analysis of Irish tourism. In some instances, such as the Revolution of Thailand or the Hong Kong umbrella revolution, these factors generate greater impact than economic factors.

The factors of sending country:

Departure tourism depends on the economic development of the country and is specifically determined by its foreign exchange reserves, leisure opportunities, and income level. Martin and Witt (1987) developed tourism demand forecasting models and emphasized the importance of choosing an appropriate variable to represent tourists' cost of living. Geyikdagi (1995) studied the related effects of investments on tourism development and the demand for travel.

Occupational structure is another tourism factor, given that tourism opportunities are often taken advantage of by company management, scholars, and researchers and not by family units. Gunadhi and Boey (1986) focused on the demand elasticities of tourism in Singapore.

Demographic composition, such as urbanization or classification of cultural level, is now regarded as another important factor. Tie-Sheng and Li-Cheng (1985) noted the same issues in their paper "Domestic tourist development in China: A regression analysis." In fact, urban dwellers in developed countries are interested in rural tourism in other countries. By contrast, urban dwellers in developing countries enjoy the urban tourism in developed countries.

Impact factors of host country and sending country:

The political relationship between the host country and the sending country sometimes lie in their economic relations, which become a decisive influence on tourism demand. The balance of payments, interest rates, monetary policies, and exchange rates also have a decisive impact in general. When the national currency devaluates, tourism prices tend to attract foreign tourists, thereby stimulating the growth of the tourism industry. However, such principle is not simple to generalize. Take for example Japan's recent monetary easing policy referred to as "The Abe Mix." Although this policy has improved the export-oriented enterprises and the status of the tourism industry, it failed to play a significant role in enhancing the overall economy of the country.

As previously mentioned, if a country can sustain their tourism numbers while continuously attracting more tourists, the national economy is likely to be given a boost. The issue is the limited number of tourists, which makes a competitive tourism market particularly important for governments.

Suppose all the impact factors of the tourism industry, such as security, public facilities, can be regulated to improve the maintenance of natural areas, artificial scenic construction, and so on. We represent the areas for improvement as T . The government uses taxes to improve its preparedness for T and increase its tourism competitiveness. In this way, we can study how the government uses the tax leverage to achieve the most favorable outcome as it competes with another country.

Unfortunately, references related to this subject are limited. Most studies are focused on areas such as one commodity trafficking, the local economic structure, and household income. The material on competition between countries is relatively few. An example is the work of García-Ferrer (1997), who explored forecasting international tourism demand in Spain. The few studies that explore competition between countries include the works of Vasilios (1987) and Papatheodorou (1999), in which they examined the sightseeing competition game between Mediterranean countries from an empirical perspective and the demand for international tourism in the Mediterranean region, respectively. Meanwhile, Eadigton and Redman (1991) explored economics and tourism, Gonzalez and Moral (1995) analyzed international tourism in Spain, and White (1985) released an international travel demand model for US travel to Western Europe. Hence, competition between countries, especially in terms of tourism, is an interesting area of research that is explored in the present work.

The rest of the paper is organized as follows. Section 2 discusses the utility and surplus functions of consumers in the two countries participating in the game. Section 3 presents the sequential game in the case where the tourism industry is the leader. Section 4 explains the sequential game in the case where the government is the leader. In these games, we determine the exact role of the government. Section 5 compares results of the both case. The last section provides concluding remarks of this paper.

2. Consumer Behavior

Let us consider two countries, namely, Country 1 and Country 2. The citizens of the two countries refuse to relocate to the other country because of employment considerations. They only prefer to travel for leisure purposes. Harmonious political relations are assumed to exist between the two governments, and no artificial obstacles to movement are established. We also suppose that all the impact factors of the tourism industry, such as security and public facilities, can be controlled to improve the maintenance of natural areas, artificial scenic construction, and so on. These areas of improvement are denoted as T . For country 1, all the factors can be represented by T_1 . The same is assumed for country 2. The governments use taxes to improve their preparedness for T and to compete for tourists. In this model, the governments only impose income tax to residents and use this tax to improve T .

Domestic tourism and foreign tourism are regarded as substitute goods. For a simple analysis, we assume that the market demand structure, including the cost of enterprises, is a straight line. We then analyze the consumers in country 1 and country 2.

For the consumers of country 1, we use n_1 to denote its domestic travel frequency and p_1 to denote its tourism ticket price (assuming that the toll is already included in the ticket cost). We use n_2 to denote the country's cross-border tourism frequency and p_2 to denote the tourism ticket price (assuming that the toll is also already included in the ticket cost). w_1 is the wage rate of country 1, and r_1 is its income tax rate. Following Sakai (1990), the consumer utility U_1 is then given as

$$U_1 = \alpha_1 T_1 n_1 + \alpha_2 T_2 n_2 - \frac{1}{2}(\beta_1 n_1^2 + 2\gamma_1 n_1 n_2 + \beta_2 n_2^2).$$

In the expression, $\alpha_1, \alpha_2, \beta_1, \beta_2, \gamma_1$ are constants. Their relations are as follows:

$$\begin{aligned} \alpha_1, \alpha_2 &> 0, \\ \beta_1, \beta_2 &> 0, \\ \beta_1 \beta_2 &> \gamma_1^2, \\ \alpha_1 \beta_2 - \alpha_2 \gamma_1 &> 0, \\ \alpha_2 \beta_1 - \alpha_1 \gamma_1 &> 0. \end{aligned}$$

We also observe a competitive relationship between T_1 and T_2 . Consumer surplus is the utility minus the total cost of domestic and cross-border tourism and the income tax.

$$L_1 = U_1 - p_1 n_1 - p_2 n_2 - r_1 w_1$$

Consumer action depends on the way consumer surplus is maximized. We can use a partial differential equation for the function L_1 to derive an optimum n_1 and n_2 .

$$\begin{aligned} \frac{\partial L_1}{\partial n_1} &= \alpha_1 T_1 - \beta_1 n_1 - \gamma_1 n_2 - p_1 = 0 \\ \frac{\partial L_1}{\partial n_2} &= \alpha_2 T_2 - \beta_2 n_2 - \gamma_1 n_1 - p_2 = 0 \end{aligned}$$

$$\begin{aligned} n_1^* &= a_1 - b_1 p_1 + c_1 p_2 \\ n_2^* &= a_2 - b_2 p_2 + c_1 p_1 \end{aligned}$$

where,

$$a_1 = \frac{\alpha_1 \beta_2 T_1 - \alpha_2 \gamma_1 T_2}{\beta_1 \beta_2 - \gamma_1^2},$$

$$b_1 = \frac{\beta_2}{\beta_1 \beta_2 - \gamma_1^2},$$

$$c_1 = \frac{\gamma_1}{\beta_1 \beta_2 - \gamma_1^2},$$

$$a_2 = \frac{\alpha_2 \beta_1 T_2 - \alpha_1 \gamma_1 T_1}{\beta_1 \beta_2 - \gamma_1^2},$$

$$b_2 = \frac{\beta_1}{\beta_1 \beta_2 - \gamma_1^2}.$$

For the consumers of country 2, basically, we use the same variables as those for country 1. We use n_4 to denote the domestic travel frequency of country 2 and p_2 to denote the tourism ticket price (assuming that the toll is already included in the ticket cost). We use n_3 to represent cross-border tourism frequency of country 2 and p_1 to represent the tourism ticket (assuming that the toll is also already included in the ticket cost). w_2 is the wage rate of country 2, and r_2 is its income tax rate. The consumer utility U_2 is then given as

$$U_2 = \alpha_3 T_1 n_3 + \alpha_4 T_2 n_4 - \frac{1}{2}(\beta_3 n_3^2 + 2\gamma_2 n_3 n_4 + \beta_4 n_4^2).$$

In the expression, $\alpha_3, \alpha_4, \beta_3, \beta_4, \gamma_2$ are constants. Their relationships are as follows:

$$\begin{aligned} \alpha_3, \alpha_4 &> 0, \\ \beta_3, \beta_4 &> 0, \\ \beta_3 \beta_4 &> \gamma_2^2, \\ \alpha_3 \beta_4 - \alpha_4 \gamma_2 &> 0, \\ \alpha_4 \beta_3 - \alpha_3 \gamma_2 &> 0. \end{aligned}$$

Similarly, consumer surplus is the utility minus the total cost of the domestic and cross-border tourism and the income tax.

$$L_2 = U_2 - p_1 n_3 - p_2 n_4 - r_2 w_2$$

Consumer action also depends on how consumer surplus is maximized. We can employ a partial differential equation for function L_2 to derive an optimum n_3 and n_4 .

$$\frac{\partial L_2}{\partial n_3} = \alpha_3 T_1 - \beta_3 n_3 - \gamma_2 n_4 - p_1 = 0$$

$$\frac{\partial L_2}{\partial n_4} = \alpha_4 T_2 - \beta_4 n_4 - \gamma_2 n_3 - p_2 = 0$$

$$n_3^* = a_3 - b_3 p_1 + c_2 p_2$$

$$n_4^* = a_4 - b_4 p_2 + c_2 p_1$$

where,

$$a_3 = \frac{\alpha_3 \beta_4 T_1 - \alpha_4 \gamma_2 T_2}{\beta_3 \beta_4 - \gamma_2^2},$$

$$b_3 = \frac{\beta_4}{\beta_3 \beta_4 - \gamma_2^2},$$

$$c_2 = \frac{\gamma_2}{\beta_3 \beta_4 - \gamma_2^2},$$

$$a_4 = \frac{\alpha_4 \beta_3 T_2 - \alpha_3 \gamma_2 T_1}{\beta_3 \beta_4 - \gamma_2^2},$$

$$b_4 = \frac{\beta_3}{\beta_3 \beta_4 - \gamma_2^2}.$$

3. Sequential game: the tourism industry as the leader

Sequential games with perfect information are often solved by backward induction. At this point, we have calculated the factors that affect domestic and cross-border tourism frequency. Hence, we can now focus on how the government sets up a personal income tax rate to achieve the highest social welfare. Then, we can determine the initial pricing strategy of enterprises based on the personal income tax and corporate profit function.

As we mentioned previously, the government in this model exists to ensure their social welfare in each country. All policies are based on this condition.

For the government of country 1:

We suppose that the government collects all the income taxes to improve T_1 , that is, $T_1 = r_1 w_1$. Social welfare V_1 is equal to the sum of consumer surplus and corporate profit. Since we assume no costs for providing services of the tourism industry. That is, $V_1 = L_1 + p_1(n_1 + n_3)$,

where,

$$L_1 = U_1 - p_1 n_1 - p_2 n_2 - r_1 w_1,$$

$$U_1 = \alpha_1 T_1 n_1 + \alpha_2 T_2 n_2 - \frac{1}{2}(\beta_1 n_1^2 + 2\gamma_1 n_1 n_2 + \beta_2 n_2^2).$$

By substituting $T_1 = r_1 w_1$, n_1^* , n_2^* and n_3^* into the social welfare function V_1 , we obtain

$$\begin{aligned} V_1 = L_1 + p_1 n_1 + n_3 &= \alpha_1 \left(\frac{\alpha_1 \beta_2 w_1 r_1 - \alpha_2 \gamma_1 T_2}{\beta_1 \beta_2 - \gamma_1^2} - b_1 p_1 + c_1 p_2 \right) r_1 w_1 + \alpha_2 T_2 \left(\frac{\alpha_2 \beta_1 T_2 - \alpha_1 \gamma_1 w_1 r_1}{\beta_1 \beta_2 - \gamma_1^2} - b_2 p_2 + \right. \\ &\quad \left. c_1 p_1 \right) - \frac{1}{2} \beta_1 \left(\frac{\alpha_1 \beta_2 w_1 r_1 - \alpha_2 \gamma_1 T_2}{\beta_1 \beta_2 - \gamma_1^2} - b_1 p_1 + c_1 p_2 \right)^2 - \\ \gamma_1 &\frac{\alpha_1 \beta_2 w_1 r_1 - \alpha_2 \gamma_1 T_2}{\beta_1 \beta_2 - \gamma_1^2} - b_1 p_1 + c_1 p_2 \frac{\alpha_2 \beta_1 T_2 - \alpha_1 \gamma_1 w_1 r_1}{\beta_1 \beta_2 - \gamma_1^2} - b_2 p_2 + c_1 p_1 - \frac{1}{2} \beta_2 \frac{\alpha_2 \beta_1 T_2 - \alpha_1 \gamma_1 w_1 r_1}{\beta_1 \beta_2 - \gamma_1^2} - \end{aligned}$$

$$b_2 p_2 + c_1 p_1 - p_2 \left(\frac{\alpha_2 \beta_1 T_2 - \alpha_1 \gamma_1 w_1 r_1}{\beta_1 \beta_2 - \gamma_1^2} - b_2 p_2 + c_1 p_1 \right) - w_1 r_1 + p_1 \left(\frac{\alpha_3 \beta_4 w_1 r_1 - \alpha_4 \gamma_2 T_2}{\beta_3 \beta_4 - \gamma_2^2} - b_3 p_1 + c_2 p_2 \right).$$

The income tax rate r_1 is in the social welfare function V_1 ; thus, the government can control V_1 by choosing the income tax rate r_1 .

As mentioned previously, the government in this model exists to ensure their social welfare. We can employ a partial differential for the function V_1 to derive the optimal income tax rate r_1 .

We obtain the optimal tax rate r_1^* as follows.

$$r_1^* = \frac{r_2 w_2 K_1 + \theta_1 + \varphi_1}{Q_1 w_1}$$

where,

$$Q_1 = \frac{\alpha_1^2 \beta_2}{\beta_1 \beta_2 - \gamma_1^2},$$

$$K_1 = \frac{\alpha_1 \alpha_2 \gamma_1}{\beta_1 \beta_2 - \gamma_1^2},$$

$$\theta_1 + \varphi_1 = p_1 b_1 \alpha_1 + \frac{\alpha_1 \gamma_1^2 - \alpha_1 \beta_1 \beta_2}{\beta_1 \beta_2 - \gamma_1^2} - \frac{\alpha_3 \beta_4}{\beta_3 \beta_4 - \gamma_2^2} - p_2 c_1 \alpha_1 + \frac{\alpha_1 \gamma_1^2 - \alpha_1 \beta_1 \beta_2}{\beta_1 \beta_2 - \gamma_1^2} + \frac{\alpha_1 \gamma_1}{\beta_1 \beta_2 - \gamma_1^2} + 1.$$

A competitive relationship obviously exists between the tax rates of the two countries. Assume that the government of country 2 sets a relatively high income tax rate to increase its investments for the improvement of all the factors that can be controlled to compete for tourists. In this case, the only strategy for the government of country 1 is to raise their own tax rates and use it to develop their own tourism resources. In this way, country 1 remains attractive to tourists while sustaining its position in the game.

For the government of country 2:

Similarly, social welfare V_2 is given as $V_2 = L_2 + p_2(n_2 + n_4)$,

where,

$$L_2 = U_2 - p_1 n_3 - p_2 n_4 - w_2 r_2,$$

$$U_2 = \alpha_3 T_1 n_3 + \alpha_4 T_2 n_4 - \frac{1}{2} (\beta_3 n_3^2 + 2\gamma_2 n_3 n_4 + \beta_4 n_4^2).$$

By substituting $T_2 = r_2 w_2$, n_2^* , n_3^* and n_4^* into the social welfare function V_2 , we obtain

$$V_2 = L_2 + p_2 (n_2 + n_4) = \alpha_3 \left(\frac{\alpha_3 \beta_4 T_1 - \alpha_4 \gamma_2 w_2 r_2}{\beta_3 \beta_4 - \gamma_2^2} - b_3 p_1 + c_2 p_2 \right) T_1 + \alpha_4 w_2 r_2 \left(\frac{\alpha_4 \beta_3 w_2 r_2 - \alpha_3 \gamma_2 T_1}{\beta_3 \beta_4 - \gamma_2^2} - b_2 p_2 + c_1 p_1 \right) - \frac{1}{2} \beta_3 \left(\frac{\alpha_3 \beta_4 T_1 - \alpha_4 \gamma_2 w_2 r_2}{\beta_3 \beta_4 - \gamma_2^2} - b_3 p_1 + c_2 p_2 \right)^2 - \gamma_2 \left(\frac{\alpha_3 \beta_4 T_1 - \alpha_4 \gamma_2 w_2 r_2}{\beta_3 \beta_4 - \gamma_2^2} - b_3 p_1 + \right.$$

$$c_2 p_2) \left(\frac{\alpha_4 \beta_3 w_2 r_2 - \alpha_3 \gamma_2 T_1}{\beta_3 \beta_4 - \gamma_2^2} - b_2 p_2 + c_1 p_1 \right) - \frac{1}{2} \beta_4 \left(\frac{\alpha_4 \beta_3 w_2 r_2 - \alpha_3 \gamma_2 T_1}{\beta_3 \beta_4 - \gamma_2^2} - b_2 p_2 + c_1 p_1 \right)^2 -$$

$$p_1 \left(\frac{\alpha_3 \beta_4 T_1 - \alpha_4 \gamma_2 w_2 r_2}{\beta_3 \beta_4 - \gamma_2^2} - b_3 p_1 + c_2 p_2 \right) - w_2 r_2 + p_2 \left(\frac{\alpha_2 \beta_1 w_2 r_2 - \alpha_1 \gamma_1 T_1}{\beta_1 \beta_2 - \gamma_1^2} - b_2 p_2 + c_1 p_1 \right).$$

Again, we observe the income tax rate r_2 in the social welfare function V_2 ; thus, the government can control V_2 by choosing the income tax rate r_2 .

Similarly, we determine the optimal tax rate r_2^* as follows.

$$r_2^* = \frac{w_1 r_1 K_2 + \theta_2 + \varphi_2}{Q_2 w_2}$$

where,

$$Q_2 = \frac{\alpha_4^2 \beta_3}{\beta_3 \beta_4 - \gamma_2^2}$$

$$K_2 = \frac{\alpha_3 \alpha_4 \gamma_2}{\beta_3 \beta_4 - \gamma_2^2}$$

$$\theta_2 + \varphi_2 = p_2 \left[b_4 \alpha_4 + \frac{\alpha_4 \gamma_2^2 - \alpha_4 \beta_3 \beta_4}{\beta_3 \beta_4 - \gamma_2^2} - \frac{\alpha_2 \beta_1}{\beta_1 \beta_2 - \gamma_1^2} - p_1 \right] - c_2 \left[\alpha_4 + \frac{\alpha_4 \gamma_2^2 - \alpha_4 \beta_3 \beta_4}{\beta_3 \beta_4 - \gamma_2^2} + \frac{\alpha_4 \gamma_2}{\beta_3 \beta_4 - \gamma_2^2} + 1 \right]$$

The same effects can be observed for the government of country 2. When the government of country 1 sets a considerably high income tax rate to increase its investments for improving the factors that can be regulated to compete for tourists, the only strategy for the government of country 2 is to raise its own tax rates and use this tax to develop its own tourism resources. That is, tax rates determined by the two governments are *strategic compliments* in this case.

The equations of the optimal tax rates, namely r_1^* and r_2^* , are the reaction functions of the two countries. From these equations, we can find the Nash equilibrium tax rates as follows.

$$r_1^e = \frac{1}{w_1} \left(\frac{p_1 A_1 + p_2 B_1 + Q_2 + K_1}{Q_1 Q_2 - K_1 K_2} \right)$$

$$r_2^e = \frac{1}{w_2} \left(\frac{p_1 A_2 + p_2 B_2 + Q_1 + K_2}{Q_1 Q_2 - K_1 K_2} \right)$$

where,

$$A_1 = -\frac{\alpha_3 \beta_4}{\beta_3 \beta_4 - \gamma_2^2} Q_2 - \frac{\alpha_4 \gamma_2}{\beta_3 \beta_4 - \gamma_2^2} K_1 < 0$$

$$B_1 = -\frac{\alpha_2 \beta_1}{\beta_1 \beta_2 - \gamma_1^2} K_1 - \frac{\alpha_1 \gamma_1}{\beta_1 \beta_2 - \gamma_1^2} Q_2 < 0$$

$$A_2 = -\frac{\alpha_3 \beta_4}{\beta_3 \beta_4 - \gamma_2^2} K_2 - \frac{\alpha_4 \gamma_2}{\beta_3 \beta_4 - \gamma_2^2} Q_1 < 0$$

$$B_2 = -\frac{\alpha_2 \beta_1}{\beta_1 \beta_2 - \gamma_1^2} Q_1 - \frac{\alpha_1 \gamma_1}{\beta_1 \beta_2 - \gamma_1^2} K_2 < 0$$

It is clear that no direct relationship exists between the equilibrium tax rates and the wage rates of the two countries at the Nash equilibrium. Then, in the equilibrium,

$$T_1^e = r_1^e \cdot w_1 = \frac{p_1 A_1 + p_2 B_1 + Q_2 + K_1}{Q_1 Q_2 - K_1 K_2}$$

$$T_2^e = r_2^e \cdot w_2 = \frac{p_1 A_2 + p_2 B_2 + Q_1 + K_2}{Q_1 Q_2 - K_1 K_2}$$

Both governments use taxes to improve their preparedness for T as their effort to compete for tourists. In this model, the governments impose income tax to their residents and use such tax to improve T . It is clear that in the equilibrium the level of taxation and thus T are affected by the tourism price set by tourism enterprises. Since it can be readily shown that $Q_1 Q_2 - K_1 K_2 > 0$, and A_1, A_2, B_1, B_2 are negative, T are negatively related with the prices. In other words, it is *strategic substitute* with the prices determined by the tourism enterprises. For example, even if the domestic tourism enterprise raises the price, the government lowers tax rate and thus its investment T for tourism.

For the tourism industry of country 1:

We assess the initial pricing strategy set by the tourism industry as the leader. Given that the government in this model does not levy the corporate tax, the corporate profit can be written simply as

$$\pi_1 = p_1(n_1^e + n_3^e),$$

where,

$$n_1^e = \frac{\alpha_1 \beta_2 \left(\frac{p_1 A_1 + p_2 B_1 + Q_2 + K_1}{Q_1 Q_2 - K_1 K_2} \right) - \alpha_2 \gamma_1 \left(\frac{p_1 A_2 + p_2 B_2 + Q_1 + K_2}{Q_1 Q_2 - K_1 K_2} \right)}{\beta_1 \beta_2 - \gamma_1^2} - b_1 p_1 + c_1 p_2,$$

$$n_3^e = \frac{\alpha_3 \beta_4 \left(\frac{p_1 A_1 + p_2 B_1 + Q_2 + K_1}{Q_1 Q_2 - K_1 K_2} \right) - \alpha_4 \gamma_2 \left(\frac{p_1 A_2 + p_2 B_2 + Q_1 + K_2}{Q_1 Q_2 - K_1 K_2} \right)}{\beta_3 \beta_4 - \gamma_2^2} - b_3 p_1 + c_2 p_2.$$

The action of the tourism industry is simply to maximize its corporate profit. We can employ the first order condition to derive an optimum price p_1^* .

$$p_1^* = \frac{-p_2 g_1 - H_1}{f_1},$$

where,

$$f_1 = \frac{2A_1 \alpha_1 \beta_2 - 2A_2 \alpha_2 \gamma_1}{(Q_1 Q_2 - K_1 K_2)(\beta_1 \beta_2 - \gamma_1^2)} - 2b_1 + \frac{2A_1 \alpha_3 \beta_4 - 2A_2 \alpha_4 \gamma_2}{(Q_1 Q_2 - K_1 K_2)(\beta_3 \beta_4 - \gamma_2^2)} - 2b_3$$

$$g_1 = \frac{B_1 \alpha_1 \beta_2 - B_2 \alpha_2 \gamma_1}{(Q_1 Q_2 - K_1 K_2)(\beta_1 \beta_2 - \gamma_1^2)} + c_1 + \frac{B_1 \alpha_3 \beta_4 - B_2 \alpha_4 \gamma_2}{(Q_1 Q_2 - K_1 K_2)(\beta_3 \beta_4 - \gamma_2^2)} + c_2$$

$$H_1 = \frac{(Q_2 + K_1) \alpha_1 \beta_2 - (Q_1 + K_2) \alpha_2 \gamma_1}{(Q_1 Q_2 - K_1 K_2)(\beta_1 \beta_2 - \gamma_1^2)} + \frac{(Q_2 + K_1) \alpha_3 \beta_4 - (Q_1 + K_2) \alpha_4 \gamma_1}{(Q_1 Q_2 - K_1 K_2)(\beta_3 \beta_4 - \gamma_2^2)}$$

Since it can be readily shown that $f_1 < 0$ and $g_1 > 0$, the relationship between p_1 and p_2 is obviously *strategic compliment*.

For the tourism industry of country 2:

The corporate profit in country 2 is written as

$$\pi_2 = p_2(n_2^e + n_4^e),$$

where,

$$n_2^e = \frac{\alpha_2 \beta_1 \left(\frac{p_1 A_2 + p_2 B_2 + Q_1 + K_2}{Q_1 Q_2 - K_1 K_2} \right) - \alpha_1 \gamma_1 \left(\frac{p_1 A_1 + p_2 B_1 + Q_2 + K_1}{Q_1 Q_2 - K_1 K_2} \right)}{\beta_1 \beta_2 - \gamma_1^2} - b_2 p_2 + c_1 p_1,$$

$$n_4^e = \frac{\alpha_4 \beta_3 \left(\frac{p_1 A_2 + p_2 B_2 + Q_1 + K_2}{Q_1 Q_2 - K_1 K_2} \right) - \alpha_3 \gamma_2 \left(\frac{p_1 A_1 + p_2 B_1 + Q_2 + K_1}{Q_1 Q_2 - K_1 K_2} \right)}{\beta_3 \beta_4 - \gamma_2^2} - b_4 p_2 + c_2 p_1.$$

Similarly, the optimum price p_2^* is given as

$$p_2^* = \frac{-p_1 g_2 - H_2}{f_2},$$

where,

$$f_2 = \frac{2B_2 \alpha_2 \beta_1 - 2B_1 \alpha_1 \gamma_1}{(Q_1 Q_2 - K_1 K_2)(\beta_1 \beta_2 - \gamma_1^2)} - 2b_2 + \frac{2B_2 \alpha_4 \beta_3 - 2B_1 \alpha_3 \gamma_2}{(Q_1 Q_2 - K_1 K_2)(\beta_3 \beta_4 - \gamma_2^2)} - 2b_4,$$

$$g_2 = \frac{A_2 \alpha_2 \beta_1 - A_1 \alpha_1 \gamma_1}{(Q_1 Q_2 - K_1 K_2)(\beta_1 \beta_2 - \gamma_1^2)} + c_1 + \frac{A_2 \alpha_4 \beta_3 - A_1 \alpha_3 \gamma_2}{(Q_1 Q_2 - K_1 K_2)(\beta_3 \beta_4 - \gamma_2^2)} + c_2,$$

$$H_2 = \frac{(Q_1 + K_2) \alpha_2 \beta_1 - (Q_2 + K_1) \alpha_2 \gamma_1}{(Q_1 Q_2 - K_1 K_2)(\beta_1 \beta_2 - \gamma_1^2)} + \frac{(Q_1 + K_2) \alpha_4 \beta_3 - (Q_2 + K_1) \alpha_3 \gamma_2}{(Q_1 Q_2 - K_1 K_2)(\beta_3 \beta_4 - \gamma_2^2)}.$$

Again, since it can be readily shown that $f_2 < 0$ and $g_2 > 0$, the relationship between p_1 and p_2 is *strategic compliment*.

Based on the optimal prices described above, we can derive the equilibrium prices of both countries' tourism enterprises.

$$p_1^e = \frac{g_1 H_2 - f_2 H_1}{f_1 f_2 - g_1 g_2}$$

$$p_2^e = \frac{g_2 H_1 - f_1 H_2}{f_1 f_2 - g_1 g_2}$$

4. Sequential game: the government as the leader

We have already discussed the case in which the tourism industry is the leader. Now, we discuss the case in which the sequential actions are reversed. As we described in the previous section, sequential games with perfect information are often solved by backward induction. We can now identify the pricing strategy set by enterprises after the setting of the personal income tax rate and corporate profit function. From this identification, we can establish how the government sets the personal income tax rate to achieve the largest social welfare.

For the tourism industry of country 1:

Basically as seen before, the corporate profit function can be written as

$$\pi_1 = p_1 n_1^* + n_3^* ,$$

where,

$$n_1^* = \frac{\alpha_1 \beta_2 w_1 r_1 - \alpha_2 \gamma_1 w_2 r_2}{\beta_1 \beta_2 - \gamma_1^2} - b_1 p_1 + c_1 p_2 ,$$

$$n_3^* = \frac{\alpha_3 \beta_4 w_1 r_1 - \alpha_4 \gamma_2 w_2 r_2}{\beta_3 \beta_4 - \gamma_2^2} - b_3 p_1 + c_2 p_2 .$$

By profit maximization of the tourism industry, we can derive an optimum price p_1^* as

$$p_1^* = \frac{w_1 r_1 G_1 - w_2 r_2 H_1 + p_2 c_1 + c_2}{2 b_1 + b_3} ,$$

where,

$$G_1 = \frac{\alpha_1 \beta_2}{\beta_1 \beta_2 - \gamma_1^2} + \frac{\alpha_3 \beta_4}{\beta_3 \beta_4 - \gamma_2^2}$$

$$H_1 = \left(\frac{\alpha_2 \gamma_1}{\beta_1 \beta_2 - \gamma_1^2} + \frac{\alpha_4 \gamma_2}{\beta_3 \beta_4 - \gamma_2^2} \right)$$

As in the previous case, the relationship between p_1 and p_2 is *strategic compliment*.

For the tourism industry of country 2:

As for country 1, the corporate profit function can be written as,

$$\pi_2 = p_2 n_2^* + n_4^* ,$$

where,

$$n_2^* = \frac{\alpha_2 \beta_1 w_1 r_1 - \alpha_1 \gamma_1 w_2 r_2}{\beta_1 \beta_2 - \gamma_1^2} - b_2 p_2 + c_1 p_1 ,$$

$$n_4^* = \frac{\alpha_4 \beta_3 w_1 r_1 - \alpha_3 \gamma_2 w_2 r_2}{\beta_3 \beta_4 - \gamma_2^2} - b_4 p_2 + c_2 p_1 .$$

Similarly, the profit-maximizing price p_2^* is given as,

$$p_2^* = \frac{-w_1 r_1 H_2 + w_2 r_2 G_2 + p_1 c_1 + c_2}{2 b_2 + b_4} ,$$

where,

$$G_2 = \frac{\alpha_2 \beta_1}{\beta_1 \beta_2 - \gamma_1^2} + \frac{\alpha_4 \beta_3}{\beta_3 \beta_4 - \gamma_2^2} ,$$

$$H_2 = \left(\frac{\alpha_1 \gamma_1}{\beta_1 \beta_2 - \gamma_1^2} + \frac{\alpha_3 \gamma_2}{\beta_3 \beta_4 - \gamma_2^2} \right) .$$

Again, prices here are *strategic compliments* here.

Based on these profit-maximizing prices, we can derive the equilibrium prices chosen by the tourist corporations as,

$$p_1^e = \frac{r_2 w_2 I_1 - r_1 w_1 J_1}{R} = \frac{T_2 I_1 - T_1 J_1}{R}$$

$$p_2^e = \frac{r_1 w_1 J_2 - r_2 w_2 I_2}{R} = \frac{T_1 J_2 - T_2 I_2}{R}$$

where,

$$R = c_1 + c_2 - 4 b_1 + b_3 \quad b_2 + b_4 < 0,$$

$$I_1 = 2\left(\frac{\alpha_2\gamma_1}{\beta_1\beta_2-\gamma_1^2} + \frac{\alpha_4\gamma_2}{\beta_3\beta_4-\gamma_2^2}\right) b_1 + b_3 + \left(\frac{\alpha_2\beta_1}{\beta_1\beta_2-\gamma_1^2} + \frac{\alpha_4\beta_3}{\beta_3\beta_4-\gamma_2^2}\right) c_1 + c_2 > 0,$$

$$I_2 = 2\left(\frac{\alpha_2\beta_1}{\beta_1\beta_2-\gamma_1^2} + \frac{\alpha_4\beta_3}{\beta_3\beta_4-\gamma_2^2}\right) b_1 + b_3 + \left(\frac{\alpha_2\gamma_1}{\beta_1\beta_2-\gamma_1^2} + \frac{\alpha_4\gamma_2}{\beta_3\beta_4-\gamma_2^2}\right) c_1 + c_2 > 0,$$

$$J_1 = 2\left(\frac{\alpha_1\beta_2}{\beta_1\beta_2-\gamma_1^2} + \frac{\alpha_3\beta_4}{\beta_3\beta_4-\gamma_2^2}\right) b_1 + b_3 + \left(\frac{\alpha_1\gamma_1}{\beta_1\beta_2-\gamma_1^2} + \frac{\alpha_3\gamma_2}{\beta_3\beta_4-\gamma_2^2}\right) c_1 + c_2 > 0,$$

$$J_2 = 2\left(\frac{\alpha_1\gamma_1}{\beta_1\beta_2-\gamma_1^2} + \frac{\alpha_3\gamma_2}{\beta_3\beta_4-\gamma_2^2}\right) b_1 + b_3 + \left(\frac{\alpha_1\beta_2}{\beta_1\beta_2-\gamma_1^2} + \frac{\alpha_3\beta_4}{\beta_3\beta_4-\gamma_2^2}\right) c_1 + c_2 > 0.$$

Since it can be readily shown that $R < 0$, the tourism industry raises its price, p_i , if the infrastructure for tourism of its own, T_i , is improved.

For the government of country 1:

Similarly, the social welfare V_1 is equal to the sum of the consumer surplus and the corporate profit, that is, $V_1 = L_1 + p_1(n_1 + n_3)$,

where,

$$L_1 = U_1 - p_1n_1 - p_2n_2 - w_1r_1,$$

$$U_1 = \alpha_1T_1n_1 + \alpha_2T_2n_2 - \frac{1}{2}(\beta_1n_1^2 + 2\gamma_1n_1n_2 + \beta_2n_2^2).$$

By substituting $T_1 = w_1r_1$, n_1^* , n_2^* , n_3^* , p_1^e , and p_2^e into the social welfare function V_1 , we obtain the following equation:

$$\begin{aligned} V_1 = L_1 + p_1 n_1 + n_3 &= \alpha_1\left(\frac{\alpha_1\beta_2w_1r_1-\alpha_2\gamma_1T_2}{\beta_1\beta_2-\gamma_1^2} - b_1\frac{T_2I_1-w_1r_1J_1}{R} + c_1\frac{w_1r_1J_2-T_2I_2}{R}\right)w_1r_1 + \\ &\alpha_2T_2\left(\frac{\alpha_2\beta_1T_2-\alpha_1\gamma_1w_1r_1}{\beta_1\beta_2-\gamma_1^2} - b_2\frac{w_1r_1J_2-T_2I_2}{R} + c_1\frac{T_2I_1-w_1r_1J_1}{R}\right) - \frac{1}{2}\beta_1\frac{\alpha_1\beta_2w_1r_1-\alpha_2\gamma_1T_2}{\beta_1\beta_2-\gamma_1^2} - \\ &b_1\frac{T_2I_1-w_1r_1J_1}{R} + c_1\frac{w_1r_1J_2-T_2I_2}{R}^2 - \\ \gamma_1\frac{\alpha_1\beta_2w_1r_1-\alpha_2\gamma_1T_2}{\beta_1\beta_2-\gamma_1^2} - b_1\frac{T_2I_1-w_1r_1J_1}{R} + c_1\frac{w_1r_1J_2-T_2I_2}{R} &\frac{\alpha_2\beta_1T_2-\alpha_1\gamma_1w_1r_1}{\beta_1\beta_2-\gamma_1^2} - b_2\frac{w_1r_1J_2-T_2I_2}{R} + \\ c_1\frac{T_2I_1-w_1r_1J_1}{R} - \frac{1}{2}\beta_2\frac{\alpha_2\beta_1T_2-\alpha_1\gamma_1w_1r_1}{\beta_1\beta_2-\gamma_1^2} - b_2\frac{w_1r_1J_2-T_2I_2}{R} &+ c_1\frac{T_2I_1-w_1r_1J_1}{R}^2 - \\ \frac{w_1r_1J_2-T_2I_2}{R}\left(\frac{\alpha_2\beta_1T_2-\alpha_1\gamma_1w_1r_1}{\beta_1\beta_2-\gamma_1^2} - b_2\frac{w_1r_1J_2-T_2I_2}{R} + c_1\frac{T_2I_1-w_1r_1J_1}{R}\right) - w_1r_1 &+ \\ \frac{T_2I_1-w_1r_1J_1}{R}\left(\frac{\alpha_3\beta_4w_1r_1-\alpha_4\gamma_2T_2}{\beta_3\beta_4-\gamma_2^2} - b_3\frac{T_2I_1-w_1r_1J_1}{R} + c_2\frac{w_1r_1J_2-T_2I_2}{R}\right). & \end{aligned}$$

The government chooses the income tax rate r_1 for welfare maximization, and we can obtain the optimal income tax rates r_1 as

$$r_1^* = \frac{1-g_1 w_2 r_2}{f_1 w_1},$$

where,

$$\begin{aligned} f_1 = & \frac{2\alpha_1^2 \beta_2}{\beta_1 \beta_2 - \gamma_1^2} + \frac{2}{R} \alpha_1 b_1 J_1 + \alpha_1 c_1 J_2 + \frac{2}{R \beta_1 \beta_2 - \gamma_1^2} \alpha_1 \gamma_1 J_2 + \alpha_2 \beta_1 \gamma_1 b_1 J_1 + \alpha_2 \beta_1 \gamma_1 c_1 J_2 - \\ & \alpha_1 \beta_1 \beta_2 b_1 J_1 + \frac{1}{R^2} 2\gamma_1 b_1 b_2 J_1 J_2 + 2\gamma_1 b_2 c_1 J_2^2 + 2\gamma_1 b_1 c_1 J_1^2 + 2\gamma_1 c_1^2 J_1 J_2 + \beta_1 c_1^2 J_2^2 + 2b_2 J_2^2 + \\ & 2c_1 J_1 J_2 - \beta_2 b_2^2 J_2^2 - \beta_2 c_1^2 J_1^2 - \beta_1 b_1^2 J_2^2 - 2\beta_2 b_2 c_1 J_1 J_2 - 2b_3 J_1^2 - 2c_2 J_1 J_2 + \\ & \frac{1}{\beta_1 \beta_2 - \gamma_1^2} \left[2\alpha_1 \alpha_2 \beta_1 \beta_2 \gamma_1 - \alpha_1^2 \beta_2 \gamma_1^2 - \alpha_1^2 \beta_1 \beta_2^2 - \frac{\alpha_3 \beta_4 J_1 + \alpha_3 \beta_4 J_2}{R(\beta_3 \beta_4 - \gamma_2^2)} \right], \\ g_1 = & \frac{-2\alpha_1 \alpha_2 \gamma_1}{\beta_1 \beta_2 - \gamma_1^2} - \frac{1}{R} \alpha_2 b_2 J_2 + \alpha_2 c_1 J_1 + \alpha_1 b_1 K_1 + \alpha_1 c_1 K_2 + \frac{1}{R \beta_1 \beta_2 - \gamma_1^2} \alpha_2 \beta_1 \beta_2 b_2 J_2 + \\ & \alpha_2 \beta_1 \beta_2 c_1 J_1 + \alpha_1 \beta_1 \beta_2 b_1 K_1 + \alpha_2 \beta_1 \beta_2 c_1 K_2 - 2\alpha_1 \beta_1 \gamma_1 c_1 J_2 - \alpha_2 \beta_1 J_2 - \alpha_1 \gamma_1 K_2 - \\ & \alpha_2 \beta_1 \gamma_1 b_1 K_1 - \alpha_2 \beta_1 \gamma_1 c_1 K_2 - \alpha_2 \gamma_1^2 b_2 J_2 - \alpha_2 \gamma_1^2 c_1 J_1 + \frac{1}{R^2} (\beta_2 b_2^2 J_2 K_2 + \beta_2 b_2 c_1 J_2 K_1 + \\ & \beta_2 b_2 c_1 J_1 K_2 + \beta_2 c_1^2 J_1 K_1 + \beta_1 b_1^2 J_1 K_1 + \beta_1 b_1 c_1 J_1 K_2 - \beta_1 b_1 c_1 J_2 K_1 - \beta_1 c_1^2 J_2 K_2 - 2b_2 J_2 K_2 - \\ & c_1 K_1 J_2 - c_1 K_2 J_1 - \gamma_1 b_1 b_2 K_1 J_2 - \gamma_1 b_2 c_1 K_2 J_2 - \gamma_1 b_1 c_1 K_1 J_1 - 2\gamma_1 c_1^2 K_2 J_1 - \gamma_1 b_1 b_2 J_1 K_2 - \\ & \gamma_1 b_1 c_1 J_1 K_1 - \gamma_1 b_2 c_1 J_2 K_2 + 2b_3 K_1 J_1 + c_2 K_2 J_1 + c_2 K_1 J_2) + \frac{\alpha_1 \alpha_2 \beta_1 \beta_2 \gamma_1 - \alpha_1^2 \beta_1 \gamma_1^2}{\beta_1 \beta_2 - \gamma_1^2} + \\ & \frac{\alpha_4 \gamma_2 J_1 + \alpha_3 \beta_4 K_1}{R(\beta_3 \beta_4 - \gamma_2^2)}. \end{aligned}$$

For the government of country 2:

Similarly, the government of country 2 tries to maximize the social welfare function V_2 described as $V_2 = L_2 + p_2(n_2 + n_4)$,

where,

$$L_2 = U_2 - p_1 n_3 - p_2 n_4 - w_2 r_2$$

$$U_2 = \alpha_3 T_1 n_3 + \alpha_4 T_2 n_4 - \frac{1}{2} (\beta_3 n_3^2 + 2\gamma_2 n_3 n_4 + \beta_4 n_4^2)$$

By substituting $T_2 = w_2 r_2$, n_2^* , n_3^* , n_4^* , p_1^e , and p_2^e into the social welfare function V_2 , we obtain the following equation:

$$\begin{aligned} V_2 = L_2 + p_2 n_2 + n_4 = & \alpha_3 \left(\frac{\alpha_3 \beta_4 T_1 - \alpha_4 \gamma_2 w_2 r_2}{\beta_3 \beta_4 - \gamma_2^2} - b_3 \frac{w_2 r_2 I_1 - T_1 J_1}{R} + c_2 \frac{T_1 J_2 - w_2 r_2 I_2}{R} \right) T_1 + \\ & \alpha_4 w_2 r_2 \left(\frac{\alpha_4 \beta_3 w_2 r_2 - \alpha_3 \gamma_2 T_1}{\beta_3 \beta_4 - \gamma_2^2} - b_2 \frac{T_1 J_2 - w_2 r_2 I_2}{R} + c_1 \frac{w_2 r_2 I_1 - T_1 J_1}{R} \right) - \frac{1}{2} \beta_3 \left(\frac{\alpha_3 \beta_4 T_1 - \alpha_4 \gamma_2 w_2 r_2}{\beta_3 \beta_4 - \gamma_2^2} - \right. \\ & b_3 \frac{w_2 r_2 I_1 - T_1 J_1}{R} + c_2 \frac{T_1 J_2 - w_2 r_2 I_2}{R} \left. \right)^2 - \gamma_2 \left(\frac{\alpha_3 \beta_4 T_1 - \alpha_4 \gamma_2 w_2 r_2}{\beta_3 \beta_4 - \gamma_2^2} - b_3 \frac{w_2 r_2 I_1 - T_1 J_1}{R} + \right. \\ & c_2 \frac{T_1 J_2 - w_2 r_2 I_2}{R} \left. \right) \left(\frac{\alpha_4 \beta_3 w_2 r_2 - \alpha_3 \gamma_2 T_1}{\beta_3 \beta_4 - \gamma_2^2} - b_2 \frac{T_1 J_2 - w_2 r_2 I_2}{R} + c_1 \frac{w_2 r_2 I_1 - T_1 J_1}{R} \right) - \frac{1}{2} \beta_4 \left(\frac{\alpha_4 \beta_3 w_2 r_2 - \alpha_3 \gamma_2 T_1}{\beta_3 \beta_4 - \gamma_2^2} - \right. \\ & b_2 \frac{T_1 J_2 - w_2 r_2 I_2}{R} + c_1 \frac{w_2 r_2 I_1 - T_1 J_1}{R} \left. \right)^2 - \frac{w_2 r_2 I_1 - T_1 J_1}{R} \left(\frac{\alpha_3 \beta_4 T_1 - \alpha_4 \gamma_2 w_2 r_2}{\beta_3 \beta_4 - \gamma_2^2} - b_3 \frac{w_2 r_2 I_1 - T_1 J_1}{R} + \right. \end{aligned}$$

$$c_2 \frac{T_1 J_2 - w_2 r_2 I_2}{R} - w_2 r_2 + \frac{T_1 J_2 - w_2 r_2 I_2}{R} \left(\frac{\alpha_2 \beta_1 w_2 r_2 - \alpha_1 \gamma_1 T_1}{\beta_1 \beta_2 - \gamma_1^2} - b_2 \frac{T_1 J_2 - w_2 r_2 I_2}{R} + c_1 \frac{w_2 r_2 I_1 - T_1 J_1}{R} \right).$$

The income tax rate r_2 is chosen as

$$r_2^* = \frac{1 - g_2 w_1 r_1}{f_2 w_2},$$

where,

$$\begin{aligned} f_2 = & \frac{2\alpha_2^2 \beta_3}{\beta_3 \beta_4 - \gamma_2^2} + \frac{1}{R} 2\alpha_4 b_4 I_2 + 2\alpha_4 c_2 I_1 + \frac{1}{R \beta_3 \beta_4 - \gamma_2^2} 2\alpha_4 \gamma_2 I_1 + 2\alpha_3 \beta_4 \gamma_2 b_4 I_2 + \\ & 2\alpha_3 \beta_4 \gamma_2 c_2 I_1 - 2\alpha_4 \beta_4 \beta_3 b_4 I_2 + \frac{1}{R^2} 2\gamma_2 b_3 b_4 I_1 I_2 + 2\gamma_2 b_3 c_2 I_1^2 + 2\gamma_2 b_4 c_2 I_2^2 + 2\gamma_2 c_2^2 I_1 I_2 + \\ & \beta_4 c_2^2 I_1^2 + 2b_3 I_1^2 + 2c_2 I_1 I_2 - \beta_3 b_3^2 I_1^2 - \beta_3 c_2^2 I_1^2 - \beta_4 b_4^2 I_2^2 - 2\beta_3 b_3 c_2 I_1 I_2 - 2b_2 I_2^2 - \\ & 2c_1 I_1 I_2 + \frac{1}{\beta_3 \beta_4 - \gamma_2^2} 2\alpha_3 \alpha_4 \beta_3 \beta_4 \gamma_2 - \alpha_4^2 \beta_3 \gamma_2^2 - \alpha_4^2 \beta_4 \beta_3^2 - \frac{\alpha_2 \beta_1 I_2 + \alpha_2 \beta_1 I_1}{R(\beta_1 \beta_2 - \gamma_1^2)}, \end{aligned}$$

$$\begin{aligned} g_2 = & \frac{-2\alpha_3 \alpha_4 \gamma_2}{\beta_3 \beta_4 - \gamma_2^2} - \frac{1}{R} \alpha_3 b_3 I_1 + \alpha_3 c_2 I_2 + \alpha_4 b_4 J_2 + \alpha_4 c_2 J_1 + \frac{1}{R \beta_3 \beta_4 - \gamma_2^2} \alpha_3 \beta_3 \beta_4 b_3 I_1 + \\ & \alpha_3 \beta_3 \beta_4 c_2 I_2 + \alpha_4 \beta_3 \beta_4 b_4 J_2 + \alpha_4 \beta_3 \beta_4 c_2 J_1 - 2\alpha_3 \beta_4 \gamma_2 c_2 I_1 - \alpha_3 \beta_4 I_1 - \alpha_4 \gamma_2 J_1 - \\ & \alpha_3 \beta_4 \gamma_2 b_4 J_2 - \alpha_3 \beta_4 \gamma_2 c_2 J_1 - \alpha_3 \gamma_2^2 b_3 I_1 - \alpha_3 \gamma_2^2 c_2 I_2 + \frac{1}{R^2} (\beta_3 b_3^2 J_1 I_1 + \beta_3 b_3 c_2 J_1 I_2 + \\ & \beta_3 b_3 c_2 J_2 I_1 + \beta_3 c_2^2 J_2 I_2 + \beta_4 b_4^2 J_2 I_2 + \beta_4 b_4 c_2 J_2 I_1 - \beta_4 b_4 c_2 J_1 I_2 - \beta_4 c_2^2 J_1 I_1 - 2b_3 J_1 I_1 - \\ & c_2 I_2 J_1 - c_2 I_1 J_2 - \gamma_2 b_3 b_4 I_2 J_1 - \gamma_2 b_3 c_2 I_1 J_1 - \gamma_2 b_4 c_2 I_2 J_2 - 2\gamma_2 c_2^2 I_2 J_1 - \gamma_2 b_3 b_4 J_1 I_2 - \\ & \gamma_2 b_4 c_4 J_2 I_2 - \gamma_2 b_3 c_2 J_1 I_1 + 2b_2 I_2 J_2 + c_1 I_1 J_2 + c_1 I_2 J_1) + \frac{\alpha_3 \alpha_4 \beta_3 \beta_4 \gamma_2 - \alpha_4^2 \beta_4 \gamma_2^2}{\beta_3 \beta_4 - \gamma_2^2} + \frac{\alpha_1 \gamma_1 I_2 + \alpha_2 \beta_1 J_2}{R(\beta_1 \beta_2 - \gamma_1^2)}. \end{aligned}$$

Here, we can derive the equilibrium tax rates as follows,

$$\begin{aligned} r_1^e &= \frac{1}{w_1} \left(\frac{f_2 - g_1}{f_1 f_2 - g_1 g_2} \right) \\ r_2^e &= \frac{1}{w_2} \left(\frac{f_1 - g_2}{f_1 f_2 - g_1 g_2} \right) \end{aligned}$$

Thus, the equilibrium infrastructure for tourism, provided by both governments, are,

$$\begin{aligned} T_1^e &= \frac{f_2 - g_1}{f_1 f_2 - g_1 g_2} \\ T_2^e &= \frac{f_1 - g_2}{f_1 f_2 - g_1 g_2} \end{aligned}$$

5. Comparative analysis

Since it is difficult to compare the two cases described above in general, namely the tourism industry as the leader and the government as the leader, we focus on several specific cases in order to show the possible differences between the two cases, here. Moreover, when we compare the cases, we examine the strategic behavior of the two players, namely the

government and industry, whether they prefer to behave as leader or follower, based on payoff matrix.

We denote the consumer surplus of the first case (the industry is the leader) as L and the second case (the government is the leader) as L' . For the industry, similarly, the profits of the first case (the industry is the leader) is denoted as π , and those of the second case is π' . We also denote the social welfare of the first case (the industry is the leader) as V and the second case (the government is the leader) as V' .

Case 1.

For the most simple yet extreme case, we assume that the impact of tourists is centered entirely on α and β , and that $\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4$; $\beta_1 = \beta_2 = \beta_3 = \beta_4 = 1$; $\gamma = 0$. In this case, the citizens of the two countries have no particular preference for domestic and cross-border tourism. We can show that $L-L' > 0$ when $\alpha_1 > \frac{31}{26}$. That is, consumers can achieve the highest

consumer surplus if the industry is the leader. When $0 < \alpha_1 < \frac{31}{26}$, then $L-L' < 0$. For this area, consumers can achieve the highest surplus if the government is the leader.

Similarly, if $\alpha_1 > 1.14755$, then $V-V' > 0$. That is, the governments can achieve the highest social welfare when the industry is the leader. When $0 < \alpha_1 < 1.14755$, then $V-V' < 0$. The highest social welfare can be achieved when the government is the leader here.

Finally, when $0 < \alpha_1 < \frac{1}{2} \sqrt{\frac{1}{2}(4 + 3\sqrt{2})}$, then $\pi-\pi' > 0$. When $\alpha_1 > \frac{1}{2} \sqrt{\frac{1}{2}(4 + 3\sqrt{2})}$, then $\pi-\pi' < 0$.

Hence, we will consider what policy would be chosen by government in different ranges of α_1 .

1) $0 < \alpha_1 < \frac{1}{2} \sqrt{\frac{1}{2}(4 + 3\sqrt{2})}$

In this range, $\pi-\pi' > 0$ & $V-V' < 0$ & $L-L' < 0$, and thus the payoff matrix is as follows.

Industry Government	Leader	Follower
Leader	(V', π)	(V', π')
Follower	(V, π)	(V, π')

In this range, both of government and industry prefer leader to follower. We assume here that governments could gain the leadership by some public commitment or binding contract or so but private industries could not. Then governments could gain the leadership in the game, where consumers would enjoy higher surplus.

$$2) \frac{1}{2} \sqrt{\frac{1}{2} (4 + 3\sqrt{2})} < \alpha_1 < 1.147555$$

In this range, $\pi - \pi' < 0$, $V - V' < 0$ and $L - L' < 0$, and thus the payoff matrix is as follows.

Industry Government	Leader	Follower
Leader	(V', π)	(V', π')
Follower	(V, π)	(V, π')

In this range, the Nash equilibrium is the case where government is leader and industry follower. Therefore, consumers would enjoy higher surplus.

$$3) 1.147555 < \alpha_1$$

In this range, $\pi - \pi' < 0$ and $V - V' > 0$, and thus the payoff matrix is as follows.

Industry Government	Leader	Follower
Leader	(V', π)	(V', π')
Follower	(V, π)	(V, π')

In this range, both of government and industry prefer follower to leader. Unlike the range 1), it is not so easy to assume here that governments could force private industries to take the leadership by some public power. In addition, if $1.147555 < \alpha_1 < \frac{31}{26}$, then $L - L' < 0$. That is, there exists some conflict between consumers and government here. On the other hand, if $\alpha_1 > \frac{31}{26}$, then $L - L' > 0$ and thus there is no conflict of interest between them in this range.

Case 2.

For the second case, we assume that two different types of citizens: one is particularly keen on domestic tourism (which we tentatively attribute to psychological factors such as patriotism) while the other is particularly keen on cross-border tourism (which we tentatively attribute to foreign travels). For simplicity, we combine these preferences and find that the degree of

national enthusiasm for cross-border tourism is equal to that of the national enthusiasm for domestic tourism. Furthermore, the keen preference for traveling abroad is twice that for domestic travel: $\alpha_1 = \alpha_3 = 2\alpha_2 = 2\alpha_4$. In addition we adopt the same assumption for the other parameters, namely, $\beta_1 = \beta_2 = \beta_3 = \beta_4 = 1$; $\gamma = 0$.

We can show that $L-L' > 0$ when $0.8134 < \alpha_2 < 1.18065$. That is, consumers can achieve the highest consumer surplus if the industry is the leader. When $0 < \alpha_2 < 0.8134$, or $\alpha_2 > 1.18065$, then $L-L' < 0$. For this area, consumers can achieve the highest surplus if the government is the leader.

Similarly, if $0 < \alpha_2 < 0.17325$ or $\alpha_2 > 1.15671$, then $V-V' > 0$. That is, the governments can achieve the highest social welfare when the industry is the leader. When $0.17325 < \alpha_2 < 1.15671$, then $V-V' < 0$. The highest social welfare can be achieved when the government is the leader here.

Finally, when $0.905092 < \alpha_2 < 2.22333$, then $\pi-\pi' > 0$. When $0 < \alpha_2 < 0.905092$ or $\alpha_2 > 2.22333$, then $\pi-\pi' < 0$.

Hence, we will consider what policy would be chosen by government in different ranges of α_2 .

1) $0 < \alpha_2 < 0.17325$

In this range, $\pi-\pi' < 0$, $V-V' > 0$ and $L-L' < 0$, and thus the payoff matrix is as follows.

Industry Government	Leader	Follower
Leader	(V', π)	(V', π')
Follower	(V, π)	(V, π')

In this range, both of government and industry prefer follower to leader. Hence, it is not so easy to assume here that governments could force private industries to take the leadership by some public power. In addition, since $L-L' < 0$, there exists some conflict between consumers and government here.

2) $0.17325 < \alpha_2 < 0.905092$

In this range, $\pi-\pi' < 0$ and $V-V' < 0$, and thus the payoff matrix is as follows.

Industry Government	Leader	Follower
Leader	(V', π)	(V', π')

Follower	(V, π)	(V, π')
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In this range, the Nash equilibrium is the case where government is leader and industry follower. In addition, if $0.17325 < \alpha_2 < 0.8134$, then $L-L' < 0$. That is, there is no conflict of interest between consumers and government here. On the other hand, if $0.8134 < \alpha_2 < 0.905092$, then $L-L' > 0$ and thus there exists some conflict of interest between them in this range.

3) $0.905092 < \alpha_2 < 1.15671$

In this range, $\pi-\pi' > 0$, $V-V' < 0$ and $L-L' > 0$, and thus the payoff matrix is as follows.

Industry Government	Leader	Follower
Leader	(V', π) →	(V', π')
Follower	(V, π)	(V, π')

In this range, both of government and industry prefer leader to follower. We assume here that governments could gain the leadership by some public commitment or binding contract or so but private industries could not. Then governments could gain the leadership in the game, although consumers cannot enjoy higher surplus.

4) $1.15671 < \alpha_2 < 2.22333$

In this range, $\pi-\pi' > 0$ and $V-V' > 0$, and thus the payoff matrix is as follows.

Industry Government	Leader	Follower
Leader	(V', π)	(V', π')
Follower	(V, π)	(V, π')

In this range, the Nash equilibrium is the case where government is follower and industry leader. In addition, if $1.15671 < \alpha_2 < 1.18065$, then $L-L' > 0$. That is, there is no conflict of interest between consumers and government here. On the other hand, if $1.18065 < \alpha_2 < 2.22333$, then $L-L' < 0$ and thus there exists some conflict of interest between them in this range.

5) $\alpha_2 > 2.22333$

In this range, $\pi - \pi' < 0$, $V - V' > 0$ and $L - L' < 0$, and thus the payoff matrix is as follows.

Industry Government	Leader	Follower
Leader	(V', π)	(V', π')
Follower	(V, π)	(V, π')

In this range, both of government and industry prefer follower to leader. Hence, it is not so easy to assume here that governments could force private industries to take the leadership by some public power. In addition, since $L - L' < 0$, there exists some conflict between consumers and government here. It is quite the same as 1).

Case 3.

In this case, we assume that γ is positive rather than 0. The other assumptions are similar to Case 1. That is, $\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4$; $\beta_1 = \beta_2 = \beta_3 = \beta_4 = 2$; $\gamma = 1$.

Here, we can show that $V - V' = 0.195198333 \frac{1}{\alpha_2^2} > 0$, $\pi - \pi' = \frac{93}{1000\alpha_2} > 0$, and $L - L' = \frac{289}{1000\alpha_1^2} > 0$. Thus the payoff matrix is as follows.

Industry Government	Leader	Follower
Leader	(V', π)	(V', π')
Follower	(V, π)	(V, π')

That is, in this case, the best strategy for the government is to let the industry be the leader, which is better for consumers as well.

Case 4.

In this case, like Case 2 again, we introduce some asymmetry about preferences for domestic and foreign travel, between two nations. On the other hand, we assume positive γ like Case 3. That is, $\alpha_1 = \alpha_3 = 2\alpha_2 = 2\alpha_4$; $\beta_1 = \beta_2 = \beta_3 = \beta_4 = 2$; $\gamma = 1$.

Here, we can show

Here, we can show that $V - V' = -0.483467 \frac{1}{\alpha_2^2} < 0$, $\pi - \pi' = 0.0793316 \frac{1}{\alpha_2^2} > 0$, and $L - L' =$

$-0.562\frac{1}{\alpha_2^2} < 0$. Thus the payoff matrix is as follows.

Industry Government	Leader	Follower
Leader	<div style="border: 1px solid black; border-radius: 10px; padding: 5px; display: inline-block;"> (V', π) </div> → (V', π')	(V', π')
Follower	(V, π)	(V, π')

In this case, both of government and industry prefer leader to follower. We assume here that governments could gain the leadership by some public commitment or binding contract or so but private industries could not. Then governments could gain the leadership in the game, while consumers can enjoy higher surplus as well.

6. Concluding remarks

This study focuses on how the neighboring governments compete for tourists using income taxes to improve their infrastructure serving for domestic as well as foreign travellers. Especially, we introduce the tourism industries of both countries to the governmental competition, which compete each other for attracting visitors in order to maximize each profit.

We consider two cases in the sequential games: one in which the tourism industry is the leader and another in which the government is the leader. In either case, consumers of both countries try to maximize their utility or surplus, given the infrastructures for tourism and prices of the tour at both countries, at the third or last stage.

Although we derive the outcome of each sequential game, it is not easy to compare them in general cases. Hence, we assume several specific sets of parameters representing consumer preference, and then analyze the possible outcomes based on the strategic form where both agents choose the leadership or not. According to the results of the simulation, it is found that there are so many possible patterns. Especially, it is shown that the leadership of governments does not always guarantee better outcomes for consumers. One of the reasons may be that the social welfare function as governmental target includes the profits of tour industry in each country.

As described above, in the case where both agents prefer leadership in the game, we could assume that the governments could gain the leadership by some public commitment or binding contract but private industries could not. In the case where both agents do not prefer it, however, there exists some difficulty to determine the possible outcome.

In this study, we consider the same population for both countries. Likewise, the travel distance between two countries is assumed negligible. We had better vary these variables in the future study.

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