Systematic Thinking on the Design of Public Service Outsourcing Contract —— From the Perspective of Double Principal-agent

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Abstract

Contract outsourcing is regarded as an important means to improve public service and save service cost. Aiming at the problem of contractors' moral hazard caused by asymmetric information in the process of outsourcing, this paper establishes the double principal-agent framework of public service outsourcing based on public, government and contractor, and designs the outsourcing incentive contracts that introduces public satisfaction in both complete information and incomplete information. Model analysis and simulation results show that introducing public satisfaction into contracts can effectively promote contractors' effort, reduce agency cost of government, improve contracts flexibility as well as reduce moral hazard. The research conclusion works as the decision-making reference and theoretical basis for the government to invest in higher quality and more efficient public service.

Keywords

Public service outsourcing; Moral risk; Contract design; Public satisfaction.

1. Introduction

Since the 1970s, the new public management movement has emerged in western countries. The government introduces the market competition mechanism in the public sector, gives full play to the role of the market in optimizing the allocation of resources, and changes the mode of government monopolizing the supply of public services, so as to improve and enhance the public service. In the late 1970s, the government's reform measures achieved great results, so the outsourcing of government services was widely accepted worldwide. The decision of the central committee of the communist party of China on several major issues concerning comprehensively deepening reform clearly states that we should strengthen market-oriented construction in the field of public services and management. In principle, market mechanisms should be introduced in all administrative services that meet relevant market-oriented standards, and private capital should be encouraged to participate in the provision of services in various ways. The implementation of government public service outsourcing, on the one hand, can relieve the financial pressure of the government and accelerate the transformation of government functions; on the other hand, it can improve the quality and supply efficiency of public services and meet the public's growing and increasingly diversified demand for public services.

Due to information asymmetry, uncertainty of service output and other factors, contract outsourcing is faced with some challenges while innovating the government's public service supply system and creating an efficient service-oriented government. In the process of outsourcing, there are natural deviations and inconsistencies in the pursuit of value and goals between the government, who works as the principal and the contractor as the agent, and the contractor as the agent is likely to take advantage of its advantages in obtaining information to make benefits with immoral behaviors, which will lead to moral hazard. Therefore, how to take effective measures to prevent and reduce contractors' the moral hazard is an urgent problem to be solved for the government in the implementation of government public service outsourcing.

2. Literature Review

Through literature collection, many scholars have studied the risk and avoidance of public service outsourcing contract. Public service outsourcing involves a typical principal-agent relationship, in which the government is the principal and the contractor is the agent. Due to information asymmetry, interest deviation of both parties and other factors, contract outsourcing faces inherent adverse selection risk and moral hazard problems [1,2]. There are some problems in contract outsourcing, such as corruption, cutting corners, money and power trading[3]. Leasing for public power and erosion of public interests by market forces open the door for convenience, and tend to induce rent-seeking phenomenon[4]. Yang and Liu believe that the main factors affecting risk are the degree of market competition and the government's regulatory capacity, so the government's risk control strategy should start from the two dimensions of enhancing the degree of market competition and strengthening the government's regulatory capacity[5]. Plambeck and Taylor studied the relationship contract incentive under the condition of two-way information asymmetry from the perspective of the employer and the recipient[6]. Lu believe that third-party supervision agencies with unrelated interests can be introduced to prevent contract collusion between tenants and rent-seekers in public service outsourcing[7].

With the further advance of the construction of service-oriented government centered on public demand, the public, as direct consumers of public services, is also included in the research system. The public has the ability to identify the level of public services, and the public evaluation plays a role in the supervision of public services[8]. The right to know and the right to participate of the public should be fully considered to make up for the deficiency of the supervision mechanism[9].Existing studies show that there is a significant positive correlation between public satisfaction and public service level and performance [8,10], and public satisfaction can be taken as an important standard and basis for evaluating the government's public service level. From the perspective of public satisfaction, Wang and Wu used the method of empirical research to test the influence of individual factors of the public on the satisfaction of the government in purchasing public services[11]. For the first time, Liu and Yi et al. established a public service outsourcing quality control model with public satisfaction in mind, and verified that public satisfaction could prompt the government and the enterprise receiving the package to invest more effort cost through solving the model[12].

To sum up, existing literatures have conducted in-depth theoretical analysis on the risks and avoidance of contracts in public service outsourcing from different perspectives. More and more scholars have included the public into the regulatory system in consideration of the integrity of the system. However, most of them are empirical studies or behavioral game analysis of participants, and few of them include public satisfaction into outsourcing contracts. Based on previous studies, this paper introduces public satisfaction into service outsourcing contracts, analyzes the impact of public satisfaction on contractors' efforts from the perspective of dual principal-agent, and assists the government in designing effective incentive mechanism for contracts, so as to improve and enhance public services.

3. Model Building

3.1 Problem Description

In the outsourcing of public services, the government, as the decision maker and the contractee, sets the quantity and quality standards of public services, and entrusts contractors to produce public services and provide them to the public for consumption. As a producer of public services, contractors have the best understanding of public demand, production cost, product quality and other information. The public, as the final consumers of public services, directly perceive the value brought by public services and give feedback to the government. From the perspective of information economics, the two-principal agency framework of public service outsourcing composed of three subjects -- "government -- contractor -- public" is constructed, as shown in Fig.1.

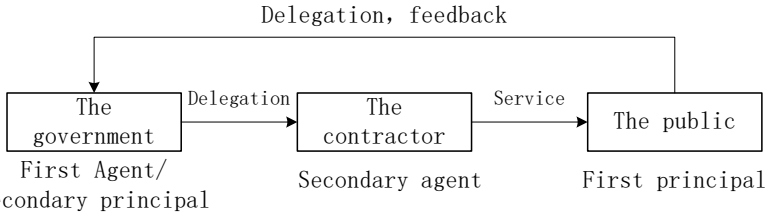

Fig.1 Common service outsourcing dual principal-agent framework

As consumers of public services, the public has the right to evaluate the level of public services, and the public evaluation can more truly reflect the level of public services. Principal-agent theory is a classic method to reduce and prevent the moral hazard of agents, which is mainly used to solve the problem of the optimal decision making of incentive contracts by principals when the agent's behavior cannot be fully observed by the principal[13]. For contractor's moral hazard problem, therefore, this article intends to adopt the method of principal-agent, the public opinion of the public service or public satisfaction to government incentive contracts for contractors, public satisfaction by analyzing model and simulation validation of contract design, the influence of the solution by using the method of quantitative analysis in the process of public service outsourcing contractors' moral hazard problem.

3.2 Research Hypothesis

Considering the principal-agent situation composed of the government and a contractor, the government shall first draw up the public service outsourcing contract and invite public bidding, then the winning contractor shall provide public services to the public according to the contract, and finally the government shall pay the contractor according to the output of the public service project evaluated. To facilitate problem analysis, the following hypothesis is proposed:

Hypothesis 1.: Output of public service outsourcing project is π, which depends on the contractor's output coefficient and effort level, and is also affected by exogenous factors. Its function form is:

$$\pi(x,\theta) = kx + \theta \tag{1}$$

Where, $k > 0$ represents the output coefficient of the contractor, x is a one-dimensional variable representing the contractor's effort level, and represents the human and material resources, capital and time invested by the contractor in the public service outsourcing project. θ is exogenous, following a normal distribution with a mean of 0 and a variance of σ^2, which is $\theta \sim N(0,\sigma^2)$.

Hypothesis 2.: According to the principal-agent theory, the principal can reduce information asymmetry by supervising the agent and obtain more information about the agent's real effort level. As the final consumers of public services, the level of effort invested by contractors in public service outsourcing projects can be reflected by the public satisfaction. The higher the public satisfaction, the higher the level of effort invested by contractors, the higher the public service level. Therefore, it is feasible to take public satisfaction as external supervision variable in order to reflect the level of effort paid by contractors more truly. To simplify the analysis and ignore the cost of the government to obtain public satisfaction, the contract form between the government and the contractor is:

$$s(\pi, m) = \alpha + \beta(\pi + pm) \tag{2}$$

s is the total payment made by the contractor upon acceptance of the contract, α is a fixed payment, which has nothing to do with service output, $\beta(0 \le \beta \le 1)$ is the revenue sharing coefficient. On the one hand, it represents the government's incentive intensity to contractors; on the other hand, it also reflects the risk sharing ratio of contractors, m is public satisfaction, subject to normal distribution with mean value of 0 and variance of δ^2, p represents the linear relationship between the contractor's income from the contract and the public satisfaction.

Generally speaking, the higher output π of public service outsourcing projects is, the higher public satisfaction m is. Therefore, m is correlated with π, and the correlation coefficient is set as u. The public satisfaction m is written into the incentive contract of public service outsourcing, so that the benefits obtained by contractors not only depend on their own performance, but also depend on the

subjective perception of public service consumers, which reflects the public-centered concept of government service.

Hypothesis 3.: The government is risk-neutral, and the expected return is U_g; the contractor is risk-averse, and the expected return is $U_s = -e^{-\rho w}$, where W represents the actual income of the contractor, and $\rho > 0$ represents the risk aversion degree of the contractor.

Hypothesis 4.: The contractor's cost consists of the following two parts: (1) cost of effort, which is a function of contractor's effort level and marginal effort cost, denoted as $C(x)=cx^2/2$ and $c > 0$ is contractor's marginal effort cost;(2) risk cost. According to $Arrow-pratt$ conclusion, the contractor's risk cost ΔRC can be expressed as:

$$\Delta RC = \rho\beta^2[\sigma^2 + p^2\delta^2 + 2p\,\mathrm{cov}(\pi, m)]/2 \quad (3)$$

3.3 Incentive Contract Construction

To sum up, the government as the principal is risk-neutral, and its expected revenue is shown in equation (4). The actual monetary revenue obtained by the contractor from the contract is shown in equation (5):

$$U_g = \pi - \alpha - \beta(kx + pm) \quad (4)$$

$$U_s = s(\pi, m) - c(x) = \alpha + \beta(kx + pm) - cx^2/2 \quad (5)$$

Since the contractor is risk averse, its deterministic equivalent income needs to take risk cost into account, as shown in equation (6):

$$Us' = \alpha + \beta kx - cx^2/2 - \rho\beta^2[\sigma^2 + p^2\delta^2 + 2p\,\mathrm{cov}(\pi, m)]/2 \quad (6)$$

For the government of the principal, the designed incentive contract must satisfy two constraints of the contractor: participation constraint IR and incentive compatibility constraint IC. Suppose the contractor's retained income is $\bar{w}$, then the principal-agent model $P1$ is established as follows:

$$P1: \max_{(\alpha,\beta,p)} U_g \quad (7)$$

$$st.\ \ IR: U_s \geq \bar{w} \quad (8)$$

$$IC: x = \arg\max_x Us' \quad (9)$$

In $P1$, equation (7) is the objective function of the government's expected revenue, equation (8) is the contractor's participation constraint, and equation (9) is the contractor's incentive compatibility constraint.

3.3.1 Contract design under full information

Under complete information, the government can observe the real effort level x of the contractor. At this time, incentive compatibility constraint IC does not work, and any effort level of the contractor can be realized by participating in the mandatory contract of constraint IR. Therefore, the government's contract to the contractor is to select α, β, p to solve the optimization problem of the following model:

$$\max_{\alpha,\beta,p} Ev = \pi - \alpha - \beta(\pi + pm) \quad (10)$$

$$st.(IR)\ \alpha + \beta kx - cx^2/2 - \rho\beta^2(\sigma^2 + p^2\delta^2 + 2p\,\mathrm{cov}(\pi, m))/2 \geq \bar{w} \quad (11)$$

In the optimal case, the participation constraint IC takes the equation, and the optimal solution is obtained by substituting the fixed payment term α of the participation constraint into the objective function:

$$x = \frac{k}{c},\ \beta = 0,\ \alpha = \bar{w} + \frac{k^2}{2c} \quad (12)$$

The pareto optimal contract with complete information is obtained. Since the government is risk-neutral and the contractor is risk-averse, the pareto optimal contract requires the contractor to bear no risk. At the same time, the fixed income paid by the government to the contractor is exactly equal to

the retained income of the contractor plus the cost of effort invested in the public service projects. The higher the effort cost or retained income of the contractor, the higher the fixed income required by the government.

3.3.2 Contract design under incomplete information

In the case of incomplete information, the government cannot observe the contractor's effort level. In this case, the contractor chooses the effort level to maximize his own benefits according to incentive compatibility constraints. By solving the first-order condition of x in equation (6), we can get : $x = k\beta / c$. Participation constraint (IR) means that the contractor accepts the contract under the condition that the benefit obtained from the contract is greater than or equal to its own retained income. Under the optimal condition, the reward paid by the government to the contractor is exactly equal to its retained income $\bar{w}$, that is, (IR) takes the equation. Find the expression of fixed payment α and substitute α into U_g to get the optimization problem:

$$\underset{p,\beta}{\text{Max}} \frac{k^2}{c} - \frac{\rho\beta^2}{2}[\sigma^2 + p^2\delta^2 + 2p\,\text{cov}(\pi, m)] - \frac{k\beta}{c} = 0 \tag{13}$$

Take the first-order condition of equation (13) on p, β, substitute it into $\text{cov}(\pi, m) = \mu\sigma\delta$, and get:

$$p = -\frac{\text{cov}(\pi, m)}{\delta^2} = -\mu\sigma / \delta < 0 \tag{14}$$

$$\beta = \frac{k^2}{k^2 + \rho c(1-\mu^2)\sigma^2} \tag{15}$$

Substitute β into the expression x, and see equation (16) for the expression of effort level:

$$x = \frac{k^3}{ck^2 + \rho c^2(1-\mu^2)\sigma^2} \tag{16}$$

When the principal cannot observe the agent's effort level, there are two types of agency costs that do not exist under complete information, namely, risk cost and incentive cost [18]. According to hypothesis 4, the risk cost is:

$$\Delta RC = \frac{\rho(1-\mu^2)\sigma^2 k^4}{2[k^2 + \rho c(1-\mu^2)\sigma^2]^2} \tag{17}$$

Incentive cost consists of two parts: the agent's effort cost saving and the client's expected output net loss, as follows:

$$\Delta c = \frac{2\rho k^4(1-\mu^2)\sigma^2 + c\rho^2 k^2(1-\mu^2)^2\sigma^4}{2[k^2 + \rho c(1-\mu^2)\sigma^2]^2} \tag{18}$$

$$\Delta\pi = \frac{\rho k^2(1-\mu^2)\sigma^2}{k^2 + \rho c(1-\mu^2)\sigma^2} \tag{19}$$

$$\Delta\pi - \Delta c = \frac{c\rho^2(1-\mu^2)^2\sigma^4 k^2}{2[k^2 + \rho c(1-\mu^2)\sigma^2]^2} \tag{20}$$

Therefore, the agency cost is:

$$Ac = \frac{\rho(1-\mu^2)\sigma^2 k^2}{2[k^2 + \rho c(1-\mu^2)\sigma^2]} \tag{21}$$

Thus, we obtain the optimal contract under incomplete information: effort level x, revenue sharing coefficient β and total agency cost Ac.

In order to analyze the influence of public satisfaction on contract design, $p = 0$ and $p \neq 0$ are taken to get the key parameter pairs of contracts without public satisfaction (contract 1) and without public satisfaction (contract 2), as Table 1.

Table 1 Comparison of key parameters of contract 1 and contract 2

Situational parameters	Contractor effort level x	Revenue sharing coefficient β	Agency costs Ac
Contract 1	$\frac{k^3}{ck^2+\rho c^2\sigma^2}$	$\frac{k^2}{k^2+\rho c\sigma^2}$	$\frac{\rho\sigma^2k^2}{2(k^2+\rho c\sigma^2)}$
Contract 2	$\frac{k^3}{ck^2+\rho c^2(1-\mu^2)\sigma^2}$	$\frac{k^2}{k^2+\rho c(1-\mu^2)\sigma^2}$	$\frac{\rho(1-\mu^2)\sigma^2k^2}{2(k^2+\rho c(1-\mu^2)\sigma^2)}$

4. Contract Analysis

4.1 Effort level analysis

Conclusion 1.: The optimal effort level of contractor x is negatively correlated with marginal effort cost c and positively correlated with output coefficient k.

Proof: the first partial derivative of x with respect to k,c can be obtained from equation (16) : $\frac{\partial x}{\partial c}<0$ and $\frac{\partial x}{\partial k}>0$, so the contractor's effort level is an increasing function of its output coefficient and a decreasing function of marginal effort cost.

In the public service outsourcing project, the contractor's effort level is restricted by his marginal effort cost and marginal output level. When the marginal effort cost of the contractor increases, more costs are required for the same level of effort, and the contractor's motivation to work hard decreases, and the effort level also decreases. When the contractor's output coefficient becomes smaller, the service output at the same level of effort is also lower, which will reduce the contractor's motivation to work hard. Before public service outsourcing contract, therefore, the government should consider output coefficient can reflect the contractor cost and effort of a series of factors, including the contractor's technical ability, management level, human capital, and past experience of outsourcing projects, etc., for the contractor to examine the qualification and access conditions, reduce the negative impact caused by information asymmetry.

Conclusion 2.: The inclusion of public satisfaction m into the public service outsourcing incentive contract is conducive to promoting the contractor to invest a higher level of effort, and the effort level is positively correlated with the correlation coefficient.

Proof: according to table 1, the difference of contractor effort level between the two contracts Δx is:

$$\Delta x=\frac{k^3}{ck^2+\rho c^2(1-\mu^2)\sigma^2}-\frac{k^3}{ck^2+\rho c^2\sigma^2}>0$$

$$\frac{\partial x}{\partial u}=\frac{2\mu k^6\rho c^2\sigma^2}{[ck^2+\rho c^2(1-\mu^2)\sigma^2]^2}>0 \qquad (22)$$

The conclusion is proved. Compared with contract 1, contract 2 introduces public satisfaction m as an external supervision variable to reduce the information asymmetry between the government and the contractor, so the government can obtain more information about the real effort level of the contractor, and then restrain the opportunistic behavior of the contractor.

It is worth noting that: ① when q, i.e. public satisfaction has nothing to do with the output of public service outsourcing project, there is no difference between contract 1 and contract 2. It is invalid to introduce public satisfaction into incentive contract, and it will not affect the effort level of the contractor in public service outsourcing project. ②when $\mu\neq0$, that is, the greater the correlation between public satisfaction and output of public service outsourcing project, the higher the level of efforts of contractors. Therefore, in order to avoid the failure risk of contract design caused by their irrelevance or low correlation, it is suggested that the government should strengthen the public participation in public service outsourcing, so as to improve the correlation coefficient. To be specific,

the public should be endowed with the right to evaluate the level of public services, strengthen publicity and education, make the public consciously fulfill the rights and obligations granted by law, and make the public effectively evaluate and supervise the quality and efficiency of public services through questionnaires, message boards on government websites, instant messaging and other means. This paper aims to establish a public service output performance evaluation system combining objective performance with subjective performance by introducing public evaluation on public service quality level, and optimize the incentive contract design for contractors.

The influence of correlation coefficient and output coefficient on contractor's effort level is tested by numerical simulation. The parameter is assigned to: $\rho=0.5, c=1, \sigma^2=4, k\in(0,1), \mu\in(0,1)$. The simulation results are shown in Fig. 2, where the X-axis is the output coefficient, the Y-axis is the correlation coefficient, and the z-axis is the effort level.

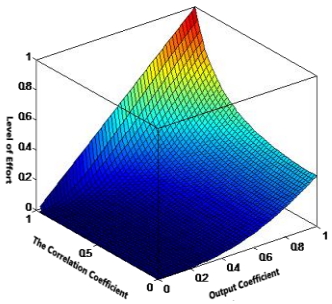

Fig. 2 Effect of output coefficient and correlation coefficient on effort level

According to the figure, contractor effort level x increases with the increase of output coefficient k and correlation coefficient μ. After public satisfaction is introduced, the magnitude of correlation coefficient changes the marginal effect of output coefficient on effort level. The higher the correlation coefficient is, the higher the slope of the curve of contractor effort level changing with output coefficient is, that is, the increase of correlation coefficient will strengthen the marginal effect of output coefficient on effort level. By comparing the curve graph of contractor effort level with output coefficient and correlation coefficient curve, it is found that contractor effort level is more sensitive to correlation coefficient, which indicates that the government can improve contractor effort level more significantly by introducing public satisfaction.

4.2 Income sharing coefficient analysis

Conclusion 3.: Revenue sharing coefficient β is the minus function of contractor's marginal effort cost c and risk aversion coefficient ρ, and the increasing function of output coefficient k.

Proof: the first partial derivative of β with respect to c, risk aversion coefficient ρ and output coefficient k of contractor's marginal effort cost is obtained from equation (15) : $\frac{\partial\beta}{\partial c}<0$, $\frac{\partial\beta}{\partial\rho}<0$, $\frac{\partial\beta}{\partial k}>0$,and the conclusion is proved.

According to conclusion 3, ① $\partial\beta/\partial c<0$ indicates that the higher the marginal effort cost q, the lower the level of effort paid by the contractor, and the higher the revenue sharing coefficient required to induce the contractor to choose the same level of effort (because $x=k\beta/c$). ② $\partial\beta/\partial k>0$ indicates that the higher the contractor's output coefficient k, the stronger its ability to resist risks, and the higher the output at the same level of efforts. At this time, the government can appropriately increase the incentive intensity of contractors to increase the risks undertaken by contractors. ③ $\partial\beta/\partial\rho<0$ indicates that different incentive strategies should be adopted for contractors with different risk attitudes. The more risks the contractor avoids, the less incentive intensity the government should give to the contractor. As can be seen from the expression of risk cost A, when the value of benefit sharing coefficient and other parameters remain unchanged, the higher the risk avoidance coefficient

is, the higher the risk cost borne by the contractor will be. At this time, the optimal contract requires to reduce the benefit sharing coefficient to reduce the risk cost borne by the contractor.

Conclusion 4.: The revenue sharing coefficient β is positively correlated with the correlation coefficient μ, that is, the introduction of public satisfaction will strengthen the government's incentive to contractors.

Proof: $\frac{\partial \beta}{\partial \mu}=\frac{2\mu k^2\rho c\sigma^2}{[k^2+\rho c(1-\mu^2)\sigma^2)]^2}>0$,the revenue sharing coefficient is an increasing function of the correlation coefficient, and the conclusion is proved.

The greater the correlation coefficient μ is, the stronger the public supervision power will be, the less the interference of exogenous uncertainties will be, and the greater the probability of contractors' opportunistic behaviors being detected will be. At this time, the government can increase the incentive intensity for contractors and urge them to invest more efforts.

The following is a numerical simulation to test the influence of correlation coefficient and marginal effort cost on revenue sharing coefficient. The parameter is assigned as follows: ρ=0.5, $k=1, \sigma^2=4, c\in(0,1), \mu\in(0,1)$. The simulation results are shown in Fig. 3, where the X-axis is the marginal effort cost, the Y-axis is the correlation coefficient, and the z-axis is the revenue sharing coefficient.

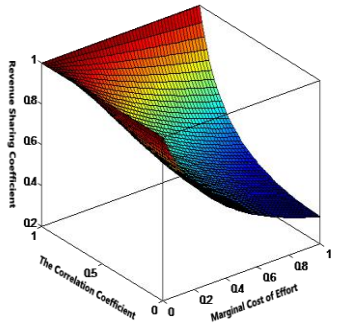

Fig. 3 Effects of marginal effort costs and correlation coefficients on revenue sharing coefficients

It can be seen from the figure that the revenue sharing coefficient β decreases with the increase of marginal effort cost c and increases with the increase of correlation coefficient μ. When the marginal effort cost is small, the correlation coefficient has little effect on the revenue sharing coefficient. The higher the marginal effort cost is, the more sensitive the correlation coefficient is to the revenue sharing coefficient. Now consider an extreme case, when π is completely dependent on m, namely, $\mu=1$,public satisfaction fully reflects the contractor's true level of effort, by the figure that revenue sharing coefficient of identity in 1, the contractor's effort level is equal to the pareto optimal level B, at the same time by A type (17) the C, namely the contractor does not undertake any risk, realize the pareto optimal results.

4.3 Agency Cost Analysis

Conclusion 5.: Agency cost is positively correlated with contractor's risk aversion coefficient ρ and output coefficient k, and negatively correlated with marginal effort cost c.

Proof: from equation (21), we can get:

$$\frac{\partial Ac}{\partial \rho}>0, \frac{\partial Ac}{\partial k}>0, \frac{\partial Ac}{\partial c}<0 \qquad (23)$$

The higher the risk aversion coefficient ρ is, the lower the profit brought by the high effort level of the contractor may be compared with that when the contractor does not accept the commission, and the enthusiasm of the contractor to work hard decreases. At this time, the optimal contract requires the government to give more incentive payment to the contractor to improve the contractor's effort level and increase the total agency cost. The larger the output coefficient k is, the higher the contractor's output will be under the unit effort level, and the greater the incentive payment from the government will be, thus increasing the total agency cost. The smaller the marginal effort cost c is,

the less the government's incentive intensity to contractors will be. Contractors will seek other ways to maximize their own interests, and the government will pay more agency costs to encourage agents to choose contracts, thus increasing the total agency costs.

Conclusion 6.: The inclusion of public satisfaction m into public service outsourcing incentive contract is conducive to reducing the agency cost of the government, and the agency cost decreases with the increase of correlation coefficient μ.

Proof: according to table 1, the difference of agency cost under two contracts and the first-order partial derivative of agency cost with respect to correlation coefficient are:

$$\Delta Ac = \frac{\rho\sigma^2k^2}{2(k^2+\rho c\sigma^2)} - \frac{\rho(1-\mu^2)\sigma^2k^2}{2(k^2+\rho c(1-\mu^2)\sigma^2)} > 0$$

$$\frac{\partial Ac}{\partial \mu} = \frac{-4\mu\rho\sigma^2k^4}{[2(k^2+\rho c(1-\mu^2)\sigma^2)]^2} < 0 \qquad (24)$$

Which is proved. According to equations (17) and (20), after the introduction of public satisfaction, both incentive cost and risk cost are reduced, thus reducing the general agency cost. Only when $\mu = 0$, the agency cost is the same. From equation (24), it can be known that the higher the correlation coefficient is, the lower the agency cost will be, until $\mu = 1$, the agency cost is zero, achieving the pareto optimal result.

Next, the influence of marginal effort cost, output coefficient and correlation coefficient on agency cost is tested by numerical simulation. The parameter assignment is: ρ=0.5, $c = 1, \sigma^2 = 4$,the simulation results are shown in Fig. 4; The parameter assignment is: ρ=0.5, $k = 0.5, \sigma^2 = 4$,the simulation results are shown in Fig. 5. Where, the X-axis is output coefficient and marginal effort cost respectively, the Y-axis is correlation coefficient, and the z-axis is agency cost.

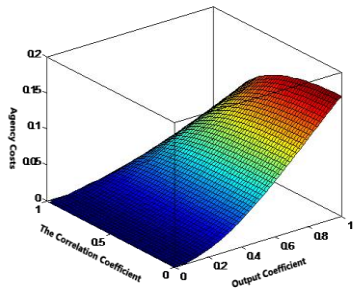

Fig. 4 Effect of output coefficient and correlation coefficient on agency cost

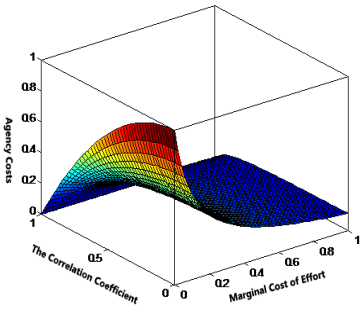

Fig. 5 Marginal effort costs and correlation coefficients on agency costs

Combining the above two figures, it can be seen that agency cost AC decreases with the increase of correlation coefficient μ and marginal effort cost c, and increases with the increase of output coefficient k. In addition, by comparing the two figures, it can be found that the increase of correlation coefficient will weaken the marginal effect of contractor's output coefficient and marginal effort cost on agency cost.

5. Conclusion and Policy Implications

At present, the extensive application of contract outsourcing in the field of public service and management has become an important means for governments of various countries to improve the level of public management and service, and it is also an inevitable choice for China to comprehensively develop and deepen reform in the field of public management and service. The key to the good operation of government public service outsourcing project lies in the government's correct selection of contractors and the design of effective incentive mechanism. Therefore, this paper focuses on the design and optimization of the "optimal contract" of public service outsourcing projects, and innovatively puts public satisfaction into incentive contracts based on the linear contract principal-agent framework of Holmstrom and Milgrom. The results show that the government can formulate the incentive and constraint mechanism of public service outsourcing project according to the public satisfaction, which can not only effectively reduce the principal-agent cost of the contract, but also encourage efforts invested by contractors and reduce potential moral hazard during the implementation of the contract.

Based on the analysis above, in order to effectively solve the moral hazard problem of contractors in public service outsourcing, we can start from the following aspects:

Firstly, improve the design of incentive contract in public service outsourcing. The government should design the optimal incentive contract on the basis of assessing the contractors' risk preference, marginal effort cost, output level and other factors. For contractors with small marginal effort cost, high marginal output and low risk avoidance degree, the revenue sharing coefficient should be increased, and the incentive intensity should be reinforced to encourage them to invest more efforts. Secondly, create conditions and guide the public to be involved actively. This study has verified the effectiveness of introducing public satisfaction to incentive contract design. Therefore, the government should adopt various means to guide the public to actively participate in the evaluation of public service level. First, the government should make government information more open. The public should be informed of the information of public service outsourcing in a timely manner through the official website of the government, press conferences, newspapers, television and other channels. The problems discovered and reflected by the public should be answered and solved timely to promote the smooth development of public service outsourcing. Second, reduce the cost of public participation, provide certain rewards for individuals who actively participate in the evaluation, and take public satisfaction as the subjective performance standard of public service outsourcing project output. Third, build a scientific public service performance evaluation system. The uncertainty and fuzziness of public service performance increase the difficulty of constraining contractors' opportunistic behaviors through contracts, and reduce the effectiveness of contracts. Through scientific performance evaluation of public services, the impact of uncertain exogenous factors on service output can be reduced, which can promote contractors to invest more efforts.

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