A Rent Seeking Theory on CEOs' Compensation

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Abstract

It is shown in this paper that wealth and entrepreneurial ability have positive effects on CEOs' expenditures in obtaining and enlarging the rent if long term (call) stock options are granted with uncertainty. While rent seeking within the firms is becoming increasingly popular, we argue that it is an efficient screening mechanism in authority allocation.

Résumé

Il est montré dans ce papier que les CEOs ont richesse et la capacité d'entrepreneur effectue positive sur leurs dépenses dans obtenir et agrandir la location si long terme (call) stock options sont allouées avec incertitude. Pendant que la location qui cherche dans les entreprises devient de plus en plus populaire, nous discutons que c'est un mécanisme de la sélection effectif dans allocation de l'autorité.

1 Introduction

In contemporary CEO compensation schemes, large sum of stock call options are granted. In Hall and Murphy (2000a), they found 97% of the US companies grant stock options to their CEOs. In ¯scal 1998, the grant-date value of stock options accounted for 40% of total pay for S&P 500 CEOs; stock-options become increasingly important for workers as well: 45 % of the US companies awarded options to their exempt salaried employees in the same year, documented in Hall and Murphy (2000a).

One fact about executive stock options is that almost all options were at-the-money, in 1998, 94% of the option grants to S&P 500 CEOs were at-the-money grants. In 1997, Henry R. Silverman of Cendant Corp. received approximately 257 million US$ in stock-option alone. The total income, including earnings from stock options, for S&P 500 CEOs were quadrupled in real terms between 1970 and 1996 however the median salary was just doubled. Therefore the increase in total pay can be largely attributed to the increase in stock options issued. In the survey by Beer and Katz (2000), senior executives are themselves quite skeptical with regard to the expected positive motivation e®ects of bonuses and stock option plans. We consider this apparent di®erence can be explained by rent seeking theory, in other words, these overwhelming stock options granted to the CEOs are essentially some economic rent to them.

The board of directors, as the representatives of the shareholders, is in charge of deciding on management compensation schemes. These so-called compensation committees only consist of external members. However the process is rather quite informal and the committee's proposal is based on a revision of rati¯cation of compensation plans worked out by the management of the human resource department. Even the advocates of stock option plans concede that the CEOs and other top managers exert some in°uence on both the level and the structure of their pay (Murphy(1990)).

The purpose for granting long term call options is to resolve or at least mitigate CEOs' managerial myopia. Hall and Liebman (1997) empirically examined the adjusted level and sensitivity of the compensation with options considered and it is found that measures of CEO pay-to-performance sensitivity increased by factor of 2 to 7 during the period from early 80's to late 90's. Again as we concerned, the level of direct cpompensation, including salary and stock options, had grown by 209% during the same period of time.

Therefore it is natural to formulate this senario into a rent seeking model and CEOs will have expenditures on in°uence costs and will receive some rent, here in this case, stock options, with uncertainty. Our model di®ers from the existing literature in that we are the ¯rst to study the wealth and ability e®ect on this rent-seeking like behaviours within a ¯rm and hence the optimality of ex ante authority allocation compared with e±ciency arguement and related comparative statics studied in the existing body of the literature.

2 The Model

Let the CEO's end of period wealth be $W_1 = E[w_i(1 + r_f) + sP_1 - x_i + \alpha_i \max(0, P_1 - P_0)]$ when the CEO obtains the rent, i.e., the large block of stock options, and $W_2 = E[w_i(1 + r_f) + sP_1 - x_i]$ otherwise, where w_i is the CEO's initial wealth at time 0, x_i is the monetary influence cost expenditure, in other words, investment in getting or enlarging the rent; s is the cash compensation sensitivity; α_i is the contracts of call options CEO i entitled and r_f is the risk free interest rate. The options are long term call options which can not be exercised for a fixed time after the grant-date, usually 10 to 20 years. We normalize time into unit.

The company's stock price at the end of the period, P_1 is

$$P_1 = P_0 + \eta + \varepsilon; \qquad \varepsilon \sim N(0, \sigma^2) \tag{2.1}$$

where P_0 is the grant-date stock price; η is the CEO's entrpreneurial ability and ε is the random shock.

As the certainty equivalent can be represented through the following way,

$$\begin{aligned} E[u(x + \xi)] &= E\{u(x) + \xi u'(x) + \frac{1}{2}\xi^2 u''(x) + O(\xi^3) \\ &= u(x) + \frac{1}{2}\sigma_\xi^2 u''(x) + O(\xi^3); \end{aligned} \tag{2.2}$$

Then the CEO i's utility maximization problem is,

$$\max E[u(w)] = \pi_i \times E\left[u(w_i(1+r_f) + sP_1 - x_i + \alpha_i \max(0, P_1 - P_0))\right] + (1 - \pi_i) \times E\left[u(w_i(1+r_f) + sP_1 - x_i)\right]. \tag{2.3}$$

where π_i is the probability of getting the block of options and $\pi_i' \equiv \frac{\partial \pi_i}{\partial x_i} > 0$, $\pi_i'' \equiv \frac{\partial^2 \pi_i}{\partial x_i^2} < 0$. Throughout the paper, we assume $u'''' \to 0$.

3 Wealth Effect

We distinguish two kinds of behaviours in rent-obtaining: rent-seeking behaviour which increases the probability that the rent is obtained and rent-augmenting behaviour which increases the size of the rent to be obtained. The wealth effect on rent seeking behaviour is discussed in this section.

3.1 The Option Valuation

We approximate the option value by Black-Scholes formula[2]. The option value is then

$$c = \max(0, P_1 - P_0)) = P_1 \Phi(D_1) - P_0 \exp(-r) \cdot \Phi(D_2). \tag{3.1}$$

[2] The options granted to the CEOs can not be exercised for a very long period, normally 10 to 20 years, to align CEOs' incentives be congruent to the firm's long term objectives. Therefore it is natural to approximate it by European call option valuation.

where $D_1 = \frac{\ln(\frac{P_1}{P_0}) + (r_f + \frac{1}{2}\sigma^2)}{\sigma}$, $D_2 = D_1 - \sigma$ and $\Phi(\cdot)$ is the cumulative distribution function of normal distribution. The asymptotic distribution of the Black-Scholes call-option price estimator $\hat{P}_1$ is

$$\sqrt{n}(\hat{P}_1 - P_1) \overset{a}{\sim} N(0, V_c), \quad V_c = \frac{1}{2}P_1^2\sigma^2\phi^2(D_1)D_2. \tag{3.2}$$

where $\phi(\cdot)$ is the probability density function of normal distribution. Based on some existing results, we have

$$\frac{\partial c}{\partial \eta} = \Phi(d_1), \tag{3.3}$$

and

$$\frac{\partial V_c}{\partial \eta} = -\eta\sigma\phi(d_1)d_2, \tag{3.4}$$

where $d_1 \equiv E[D_1] = \frac{\ln(\frac{\eta}{P_0}) + (r_f + \frac{1}{2}\sigma^2)}{\sigma}$, $d_2 = d_1 - \sigma$.

3.2 The Maximization Problem

The expected utility maximization problem can be rewritten as

$$\begin{aligned} \max_{x_i} E[u(w)] = \; & \pi_i \times \{u(w_i(1 + r_f) + sE[P_1] - x_i + \alpha_i \max(0, P_1 - P_0)) \\ & + \frac{1}{2}u''(W_1)\left[\alpha_i^2 \frac{1}{2}P_1^2\sigma^2\phi^2(d_1) + s^2\sigma^2 + s\alpha_i\Phi(d_1)\sigma^2\right]\} \\ & + (1 - \pi_i) \times \{u(w_i(1 + r_f) + sE[P_1] - x_i) + \frac{1}{2}u''(W_2)s^2\sigma^2\}. \end{aligned} \tag{3.5}$$

The first order condition is

$$\frac{\partial E[u(w)]}{\partial x_i} \equiv 0 = \pi_i' \times \left\{u_1 + \frac{1}{2}u_1''\left[\frac{\alpha_i^2}{2}P_1^2\sigma^2\phi^2(d_1) + s^2\sigma^2 + s\alpha_i\Phi(d_1)\sigma^2\right] - (u_2 + \frac{1}{2}s^2\sigma^2u_2'')\right\} - Eu'; \tag{3.6}$$

where $u_1 = u(W_1); u_2 = u(W_2); Eu' = \pi_i \times \left\{u_1' + \frac{1}{2}u_1'''\left[\frac{\alpha_i^2}{2}P_1^2\sigma^2\phi^2(d_1) + s^2\sigma^2 + s\alpha_i\Phi(d_1)\sigma^2\right]\right\} + (1 - \pi_i) \times \left\{u_2' + \frac{1}{2}s^2\sigma^2u_2'''\right\}.$

Let $\Sigma_1 = \left[\frac{\alpha_i^2}{2}EP_1^2\sigma^2\phi^2(d_1) + s^2\sigma^2 + s\alpha_i\Phi(d_1)\sigma^2\right].$ By total differentiating (3.6), we have

$$\begin{aligned} 0 = \; & \{\pi_i''\{u_1 + \frac{1}{2}u_1''\Sigma_1 - (u_2 + \frac{1}{2}s^2\sigma^2u_2'')\} \\ & - 2\pi_i'(u_1' + \frac{1}{2}u_1'''\Sigma_1 - (u_2' + \frac{1}{2}s^2\sigma^2u_2''')) + Eu''\}dx_i \\ & + (1 + r_f)(\pi_i'\{u_1' + \frac{1}{2}u_1'''\Sigma_1 - (u_2' + \frac{1}{2}s^2\sigma^2u_2''')\} - Eu'')dw_i. \end{aligned} \tag{3.7}$$

Rewrite (3.7), we then have

$$\frac{dx_i}{dw_i} = -\frac{(1 + r_f)(\pi_i'\{u_1' + \frac{1}{2}u_1'''\Sigma_1 - (u_2' + \frac{1}{2}s^2\sigma^2u_2''')\} - Eu'')}{\pi_i''\{u_1 + \frac{1}{2}u_1''\Sigma_1 - (u_2 + \frac{1}{2}s^2\sigma^2u_2'')\} - 2\pi_i'(u_1' + \frac{1}{2}u_1'''\Sigma_1 - (u_2' + \frac{1}{2}s^2\sigma^2u_2''')) + Eu''} \tag{3.8}$$

By assumption the CEO's UMP has a determinated solution and the second-order condition is satisfied, the following holds,

$$\begin{aligned} \frac{\partial^2 Eu}{\partial x_i^2} = \; & \pi_i''\{u_1 + \frac{1}{2}u_1''\Sigma_1 - (u_2 + \frac{1}{2}s^2\sigma^2u_2'')\} - 2\pi_i'(u_1' + \frac{1}{2}u_1'''\Sigma_1 \\ & - (u_2' + \frac{1}{2}s^2\sigma^2u_2''')) + Eu'' \\ < \; & 0. \end{aligned} \tag{3.9}$$

Therefore

$$\frac{dx_i}{dw_i} \geq 0$$

if and only if $(1 + r_f)(\pi'_i\{u'_1 + \frac{1}{2}u'''_1\Sigma_1 - (u'_2 + \frac{1}{2}s^2\sigma^2u'''_2)\} - Eu'') \geq 0.$

$$\begin{aligned} & \pi'_i\{u'_1 + \frac{1}{2}u'''_1\Sigma_1 - (u'_2 + \frac{1}{2}s^2\sigma^2u'''_2)\} - Eu'' \\ = \; & \pi'_i(u_1 - u_2)\frac{u'_1 - u'_2}{u_1 - u_2} + \pi'_i\frac{1}{2}(\Sigma_1u'''_1 - s^2\sigma^2u'''_2) + A(W_1)\pi_iu'_1 + A(W_2)(1 - \pi_i)u'_2 \end{aligned} \tag{3.10}$$

where $A(\cdot)$ is the player's coefficient of absolute risk aversion. We assume that $dA(w)/dw \leq 0$; i.e., the absolute risk aversion is (weakly) decreasing in wealth. Consequently, the players have positive prudence, i.e., $u''' \geq 0$ and $-\frac{u'''_1}{u''_1} \geq A(W_1).$

Denote $f(u_1, u_2) = -\frac{u'_1 - u'_2}{u_1 - u_2} > 0$; then by (3.10) we have

$$\begin{aligned} & \pi'_i(u_1 - u_2)\frac{u'_1 - u'_2}{u_1 - u_2} + \pi'_i\frac{1}{2}(\Sigma_1u'''_1 - s^2\sigma^2u'''_2) + A(W_1)\pi_iu'_1 + A(W_2)(1 - \pi_i)u'_2 \\ \geq \; & f(u_1, u_2)[\pi_iu'_1 + (1 - \pi_i)u'_2 - \pi'_i(u_1 - u_2)] + \frac{1}{2}\pi'_i\left[\frac{\alpha_i^2}{2}EP_1^2\sigma^2\phi^2(d_1) + s\alpha_i\Phi(d_1)\sigma^2\right]u'''_1 \end{aligned} \tag{3.11}$$

if

$$A(W_1) \geq A(W_2) + \frac{1}{t}\left(A(W_2) - \frac{u'_1 - u'_2}{u_1 - u_2}\right); \tag{3.12}$$

where $t = \frac{\pi_iu'_1}{\pi_iu'_1 + (1 - \pi_i)u'_2}.$ By mean-value theorem, there is a $\theta \in [W_2, W_1]$ such that $u''(\theta) = \frac{u'_1 - u'_2}{u_1 - u_2}.$ So we can rewrite condition (3.12) as

$$A(W_1) \geq A(W_2) + \frac{1}{t}(A(W_2) - u''(\theta)). \tag{3.13}$$

We further rearrange the terms in the RHS of (3.11) as

$$
\begin{aligned}
&\text{RHS of (3.11)} \qquad\qquad (3.14)\\
= \;& f(u_1;u_2)[Eu' - \pi_i'(u_1 - u_2)] + \frac{1}{2}\pi_i'\left[\frac{\alpha_i^2}{2}P_1^2\sigma^2\phi^2(d_1) + s\alpha_i\Phi(d_1)\sigma^2\right]u_1''' \\
&+\frac{1}{2}f(u_1;u_2)\pi_i'\left[\Sigma_1 u_1'' - s^2\sigma^2 u_2''\right] + \frac{f(u_1;u_2)}{2}\left(\pi_i\Sigma_1 u_1''' + (1-\pi_i)s^2\sigma^2 u_2'''\right)\\
\ge \;& \frac{\pi_i'}{2}(\Sigma_1 - s^2\sigma^2)u_1''' - \frac{f(u_1;u_2)}{2}[\pi_i(\Sigma_1 - s^2\sigma^2) + s^2\sigma^2]u_1''' + \frac{\pi_i' f(u_1;u_2)}{2}(\Sigma_1 - s^2\sigma^2)u_1''
\end{aligned}
$$

We find that a condition for (3.14) ≥ 0 to hold is

$$-\frac{u_1'''}{u_1''} \ge -u''(\theta) - \frac{\pi_i'}{\pi_i}.$$

Therefore under these conditions,

$$\frac{dx_i}{dw_i} \ge 0.$$

We then conclude the following proposition.

Proposition 1 If the rent seekers in the authority competition within a firm exhibit non-increasing absolute risk aversion, $d(-\frac{u''}{u'})\phi dw \le 0$; the relative prudence is greater than the difference between risk aversion and likelihood ratio, i.e., $-\frac{u_1'''}{u_1''} \ge -u''(\theta) - \frac{\pi_i'}{\pi_i}$; and $A(W_1) \ge A(W_2) + \frac{1}{t}(A(W_2) - u''(\theta))$; then the rent seekers will have (weakly) monotonic increasing wealth effect on influent cost expenditures in rent-seeking sense, i.e.,

$$\frac{dx_i}{dw_i}\Big|_{\alpha_i = const} \ge 0.$$

Thus, it is shown that if the CEO's absolute risk aversion is decreasing in wealth, and he is prudent enough in an Knightian entrepreneur's sense, the initial wealth of the CEO will have unambiguously positive effect on his expenditure in rent-seeking activities.

4 Entrepreneurial Ability Effect

Total differentiating the first order condition (3:6) yields

$$\frac{dx_i}{d\theta_i} = -\frac{\pi_i'\{u_1'(s+\alpha_i\Phi(d_1)) + \frac{u_1'''}{2}(s+\alpha_i\Phi(d_1))\Sigma_1 + \frac{u_1''}{2}\frac{\partial\Sigma_1}{\partial\theta} - su_2' - \frac{1}{2}s^3\sigma^2u_2'''\} - \{\pi_i[u_1''(s+\alpha_i\Phi(d_1)) + \frac{u_1'''}{2}\frac{\partial\Sigma_1}{\partial\theta}] + (1-\pi_i)su_2''\}}{\pi_i''\{u_1 + \frac{1}{2}u_1''\Sigma_1 - (u_2 + \frac{1}{2}s^2\sigma^2u_2'')\} - 2\pi_i'(u_1' + \frac{1}{2}u_1'''\Sigma_1 - (u_2' + \frac{1}{2}s^2\sigma^2u_2''')) + Eu''} \tag{4.1}$$

where

$$\frac{\partial\Sigma_1}{\partial\theta} \equiv \frac{\partial\left[\frac{\alpha_i^2}{2}P_1^2\sigma^2\phi^2(d_1) + s^2\sigma^2 + s\alpha_i\Phi(d_1)\sigma^2\right]}{\partial\theta}.$$

Evaluating $\frac{\partial\Sigma_1}{\partial\theta}$; we have

$$\frac{\partial\Sigma_1}{\partial\theta} \equiv \alpha_i^2E[P_1]\sigma^2\phi(d_1)\left(\phi(d_1) + \frac{P_0}{\sigma}\right) + s\alpha_i\phi(d_1)\frac{P_0}{\sigma E[P_1]} \geq 0.$$

Assuming again that the second order condition (3:9) is satisfied, we need to show the numerator of (4.1) is nonnegative in order to have $\frac{dx_i}{d\eta_i} \geq 0$; that is,

$$
\begin{aligned}
&\pi'_i \left\{ u'_1 (s + \alpha_i \Phi(d_1)) + \frac{u'''_1}{2} (s + \alpha_i \Phi(d_1)) \Sigma_1 + \frac{u''_1}{2} \frac{\partial \Sigma_1}{\partial \eta} - s u'_2 - \frac{1}{2} s^3 \sigma^2 u'''_2 \right\} \qquad (4.2)\\
&- \left\{ \pi_i \left[u''_1 (s + \alpha_i \Phi(d_1)) + \frac{u'''_1}{2} \frac{\partial \Sigma_1}{\partial \eta} \right] + (1 - \pi_i) s u''_2 \right\} \\
= \; & \pi'_i (s + \alpha_i \Phi(d_1)) u'_1 + \left(\begin{array}{c} \frac{\pi'_i}{2} \left(\alpha_i^2 E[P_1] \sigma^2 \phi(d_1) \left[\phi(d_1) + \frac{P_0}{\sigma} \right] + s \alpha_i \phi(d_1) \frac{P_0}{\sigma E[P_1]} \right) \\ - \pi_i (s + \alpha_i \Phi(d_1)) \end{array} \right) u''_1 \\
&+ \frac{1}{2} \left(\begin{array}{c} \pi'_i \left[\frac{\alpha_i^2}{2} P_1^2 \sigma^2 \phi^2(d_1) + s^2 \sigma^2 + s \alpha_i \Phi(d_1) \sigma^2 \right] (s + \alpha_i \Phi(d_1)) - s^3 \sigma^2 \pi'_i \\ - \pi_i \left(\alpha_i^2 E[P_1] \sigma^2 \phi(d_1) \left[\phi(d_1) + \frac{P_0}{\sigma} \right] + s \alpha_i \phi(d_1) \frac{P_0}{\sigma E[P_1]} \right) \end{array} \right) u'''_1 \\
&- [\pi'_i s u'_2 + (1 - \pi_i) s u''_2] \\
\geq \; & 0.
\end{aligned}
$$

A set of conditions for (4.2) to hold is

The rent seeker's absolute risk aversion at W_1, $A(W_1)$, satisfies

$$A(W_1) \leq \frac{\pi_i (s + \alpha_i \Phi(d_1))}{\frac{\pi'_i}{2} \left(\alpha_i^2 E[P_1] \sigma^2 \phi(d_1) \left[\phi(d_1) + \frac{P_0}{\sigma} \right] + s \alpha_i \phi(d_1) \frac{P_0}{\sigma E[P_1]} \right) - \pi_i (s + \alpha_i \Phi(d_1))}; \tag{4.3}$$

the likelihood ratio of winning the rent, $\frac{\pi'_i}{\pi_i}$, satisfies

$$\frac{\pi'_i}{\pi_i} \geq \frac{\alpha_i^2 E[P_1] \sigma^2 \phi(d_1) \left[\phi(d_1) + \frac{P_0}{\sigma} \right] + s \alpha_i \phi(d_1) \frac{P_0}{\sigma E[P_1]}}{\left[\frac{\alpha_i^2}{2} P_1^2 \sigma^2 \phi^2(d_1) + s^2 \sigma^2 + s \alpha_i \Phi(d_1) \sigma^2 \right] (s + \alpha_i \Phi(d_1)) - s^3 \sigma^2}; \tag{4.4}$$

and the rent seeker's absolute risk aversion at W_2, $A(W_2)$ is not less than the hazard rate, i.e.,

$$A(W_2) \geq \frac{\pi'_i}{1 - \pi_i}. \tag{4.5}$$

Therefore we conclude the following theorem,

Theorem 2 If Conditions (4:3), (4:4) and (4:5) are satisfied, then the the CEOs' entrepreneurial abilities will have unambiguous positive effect on rent seeking expenditures, i.e.,

$$\frac{dx_i}{d\theta_i} \geq 0. \tag{4.6}$$

While the condition (4:3) and (4:4) say that the player should be less risk averse when wealthy, condition (4:5) says that he shoud be relatively risk averse when he is less wealthy. It is not hard to find that the three conditions are interrelated, i.e., with a higher likelihood ratio, the player should have a higher risk aversion at W_2 and less risk averse at W_1. The intuition behind it is if the likelihood of winning the rent is relatively low, the more able CEO would spent more on influent costs as the expected marginal benefit from rent seeking expenditures, which is a risky investment, is higher relative to the risk cost while the conditions on risk aversion are more restictive otherwise.

5 Rent Augmenting Behaviours

In this section we assume that the probability of winning the rent is exogenously given. The fraction of the rent to be obtained, α_i, is endogenous instead. Moreover, $\alpha_i' \equiv \partial\alpha_i / \partial x_i > 0$; $\alpha_i'' \equiv \partial^2\alpha_i / \partial x_i^2 < 0$; $\alpha_i(0) = 0$ and $\partial\alpha_i / \partial x_j < 0$, $\forall i \neq j$.

The maximization problem is still

$$\max_{x_i} E[u(w)] = \pi_i E u_1 + (1 - \pi_i) E u_2. \tag{5.1}$$

However the first order condition now turns into

$$\begin{aligned}\frac{\partial EU}{\partial x_i} = {} & \pi_i \left[\alpha_i' c u_1' + \frac{1}{2}\frac{\partial \Sigma_1}{\partial \alpha_i} u_1'' + \frac{1}{2}\Sigma_1 \alpha_i' c u_1''' \right] \\ & - \pi_i \left(u_1' + \frac{1}{2} u_1''' \Sigma_1 \right) - (1 - \pi_i)(u_2' + \frac{1}{2} s^2 \sigma^2 u_2''')\end{aligned} \tag{5.2}$$

5.1 Wealth Effect

In order to get see the wealth effect on rent-augmenting behaviours, total differentiate the first order condition (5.2); we have the following,

$$\frac{dx_i}{dw_i} = - \frac{(1 + r_f)\left\{ \pi_i(\alpha_i' c u_1'' + \frac{1}{2}\frac{\partial \Sigma_1}{\partial \alpha_i} u_1''') - \pi_i u_1'' - (1 - \pi_i) u_2'' \right\}}{\begin{aligned}&\{\pi_i \alpha_i'^2 c^2 u_1'' - \pi_i u_1'' \alpha_i' c + \pi_i u_i' \frac{\partial(\alpha_i' c)}{\partial x_i} + \pi_i u_1''(1 - \alpha_i' c) + \frac{\pi_i}{2}(EP_1^2 \sigma^2 \phi^2(d_1)) u_1'' \\ &+ \frac{1}{2}(\alpha_i EP_1^2 \sigma^2 \phi^2(d_1) + s\Phi(d_1)\sigma^2)\alpha_i' c u_1''' + \frac{\pi_i}{2}\frac{\partial(\Sigma_1 \alpha_i' c u_1''')}{\partial x_i} + (1 - \pi_i)(u_2' + \frac{1}{2} s^2 \sigma^2 u_2''')\end{aligned}}; \tag{5.3}$$

where

$$\frac{\partial \Sigma_1}{\partial \alpha_i} = \alpha_i EP_1^2 \sigma^2 \phi^2(d_1) + s\Phi(d_1)\sigma^2 \geq 0.$$

The second order condition is satisfied, i.e.,

$$\begin{aligned}&\{\pi_i \alpha_i'^2 c^2 u_1'' - \pi_i u_1'' \alpha_i' c + \pi_i u_i' \frac{\partial(\alpha_i' c)}{\partial x_i} + \pi_i u_1''(1 - \alpha_i' c) + \frac{\pi_i}{2}(EP_1^2 \sigma^2 \phi^2(d_1)) u_1'' + \\ &\frac{1}{2}(\alpha_i EP_1^2 \sigma^2 \phi^2(d_1) + s\Phi(d_1)\sigma^2)\alpha_i' c u_1''' + \frac{\pi_i}{2}\frac{\partial(\Sigma_1 \alpha_i' c u_1''')}{\partial x_i} + (1 - \pi_i)(u_2' + \frac{1}{2} s^2 \sigma^2 u_2''') \\ &< 0.\end{aligned} \tag{5.4}$$

Therefore, we need to determine the sign of the numerator of (5.3). Given that $r_f > 0$, then

$$\begin{aligned} & \text{sign}\left[(1+r_f)\left\{\pi_-\left(\alpha_-' c u_1'' + \frac{1}{2}\frac{\partial \Sigma_1}{\partial \alpha_-}u_1'''\right) - \pi_- u_1'' - (1-\pi_-)u_2''\right\}\right] \\ = \ & \text{sign}\left[\pi_-\left(\alpha_-' c u_1'' + \frac{1}{2}\frac{\partial \Sigma_1}{\partial \alpha_-}u_1'''\right) - \pi_- u_1'' - (1-\pi_-)u_2''\right]. \end{aligned}$$

Rewritting the numerator of (5.3), we have

$$\begin{aligned} & \pi_-\left(\alpha_-' c u_1'' + \frac{1}{2}\frac{\partial \Sigma_1}{\partial \alpha_-}u_1'''\right) - \pi_- u_1'' - (1-\pi_-)u_2'' && (5.5) \\ = \ & -A(W_1)\pi_- u_1'(\alpha_-' c - 1) + A(W_2)u_2'(1-\pi_-) + \frac{\pi_-}{2}\frac{\partial \Sigma_1}{\partial \alpha_-}u_1''' \\ \geq \ & A(W_1)\left[u_2'(1-\pi_-) - \pi_- u_1'(\alpha_-' c - 1)\right] + \frac{\pi_-}{2}\frac{\partial \Sigma_1}{\partial \alpha_-}u_1''' \\ = \ & A(W_1)\left[u_2'(1-\pi_-) - \pi_- u_1'(\alpha_-' c - 1) - \frac{1}{2}\frac{\partial \Sigma_1}{\partial \alpha_-}u_1'' - \frac{1}{2}\Sigma_1\alpha_-' c u_1''' + \frac{\pi_-}{2}u_1'''\Sigma_1 + \frac{1-\pi_-}{2}s^2\sigma^2 u_2'''\right] \\ & + \frac{\pi_-}{2}\frac{\partial \Sigma_1}{\partial \alpha_-}u_1''' - A(W_1)\left(\frac{\pi_-}{2}u_1'''\Sigma_1 + \frac{1-\pi_-}{2}s^2\sigma^2 u_2''' + \frac{\pi_-}{2}\frac{\partial \Sigma_1}{\partial \alpha_-}u_1'' + \frac{\pi_-}{2}\Sigma_1\alpha_-' c u_1'''\right) \\ = \ & \frac{\pi_-}{2}\frac{\partial \Sigma_1}{\partial \alpha_-}u_1''' - A(W_1)\left(\frac{\pi_-}{2}u_1'''\Sigma_1 + \frac{1-\pi_-}{2}s^2\sigma^2 u_2''' + \frac{\pi_-}{2}\frac{\partial \Sigma_1}{\partial \alpha_-}u_1'' + \frac{\pi_-}{2}\Sigma_1\alpha_-' c u_1'''\right) \\ \geq \ & \left[\frac{\pi_-}{2}\frac{\partial \Sigma_1}{\partial \alpha_-} - A(W_1)\left(\frac{\pi_-}{2}\Sigma_1 + \frac{1-\pi_-}{2}s^2\sigma^2 + \frac{\pi_-}{2}\Sigma_1\alpha_-' c\right)\right]u_1'''. && (5.6) \end{aligned}$$

where in the second step we exploited non-increasing absolute risk aversion and the third step we embedied first order condition (5.2).

Proposition 3 If the rent seeker's absolute risk aversion at wealth W_1, $A(W_1)$, satisfies,

$$A(W_1) \leq \frac{\pi_-\left(\alpha_- E P_1^2\sigma^2\phi^2(d_1) + s\Phi(d_1)\sigma^2\right)}{\pi_-(\Sigma_1 + \Sigma_1\alpha_-' c) + (1-\pi_-)s^2\sigma^2},$$

then the rent seeker's wealth will have unambiguous positive effect on his rent augmenting behaviours, i.e.,

$$\frac{dx_i}{dw_i} \geq 0.$$

Proof. It follows from (5.6) immediately. ■

In this paricular rent augmenting game; the conditions for positive wealth effect are less than restrictive relative to those in rent seeking games, though both require the entrepreneur who exhibits increasing influent costs on wealth to be less risk averse when he is wealthy.

5.2 Entrepreneurial Ability Effect

We consider the entrepreneurial ability effect in managerial rent augmenting games.

We are now interested in $\frac{\partial x_i}{\partial \eta_i}$ in the utility maximization problem (5.1). Total differentiating first order condition (5.2) yields

$$\frac{dx_i}{d\eta_i} = -\frac{\begin{array}{l}\pi_i\{u_1''(s+\alpha_i\Phi(d_1))a_i'c + \frac{u_1'''}{2}(s+\alpha_i\Phi(d_1))\frac{\partial\Sigma_1}{\partial\alpha_i} + \alpha_i'\Phi(d_1)u_1' - (1-\pi_i)su_2'' \\ +\frac{1}{2}\left[-2\alpha_i\eta_i\phi^2(d_1)\sigma d_2 + s\frac{\phi(d_1)}{EP_1}\right]u_1'' + \frac{1}{2}\left[-\alpha_i^2\eta_i\phi^2(d_1)\sigma d_2 + s\alpha_i\frac{\phi(d_1)}{EP_1}\right]\alpha_i'cu_1''' \\ +\frac{1}{2}\Sigma_1\alpha_i'\Phi(d_1)u_1'''\} - \pi_i\left(u_1''(s+\alpha_i\Phi(d_1)) + \frac{1}{2}\left[-\alpha_i^2\eta_i\phi^2(d_1)\sigma d_2 + s\alpha_i\frac{\phi(d_1)}{EP_1}\right]u_1'''\right)\end{array}}{\pi_i''\{u_1 + \frac{1}{2}u_1''\Sigma_1 - (u_2 + \frac{1}{2}s^2\sigma^2u_2'')\} - 2\pi_i'(u_1' + \frac{1}{2}u_1'''\Sigma_1 - (u_2' + \frac{1}{2}s^2\sigma^2u_2''')) + Eu''}. \tag{5.7}$$

Assuming that second order condition holds for the maximization problem, we only need to show that the numerator of (5.7) is nonnegtive. The numerator of (5.7) can be written as

$$
\begin{aligned}
& -A(W_1)\pi_- u_1' \alpha_-' c(s+\alpha_-\Phi(d_1)) + \pi_-\alpha_-'\Phi(d_1)u_1' + \pi_-\frac{u_1'''}{2}(s+\alpha_-\Phi(d_1))\frac{\partial\Sigma_1}{\partial\alpha_-} + \frac{1}{2}\Sigma_1\alpha_-'\Phi(d_1)u_1''' \\
& \quad + A(W_2)(1-\pi_-)su_2' - \pi_- u_1''(s+\alpha_-\Phi(d_1)) - \frac{\pi_-}{2}\left[-\alpha_-^2\eta_-\phi^2(d_1)\sigma d_2 + s\alpha_-\frac{\phi(d_1)}{EP_1}\right]u_1''' \\
& \quad + \frac{\pi_-}{2}\left[-2\alpha_-\eta_-\phi^2(d_1)d_2 + s\frac{\phi(d_1)}{EP_1}\right]u_1'' + \frac{\pi_-}{2}\left[-\alpha_-^2\eta_-\phi^2(d_1)\sigma d_2 + s\alpha_-\frac{\phi(d_1)}{EP_1}\right]u_1'''\alpha_-'c \\
& -\pi_- u_1'\alpha_-'c + \pi_- u_1' + \pi_-\Sigma_1\frac{u_1'''}{2} + (1-\pi_-)u_2' - \frac{\pi_-}{2}\left[\alpha_- EP_1^2\sigma^2\phi^2(d_1) + s\sigma^2\Phi(d_1)\right]u_1'' \\
\geq \;& -\frac{\pi_-}{2}\Sigma u_1'''\alpha_-'c + \frac{1-\pi_-}{2}s^2\sigma^2u_2''' \\
= \;& 0;
\end{aligned}
$$

if

1. the entrepreneur is not too risk averse when he is wealthy, i.e.,

$$A(W_1) \leq \frac{1+\alpha_-\Phi(d_1) - \alpha_-'c}{\alpha_-'c(s+\alpha_-\Phi(d_1))}; \tag{5.8}$$

   and he should be prudent as well, i.e.,

$$A(W_2) \geq \frac{1}{s}; \tag{5.9}$$

2. expected variance of the output on the project flow of the firm shall be not too large, i.e.,

$$\Sigma \leq (s+\alpha_-\Phi(d_1))\frac{\partial\Sigma_1}{\partial\alpha_-}; \tag{5.10}$$

   secondly, cross derivative of the variance on the size of the rent and entrepreneurial ability should be limited to a certain degree, i.e.,

$$\frac{\partial^2\Sigma_1}{\partial\alpha_-\partial\eta_-} \leq 2(s+\alpha_-\Phi(d_1)) - \frac{\partial\Sigma_1}{\partial\alpha_-}; \tag{5.11}$$

in other words, variance does not increase significantly with respect to share of the rent and managerial abilities so that the CEO's utility will not lowered down substantially due to risk-taking. Moreover, variance does not diverge with respect to entrepreneurial abilities, i.e.,

$$\frac{\partial \Sigma_1}{\partial \eta_i} \leq \Sigma \alpha_i c; \tag{5.12}$$

3. the probability ratio for this single Bernoulli trail should be not too small to making rent augmenting activities meaningful, i.e.,

$$\frac{\pi_i}{1 - \pi_i} \geq \frac{s^2 \sigma^2}{\left(\alpha'_i \frac{\partial \Sigma_1}{\partial \eta_i} c + \Sigma \Phi(d_1)\right)}. \tag{5.13}$$

Proposition 4 If the utility maximization problem (5:1) is not trivial in the sense that rent augmenting activities do not bring overwhelming variance increment with respect to the share size and entrepreneurial abilities, and the prbability ratio is not too small, i.e., conditions (5:10) (5:11); (5:12) and (5:13) are satisfied, and also the rent seeker exhibits an Knightian entrepreneur's risk attitude, i.e., (5:8) and (5:9) hold, then the rent seeker's entrepreneurial ability has unambiguous positive effect on his influent cost expenditure in enlarging his share of the rent to be obtained, i.e.,

$$\frac{\partial x_i}{\partial \eta_i} \geq 0. \tag{5.14}$$

6 Concluding Remarks

Although rent seeking is long forgotten by economists in analysing incentive problems within the ¯rms, we ¯nd it still appealing in exploring candidate selecting mechanism and authority allocation in contemporary ¯rms. Our intention is not to explain the origin or the quantity of managerial rent per se but to verify if the mechanism is still e±cient within this rent seeking framework. This model, once again, is a combination of hidden information and hidden action, where the hidden information is CEOs' entrepreneurial abilities and the hidden action is his expenditure on in°uence costs.

Contrary to the widespreading nature of ine±ciency and welfare losses caused by rent seeking activities in governmental regulation, procurements and other collective problems, our model shows that the rent seeking like behaviours may be an e±cient mechanism in authority allocation competition within the ¯rms. The intuition behind these claims is that ¯rms are di®erent with governments in the way that entrepreneurship is essential for ¯rms' survival and prosperity, therefore rent-seeking improves the tradeo® between acquiring a productive manager but to lose some control rights and fractions of pro¯ts, and, having a low ability CEO but keep a larger share of the the pie he creates.

Our main results indicate that given initial wealth is known to all stakeholders, in°uence cost expenditure is a signal of his entrepreneurial abilities and risk attitude. We claim that second best outcome on rent dissipation, henceforth authority allocation within the ¯rms, will occur.

We study the wealth e®ect on rent augmenting like behaviours in CEOs' stock-option enlargement competition, and we found even looser conditions.

As in the real corporate life, rent seeking behaviour is coupled with rent augmenting behaviours, this model shows us that if an entrepreneur is cautious in investing on risky assets when his available liquid assets are limited but less risk averse when his personal wealth is high enough, then he will unambiguously spend more on rent seeking like activities in return for obtaining and enlarging the shares of company stock option (call) which will be granted to him, if he is wealthy and/or his entrepreneurial abilities are high. Indeed, these particular conditions on risk attitude imposed in Propositions 3 and 4 depict an Knightian entrepreneur's risk attitude in our understanding.

Further research can be focused on the di®erent e®ects with more complicated pay schemes as well as the relationship between an entrepreneurial ¯rm and outside investors. It should be promising not only because the current literature on this topic is nearly blank but also because of the increasing popularity of stock or option based compensation plans.

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