Compensation incentive of innovation staffs undertaking multiple tasks

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Abstract: A scientific and reasonable reward system plays a very important role in stimulating the technological innovators of the enterprises. In this paper, we analyze the behavior of the research staff in the enterprise, and the managers and the research staff of the enterprise are regarded as the principal and agent respectively, and then we design a compensation contract by establishing the principal-agent model. Finally, the influence factors of the optimal incentive weight in the contract are studied through numerical simulation, based on the results obtained, we propose our own suggestions.

Keywords Compensation incentive, Principal agent model, Technological innovation; compensation contract

INTRODUCTION

For enterprises, scientific researchers are human resources with special contributions, which directly determine the development prospects of the enterprises. A scientific and effective compensation contract is very important for mobilizing research staff's enthusiasm and creativity and promoting the technological innovation activities of enterprises.

In 2016, Professor Peng Jianjun conducted a questionnaire survey of 150 knowledge workers, and the results show that the top five incentive factors of Chinese knowledge workers are wages and bonus, personal growth and development, challenging work, the future of the enterprise and guaranteed and stable work.[Jan, *et. al.*, 2011] According to Liu Xingguo, when design the incentive system of the research staff, we should consider a lot of factors, such as the internal and external environment of the company, the characteristics of the research staff, the rationality of compensation, the management system and cultural construction.[Chen, *et. al.*, 2006] Ye Lu analyzed the shortcomings and the deficiencies in the mechanism of domestic research institute and explored how to improve the incentive effect on the research staff. In addition, she established a Integrated incentive system constituted by a training and development incentive subsystem, a compensation incentive subsystem and a career development planning incentive subsystem. Finally, she proposed some specific incentive measures.

From the content above, we can see that in recent years, scholars at home and abroad have done a lot of research on the incentive of technological innovation, and the results show that a scientific and reasonable salary contract plays a very important role in the incentive of research staff. However, previous scholars have not conducted an in-depth exploration of the design and composition of specific compensation contracts, and there was no enough research on the factors affecting the compensation contracts. Through the analysis of the behavior of the research staff, this paper establishes a principal-agent model. [Houston, *et. al.*, 1995]Assume that the agent performs three kinds of work at the same time and pay three types of efforts. Based on the assumption, we conduct an in-depth study on the design of the compensation contract, focusing on the effect on the optimal incentive weights of the correlation between the measures and the correlation between the agent's efforts. Finally, according to the results obtained by numerical simulation, we put forward our own suggestions.

MODEL

In the model of this article, the client is the manager of the enterprise, and the agent is the technology research and development personnel of the enterprise. We assume a risk-neutral principal who hires a risk- repugnant agent and the goal of both sides is to maximize its utility function. The agent performs three interrelated tasks, his effort affects firm profit but is unobservable to the principal because of the existence of information asymmetry.

The principal observes firm profit along with two performance measures at the end of the period, and these measures hierarchically relate to one another, each measure's outcome affects the next measure's results. We label these measures y_1, y_2 and y_3 respectively. Among which, y_1 is the innovation theory measure and it represents the theoretical achievements and patent the agent gain in their daily work, y_2 is the innovation benefit measure and it represents the benefit the staff bring to the enterprise through their technological innovation activities, y_3 is

the profit measure and it represents the accounting profit of the firm. In addition, we label the effort agent pay innovation theory-oriented effort, innovation benefit-related effort and profit-related effort (a_1, a_2 and a_3, , respectively).

It is assumed that the index of innovation theory is a linear function of innovation theory-oriented effort. The innovation theory measure is defined as

$y_1 = a_1 + \varepsilon_1$, where $a_1 \geq 0$, $\varepsilon_1 \sim N(0, \sigma_1^2)$.

The innovation benefit measure, y_2, is directly affected by the innovation theory measure and innovation benefit-related effort, and it is defined as

$y_2 = a_2 + \beta_1(a_1 + \varepsilon_1) + \varepsilon_2$, where $a_2 \geq 0$, $\varepsilon_2 \sim N(0, \sigma_1^2)$.

The parameter β_1 reflects the relation between the innovation benefit measure and the innovation theory measure. The firm's accounting profit, y_3, is directly affected by the innovation benefit measure and profit-related effort. The profit measure is defined as

$y_3 = a_3 + \beta_2[a_2 + \beta_1(a_1 + \varepsilon_1) + \varepsilon_2] + \varepsilon_3$,

where $a_3 \geq 0$, $\varepsilon_3 \sim N(0, \sigma_1^2)$.

The parameter β_2 reflects the relation between the profit measure and the innovation benefit measure. All error terms (i.e., ε_1, ε_2, and ε_3) are independent of one another. However, due to the interrelationship between the performance measures, the performance measures are correlated.

According to the contents described, the principal offers the agent a contract, w, which depends on the measures mentioned above. For tractability, and consistent with prior literature, we assume a linear compensation scheme. The compensation scheme consists of a fixed salary component, f, and two components based on the innovation theory and innovation benefit measures. The wage is represented as

$w = f + v_1 y_1 + v_2 y_2$.

Where v_1 and v_2 represent the ratio of the salary of the agent to the innovation theory measure and innovation benefit measure respectively.

Based on the compensation contract offered, the agent performs three types of work to maximize his expected utility. He incurs a personal cost of effort, $\kappa(a_1, a_2, a_3)$, which consists of a cost for each type of effort and an additional (reduced) cost if the efforts are substitutes (complements). The agent's cost of effort is defined as

$\kappa(a_1, a_2, a_3) = 0.5(a_1^2 + a_2^2 + a_3^2) + ma_1a_3 + na_2a_3$

The parameter m reflects the relationship between a_1 and a_3, and the parameter n reflects the relationship between a_2 and a_3. When $m(n) > 0$, the agent's cost of effort is higher than the case in which the efforts are independent. Then, the efforts are substitutes; performing one task increases the marginal cost of performing the other task. For complementary efforts, $m(n) < 0$, performing one

task lowers the marginal cost of performing the other task.

The agent has a negative exponential utility function with an Arrow-Partt measure of absolute risk aversion, r. The utility function is represented by

$u = -\exp[-r(w - \kappa(a_1, a_2, a_3))]$

With normally distributed uncertainty and negative exponential utility, the agent's problem can be expressed as maximizing the certainty equivalent of the expected utility. The certainty equivalent, which equals the mean value of compensation minus the agent's cost of effort and the risk premium, is expressed as

$CE(w, a_1, a_2, a_3) = E(w) - \kappa(a_1, a_2, a_3)$

$- \frac{1}{2} r\{v_2^2 \sigma_2^2 + [(v_1 + \beta_1 v_2)\sigma_1]^2 + 2v_2\sigma_2(v_1 + \beta_1 v_2)\sigma_1\beta_1)\}$

The principle solves the following problem:

$\max \Pi = E(y_3 \mid a_1, a_2, a_3) - E(w)$

subject to (IR) $CE(w, a_1, a_2, a_3) \geq \varpi$

(IC) $a_1, a_2, a_3 \in \max CE(w, a_1, a_2, a_3)$

The principal selects the incentive weights to maximize firm profits less the agent's wage, subject to the agent meeting his participation and incentive compatibility constraints. The participation constraint ensures that the agent earns, in expectation, at least an amount equal to his next best alternative. Finally, the agent selects proper level of efforts to maximize his expected utility. The incentive compatibility constraint reflects this condition.

SOLUTION AND NUMERICAL SIMULATIONS

According to the contents described above, the certainty equivalent can be expressed as

$CE = f + v_1 a_1 + v_2 a_2 + v_2 \beta_1 a_1 - [0.5(a_1^2 + a_2^2 + a_3^3) + ma_1a_3 + na_2a_3]$

$- \frac{1}{2} r\{v_2^2 \sigma_2^2 + [(v_1 + \beta_1 v_2)\sigma_1]^2 + 2v_2\sigma_2(v_1 + \beta_1 v_2)\sigma_1\beta_1)\}$

Taking first order conditions of the certainty equivalent with respect to a_1, a_2, and a_3, and solving these equations for a_1, a_2, and a_3 gives:

$$\begin{cases} a_1 = v_1 + v_2\beta_1 - m(nv_2 + mv_1 + mv_2\beta_1)(m^2 + n^2 - 1)^{-1} \\ a_2 = v_2 - n(nv_2 + mv_1 + mv_2\beta_1)(m^2 + n^2 - 1)^{-1} \\ a_3 = (nv_2 + mv_1 + mv_2\beta_1)(m^2 + n^2 - 1)^{-1} \end{cases}$$

Without loss of generality, we assume that the agent's expected wage net of effort cost in another position, ϖ, is zero. Then the objective function can be expressed as

$\Pi = E(y_3) - E(w) = a_3 + \beta_2 a_2 + \beta_1\beta_2 a_1 - [0.5(a_1^2 + a_2^2 + a_3^3) + ma_1a_3 + na_2a_3]$

$- \frac{1}{2} r\{v_2^2 \sigma_2^2 + [(v_1 + \beta_1 v_2)\sigma_1]^2 + 2v_2\sigma_2(v_1 + \beta_1 v_2)\sigma_1\beta_1)\}$

Substituting the solutions for a_1, a_2 and a_3 into the objective function, and we can get the optimal results of the weights placed on the performance measures, v_1 and v_2. In view of the excessive number of variables in the model and the complexity of the calculation, the next phase of the solution will be

divided into two parts, one of which is to assume that $m=0$, which means that the relationship between a_1 and a_3 is zero; the other is to assume that $n=0$, which is to say that the relationship between a_1 and a_3 is zero. In the following discussion, we will analyze the variation tendency of the optimal weights placed on the performance measures in these two cases.

The analysis of the optimal weights when *m=0*

When $m=0$, there is no relationship between a_1 and a_3, and the expressions of the level of the efforts are as following

$$\begin{cases} a_1 = v_1 + v_2\beta_1 \\ a_2 = v_2(1-n^2)^{-1} \\ a_3 = nv_2(n^2-1)^{-1} \end{cases}$$

Bring the expressions above into the target function and we can get

$$\Pi = nv_2(n^2-1)^{-1} + \beta_2[v_2(1-n^2)^{-1} + \beta_1(v_1+v_2\beta_1)]$$

$$-\frac{1}{2}[(v_1+v_2\beta_1)^2 + v_2^2(n^2-1)^{-2} + n^2v_2^2(n^2-1)^{-2}] + n^2v_2^2(n^2-1)^{-2}$$

$$-\frac{1}{2}r(v_2^2\sigma_2^2 + v_1^2\sigma_1^2 + \beta_1^2v_2^2\sigma_1^2 + 2v_1\beta_1v_2\sigma_1^2 + 2v_1v_2\sigma_1\sigma_2\beta_1 + 2\sigma_1\sigma_2\beta_1^2v_2^2)$$

To find out the solution of the optimal incentive weight v_1^* and v_2^*, we take the first order conditions of the target function with respect to v_1^* and v_2^*, to simplify the expression, we define that $(n^2-1)^{-1}=D$, then we can get

$$\frac{\partial\Pi}{\partial v_1} = \beta_1\beta_2 - v_1 - v_2\beta_1 - r\sigma_1^2v_1 - r\beta_1v_2\sigma_1^2 - rv_2\sigma_1\sigma_2\beta_1$$

$$\frac{\partial\Pi}{\partial v_2} = nD - \beta_2D + \beta_1^2\beta_2 - \beta_1v_1 - D^2v_2 + n^2D^2v_2 - r\sigma_2^2v_2$$

$$-r\beta_1^2\sigma_1^2v_2 - r\beta_1\sigma_1^2v_1 - r\sigma_1\sigma_2\beta_1v_1 - 2r\sigma_1\sigma_2\beta_1^2v_2$$

Assuming the results of the two expressions above are zero and solving the equations for v_1 and v_2, to simplify the expression, we define that $(1+r\sigma_1^2+r\sigma_1\sigma_2)=Q$, $(1+r\sigma_1^2)^{-1}=F$, and we can get

$$v_1^* = F\beta_1\beta_2 - FQ(nD - \beta_2D + \beta_1^2\beta_2 - \beta_1^2\beta_2FQ)$$

$$*[\beta_1^2(1+r\sigma_1^2+2r\sigma_1\sigma_2-FQ^2)+(1-n^2)^{-1}+r\sigma_2^2]^{-1}$$

$$v_2^* = (nD - \beta_2D + \beta_1^2\beta_2 - \beta_1^2\beta_2FQ)$$

$$*[\beta_1^2(1+r\sigma_1^2+2r\sigma_1\sigma_2-FQ^2)+(1-n^2)^{-1}+r\sigma_2^2]^{-1}$$

In the following discussion, we will talk about the influences of the correlation coefficient, β_1, β_2, and n on the optimal incentive weight in this model. To simplify the problem, we assign some of these variables that are often treated as constants. In previous studies, the absolute risk aversion coefficients are always between 2 and 2.5, so in this paper, we make $r=2$, and for further simplification, we assume that ε_1 and ε_2 subject to standardized normal distribution, which means that $\sigma_1=1$ and $\sigma_2=1$. And now we will analyze the problem by using Matlab.

1) The influence on the optimal incentive weights of β_1

Assume that $\beta_2=1$, it can be clearly seen from the results above that when $n>0$, the effort the agent pay, a_3 will be zero, so we assume that $n=-0.5$, the following figure shows the results of the optimal incentive weights with β_1 taking different numerical values.

As the numerical value of v_1^* is always negative, we take $v_1^*=0$, and the relationship between β_1 and v_2^* can be illustrated as follows.

Figure 1 relationship between β_1 and v_2^*
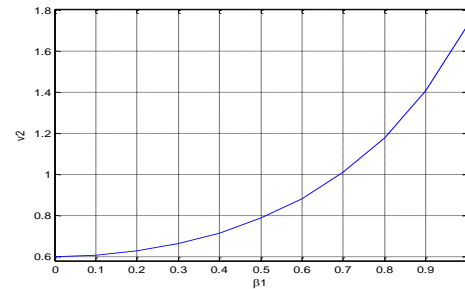
Based on the data in the table and the trend of the graphics, the following results can be obtained, the numerical value of v_1^* is always negative, so we take $v_1^*=0$, which means that in the optimal compensation contract, the weight on the measure, y_1, is zero. And with the increase of β_1, the numerical value of v_2^* increases, which means that the weight on the measure, y_2, increases. In addition, the trend of the graphics also shows that when the numerical value of β_1 is relatively small, the speed of the growth of the weight is slower, and vice versa.

Considering the actual situation, the relationship between a_1 and a_3 is zero, the innovation benefit measure includes a measure of the effort, a_1, so in the compensation contract, the innovation theory measure does not provide new information about the staff, therefore, the managers of the enterprise need no more individual incentives to the innovation theory measure. As for the incentive weight, v_2^*, with the increase of correlation between the innovation theory measure and the innovation benefit measure, the effort the staff pay, a_1, will increase the innovation benefit measure simultaneously while improving the achievements of innovation theory. Therefore, as long as the principal increase the numerical value of v_2^*, the level of a_1 and a_2 can be improved simultaneously. Conversely, with the decrease of the numerical value of β_1, if the principal didn't decrease the incentive weight, v_2^*, the staff will increase the level of a_2 while decrease the other, which will cause poor incentive effect on the

innovation activities of the enterprise. Furthermore, when the level of the numerical value of β_1 is relatively high, the incentive effect on a_1 of v_2^* will be better, this is also the reason why the growth of the curve shown in the figure is faster gradually.

1) Effect on the optimal incentive weights β_2

Assume that $\beta_1 = 1$ and $n=-0.5$, the following table shows the results of the optimal incentive weights with β_2 taking different numerical values.

When the numerical value of v_1^* is negative, we take $v_1^* = 0$, and the relationship between β_2 and v_2^* can be illustrated as follows.
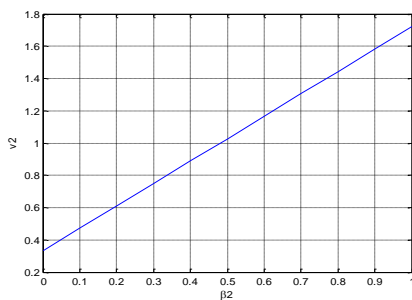

Figure 2 Relationship between β_2 and v_2^*

It is obvious that the numerical value of v_1^* is always negative, so we take $v_1^* = 0$, and the numerical value of v_2^* increases with the increase of β_2. We can also see that v_2^* and β_2 are increasing in proportion according to the tendency of the curve.

Just as the description above, the incentive weight on the innovation theory measure is always zero because it doesn't provide new information about the staff. In addition, with the increase of the numerical value of β_2, the relationship between profit measure and the innovation benefit measure will be enhanced, in order to increase the profit, the principal will encourage the staff to improve the numerical value of the innovation benefit measure, so they will increase the numerical value of v_2^*. And because the change of β_2 has no influence on the incentive effect of v_2^*, so the curve above shows a tendency of direct proportion.

2) Effect on the optimal incentive weights n

Assume that $\beta_1=\beta_2=1$ and the numerical value of n remains negative, the following figure shows the results of the optimal incentive weights with n taking different numerical values.

When the numerical value of v_1^* is negative, we take $v_1^* = 0$, and the relationship between n and v_2^* can be illustrated as follows.
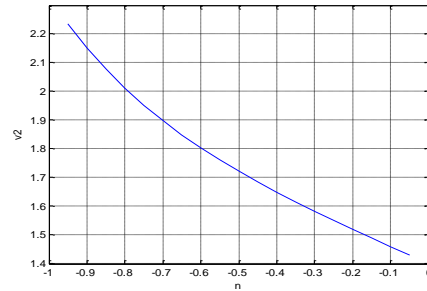

Figure 3 Relationship between n and v_2^*

Based on the data in the table and the tendency of the curve, the following results can be obtained, the incentive weight on the innovation theory measure is always zero, the reason is that the innovation theory measure doesn't provide new information about the staff. With the numerical value of n remains negative, the relationship between a_2 and a_3 is complementary, which means that the agent will reduce the marginal cost of the other job when performing one of these two tasks. With the increase of the complementary degree between the two efforts (the numerical value of n decreases), the principal will increase the numerical value of the incentive weight on the innovation benefit measure, and then the agent will pay higher level of the effort, a_2 and a_3, meanwhile. Finally, the profit of the enterprise will be improved.

The analysis of the optimal weights when $n=0$

When $n=0$, there is no relationship between a_2 and a_3, and the expressions of the level of the efforts are as following

$$\begin{cases} a_1 = v_1 + v_2\beta_1 - m(mv_1 + mv_2\beta_1)(m^2 - 1)^{-1} \\ a_2 = v_2 \\ a_3 = (mv_1 + mv_2\beta_1)(m^2 - 1)^{-1} \end{cases}$$

Bring the expressions above into the target function and to simplify the expression, we define that $(m^2 - 1)^{-1} = D$, and then we can get

$$\Pi = (mv_1 + mv_2\beta_1)D + \beta_2v_2 + \beta_1\beta_2[v_1 + v_2\beta_1 - (m^2v_1 + m^2v_2\beta_1)D] - \frac{1}{2}[v_1 + v_2\beta_1 - (m^2v_1 + m^2v_2\beta_1)D]^2$$
$$- \frac{1}{2}v_2^2 - \frac{1}{2}(mv_1 + mv_2\beta_1)^2 D^2 - m[v_1 + v_2\beta_1 - (m^2v_1 + m^2v_2\beta_1)D](mv_1 + mv_2\beta_1)D$$
$$- \frac{1}{2}r(v_2^2\sigma_2^2 + v_1^2\sigma_1^2 + \beta_1^2v_2^2\sigma_1^2 + 2v_1\beta_1v_2\sigma_1^2 + 2v_1v_2\sigma_1\sigma_2\beta_1 + 2\sigma_1\sigma_2\beta_1^2v_2^2)$$

To find out the solution of the optimal incentive weight v_1^* and v_2^*, we take the first order conditions of the target function with respect to v_1^* and v_2^*, and for further simplification, we define that

$$D^2(1+m^2) + \sigma_1^2 r - \sigma_1\sigma_2 r = F \quad , \qquad r\sigma_1^2 D^{-1} + \sigma_1\sigma_2 r - 1 = Q \quad ,$$

then we can get

$$v_1^* = \beta_1\beta_2 + \frac{1}{2}r\sigma_1^2 D^{-1} - m + \beta_1 Q[mD\beta_1 + \beta_2 - \beta_1^2\beta_2 D - \beta_1 F(\beta_1\beta_2 + \frac{1}{2}r\sigma_1^2 D^{-1} - m)]$$
$$\{\beta_1^2 FQ + [\beta_1 D^2(1+m^2) + 1 + \sigma_2 r + \beta_1^2\sigma_1^2 r + 2\sigma_1\sigma_2\beta_1^2 r]\}^{-1}$$

$$v_2^* = [mD\beta_1 + \beta_2 - \beta_1^2\beta_2 D - \beta_1 F(\beta_1\beta_2 + \frac{1}{2}r\sigma_1^2 D^{-1} - m)]$$

$$\{\beta_1^2 FQ + [\beta_1 D^2(1+m^2) + 1 + \sigma_2 r + \beta_1^2\sigma_1^2 r + 2\sigma_1\sigma_2\beta_1^2 r]\}^{-1}$$

In the following discussion, we will talk about the influences of the correlation coefficient, β_1, β_2, and m on the optimal incentive weight in this model. To simplify the problem, we assign some of these variables that are often treated as constants. In previous studies, the absolute risk aversion coefficients are always between 2 and 2.5, so in this paper, we make $r = 2$, and for further simplification, we assume that ε_1 and ε_2 subject to standardized normal distribution, which means that $\sigma_1 = 1$ and $\sigma_2 = 1$. And now we will analyze the problem by using MATLAB.

1) Effect on the optimal incentive weights β_1

Assume that $\beta_2 = 1$, it can be clearly seen from the results above that when $m>0$, the effort the agent pay, a_3 will be zero, so we assume that m=-0.5, the following figure shows the results of the optimal incentive weights with β_1 taking different numerical values.
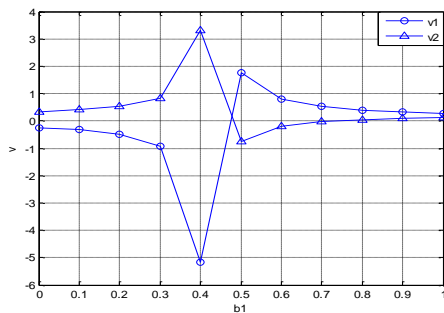

Figure 4   influence on the optimal incentive weights β_1

According to the data and the tendency of the curve, the following results can be obtained. When the numerical value of β_1 stays at a lower level, the incentive weight on the innovation theory measure is zero, while the weight on the innovation benefit measure increases with the increase of β_1, and the growth rate is faster and faster. And the phenomenon can be explained as follows. When the relevance between the innovation theory measure and benefit measure is relatively small, the contribution of the innovation theory measure to the innovation benefit measure is at a low level, therefore caused a low contribution to the profit measure, so the principal will choose to encourage the innovation benefit measure. With the enhancement of the relevance, the numerical value of v_2^* will increase gradually. And because the increase of the numerical value of β_1 will strengthen the incentive effect, the growth rate is getting faster and faster. When the numerical value of β_1 increases to a certain level, due to the complementarity between the innovation theory-oriented effort and the profit-related effort, the

comprehensive incentive effect brought by the innovation theory measure is higher than the incentive effect brought by the innovation benefit measure, the principal will choose to encourage the innovation theory measure. But with the increase the numerical value of β_1, the strengthening effect on the incentive weight, v_2^*, will gradually exceed the complementarity effect between the innovation theory-oriented effort and the profit-related effort, so the numerical value of v_2^* increases while the numerical value of v_1^* decreases.

2) Effect on the optimal incentive weights β_2

Assume that $\beta_1 = 1$, it can be clearly seen from the results above that when $m > 0$, the effort the agent pay, a_3 will be zero, so we assume that m=-0.5, the following figure shows the results of the optimal incentive weights with β_2 taking different numerical values.
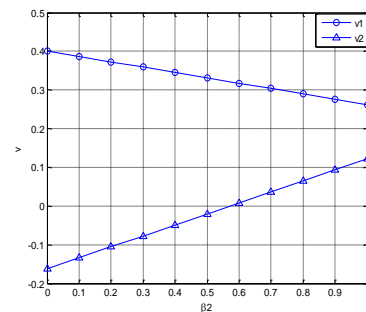

Figure 5   influence on the optimal incentive weights β_2

According to the data in the table and the trend of the curve, the following results can be obtained. The incentive weight on the innovation theory measure decreases with the increase of the numerical value of β_2. While the incentive weight on the innovation benefit measure is zero at first, when the numerical value of β_2 increases to a certain level, the incentive weight, v_2^*, increases with the increase of the numerical value of β_2. And according to the trend of the curve, both of them change in a positive proportion.

The results can be explained as follows. The relationship between the innovation theory-oriented effort and the profit-related effort is complementary, a lower level of β_2 means the relevance between the innovation benefit measure and the profit measure is weak, and at this time, the managers would like to encourage the agent to pay higher level of a_1, thus to increase the level of a_3, so that to raise the profit of the enterprise, Under this circumstance, the incentive effect of the innovation theory measure is better than the innovation benefit measure. A higher level β_2 means the contribution of the innovation benefit

measure to the profit is at a higher level, then the manager will choose the innovation benefit measure. So with the increase of the numerical value of β_2, the incentive weight on the innovation theory measure decreases and the incentive weight on the innovation benefit measure increases. And the reason of both changes are in a positive proportion is that the change of the numerical value of β_2 doesn't have influences on the incentive effect.

3) Effect on the optimal incentive weights m

Assume that $\beta_1 = \beta_2 = 1$ and the numerical value of m remains negative, the following figure shows the results of the optimal incentive weights with m taking different numerical values.
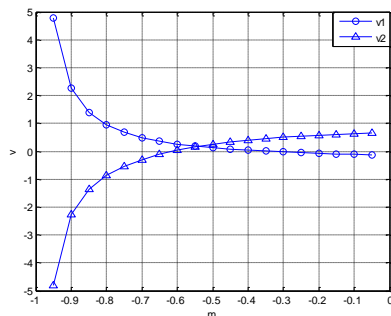

Figure 6   Influence on the optimal incentive weight m

As we can see from the data in the table and the trend of the curve, with the enhancement of the complementarity of the innovation theory-oriented effort and the profit-related effort, the incentive weight on the innovation theory measure increases from zero to positive, while the incentive weight on the innovation benefit measure decreases from positive to zero, and the rate of both changes are faster and faster. And the reason can be explained as follows, when the complementarity of the innovation theory-oriented effort and the profit-related effort is at a lower level, the incentive effect of the innovation benefit measure is higher than the incentive effect of the innovation theory measure plus the utility of the complementary effect, so the managers choose the innovation benefit measure, and contrarily, the managers will choose the innovation theory measure. And the slope of a curve is determined by the influences of the complementarity on the incentive effect.

Assume that the compensation of a salesman is only linked to his own performance, i.e., $S_i = \omega_i + \alpha_i \pi_i$, and $\alpha_i > 0, i = 1, 2$.

CONCLUSIONS

Based on the analysis of the model above, we have obtained the following conclusions.

When there is no relationship between the innovation theory-oriented effort and the profit-related effort, the information contained in the innovation theory measure overlaps with the information contained in the innovation benefit measure, the principal will not stimulate the innovation theory measure separately, that is to say, its incentive weight is always zero. While the incentive weight on the innovation benefit measure will change with the change of the relationship between the agent's tasks and the efforts. The specific variation trend is as follows, when the correlation between the innovation benefit measure and the innovation theory measure increases, the incentive weight becomes larger, when the correlation between the innovation benefit measure and the profit measure increases, the incentive weight becomes larger, when the complementarity between the innovation benefit-related effort and the profit-related effort, the incentive weight becomes larger.

When there is no relationship between the innovation benefit-related effort and the profit-related effort, the variation trend of the incentive weights on the innovation theory measure and the innovation benefit measure are very complicated. The different range of the correlation coefficient and the change trend will have different impacts on the optimal incentive weights, and the extent of the impact is also different, which has been analyzed above already.

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