Optimism, Overconfidence and Severance Pay

Clara Graziano* and Annalisa Luporini†

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Abstract

We analyze the different effects of optimism and overconfidence on managerial compensation when the compensation package includes severance pay. We find that managerial optimism does not alter incentive compensation in case of retention but it increases severance pay in case of dismissal. Overconfidence instead increases severance pay but reduces incentive pay. Both optimism and overconfidence lead to higher entrenchment. Overall our model shows that when severance pay is taken into account, optimism and overconfidence are likely to be detrimental for the firm. Thus, the intense use of incentive pay found in compensation packages of overconfident CEOs may backfire when severance pay and replacement policy are considered.

JEL classification: J33, M52, L21.

Keywords: overconfidence, managerial compensation, severance pay, entrenchment, firing policy.

1 Introduction

A vast and well-documented empirical evidence suggests that overconfidence is a common phenomenon at the root of several observed behaviors. Several papers have shown that consumers and investors decisions may deviate from predictions based on rational expectations because of behavioral biases (see the surveys in Grubb 2015 and Kent and Hirschleifer 2015). Recently, attention has focused on managerial biases since it appears that the incidence of overconfidence is particularly high among CEOs (Malmendier and Tate, 2015). Managerial biases have been studied both from a theoretical and empirical prospective. Overconfidence and optimism have been shown to influence contract design and CEO

*Corresponding author, University of Udine and CESifo; address: University of Udine, Department of Economics and Statistics, via Tomadini 30, 33100 Udine , Italy; email: clara.graziano@uniud.it

†University of Florence and CESifo.

behavior in many different settings, as CEO choice of projects (see the survey in Melmandier and Tate 2005), CEO hiring (Goel and Thakor 2008) and CEO compensation (de La Rosa 2011, Gervais et al. 2011 and Otto 2014).

Managerial overconfidence, by inducing the manager to overestimate the probability of positive outcomes, may be beneficial for the principal. In a standard agency model with moral hazard, the optimal contract trades off risk insurance and incentive provision. Managerial overconfidence (and the resulting divergence of beliefs between principal and agent) affects the tradeoff between risk and incentive and makes it easier to satisfy the incentive compatibility constraint. This is so because the manager overestimates the probability of success and this in turn makes it cheaper to induces him/her to exert effort. In other words, the compensation necessary to induce the agent to exert a given level of effort decreases (See de La Rosa 2011, Gervais et al. 2011, Otto 2014, and Humphery-Jenner et al. 2016). Hence, firms can exploit the misvaluation of their executives offering a compensation structure with a particularly heavy incentive pay (the so-called exploitation hypothesis empirically investigated in Humphery-Jenner et al. 2016).

Another strand of literature has analyzed severance pay and its role from an optimal contracting point of view. Severance agreements are an important component of a managerial contract when the manager has to make long-lasting investments, so that the prospect of being replaced may interfere with his/her decision. If the board cannot commit to retain him once the investment is in place, there is room for opportunistic behavior. The unobservability and the firm-specific nature of the investment create the moral hazard problem that severance pay may alleviate. First, by increasing the cost of firing the incumbent manager, severance pay may optimally reduce the firing probability the manager faces (Almazan and Suarez 2003). Second, it may incentivize the manager to resign when he realizes that the firm value may be higher under a new CEO (Inderst and Mueller, 2010). On the other hand, the critics of severance pay have pointed out that, by insulating the manager from the consequences of poor performance, severance pay is simply a "reward for failure" that violates the pay-for-performance principle of agency theory (see for example Bebchuk and Fried 2004).

Though overconfidence may affect severance pay and the replacement decision in many ways, there are no studies of its effects on optimal severance agreements and board's replacement decision. The present paper is a first attempt to fill this gap by studying how managerial biases affect the severance pay required by an overconfident CEO and how this, in turn, influences the replacement decision. We follow previous literature (see, among others, de la Rosa 2011) and we distinguish between optimism according to which the manager has a subjective belief on the probability of success higher than the "true" probability, and overconfidence that increases manager's assessment of the increase in the probability of success due to his/her effort.

Our paper analyzes the implication of overconfidence on managerial severance pay and replacement probability when both the board and the manager are risk neutral and the manager has some bargaining power. If contractual sev-

erance pay is not high enough, the manager can bargain to get better condition in case of replacement. The assumption of risk neutrality rules out the possibility to exploit managerial overconfidence to reach a better risk allocation as in previous moral hazard models of overconfidence (see De La Rosa and Otto). Despite risk neutrality, overconfidence greatly affects the optimal contract.

The main findings of the paper can be summarized as follows. First, the overall impact of optimism is negative because optimism results in higher severance pay and higher entrenchment without being counterbalanced by any positive effect on incentives. Indeed, if the manager is optimist, he overstates the payment to be received if confirmed, increasing the status quo point in the bargaining with the board over the departure condition and this in turn increases the firing cost. There are cases in which managerial bargaining power results in a severance pay so high to induce the board to always retain the manager even if a better replacement shows up (no replacement at all). As a result of this, firm value decreases in managerial optimism even in a simple model that does not take into account the traditional shortcomings of overestimation of the probability of success (too risky investments, underinvestment in information acquisition).

The second finding of the paper is that overconfidence mitigates the effect of optimism. Indeed, overconfidence decreases the compensation necessary to induce the manager to make to firm-specific investment, as found also in previous literature. Thus, on the one side there is a positive incentive effect. However, on the other side, overconfidence also increases severance pay, and this leads to a higher cost for replacing the manager and a lower than optimal turnover. The positive incentive effect may be more than compensated by a negative entrenchment effect.

Overall, our study shows that severance agreements are strongly affected by managerial biases and the gain from a lower incentive pay induced by overconfidence may be more than offset by a higher severance pay. Thus, the attempt to exploit executive overconfidence through an heavy use of incentive-pay documented for example by Humphery-Jenner et al. (2016) can backfire when the opportunity of replacing the manager is considered. Given that the negative effect of optimism and overconfidence results from the bargaining over the terms of replacement between the manager and the board, the model suggests that managerial bargaining power has a particularly negative effect when the manager is overconfident. In this sense we can say that a governance structure with a board able to restrain managerial power becomes even more important when optimism and overconfidence increase the payment required by the manager to leave the firm.

2 The model

Consider a board that perfectly represents the shareholders so that its objective is to maximize firm's value. The board hires a CEO. The cash flow generated by the firm depends on CEO ability. To simplify matters we consider only

two possible outcomes: $r = 0$ and $r = R > 0$. The probability of success of the project depends on the ability of the CEO and is denoted by p. The manager can make a firm-specific investment that increases the probability of success. More specifically, the manager can increase such probability from p_L to p_H with $p_H > p_L$ by investing in specific human capital. The cost of this investment is borne by the CEO and is denoted by I. The investment is unverifiable, though it is observable by the board. Consequently the board knows the manager's ability.

After the manager has undertaken the investment or after he has decided not to invest, a new manager materializes who may be of superior ability than the incumbent. The probability of success under the replacement is denoted by q. Both the board and the incumbent observe the ability of the replacement (i.e. they observe the realization of q). When a replacement shows up, the board decides whether to fire the incumbent manager and hire the replacement. We assume that the CEO can oppose such substitution. Hence the replacement can take place only with the consent of the incumbent. This implies that the board negotiates with the CEO the payment necessary to induce him to leave if contractual conditions are not good enough, that is if contractual conditions do not ensure a payment at least as large as what the manager can obtain by staying with the firm. Replacement takes place only with mutual agreement between board and CEO.

If the incumbent CEO remains in office, he enjoys benefit of control $C > 0$. This may create a conflict between shareholders and manager, but at the same time it may make it easier to induce the manager to invest.

We focus our attention on the contract offered to the manager and we assume that, at the contracting stage, both the CEO and the board anticipate that the CEO may be fired if a better manager becomes available. The contract aims at providing the proper incentive for the manager to make the investment in order to increase probability of success. To this end, we consider a simple incentive contract with base salary normalized to 0, incentive pay w, contingent on the high return R, and severance pay s. Severance pay, providing a payment in case the manager is replaced, is an essential element of the contract. The contract maximizes the expected terminal cash flow of the project net of the cost of CEO compensation.

The incumbent manager is optimist and overstates the probability of success both when he undertakes his firm-specific investment and when he does not. The effect however may be different in the two cases. When the manager undertakes the investment in fact he may also become overconfident in the outcome of such investment making the estimate of success to increase even more. More formally, the manager attributes probability $p_L + \theta_L$ to success in the absence of investment and probability $p_H + \theta_H \leq 1$, to success following the investment, where $\theta_H \geq \theta_L$. The difference $\theta_H - \theta_L$ then becomes a measure of overconfidence. In the following section we assume $\theta_H = \theta_L = \theta$. In other words in Section 3 we assume that the manager is optimist but not overconfident. In this case the highest possible value of θ is $\theta = (1 - p_H)$. In Section 4 we also introduce overconfidence and assume $\theta_H > \theta_L = \theta$.

The board knows the manager is optimist, and possibly overconfident, and takes this into account when offering the contract. On the other hand, the manager knows that the board only attributes probability p_H to return R, following the manager's investment and probability p_L if the investment is not undertaken. Such heterogeneity of beliefs affects both the original contract and subsequent renegotiation. In particular, the manager, holding veto power upon his own replacement, will try and obtain the gains from replacement as calculated on the ground of his own beliefs (thus obtaining higher gains). Since we consider a context where the CEO can always oppose being replaced, a replacement can effectively take place only if it brings some benefit to both the board and the incumbent. The manager will only consent to replacement if his utility is not reduced with respect to what he expects to receive by staying with the firm.

We assume that the manager is protected by limited liability. Furthermore, we assume that the reservation utility is zero. This assumption greatly simplifies the analysis at the cost of giving no role to the participation constraint.

The following assumption captures the idea that firm-specific investment is necessary to avoid being less productive than the replacement.

Assumption 1: If the incumbent CEO does not invest, the replacement CEO has always higher probability of success than what CEO believes to obtain. Conversely, by investing, the incumbent CEO may have higher probability of success than the replacement:

$$p_L + \theta < \underline{q} < p_H < \overline{q} = 1. \tag{1}$$

The above condition implies that if the incumbent CEO makes no specific human capital investment, he should always been replaced, even when the replacement's quality is the lowest possible. Let us further assume that $(1-p_H)R > C$. As will become clear later, this assumption guarantees that when the best possible replacement shows up, the gain from replacing the CEO is large enough to compensate his loss of benefits.

The timing in the model can be summarized as follows:

t=0: Board offers compensation contract (w, s) to the manager. Manager decides whether to accept it.

t=1: If the manager accepts the contract, he chooses whether to make firm specific investment

t=2: Rival CEO appears. Board and incumbent manager observe the latter's ability. Board evaluates whether it is profitable to replace the incumbent. If this is the case and contractual s is too low for the incumbent to accept the replacement, renegotiation occurs and a new level of severance pay , s', is agreed upon.

t=3: Cash flow realizes. Manager is paid the compensation agreed upon.

The model is solved by working backwardly.

1. First, we find the outcome of the renegotiation under an arbitrary initial contract and the subsequent board's replacement decision,.

2. Given the replacement decision, we determine how the incumbent's incentives to invest depend on the initial contract and in particular on severance pay

3. Finally, given the replacement decision and manager's investment, we find which incentive compatible contract is the best.

3 Bargaining and Replacement when the manager is optimist

An important assumption in what follows is that the manager can credibly threaten to resist being replaced. This gives him some power in the bargaining with the board over the condition for his replacement. Our model builds upon the model of Almazan and Suarez (2003) who challenge the view that board full control of replacement decision is always the best arrangement. On the contrary, these authors show that providing the CEO with some power in the bargaining with the board may bring savings on the overall cost of the managerial compensation package. Severance pay accomplishes this by increasing the cost of replacement, preventing in this way the board from behaving opportunistically once the manager has undertaken a costly firm-specific investment. Almazan and Suarez show that using severance pay and some degree of entrenchment rather than just incentive pay can be a cheaper way to induce the manager to take the desired action.

Also in our model the manager has to undertake a firm-specific and non contractible investment and severance pay restrains the board from firing the incumbent CEO whenever a slightly better manager materializes. The novel aspect of our model is the analysis of the influence of managerial biases on the role of severance pay.

3.1 Stage 3: Renegotiation

Let us first of all establish the conditions that make a replacement advantageous for both the incumbent CEO and the board. Given (1), the board will always want to replace a manager who has not made the specific investment. However, in order to have the incumbent accept replacement, severance pay (either contractual or renegotiated) must compensate the manager for what he looses by separating from the firm. When the incumbent has not made the specific investment, severance pay must ensure a payment equal to $(p_L + \theta)w + C$.

Let us then consider the case where the CEO has made the investment. Given that the board wants to maximize firm value, it wants to replace the incumbent manager if :

$$qR - s \geq p_H(R - w)$$

where the LHS incorporates the fact that if the incumbent CEO is replaced, no incentive pay is paid to the new CEO.

The incumbent consents to replacement if:

$$s \geq (p_H + \theta)w + C \tag{2}$$

where the RHS represents what the CEO expects to receive if he opposes replacement.[1]

The two conditions above are simultaneously satisfied when:

$$(q - p_H)R + p_H w \geq s \geq (p_H + \theta)w + C.$$

This implies that for replacement to occur, it must be the case that:

$$(q - p_H)R \geq \theta w + C$$

the increase in the expected return from replacement is not lower than what is lost by the incumbent manager when he leaves the firm.

Let $\widehat{q}_O$ denote the value of q that satisfies the above condition with equality, $(\widehat{q}_O - p_H)R = \theta w + C$, so that:

$$\widehat{q}_O = p_H + \frac{\theta w + C}{R} \tag{3}$$

When $q > \widehat{q}_O$ the incumbent should be replaced even if he has made the firm-specific investment, while he should be retained when $q \leq \widehat{q}_O$. Note that without overoptimism, replacement should occur whenever $q > \widetilde{q} = p_H + \frac{C}{R}$. Indeed, optimism increases the cutoff value because it makes it more costly to induce the incumbent CEO to accept being replaced and makes $\widehat{q}_O$ depend on the wage. This is so because the CEO believes that, if he stays with the firm, he will get the incentive pay w with probability $p_H + \theta$ rather than with probability p_H.

To fully characterize the contract offered to the CEO, we have to determine three variables: w, s and $\widehat{q}_O$. The above conditions tell us that, in order for the replacement to occur, severance pay must be sufficiently high. But should the contractual level s be so high as to satisfy (2)? Not necessarily, because severance pay can be renegotiated if both parties find it profitable to replace the incumbent. We will show below that it may be optimal to set a low contractual s in order to reduce the cost of inducing the CEO to undertake the human capital investment.

To determine the renegotiated severance pay, consider the case where the board wants to replace the incumbent. This may occur if the incumbent has not invested ($p = p_L$) or if he has made the specific investment ($p = p_H$) and a replacement with $q > \widehat{q}_O$ appears. Given that the incumbent can oppose replacement, the manager will accept being replaced only if s is at least as large

[1] Overconfidence introduces a difference with Almazan and Suarez case because now the renegotiation payoff includes a payment related to managerial overconfidence, thus this remuneration is comparatively less attractive than in the standard case without overconfidence.

as what he can gain by staying with the firm. If s is low, the incumbent can credibly oppose replacement but what he can obtain will depend on whether he has made the investment. In both cases, renegotiation can be represented as a game where the board makes a take-it-or-leave-it offer to the CEO. The following proposition on the possible outcomes from renegotiation then immediately follows from the discussion above.

Proposition 1: *i) When the incumbent CEO invests so that $p = p_H$, then the incumbent is replaced if $q > \widehat{q}_O$ and his expected compensation is:*

$$\begin{array}{ll} (p_H + \theta)w + C & \text{if} \quad s < (p_H + \theta)w + C \\ s & \text{if} \quad s \geq (p_H + \theta)w + C. \end{array}$$

If instead $q \leq \widehat{q}$ the incumbent stays and his expected compensation is $(p_H+\theta)w$.

ii) When the incumbent does not invest so that $p = p_L$, then he is always replaced and gets

$$\begin{array}{ll} (p_L w + \theta) + C & \text{if} \quad s < (p_L w + \theta) + C \\ s & \text{if} \quad s \geq (p_L w + \theta) + C. \end{array}$$

Suppose the incumbent has made the investment and $s > (p_H + \theta)w + C$, there is no incentive to resist dismissal in the presence of a replacement with $q > \widehat{q}_O$. If instead $s \leq (p_H + \theta)w + C$, the board makes a take-it-or-leave-it offer to dismiss the manager for a payment $s' = (p_H + \theta)w + C$ and the manager accepts it. Finally, suppose the incumbent has not invested. For the same reasons, he will accept to leave only if $s \geq (p_L w + \theta) + C$, or if the board offers to pay $s' = (p_L w + \theta) + C$ at the renegotiation stage.

3.2 Stage 2: Incentive contract and replacement

Given the replacement decision, we can determine the incentive pay necessary to induce the CEO to make the investment in specific skill. The incentive compatibility constraint (ICC) requires:

$$E_q[W + C|p_H] - E_q[W|p_L] \geq I \tag{4}$$

where I is the cost of the investment. Notice that, in order to satisfy the constraint at the lowest cost, $E_q[W|p_L]$ should be kept as low as possible. We know that if the incumbent makes no investment, he is always replaced. Proposition 1 tells us that $(p_L + \theta)\, w + C$ is the lowest payment that the incumbent can accept in order to leave. This implies that the lowest value of $E_q[W|p_L]$ is $(p_L + \theta)\, w + C$. We will later check that there is no reason to set s higher than $(p_L + \theta)\, w + C$ implying $E_q[W|p_L] = s = (p_L + \theta)\, w + C$. For the moment we assume that this is satisfied and we compute $E_q[W + C|p_H]$:

$$E_q[W + C|p_H] = \int_{\underline{q}}^{\widehat{q}} [(p_H + \theta)w + C]f(q)dq + \int_{\widehat{q}}^{1} [(p_H + \theta)w + C]f(q)dq$$

$$= (p_H + \theta)w + C.$$

Substituting the values of $E_q[W + C|p_H]$ and $E_q[W|p_L]$ in (4) we obtain:

$$(p_H - p_L)w \geq I.$$

The lowest wage that satisfies the ICC then is:

$$w = \frac{I}{(p_H - p_L)}.$$

The above expression does not depend on θ (and is thus the same as in the absence of optimism) because we are considering the peculiar case in which the incumbent CEO is optimist but not overconfident. Optimism increases the incumbent's beliefs of success by the same amount both if he makes and he does not make the investment.

Optimism however affects the probability of replacement via the dependence of $\widehat{q}_O$ on θ in (3). We already know that $\widehat{q}_O = p_H + \frac{\theta w + C}{R}$ is greater than the corresponding value in the absence of overconfidence $\widetilde{q} = p_H + \frac{C}{R}$. We can now substitute the value of the wage in the expression for $\widehat{q}_O$ in order to analyze how optimism affects entrenchment:

$$\widehat{q}_O = p_H + \frac{C}{R} + \frac{\theta}{R}\frac{I}{(p_H - p_L)}. \tag{5}$$

Proposition 2. *The value of $\widehat{q}_O$ is increasing in θ up to $\widehat{q}_O = 1$ for $\theta = \frac{(1-p_H)R-C}{I}(p_H - p_L)$*

Proof. Follows immediately from (5)

The value of $\widehat{q}_O$ is increasing in θ and it can reach 1 for θ high enough. Recall that the highest possible value of θ is $\overline{\theta} = 1 - p_H$. Then the difference $(p_H - p_L)$ must be sufficiently low to satisfy $\frac{(1-p_H)R-C}{I}(p_H - p_L) < 1 - p_H$. If we substitute $\overline{\theta} = 1 - p_H$ in (5) we get:

$$\widehat{q}_O = p_H + \frac{C}{R} + \frac{(1-p_H)}{R}w \geq 1 \qquad \Rightarrow$$
$$p_H(R - w) + C + w \geq R$$

or:

$$(1 - p_H)R \leq C + w(1 - p_H) = C + \frac{(1-p_H)I}{p_H - p_L}$$

which is compatible with our assumption $(1 - p_H)R > C$ for sufficiently high values of wage w, i.e. high values of I and small values of $(p_H - p_L)$. Note that $(p_H - p_L)$ is the signal used by the board to remunerate the manager when

investing. A small value of $(p_H - p_L)$ simply indicates that the signal is very noisy and using incentive pay is not efficient.

Proposition 2 indicates that for θ high enough and adequate values of the other parameters, we may end up in the limit case in which the CEO is never replaced.

3.3 Stage 1: The optimal compensation contract

What are the consequences of incumbent's entrenchment on firm value? Given that in equilibrium the investment is made, the **value of the firm** when the incumbent manager is optimist is:

$$V_O = \int_{\underline{q}}^{\widehat{q}_O} p_H(R-w)f(q)dq + \int_{\widehat{q}_O}^{1} \{[qR-(p_H+\theta)w]-C\}\, f(q)dq. \tag{6}$$

Notice that V_O is decreasing in w, and (as in A-S) it is independent of s, the contractual severance pay. Since V_O is independent of s, it is set equal to the lowest possible value that satisfies the ICC constraint, i.e. $s = (p_L + \theta)w + C$.

Proposition 3. *The optimal value of the contractual severance pay is* $s = (p_L + \theta)\, w + C$.

Proof. See Appendix.

Substituting the value of w derived from incentive compatility constarint (4), we obtain:

$$V_O = \int_{\underline{q}}^{\widehat{q}_O} p_H(R-\frac{I}{(p_H-p_L)})f(q)dq + \int_{\widehat{q}_O}^{1} \left\{[qR-(p_H+\theta)\frac{I}{(p_H-p_L)}]-C\right\} f(q)dq. \tag{7}$$

Firm value is decreasing in θ because a higher θ increases the renegotiated severance pay necessary to induce the CEO to accept replacement in the presence of a replacement with $q > \widehat{q}_O$.

Let us now compare such value of V_O to the value V_{NO} that would obtain in the absence of optimism ($\theta = 0$).

$$V_{NO} = \int_{\underline{q}}^{\widetilde{q}} p_H(R-\frac{I}{(p_H-p_L)})f(q)dq + \int_{\widetilde{q}}^{1} \left\{[qR-(p_H)\frac{I}{(p_H-p_L)}]-C\right\} f(q)dq$$

Proposition 4. *Optimism reduces the value of the firm, i.e.* $V_O < V_{NO}$ *for* $\theta > 0$.

Proof. Consider the difference $V_O - V_{NO}$.It is

$$V_O - V_{NO} = \int_{\widetilde{q}}^{\widehat{q}_O} \left\{ (p_H - q)\, R - \frac{(1-p_H)I}{(p_H - p_L)}) + C \right\} f(q)dq - \int_{\widehat{q}_O}^{1} \theta f(q)dq < 0 \quad (8)$$

□

Optimism reduces the value of the firm because on the one hand, it increases entrenchment thus reducing gains from replacement and on the other hand it increases the cost of having the CEO accept replacement when q is high enough.

4 Bargaining and replacement when the manager is both optimist and overconfident

Consider now the more general case in which $\theta_H \neq \theta_L$ with $\theta_H > \theta_L = \theta$. The manager overstates the probability of success and overvaluetes the effect of his investment. Using the terminology of de la Rosa, the manager is both optimist and overconfident. We still assume that the manager can oppose his replacement, and opposition is credible if severance pay is smaller than what he believes would receive by staying with the firm.

4.1 Stage 3: Renegotiation

Again, the board will always want to replace a manager who has not made the specific investment but in order to have the incumbent accept replacement, severance pay (either contractual or renegotiated) must compensate the manager for what he looses by separating from the firm, i.e. it must ensure a payment equal to $(p_L + \theta)w + C$.

Let us then consider the case where the CEO has made the investment. The conditions for both the board and the CEO to accept replacement now are

$$qR - s \geq p_H(R - w)$$

and

$$s \geq (p_H + \theta_H)w + C \quad (9)$$

respectively. As expected, the behavior of the board does not change because the board is unaffected by the bias of the CEO and uses the "right" probability. The cutoff value used to replace the incumbent is the value of q that satisfies

$$(q - p_H)R = \theta_H w + C$$

Let us denote the present case with both optimism and overconfidence by the subscript $_{OO}$. Then

$$\widehat{q}_{OO} = p_H + \frac{C}{R} + \frac{\theta_H}{R} w_{OO}.$$

Note that also in this case the cutoff value of q is larger than the cutoff value when the manager is neither optimist nor overconfident: $\widehat{q}_{OO} > \widetilde{q}$.

It is immediate to see that Proposition 1 is essentially unchanged:

Proposition 5: *i) When the CEO invests so that $p = p_H$, the incumbent is replaced if $q > \widehat{q}_{OO}$ and his expected compensation is:*

$(p_H + \theta_H)w + C$ *if* $s < (p_H + \theta_H)w + C$

s *if* $s \geq (p_H + \theta_H)w + C$.

If instead $q \leq \widehat{q}_{OO}$ incumbent stays and his expected compensation is $(p_H + \theta_H)w$.

ii) When the incumbent does not invest so that $p = p_L$, then he is always replaced and gets

$(p_L w + \theta_L) + C$ *if*$\_\_\_$ $s < (p_L w + \theta_L) + C$.

s *if* $s \geq (p_L w + \theta_L) + C$.

In the following we assume that the manager makes the investment. At the end of the section we will prove that this is indeed the case.

4.2 Stage 2: Incentive contract and replacement

Consider now the incentive compatibility constraint. We have $E_q[W|p_L] = s = (p_L + \theta_L)w + C$ and $E_q[W + C|p_H] = (p_H + \theta_H)w + C$, then the ICC

$$E_q[W + C|p_H] - E_q[W|p_L] \geq I$$

can be written as

$$(p_H + \theta_H)w + C - (p_L + \theta_L)w - C \geq I$$

or

$$(p_H + \Delta_\theta - p_L)w \geq I$$

where $\Delta_\theta = \theta_H - \theta_L = \theta_H - \theta$. Then, the lowest wage that satisfies the ICC when the manager is both optimist and overconfident is given by

$$w_{OO} = \frac{I}{(p_H + \Delta_\theta - p_L)}.$$

Note that overconfidence has decreased the incentive pay necessary to induce the manager to invest: $w_{OO} < w$. Substituting this in the expression for the cutoff value $\widehat{q}_{OO}$ we obtain:

$$\widehat{q}_{OO}(\theta_H) = p_H + \frac{C}{R} + \frac{(\theta_L + \Delta_\theta)I}{R\,(p_H + \Delta_\theta - p_L)}.$$

The effect of overconfidence on $\widehat{q}_{OO}$ is ambiguous because there are two opposite effect; on the one hand w_{OO} is lower than w and this reduces $\widehat{q}_{OO}$; on the other

hand w_{OO} is multiplied by $\theta_H > \theta$ with a positive effect on $\widehat{q}_{OO}$. Let us compare this cutoff value with the one derived in the case where the manager is only optimist.

$$\widehat{q}_{OO} - \widehat{q}_O = \frac{\theta_H}{R} \frac{I}{(p_H + \Delta_\theta - p_L)} - \frac{\theta}{R} \frac{I}{(p_H - p_L)}$$

or:

$$\widehat{q}_{OO} - \widehat{q}_O = \frac{I}{R} \frac{\Delta_\theta (p_H - p_L - \theta)}{(p_H + \Delta_\theta - p_L)(p_H - p_L)}.$$

which is positive only if the degree of optimism θ, is small enough, so that $p_H \geq p_L + \theta$. If, on the contrary, θ is large and $p_H < p_L + \theta$, the result is exactly the opposite: $\widehat{q}_{OO} \leq \widehat{q}_O$

In general, the cutoff $\widehat{q}_{OO}$ is increasing in overconfidence (i.e., in Δ_θ) when $p_H > p_L + \theta$ and decreasing otherwise:

$$\frac{\partial \widehat{q}_{OO}}{\partial \Delta_\theta} = \frac{IR\,(p_H + \Delta_\theta - p_L) - IR(\theta + \Delta_\theta)}{[R\,(p_H + \Delta_\theta - p_L)]^2} = \frac{I(p_H - p_L - \theta)}{R\,(p_H + \Delta_\theta - p_L)^2}.$$

This implies that when the distortion arising from optimism is relatively small, overconfidence introduces an additional distortion in the replacement decision and $\widehat{q}_{OO}(\theta_H)$ increases with Δ_θ. If instead, the degree of optimism is large, then overconfidence may mitigate the distortion in the replacement decision and $\widehat{q}_{OO}(\theta_H)$ decreases with Δ_θ. Note however, that $\widehat{q}_{OO}$ is always larger than $\widetilde{q}$.

Let assume that $p_H \geq p_L + \theta$. Then, overconfidence decreases the wage necessary to satisfy the ICC and at the same time it increases the cutoff value $\widehat{q}_{OO}$ resulting in higher entrenchment.

The value of the firm is:

$$V_{OO} = p_H(R - w_{OO}) + \int_{\widehat{q}_{OO}}^{1} [(q - p_H)R - (\theta_H w_{OO} + C)]\, f(q)dq.$$

The first term on the RHS is the value of the firm when the incumbent is confirmed. The second term is positive only if $\widehat{q}_{OO} < 1$. The following proposition analyzes the effect of an increase in the degree of overconfidence θ_H, taking the level of optimism θ as given.

Proposition 6: For a given value of optimism θ, the value of the firm is increasing in overconfidence: $\frac{\partial V_{OO}}{\partial \theta_H} \geq 0$.

Proof: Note that $\frac{\partial w_{OO}}{\partial \theta_H} = -\frac{I}{(p_H + \Delta_\theta - p_L)^2} = -\frac{w_{OO}}{(p_H + \Delta_\theta - p_L)} < 0$ and $\frac{\partial \widehat{q}_{OO}}{\partial \theta_H} = \frac{1}{R} \frac{\partial (\theta_H w_{OO})}{\partial \theta_H} = \frac{w_{OO}}{R} - \frac{\theta_H I (p_H - p_L)}{R(p_H + \Delta_\theta - p_L)} =$ .Then:

$$\frac{\partial V_{OO}}{\partial \theta_H} = -p_H \frac{\partial w_{OO}}{\partial \theta_H} - \int_{\widehat{q}}^{1} [w_{OO} + \theta_H \frac{\partial w_{OO}}{\partial \theta_H}] f(q)dq - \frac{\partial \widehat{q}}{\partial \theta_H} [(\widehat{q} - p_H)R - (\theta_H w_{OO} + C)]\, f(\widehat{q})$$

$$= w_{OO}\frac{p_H}{p_H+\Delta_\theta-p_L} - \int_{\widehat{q}_{OO}}^{1} w_{OO}\left(\frac{p_H-\theta_H-p_L}{p_H+\Delta_\theta-p_L}\right) f(q)dq$$

then:

$$\frac{\partial V_{OO}}{\partial \theta_H} = \frac{w_{OO}}{p_H+\Delta_\theta-p_L}\left[p_H - \int_{\widehat{q}_{OO}}^{1}(p_H-\theta_H-p_L)f(q)dq\right] > 0$$

□

Proposition 6 indicates that, given that the manager is optimistic, some overconfidence is beneficial for the firm. We can evaluate the impact of overconfidence by comparing the value of the firm when the manager is both optimist and overconfident to the value of the the firm obtained in the standard case in which both the board and the manager use the "right" probability of success:

$$V_{OO} - V_{NO} = -p_H(w_{OO}-w) - \int_{\widetilde{q}}^{\widehat{q}_{OO}} \left[R(q-p_H)+C\right] f(q)dq - \int_{\widehat{q}_{OO}}^{1} \theta_H w_{OO} f(q)dq \tag{10}$$

The first term on the RHS is positive ($w_{OO} < w$) and represents the gain due to the lower incentive compensation paid to an overconfident manager. The other two terms are negative and represent the cost of overconfidence; the second term is the expected loss arising from the distortion in the replacement decision resulting from the higher cutoff value used when the incumbent is overconfident, and the last term is the expected cost of the additional severance pay that an overconfident incumbent receives when replaced. Note that given that $\widehat{q}_{OO}$ is increasing in θ_H as overconfidence rises, the interval of the second integral increases while the interval of the last one decreases. In general, the sign of the above difference is indeterminate reflecting the fact that overconfidence has both advantages and disadvantages. Some additional assumption on the probability distribution of q is necesssary to sign the difference. (For example we could assume that q is uniformly distributed over the interval $[\underline{q}, 1]$.)

Let now compare the value of the firm when the manager is both optimist and overconfident to the case with only optimism analyzed in the previous section.

$$V_{OO} - V_O = -p_H(w_{OO}-w) + \int_{\widehat{q}_O}^{\widehat{q}_{OO}} \left[R(p_H-q)+\theta w_{OO}+C\right] f(q)dq + \int_{\widehat{q}_{OO}}^{1} \left[\theta(w-w_{OO}) - \Delta_\theta w_{OO}\right] f(q)dq$$

$$V_{OO} - V_O = -p_H(w_{OO}-w) - \int_{\widehat{q}_O}^{\widehat{q}_{OO}} \left[R(q-p_H)-\theta w_{OO}-C\right] f(q)dq - \int_{\widehat{q}_{OO}}^{1} \frac{I\Delta_\theta(p_H-p_L-\theta)}{(p_H+\Delta_\theta-p_L)(p_H-p_L)} \tag{11}$$

The sign of this difference depends on the relationship between $\widehat{q}_{OO}$ and $\widehat{q}_O$, which in turn depends on the sign of $p_H - p_L - \theta$. If θ is "small", (i.e. $p_H - p_L \geq \theta$), then the first term on the RHS is positive and the other two are negative. This does not rule out the possibility that the overall sign is positive, but it makes it unlikely. If, on the contrary, θ is "large" in the sense that $p_H - p_L < \theta$ so that $\widehat{q}_{OO} < \widehat{q}_O$, all terms are positive and $V_{OO} - V_O > 0$. Then we have:

Proposition 7. *In the presence of a high degree of optimism (θ large) a (moderate) overconfidence increases firm value.*

Proof. Follows immediately from 11.

If t overconfidence reduces the distortion introduced by managerial optimismin the board replacement decision, the value of the firm is higher when the manager is both optimist and overconfident rather than only optimist.

5 Conclusion

The paper has examined the different effects of optimism and overconfidence on severance pay and board's replacement decision if a better manager shows up after the CEO has made a firm specific investment. Both optimism and overconfidence result in higher severance pay and lower turnover. When the manager is optimist, the higher severance pay has no countervailing positive effect in our model and firm value is reduced. Overconfidence, on the contrary, presents a tradeoff: similarly to optimism, it has a negative effect on severance pay but it also has a positive effect on the incentive pay because it makes it cheaper to satisfy the incentive compatibility constraint. However, despite the positive effect, firm value is likely to be lower when the manager is overconfident if compared to the value when the manager has no bias.

The model assumed a predetermined bargaining power of the incumbent manager who, in case of replacement, is able to obtain what he believes he would get by staying with firm. The results of our analysis are therefore strongly affected by managerial bargaining power. We plan to examine how changing the incumbent power in the renegotiation with the board would affect the result in a future extension.

In our model overconfidence reduces managerial turnover leading to CEO entrenchment. Several papers have shown that some degree of CEO entrenchment may be optimal for different reasons (Inderst and Muller 2010, Casamatta and Gruembel 2010, Manso 2011) but this, as far as we know, is the first model that relates CEO entrenchment to overconfidence.

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