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The Role of Government Support in Daily Business Operations and Information Technology Innovation of Medical Tourism Enterprises under COVID-19

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Full Research Paper

The Role of Government Support in Daily Business Operations and Information Technology Innovation of Medical Tourism Enterprises under COVID-19

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Abstract: COVID-19 has posed unprecedented challenges to medical tourism due to the global nature of its pandemic effect. Government support plays an essential role in the recovery and further development of the medical tourism industry. With the support of government, medical tourism enterprises, on the one hand, will maintain their daily business operations and wait for the mitigation of the pandemic. On the other hand, they will carry out information technology innovation in medical tourism and develop new businesses to create profits. Therefore, we construct a multitask principal-agent model for government and enterprises in the medical tourism industry, and discuss the influence of several critical exogenous variables on the decision strategies of the government and enterprises from the perspective of resilience. Numerical simulation is used to verify the effectiveness of the relevant conclusions. This paper can provide some decision-making basis and reference to realize the digital transformation and sustainable development of medical tourism industry under the COVID-19 crisis.

Keywords: medical tourism, COVID-19, resilience, government support, information technology innovation

1. INTRODUCTION

The World Tourism Organization defines medical tourism (MT) as "international tourism services with the theme of medical care, disease and health, rehabilitation and recuperation "[1]. Due to the differences in medical service prices among countries, for example, the medical tourism surgery costs in India, Thailand and Malaysia are only one-tenth of those in the United States [2], customers will seek medical treatment in another country. There are many medical tourism enterprises (including hospitals and care settings, hotels, scenic spots, and enterprises providing related supporting services, such as medical tourism agencies and airlines). Customers and these enterprises constitute a medical tourism supply chain, in which the government is an important participant and medical tourism agencies are the core enterprises. Medical tourism agencies in China, such as Saint Lucia Consulting, provide consumers with a series of health products such as overseas medical treatment and physical examination, and the service contents include hospital recommendation, case translation, appointment of designated experts, medical visas processing, air tickets and accommodation reservations, airport pick-up, medical treatment accompany and returning home follow-up [3].

The COVID-19 outbreak has touched nearly all countries with surprising speed and severity, which has posed critical health challenges worldwide [4]. Due to the rapid spread of COVID-19, many countries suspended their visa-on-arrival policies and announced travel bans, which in turn grounded airplanes, closed hotels and resorts, and suspended destination businesses [5]. Medical tourism is one industry that cannot hold its ground without the mobility of tourists [6]. Mobility dropped sharply from mandated travel restrictions, which made medical tourism enterprises face a remarkable decline in turnover and business volume, and halted the medical

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tourism industry. The medical tourism industry has a high barrier, and due to the diversity of medical tourism enterprises, the operation of the medical tourism supply chain has multiple risks, which are the most significant difference between medical tourism and general tourism. What's more, medical tourism is one of the labor-intensive sectors. Such a slowdown for the industry may put millions of jobs at risk [7], thereby threatening to roll back the progress made on the front of sustainable development goals.

Faced with the impact of COVID-19, on the one hand, medical tourism enterprises will maintain their daily business operations through reasonable cost control and certain capital reserves, and wait for the mitigation of the pandemic. On the other hand, enterprises will use information technology in medical tourism to start new businesses, such as telemedicine services provided by hospitals and medical tourism agencies when customers cannot go abroad [8], and meet the patients' medical demands with the help of cloud intelligent system and data interactive consultation platform. Hotel operators use big data to analyze the needs, travel distance and health status of medical tourism customers so as to promote customer management during the pandemic. New technologies such as 5G, AI, VR and big data in scenic spots are widely applied in health tourism products to provide customized services for customers [9]. The integrated development of information technology and the medical tourism industry has become a new development trend, and information technology innovation has become a fundamental element of medical tourism [10], which helps medical tourism enterprises develop their core competitiveness while maintaining independence, and enhance their self-regulation in the face of crisis. Information technology innovation is fundamental to building enterprise resilience and maintaining long-term competitive advantage. Medical tourism enterprises try to improve resilience from these two aspects to cope with the pandemic crisis. However, workforce, material and financial resources that enterprises need to pay in these two aspects are different. So they should consider comprehensively in different stages of COVID-19.

Resilience is the ability of enterprises to adapt to crises and quickly recover from crises [11], which helps enterprises achieve business stability and adaptability to various risks in natural disasters and emergencies. It can dynamically integrate resources, actively mobilize enterprise funds, information, social networks and other factors, and help enterprises respond quickly in a crisis and recover quickly after the crisis. The resilience adaptative cycle suggests four general phases of a change event: (re-)organization (innovation and creativity), growth (exploiting opportunities), consolidation (establishing fixed institutions and rules), and collapse (failure of fixed institutions to adapt to context changes) [12]. The COVID-19 pandemic has caused a significant, although not total, collapse of the medical tourism industry. The collapse is still taking place, and the re-organization of the industry is just barely beginning. The medical tourism industry is starting to enter a re-organization phase of innovation and creativity.

Actually, the government plays a crucial role in improving enterprise resilience, because “bottom-up” strategies are more feasible to implement in response to the epidemic crisis [13]. The government, a promoter of the development of medical tourism, usually takes the medical tourism destinations as the development goal, then plans and develops various medical tourism resources in the regions. The government not only provides policies and economic support for the local development of medical tourism but also has the responsibility of supervision and management [14]. During the pandemic, the government has issued a series of support policies and measures, including financial subsidies, tax relief and government procurement [15], which can enhance the confidence of medical tourism enterprises in responding to the pandemic and enhance their resilience. In promoting the recovery and development of the medical tourism industry, there is a significant principal-agent relationship between the government and medical tourism enterprises. The goal of the principal government is to help medical tourism enterprises improve resilience and promote the development of medical tourism industry, while the goal of agent medical tourism enterprises is different, and they pay more attention to economic benefits. At the same time, there is information asymmetry between the government and enterprises.

The government cannot observe the effort level of enterprises after receiving financial support, and enterprises may take opportunistic behavior. Therefore, for the government, designing reasonable and effective incentive strategies to help medical tourism enterprises maintain daily business operations and carry out information technology innovation to improve resilience and realize the further development of the medical tourism industry under COVID-19 has become a critical practical issue.

Previous studies on medical tourism mainly focused on the development model, resource and product development, market segmentation and expansion, development potential [16], and mainly used investigation or empirical research methods. The analysis of health, tourism, hotel and aviation industries under the pandemic focused on the impact mechanism and coping strategies, mainly qualitative analysis. However, this paper creatively introduces the principal-agent theory into the medical tourism research field and constructs multitask principal-agent models between government and enterprises. From the resilience perspective, we analyze the impact of government support policy formulation on enterprises' daily business operations and information technology innovation. Furthermore, we discuss the optimal behavior decision-making of both sides, which provides valuable managerial insights for the government and enterprises, helps the digital transformation of the medical tourism industry, and realizes the sustainable development of the industry.

2. PROBLEM DESCRIPTION AND RESEARCH HYPOTHESIS

2.1 Problem description

In the principal-agent relationship between the government and medical tourism enterprises, the government, as the principal, will provide industrial support to the agent enterprises in order to promote the recovery of medical tourism industry under the pandemic. And then, enterprises determine their efforts in medical tourism services (including maintaining daily business operations and information technology innovation) according to the expected benefits obtained by the incentive policies. Subsequently, the government decides the optimal incentive level for enterprises based on the development status of medical tourism.

2.2 Research hypothesis

(1) Suppose $a=(a_1,a_2)$ represents the effort level of medical tourism enterprises in two tasks, where a_1 is the effort level to maintain daily business operations (task 1) and a_2 is the effort level to carry out information technology innovation (task 2), $a_i>0$, $i=1,2$.

(2) Assume the production function of task i of medical tourism enterprises is $x=a_i+\theta_i$, where θ_i is the external random factor affecting the production, θ_1 and θ_2 are independent of each other, and $\theta_i \sim N(0,\sigma_i^2)$, $i=1,2$.

(3) Contracts where the government pays incentive rewards to medical tourism enterprises take linear forms: $S(x)=\alpha+\beta_i x_i$, where α is the fixed income and β_i is the incentive coefficient of each task, $0\le\beta_i\le1$, $i=1,2$.

(4) Let the effort cost of the two tasks of medical tourism enterprises be $C(a_1,a_2)=\frac{1}{2}(b_1a_1^2+b_2a_2^2)$, where b_i is the effort cost coefficient of task i, $b_i>0\ (i=1,2)$, and $C(a_i)'>0$, $C(a_i)''>0$.

(5) Suppose the government has a neutral risk, and the medical tourism enterprises intend risk aversion with invariable risk aversion feature. Therefore, the risk cost of medical tourism enterprises is $RC=\frac{1}{2}\rho Var(S(x))=\frac{1}{2}\rho(\beta_1^2\sigma_1^2+\beta_2^2\sigma_2^2)$, where ρ is the risk aversion coefficient and $\rho>0$.

(6) The expected benefit of the government is the Cobb-Doulgas production function that condenses the two task efforts of enterprises, and the benefit function is $V=Bx_1^q x_2^{1-q}$, where B represents the

comprehensive service capacity of enterprises, $B > 0$. q and $1-q$ are about the relative importance of the two tasks, and represent output elasticity, $0 < q < 1$.

3. MODEL BUILDING AND CONCLUSION ANALYSIS

3.1 Model building and solving

According to the research hypothesis, for the risk-neutral government, the expected benefit is equal to the definite equivalence income, as follows:

$$E(V) = E(V - S(x)) = Ba_1^q a_2^{1-q} - \alpha - \beta_1 a_1 - \beta_2 a_2$$

Due to the absolute risk aversion of medical tourism enterprises, the definite equivalent income needs to subtract the risk cost, so the actual definite equivalence income of medical tourism enterprises is:

$$E(U) - RC = \alpha + \beta_1 a_1 + \beta_2 a_2 - \frac{1}{2}(b_1 a_1^2 + b_2 a_2^2) - \frac{1}{2}\rho(\beta_1^2\sigma_1^2 + \beta_2^2\sigma_2^2)$$

In the case of information asymmetry between the government and medical tourism enterprises, enterprises' effort level is difficult to observe by the government. Therefore, the optimal incentive contract must meet the incentive compatible constraints while meeting the participation constraints. The multitask principal-agent model is:

$$\max E(V) = Ba_1^q a_2^{1-q} - \alpha - \beta_1 a_1 - \beta_2 a_2 \tag{1}$$

$$s.t.(IR)\alpha + \beta_1 a_1 + \beta_2 a_2 - \frac{1}{2}(b_1 a_1^2 + b_2 a_2^2) - \frac{1}{2}\rho(\beta_1^2\sigma_1^2 + \beta_2^2\sigma_2^2) \ge \omega \tag{2}$$

$$s.t.(IC)(a_1, a_2) \in are\max \alpha + \beta_1 a_1 + \beta_2 a_2 - \frac{1}{2}(b_1 a_1^2 + b_2 a_2^2) - \frac{1}{2}\rho(\beta_1^2\sigma_1^2 + \beta_2^2\sigma_2^2) \tag{3}$$

Taking the derivative of a_1 and a_2 with respect to formula (3), we can get:

$$a_1 = \frac{\beta_1}{b_1}, \quad a_2 = \frac{\beta_2}{b_2} \tag{4}$$

Under the optimal situation, the remuneration paid by the government will not make the definite equivalent income of the medical tourism enterprise exceed their reserve income level. Therefore, the participation constraint takes the equal sign, that is:

$$\alpha + \beta_1 a_1 + \beta_2 a_2 - \frac{1}{2}(b_1 a_1^2 + b_2 a_2^2) - \frac{1}{2}\rho(\beta_1^2\sigma_1^2 + \beta_2^2\sigma_2^2) = \omega \tag{5}$$

The fixed income is solved from formula (5) and substituting α and formula (4) into the objective function. The expected benefit of the government is:

$$E(V) = -\frac{\beta_1^2}{b_1} - \frac{\beta_2^2}{b_2} + B\left(\frac{\beta_1}{b_1}\right)^q \left(\frac{\beta_2}{b_2}\right)^{1-q} + \frac{1}{2}\left(\frac{\beta_1^2}{b_1} + \frac{\beta_2^2}{b_2} - \rho\beta_1^2\sigma_1^2 - \rho\beta_2^2\sigma_2^2\right) - \omega \tag{6}$$

Taking the derivative of β_1 and β_2 with respect to formula (6) and making their derivatives equal to zero, we have:

$$\frac{\partial E(V)}{\partial \beta_1} = -\frac{\beta_1}{b_1} + \rho\beta_1\sigma_1^2 + \frac{Bq\left(\frac{\beta_1}{b_1}\right)^{q-1}\left(\frac{\beta_2}{b_2}\right)^{1-q}}{b_1} = 0 \tag{7}$$

$$\frac{\partial E(V)}{\partial \beta_2} = -\frac{\beta_2}{b_2} + \rho\beta_2\sigma_2^2 + \frac{B(1-q)\left(\frac{\beta_1}{b_1}\right)^{q}\left(\frac{\beta_2}{b_2}\right)^{-q}}{b_2} = 0 \tag{8}$$

From formula (7) and formula (8), we can obtain:

$$\frac{\beta_1}{\beta_2}=\left(\frac{qb_1\left(1+b_2\rho\sigma_2^2\right)}{(1-q)b_2\left(1+b_1\rho\sigma_1^2\right)}\right)^{\frac{1}{2}} \tag{9}$$

By substituting formula (9) into formula (7) and formula (8), the optimal incentive coefficients of two tasks can be obtained:

$$\beta_1^*=\frac{Bq\left(\frac{b_1}{b_2}\right)^{q-1}}{1+b_1\rho\sigma_1^2}\left(\frac{qb_1\left(1+b_2\rho\sigma_2^2\right)}{(1-q)b_2\left(1+b_1\rho\sigma_1^2\right)}\right)^{\frac{q-1}{2}} \tag{10}$$

$$\beta_2^*=\frac{B(1-q)\left(\frac{b_1}{b_2}\right)^{q}}{1+b_2\rho\sigma_2^2}\left(\frac{qb_1\left(1+b_2\rho\sigma_2^2\right)}{(1-q)b_2\left(1+b_1\rho\sigma_1^2\right)}\right)^{\frac{q}{2}} \tag{11}$$

By substituting formula (10) and formula (11) into formula (4), the optimal effort levels of the two tasks can be obtained:

$$a_1^*=\frac{Bq\left(\frac{b_1}{b_2}\right)^{q-1}}{b_1+b_1^2\rho\sigma_1^2}\left(\frac{qb_1\left(1+b_2\rho\sigma_2^2\right)}{(1-q)b_2\left(1+b_1\rho\sigma_1^2\right)}\right)^{\frac{q-1}{2}} \tag{12}$$

$$a_2^*=\frac{B(1-q)\left(\frac{b_1}{b_2}\right)^{q}}{b_2+b_2^2\rho\sigma_2^2}\left(\frac{qb_1\left(1+b_2\rho\sigma_2^2\right)}{(1-q)b_2\left(1+b_1\rho\sigma_1^2\right)}\right)^{\frac{q}{2}} \tag{13}$$

Substituting the optimal equilibrium solution a_1^*， a_2^*， β_1^* and β_2^* into formula(5) and the objective function, we can get the optimal fixed income of medical tourism enterprises and the optimal expected benefits of the government:

$$\begin{aligned}\alpha^*=\omega-&\frac{1}{2qb_1^5\left(1+\rho b_2\sigma_2^2\right)^3}B^2(q-1)^2\left(\frac{b_1}{b_2}\right)^{2q}\left(\frac{qb_1\left(1+\rho b_2\sigma_2^2\right)}{(1-q)b_2\left(1+\rho b_1\sigma_1^2\right)}\right)^{1+q}\\ &*\left((q-1)b_1^4\left(\rho b_2\sigma_2^2-1\right)+(q-1)\rho b_1^5\sigma_1^2\left(\rho b_2\sigma_2^2-1\right)+qb_2^4\left(1+\rho b_2\sigma_2^2\right)-q\rho b_1 b_2^4\sigma_1^2\left(1+\rho b_2\sigma_2^2\right)\right)\end{aligned} \tag{14}$$

$$\begin{aligned}E(V)^*=-\alpha-&\frac{B^2q^2\left(\frac{b_1}{b_2}\right)^{2(q-1)}\left(\frac{qb_1\left(1+\rho b_2\sigma_2^2\right)}{(1-q)b_2\left(1+\rho b_1\sigma_1^2\right)}\right)^{q-1}}{b_1\left(1+\rho b_1\sigma_1^2\right)^2}-\frac{B^2(q-1)^2\left(\frac{b_1}{b_2}\right)^{2q}\left(\frac{qb_1\left(1+\rho b_2\sigma_2^2\right)}{(1-q)b_2\left(1+\rho b_1\sigma_1^2\right)}\right)^{q}}{b_2\left(1+\rho b_2\sigma_2^2\right)^2}\\ +B&\left(\frac{Bq\left(\frac{b_1}{b_2}\right)^{q-1}\left(\frac{qb_1\left(1+\rho b_2\sigma_2^2\right)}{(1-q)b_2\left(1+\rho b_1\sigma_1^2\right)}\right)^{\frac{1}{2}(q-1)}}{b_1+\rho b_1^2\sigma_1^2}\right)^{q}\left(\frac{B(1-q)\left(\frac{b_1}{b_2}\right)^{q}\left(\frac{qb_1\left(1+\rho b_2\sigma_2^2\right)}{(1-q)b_2\left(1+\rho b_1\sigma_1^2\right)}\right)^{q/2}}{b_2+\rho b_2^2\sigma_2^2}\right)^{1-q}\end{aligned} \tag{15}$$

3.2 Conclusion analysis

Conclusion 1 The effort levels of medical tourism enterprises in two tasks are positively correlated with the government's incentive coefficients and negatively correlated with the effort cost of each task.

It can be seen from $a_1 = \frac{\beta_1}{b_1}$ and $a_2 = \frac{\beta_2}{b_2}$ that the government's incentive intensity to medical tourism enterprises can effectively improve the enterprise's effort level and enhance the enterprise's resilience. At the same time, conclusion 2 shows that medical tourism enterprises can also improve the effort level by reducing the effort cost coefficient. Especially under the COVID-19 crisis, some enterprises will try to reduce the daily operating expenses to survive.

Conclusion 2 The optimal effort levels of medical tourism enterprises a_1^*, a_2^* are increasing in B, but decreasing in b_1, b_2, ρ and σ_1^2, σ_2^2.

$$\text{Proof: } \frac{\partial a_1^*}{\partial B} > 0, \frac{\partial a_2^*}{\partial B} > 0, \frac{\partial a_1^*}{\partial b_1} < 0, \frac{\partial a_2^*}{\partial b_2} < 0, \frac{\partial a_1^*}{\partial \rho} < 0, \frac{\partial a_2^*}{\partial \rho} < 0, \frac{\partial a_1^*}{\partial \sigma_1^2} < 0, \frac{\partial a_2^*}{\partial \sigma_2^2} < 0.$$

Conclusion 2 shows that the optimal effort levels of enterprises to maintain daily business operations and carry out information technology innovation are affected by multiple factors. The comprehensive service capability can help enterprises carry out two tasks under the pandemic. With the enhancement of comprehensive service capacity, the effort levels of enterprises will improve. Such enterprises have strong resilience on sufficient economic reserves and workforce support to face external shocks such as the COVID-19, as well as carry out information technology innovation. However, considering medical tourism enterprises' costs and external risks in maintaining daily operation and technological innovation, the optimal effort levels will be reduced accordingly.

Conclusion 3 The ratio of the optimal effort levels of medical tourism enterprises to the two tasks N is increasing in q, b_2 and σ_2^2, but decreasing in b_1 and σ_1^2.

$$\text{Proof: } \frac{a_1^*}{a_2^*} = \left(\frac{q b_2 \left(1 + b_2 \rho \sigma_2^2\right)}{(1-q) b_1 \left(1 + b_1 \rho \sigma_1^2\right)} \right)^{\frac{1}{2}} = N, \quad \frac{\partial N}{\partial q} > 0, \frac{\partial N}{\partial b_1} < 0, \frac{\partial N}{\partial b_2} > 0, \frac{\partial N}{\partial \sigma_1^2} < 0, \frac{\partial N}{\partial \sigma_2^2} > 0.$$

Conclusion 3 shows that medical tourism enterprises decide the optimal effort levels according to the relative importance of the two tasks and are willing to make more efforts for the task with high importance. Therefore, under the COVID-19 crisis, enterprises need to make clear the service priorities in different periods, and timely transmit the attention and the effort levels of the two tasks to the government, so that the government can dynamically adjust the incentive strategies according to the strategic intention of the enterprises in different periods. In addition, when the cost of a certain task and its exogenous uncertainties are small, enterprises tend to invest more effort in this task, thus increasing their resilience. For the task of maintaining daily business operations, the difficulty of carrying out medical tourism business under the pandemic increases the cost of enterprises' efforts, and the suddenness and high infectivity of the COVID-19 virus increase the uncertainty of enterprises' efforts. For the task of information technology innovation, the capital investment and talent introduction required in the early stage increases the cost of enterprises' efforts, and the fuzziness and subjectivity of customers' perception of medical tourism services with information technology increase the uncertainty of enterprises' efforts. Therefore, enterprises should make efforts to improve resilience for medical tourism service tasks with high relative importance, low investment cost and low risk under COVID-19.

Conclusion 4 The optimal incentive coefficients of the government β_1^*, β_2^* are increasing in B, but decreasing in b_1, b_2, ρ and σ_1^2, σ_2^2.

Proof: $\frac{\partial\beta_1^*}{\partial B}>0$, $\frac{\partial\beta_2^*}{\partial B}>0$, $\frac{\partial\beta_1^*}{\partial b_1}<0$, $\frac{\partial\beta_2^*}{\partial b_2}<0$, $\frac{\partial\beta_1^*}{\partial\rho}<0$, $\frac{\partial\beta_2^*}{\partial\rho}<0$, $\frac{\partial\beta_1^*}{\partial\sigma_1^2}<0$, $\frac{\partial\beta_2^*}{\partial\sigma_2^2}<0$.

Conclusion 4 shows that the optimal incentive coefficients are positively related to the comprehensive service ability of enterprises, because such enterprises have strong resilience, high enthusiasm and initiative to improve medical tourism effort levels. Therefore, the government's incentive level for these enterprises naturally increases. At the same time, with the increase of effort cost coefficient, enterprise risk aversion and external random factors, the effort levels of enterprises will decrease, and the expected benefits obtained by the government will decrease accordingly so that the government will reduce the incentive intensity for enterprises.

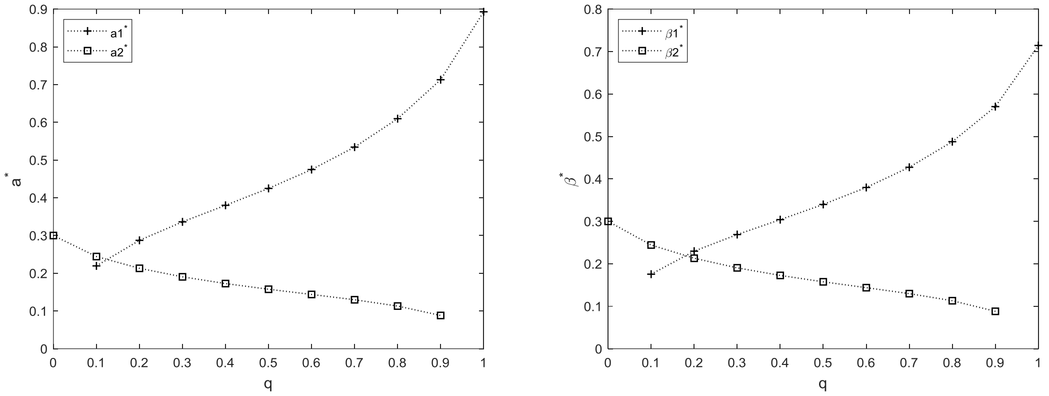
Conclusion 5 The relative incentive intensity coefficient M is increasing in q, b_1 and σ_2^2, but decreasing in b_2 and σ_1^2.

Proof: $\frac{\beta_1^*}{\beta_2^*}=\left(\frac{qb_1\left(1+b_2\rho\sigma_2^2\right)}{(1-q)b_2\left(1+b_1\rho\sigma_1^2\right)}\right)^{\frac{1}{2}}=M$, $\frac{\partial M}{\partial q}>0$, $\frac{\partial M}{\partial b_1}>0$, $\frac{\partial M}{\partial b_2}<0$, $\frac{\partial M}{\partial\sigma_1^2}<0$, $\frac{\partial M}{\partial\sigma_2^2}>0$.

From $\frac{\partial M}{\partial q}>0$, we know that the importance of maintaining daily business operations is positively correlated with the relative incentive intensity, and the importance of information technology innovation is negatively correlated with the relative incentive intensity coefficient. This means that a medical tourism business that brings more significant benefits, that is, the business of high relative importance, the government should increase the incentive intensity for such business of enterprises. The relative incentive intensity coefficient is positively correlated with the effort cost coefficient of maintaining daily business operations task, and negatively correlated with the effort cost coefficient of information technology innovation task. It can be seen from the above that when the effort cost coefficients increase, the effort levels and incentive coefficients of medical tourism enterprises will decrease correspondingly. However, if enterprises provide two services simultaneously, the government will encourage the appropriate business of enterprises according to its own measurement standards. The government's incentive behavior is based on the actual output performance of the two tasks of the enterprise. If the uncertainty of the service is higher, it is more difficult to measure the effort level and output performance in this service. At this time, the blind incentive may breed the opportunistic behavior of enterprises. Therefore, considering the balance between the two tasks, the government and enterprises should be equal in information and responsibility, and enterprises should allow customers to participate in interaction to reduce the uncertainty of medical tourism services.

4. NUMERICAL SIMULATION

To further analyze the impact of relevant parameters on the optimal equilibrium solutions of the government and medical tourism enterprises, we carried out the numerical simulation with $B=3$, $b_1=0.8$, $b_2=1$, $\rho=1$, $\sigma_1^2=2$, $\sigma_2^2=3$.



(a) The impact of q on a^* (b) The impact of q on β^*

Figure 1. The impact of relative importance parameter on optimal effort level and optimal incentive coefficient

As shown in Figure 1, when the relative importance of a task increases, the enterprises' optimal effort level and incentive coefficient for the task will increase, while the optimal effort level and incentive coefficient for another task will decrease. In the light of medical tourism practice, enterprises should not only highlight the strategic priority of the two tasks, but also give enough consideration to the two tasks according to the spread and control of COVID-19. In the severe epidemic period, some enterprises need to consider the current resilience and actively carry out information technology innovation with the support of the government in order to develop new business and gain revenue. However, they need to maintain the ability to conduct daily business operations to resume regular business after the pandemic quickly. In the early stage of the outbreak and the later stage of control, the business focus of enterprises returns to the daily business operations, but it should not be damaged or lower than the minimum output standard obtained by information technology innovation. At this time, the new business brought by information technology has become a supplement to the daily business operations.

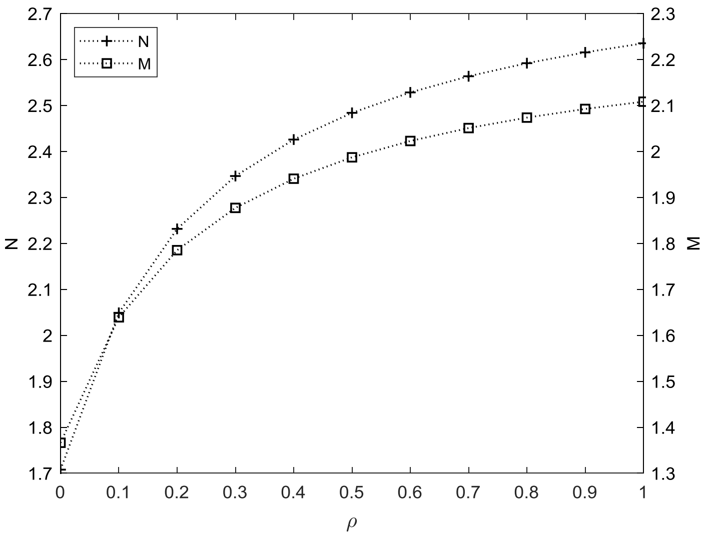


Figure 2. The impact of risk aversion coefficient on the ratio of effort levels and relative incentive intensity

Figure 2 shows that the ratio of optimal effort levels and relative incentive intensity coefficient are positively correlated with the risk aversion coefficient. With the reduction of risk aversion, enterprises will improve their efforts in information technology innovation. Considering the possibility of risk loss in providing medical tourism services under the pandemic, enterprises with low-risk aversion are more willing to take actions to build resilience and create new profit sources actively. Moreover, the government will also incentivize enterprises to carry out such business. However, enterprises with high-risk aversion focus on improving their ability to maintain daily business operations to wait for the mitigation of COVID-19, and they avoid the pandemic risk in this way. Although potential or uncertain losses can be avoided, the opportunity to gain benefits will also be lost if they give up the information technology innovation in medical tourism.

5. CONCLUSIONS

Under the impact of COVID-19, the government will implement incentive policies for enterprises to promote the recovery and development of medical tourism industry. In order to cope with the pandemic crisis, medical tourism enterprises will make efforts in two aspects with the support of the government. One is to maintain daily business operations; the other is to carry out information technology innovation in medical tourism, and enterprises improve their resilience through the two ways. Therefore, we construct multitask principal-agent models between government and enterprises, and analyze the conclusions from the perspective of resilience. The results show that:

(1) The effort levels on two tasks of medical tourism enterprises are directly related to the incentive intensity of the government. The enterprises' comprehensive service ability, effort cost, risk aversion coefficient and external random factors will all affect the optimal effort levels.

(2) The optimal effort level on a certain task is positively related to the relative importance of the task. When the effort cost of the task is small, and there are few external random factors, medical tourism enterprises tend to prioritize the task.

(3) When medical tourism enterprises enhance the relative importance of a certain task, the government's incentive intensity for the task will increase and that for another task will decrease. When enterprises adjust the relative importance of tasks according to different stages of the pandemic, they should consider different task objectives and highlight business priorities, so as to improve resilience and create more benefits.

(4) The relative incentive intensity of the government to the two tasks is negatively correlated with external random factors. The medical environment under COVID-19 has aggravated the risk and uncertainty of medical tourism servers in the case of information asymmetric, and the government's blind incentives may lead to moral hazard behavior of enterprises.

Some have described the COVID-19 crisis as an equalizer, which offers a rare and invaluable opportunity to rethink and reset medical tourism [17]. It is the best time for the digital transformation of medical tourism. Transformations like restarting, reorganizing, and assimilating the medical tourism industry according to the latest standards and rules are required to revive the industry. The government and enterprises should work together to transform the medical tourism industry into a much more sustainable form, and pay more attention to equitable and inclusive development [18].

There are still some limitations in this paper. The government studied in this paper is risk-neutral, and medical tourism enterprises are risk aversion, and other risk preferences are not discussed. In addition, we only analyze the role of government and enterprises in the medical tourism industry. In future research, medical tourism customers can be introduced to analyze and explore the impact of customer satisfaction and risk aversion on healthcare.

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