Research on Combination of Inventive Mechanisms for Marketization-recruited CEOs in State-Owned Enterprises

PING SUN, WEN XIAO and SHENG MA

ABSTRACT

The reform of state-owned enterprises has entered into a critical and deep-water area. Exploratory research on incentive methods for CEOs who are recruited into state-owned enterprises through market needs theoretical guidance and support from the related theories of incentive scheme and mechanism. The extant literature studied the combination of incentive mechanisms for CEOs; however, substitution relationship and complementary relationship between different incentive mechanisms are under-researched. This study develops theoretical models to study the effectiveness and restrictiveness interacted between different incentive mechanisms. According to our findings, the short-term performance share incentive and the effectiveness of long-term stock ownership incentive has a negative correlation with CEO risk aversion, environmental uncertainty and stock market uncertainty; the short-term performance share incentive, the long-term stock ownership incentive and CEO control incentive are complementary. Increase of CEO delegation should be considered when principal increases the CEO short-term performance share and long-term stock ownership incentive. Along with the development of enterprise, the effectiveness of CEO material incentive decreases, and the material incentive barely substitute the immaterial incentive. Principal needs to pay more focus on CEO immaterial incentive. This study enriches the extant literature by contributing implications to combination of incentive mechanisms for marketization-recruited CEOs in state-owned enterprises.

INTRODUCTION

According to the principal-agent theory, under the asymmetric information, the principal should pay the agent based on performance for the purpose of incentive. Only under this approach, the agent is rationally willing to work harder for the principal and a higher input can be expected from the agent [1].

Ping Sun, Chengdu University, East Mausoleum, 610106, Chengdu, Sichuan, P.R. China. Wen Xiao, University of Electronic Science and Technology of China, No. 2006, Xiyuan Ave, West Hi-Tech Zone, 611731, Chengdu, Sichuan, P.R. China. Sheng Ma, Chengdu University, East Mausoleum, 610106, Chengdu, Sichuan, P.R. China.
CEO acts as the top-level agent in a company's principal-agent chain. The inventive scheme on CEO is crucially important for company's value creation. Incentive issue in state-owned enterprises (SOEs) represents higher complexity than that in private enterprises. The ultimate principal in SOEs is ambiguously identified. The SOEs reform has stepped into the deep-water period. In August 2015, the Central Committee of the Communist Party of China and the State Council raised “practicing professional manager system, implementing mixture of internal training and external recruitment, smoothening channel of identity transformation of administrators and professional managers, recruiting and managing professional managers in market approach, increasing ratio of marketization recruitment, and speeding up exit mechanism”, and “practicing marketized compensation system among managers through marketization recruitment, and exploring multi-way to improve the middle and long term incentive mechanism”.

A lot of literature has focused on combination of CEO incentive mechanisms. The extant research divide the CEO incentive mechanism into material incentive and non-material incentive. The former refers to the material compensation paid to the CEO. Due to principal's focus on both short-term and long-term firm performance, the CEO material compensation consists of two parts: profit-sharing mechanism based on short-term performance, and equity incentive based on long-term performance, including current share, option share and stock option incentive. The principal needs to consider a rational incentive combination in which the short-term and long-term incentive are compatible. This incentive combination can maximize the principal's utility [2, 3]. In addition to the material compensation, the CEO's material incentive also include control right incentive and reputation incentive [4-6]. Burton (2006) addresses that the non-material incentive mechanism can promote the organization's long-term healthy development by satisfying the agent's complex internal needs [7]. However, this research did not give a better answer to the question: is there substitution or supplementary relationship between the different mechanisms?

This paper contributes to studying the effectiveness of different incentive mechanisms and their interaction relationship by building theoretical models, enriching the literature on CEO incentive, and providing implications to incentive combination for SOEs' professional managers through marketization recruitment.

THEORETICAL MODEL

Model Assumptions

Assumption 1: The CEO's total input \( m \) consists of two parts, \( m_1 \) for company's short-term performance creating, and \( m_2 \) for long-term performance. The CEO selects an input combination of \( m_1 \) and \( m_2 \), representing as \( m = (m_1, m_2) \in N_1 \times N_2 \). \( N_1 \times N_2 \) represents the space of CEO's input selection. The cost function of input is 
\[
  c(m_i) = \frac{b_i}{2} m_i^2 \quad (b_i > 0, \; i = 1, 2). 
\]

Assumption 2: The performance produced by CEO's input is a two-dimension vector 
\[
  \pi = \begin{pmatrix} \pi_1 \\ \pi_2 \end{pmatrix} = \begin{pmatrix} r_1 m_1 + \varepsilon_1 \\ r_2 m_2 + \varepsilon_2 \end{pmatrix}. 
\] 
\( \pi_1 = r_1 m_1 + \varepsilon_1 \) represents the company's short-term performance, among which \( r_1 \) represents the marginal effect of CEO's input \( m_i \) on...
short-term performance, that is a greater short-term performance will be produced with a same $m_1$ under a greater $r_1$; $e_1$ is a normally distributed random variable whose mean is zero and variance is $\sigma_1^2$, this explains the external uncertainty the CEO faces when creating company's short-term performance. Similarly, $\pi_2 = r_2 m_2 + e_2$ represents the company's long-term performance, measured by the actual market value of the company's stock. $r_2$ represents the marginal effect of CEO's input $m_2$ on long-term performance, that is a higher market value will be obtained with a same $m_2$ under a greater $r_2$; $e_2$ is a normally distributed random variable whose mean is zero and variance is $\sigma_2^2$, this explains the external uncertainty the CEO faces when improving company's market value. Value of $r_1$ and $r_2$ is related with CEO's control rights. A greater CEO's control rights, the greater marginal effect of CEO's input on short-term performance $r_1$ and long-term performance $r_2$; $\sigma_1^2$ and $\sigma_2^2$ mutually independent.

Assumption 3: The principal has no direct observation over the CEO's input $m_1$ and $m_2$, external uncertainty $e_1$ and $e_2$. However, the principal can observe the company's short-term performance $\pi_1$ and long-term performance $\pi_2$ (the market value of company stock) created by CEO's input.

Assumption 4: The principal signs a linear incentive contract $s(\pi) = \alpha + \beta_1 \pi_1 + \beta_2 \pi_2$ with the CEO, among which $\alpha$ represents CEO's fixed earning with no relation with $\pi_1$ and $\pi_2$; $\beta = (\beta_1, \beta_2)$ represents CEO's performance-based compensation share, $\beta_1$ represents CEO's share of short-term performance, also the short-term incentive degree given to the CEO by the principal, and $\beta_2$ represents CEO's share of equity incentive, also the long-term incentive degree given to the CEO by the principal.

Assumption 5: The principal is risk neutral. The principal's expected revenue is:

$$ Ev = E(\pi_1 - \alpha - \beta_1 \pi_1) + \delta E(\pi_2 - \beta_2 \pi_2) = -\alpha + (1 - \beta_1) r_1 m_1 + \delta (1 - \beta_2) r_2 m_2 \quad (1) $$

among which $\delta$ is the discount factor, $0 \leq \delta \leq 1$.

Assumption 6: The principal is risk-aversion. The agent's utility function is $u = -e^{-\rho \omega_1} - \delta e^{-\rho \omega_2}$, among which $\rho$ as the CEO's absolute risk aversion, $\omega_1$ as the CEO's actual income from share of short-term performance, and $\omega_2$ as the CEO's income from the long-term equity incentive.

CEO's actual short-term income is:

$$ \omega_1 = \alpha + \beta_1 \pi_1 - c(m_1) = \alpha + \beta_1 (r_1 m_1 + \varepsilon_1) - \frac{b_1}{2} m_1^2 \quad (2) $$

CEO's certain equivalent income from short-term performance is:

$$ \omega_{\omega_1} = E(\omega_1 - \frac{1}{2} \rho \beta_1^2 \sigma_1^2) = \alpha + \beta_1 r_1 m_1 - \frac{b_1}{2} m_1^2 - \frac{1}{2} \rho \beta_1^2 \sigma_1^2 \quad (3) $$

Similarly, CEO's actual income from long-term equity incentive is:
\[ \omega_2 = \beta_2 \pi_2 - c(m_2) = \beta_2 (r_2 m_2 + e_2) - \frac{b_2}{2} m_2^2 \] (4)

CEO's certain equivalent income from long-term performance is:

\[ \omega_{q_2} = E \omega_2 - \frac{1}{2} \rho \beta_2^2 \sigma_2^2 = \beta_2 r_2 m_2 - \frac{b_2}{2} m_2^2 - \frac{1}{2} \rho \beta_2^2 \sigma_2^2 \] (5)

Thus, CEO's total certain equivalent income is:

\[ \omega_q = \omega_{q_1} + \delta \omega_{q_2} = \alpha + \beta_1 r_1 m_1 - \frac{b_1}{2} m_1^2 - \frac{1}{2} \rho \beta_1^2 \sigma_1^2 + \delta \beta_2 r_2 m_2 - \delta \frac{b_2}{2} m_2^2 - \delta \frac{1}{2} \rho \beta_2^2 \sigma_2^2 \] (6)

CEO's total maximized expected utility function \( Eu = -E(e^{-\rho \omega} + \delta e^{-\rho \omega}) \) is equivalent to the above total certain equivalent income.

**Model Construction**

Based on the above assumptions, under the asymmetric information that CEO's input \( m_1 \) and \( m_2 \) cannot be observed by the principal, and CEO-produced company's short-term performance \( \pi_1 \) and long-term performance \( \pi_2 \) can be observed by the principal, the principal selects \((\alpha, \beta_1, \beta_2)\) to realize his expected maximal revenue \( Ev \) as follow:

\[
\max_{\alpha, \beta_1, \beta_2} Ev = -\alpha + (1 - \beta_1) r_1 m_1 + (1 - \beta_2) r_2 m_2
\]

s.t. (IR) \[ \alpha + \beta_1 r_1 m_1 - \frac{b_1}{2} m_1^2 - \frac{1}{2} \rho \beta_1^2 \sigma_1^2 + \delta \beta_2 r_2 m_2 - \delta \frac{b_2}{2} m_2^2 - \delta \frac{1}{2} \rho \beta_2^2 \sigma_2^2 \geq \omega \]

(IC) \( (m_1, m_2) \in \arg \max \alpha + \beta_1 r_1 m_1 - \frac{b_1}{2} m_1^2 - \frac{1}{2} \rho \beta_1^2 \sigma_1^2, \quad \forall (m_1, m_2) \in N_1 \times N_2 \)

\( \omega \) represents the CEO's reserved income.

Solution to the above model is the optimized performance share for CEO:

\[
\beta_1^* = \frac{r_1^2}{r_1^2 + b_1 \rho \sigma_1^2}
\] (8)

\[
\beta_2^* = \frac{r_2^2}{r_2^2 + b_2 \rho \sigma_2^2}
\] (9)

The CEO's optimal combination of input is

\[
m^* = (m_1^*, m_2^*) = \left( \frac{\beta_1^* r_1}{b_1}, \frac{\beta_2^* r_2}{b_2} \right)
\] (10)
Model Analysis

EFFECTIVENESS OF COMBINATION OF INCENTIVE MECHANISMS FOR MARKETIZATION - RECRUITED CEO

From equation (8), (9) and (10), we can get proposition 1-5 as follows:

Proposition 1: \( \frac{\partial m_1^*}{\partial \beta_1^m} > 0 \) and \( \frac{\partial m_2^*}{\partial \beta_2^m} > 0 \) demonstrate that CEO's inputs into short-term performance and long-term performance increase with the increase of CEO's income share of short-term performance and long-term equity incentive. This proposition illustrates that when CEO's input is asymmetric information to the principal, the principal can change the short-term performance sharing mechanism and long-term equity incentive mechanism on CEO, thus to effectively motivate the CEO to choose an optimal combination of input which meets the principal's expectation.

Proposition 2: \( \frac{\partial \beta_1^*}{\partial \rho} < 0 \) and \( \frac{\partial \beta_2^*}{\partial \rho} < 0 \) demonstrate that CEO's optimal share of short-term performance and optimal share of long-term equity incentive decrease with the increase of CEO's absolute risk aversion CEO's short-term performance sharing mechanism \( \rho \). This proposition illustrates that CEO's short-term performance sharing mechanism and long-term performance sharing mechanism have a negative relationship with CEO's risk aversion. The higher CEO's risk aversion, the higher cost that the CEO bears for the higher incentive risk. In this case, the principal should provide lower incentive degree of both short-term and long-term incentive.

Proposition 3: \( \frac{\partial \beta_1^*}{\partial \sigma_1^t} < 0 \) and \( \frac{\partial \beta_2^*}{\partial \sigma_2^t} < 0 \) demonstrate that CEO's optimal share of short-term and long-term performance share decrease with the increase of business environmental uncertainty and stock market uncertainty. This proposition illustrates that the effectiveness of CEO's short-term performance sharing mechanism and long-term equity incentive mechanism has a negative relationship with business environmental uncertainty and stock market uncertainty.

Proposition 4: \( \frac{\partial m_1^*}{\partial r_1} > 0 \) and \( \frac{\partial m_2^*}{\partial r_2} > 0 \) demonstrate that when CEO's control rights increases, both \( r_1 \) CEO's marginal effect on short-term performance and \( r_2 \) CEO's marginal effect on long-term performance increase, while CEO's both short-term and long-term input increase. This proposition illustrates that the principal can effectively motivate the CEO to choose a higher input through empowerment, thus control rights become an effective CEO incentive scheme.

Proposition 5: \( \frac{\partial m_1^*}{\partial b_1} < 0 \) and \( \frac{\partial m_2^*}{\partial b_2} < 0 \) demonstrate that CEO's input into short-term performance and long-term performance decrease with the cost coefficient of input. This proposition illustrates that the CEO faces rise of cost caused by increasing external environmental uncertainty and managerial complexity during the company's growth and expansion. The effectiveness of current CEO material incentive (CEO short-term performance sharing mechanism and long-term equity incentive) decreases. In this case, a new incentive scheme needs to be introduced to solve the issue of CEO's decreased input.
THE INTERACTION RELATIONSHIP BETWEEN INCENTIVE COMBINATION FOR MARKETIZATION-RECRUITED CEOS

From equation (8) and (9), we can get proposition 6-7 as follows:

Proposition 6: \( \frac{\partial \beta_1^*}{\partial r_1} > 0 \) and \( \frac{\partial \beta_2^*}{\partial r_2} > 0 \) demonstrate that when CEO's control rights increases, CEO's marginal effect \( r_1 \) and \( r_2 \), on both short-term and long-term performance increase, and the optimal share of short-term performance and long-term equity incentive increase. This proposition illustrates that there is a supplementary relationship between CEO's performance sharing mechanisms and CEO's control rights incentive.

Proposition 7: \( \frac{\partial \beta_1^*}{\partial b_1} < 0 \) and \( \frac{\partial \beta_2^*}{\partial b_2} < 0 \) demonstrate that CEO's optimal short-term and long-term performance share decrease with the cost coefficient of CEO's input into short-term and long-term performance creating. This proposition illustrates that the effectiveness of CEO's material incentive decreases when the company grows. The material incentive mechanism cannot substitute the non-material incentive.

CONCLUSIONS AND IMPLICATIONS

This paper constructs theoretical model to study the effectiveness of different CEO incentive mechanisms and their interaction relationships. According to our findings, the effectiveness of CEO short-term performance sharing mechanism and long-term equity incentive is negative related to CEO's risk aversion, business environmental uncertainty and stock market uncertainty; CEO short-term performance sharing mechanism and long-term equity incentive have supplementary relationship with CEO control rights incentive; CEO material incentive cannot substitute CEO non-material incentive. Our findings enrich the CEO incentive literature and provide recommendations to improve the incentive combination for SOE’s professional managers recruited through marketization channel.

(1) The effectiveness of CEO material incentive (short-term performance sharing mechanism and long-term equity incentive) is negative related to CEO's risk aversion, business environmental uncertainty and stock market uncertainty. This finding concludes that CEO's risk aversion, business environmental uncertainty and stock market uncertainty should be considered when design the material incentive mechanisms for SOE’s CEO recruited from marketization channel.

(2) CEO short-term performance sharing mechanism and long-term equity incentive have supplementary relationship with CEO control rights incentive. Increase of empowerment to the CEO should simultaneously be taken into consideration when the principal considers increase of CEO material incentive. This finding can be concluded from two aspects. On the one hand, principal's control over the company decreases when CEO's control rights increases. Being the company's owner and ultimate person liable, the principal has high risk cost. The principal offers more share of short-term and long-term performance to the CEO to realize the optimal risk sharing between principal and CEO. On the other hand, for the purpose of company's growth, increase of empowerment to CEO should be simultaneously considered when the principal considers an increase of CEO material incentive, otherwise the incentive
effectiveness will be reduced. This finding can explain the phenomenon occurring in many companies that executive managers have more complaint over insufficient empowerment from the principal but higher satisfaction to their compensation. This finding illustrates that SOEs should pay focus on mixture and supplementary of material incentive and non-material control rights incentive when SOEs motivate market-recruited CEOs. To gain a better incentive effectiveness, bilateral incentive like increase of CEO material incentive while non-increase of control rights incentive should be avoided.

(3) The effectiveness of CEO material incentive decreases in the process of company growth. CEO material incentive cannot substitute CEO non-material incentive. The principal needs focus more on CEO non-material incentive. In the company's development process, the CEO faces increasing external environmental uncertainty and internal managerial complexity. In spite of increasing absolute value of compensation, the CEO's opportunity value may decrease. It becomes difficult for the principal to achieve higher level of CEO's input into performance through simple CEO material incentive. Non-material incentive should be designed into the incentive mechanism. This finding concludes that the SOEs should pay attention to CEO non-material incentive like balance between high work pressure and life leisure.

ACKNOWLEDGEMENT

This thesis supported by the West Projects of National Social Science Foundation of China (15XGL008).

REFERENCES