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# INCENTIVES ‘AND’ STATUS<sup>1</sup>

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## **Abstract:**

*This paper characterizes the structure of monetary incentives in an organization with varying differences in employee status. With the help of a moral hazard framework with limited liability we show that for agents with lower outside option increased status leads to lower incentive pay whereas exactly the opposite happens for agents with higher outside option. For agents with very high status such that the limited liability doesn't bind, an exogenous increase in status level leads to an unambiguous decrease in optimal incentive payment.*

**Keywords:** Status, incentives, motivation, moral hazard, optimal contract

**JEL Classifications:** D86, L14, L20

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## Introduction:

There is a wealth of research in organization theory which have identified and studied the role of monetary and non-monetary incentives (like status) in eliciting desirable effort by the agents. But very few studies have examined how the optimal incentive scheme changes for agents with differing status. In this paper we explore how the optimal monetary incentive scheme varies with persons holding different status. Note that in this paper ‘status’ is *not* conferred as an incentive, it arises out of rank holding of the employee within the firm and hence person’s status level is assumed to be exogenous<sup>2</sup>. This is an important point of departure from the papers by Besley and Ghatak (2008) and Auriol and Renault (2008), where status is bestowed as a non-monetary incentive. Therefore in this paper, given the hierarchical structure (positions or status) in a firm, we completely characterize the optimal monetary incentives for agents as a function (with slight abuse of the term) of status-levels<sup>3</sup> when agents are intrinsically motivated<sup>4</sup> and are status-conscious, in the sense that they value the same monetary payoff differently. To explain this a bit, when a flat monetary incentive payment is offered to agents across all status levels an agent of higher status might not value the incentive as highly as an agent holding low status. This is because comparison matters to human beings and it affects their well-being as well. Human beings do not solely care about their absolute level of pay but are also concerned about their relative position vis-a-vis others around them in their workplace and also in the social ladder.<sup>5</sup> We incorporate this effect in our model.

Specifically, in this paper we use a moral hazard framework with limited liability a la Innes (1990), Besley and Ghatak (2005), Banerjee (2011) and introduce an exogenous status parameter in the model. Given a fixed incentive bonus, agents with higher status value it less

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<sup>2</sup> Often the allocation of status in a formal hierarchy within a firm is constrained by production process (like technology) and creation of new level within the hierarchy is not always costless. Creation of new positions are often time consuming. As every organization has to abide by some human resource policy, creation of ranks cannot take place at any time point of the year. Hence it is costly in this respect. Status, therefore, cannot be always conferred as an incentive to motivate agents.

<sup>3</sup> Though job titles, medals, etc. convey status on the agents but in this paper we have assumed that agent enjoys status only from the rank she holds in the organization

<sup>4</sup> A la Besley and Ghatak(2005): where they have identified and defined an agent as ‘motivated’ if the agents get intrinsic benefit through her participation in the job. Section 3 explores interesting cases where status and motivation are correlated.

<sup>5</sup> See for instance, works by Duesenberry (1949), Easterlin (1974), Clark and Oswald (1996),McBride (2001), Luttmer (2005), Brown et al (2007), K.Fleissbach et al(2007), Clark et al(2008).

compared to agents with lower status<sup>6</sup> and this is a crucial feature of this model. In this framework we show that for low outside option and “incentive conscious”<sup>7</sup> agents of moderately high status, increased status leads to lower incentive pay, whereas exactly the opposite happens for agents with higher outside option. These results also hold for agents whose valuation of both fixed wage and incentive changes with differing status. For “incentive conscious” agents with very high status such that the limited liability doesn’t bind, an exogenous increase in status level leads to an unambiguous decrease in optimal incentive payment. Thus this paper makes an attempt to characterize how the optimal incentive scheme varies in response to exogenous change in the status level of agents. The point worth mentioning is that in essence for lower-outside option and for agents with very high status our result is different from Auriol and Renault (2008) where they show that high performance reward goes to the agent with higher status, whereas we get back their result in case of higher outside option. But while analyzing the results one should also remember the fundamental difference that in our paper status is not conferred as an incentive whereas in their paper status is conferred as a non-monetary incentive.

Our study, in a way, contributes to the emerging literature which studies the importance of presence of status and its implication in economic theory. Status consciousness arises from the fact that human beings make social comparison. The social comparison theory by social psychologist Leon Festinger (1954) states that individuals make comparison to evaluate their own opinions and desires with respect to others. The importance of social comparison has also been widely documented in shaping individual utility by subjective well-being literature. A pioneering work by Easterlin (1974) in the studies of subjective happiness has shown empirically a paradoxical situation, where most people want more income and yet when societies become richer they do not become happier. Easterlin paradox has been explained by Clark and Oswald (1996), McBride (2001), Hopkins and Kornienko(2004), Luttmer (2005), Clark et al(2008) by incorporating relative income in individual’s utility function. They have provided empirical evidence in support of the hypothesis that relative-income does matter in individual assessments of subjective well-being. The fact that human beings make social comparison while assessing the

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<sup>6</sup> A lower grade staff might value a \$1 bonus differently than a CEO of that firm and we assume that the \$1 bonus is valued relatively highly by the lower grade staff than the CEO. This assumption seems straightforward and realistic.

<sup>7</sup> An agent is said to be “incentive conscious” if the valuation of only the monetary incentive changes with differing status.

value of their remuneration has also been asserted by neurophysiological evidence as shown by K.Fleissbach et al(2007), in the area of Neuroeconomics .

Different to our study, individuals' craving for status has important economic implication<sup>8</sup>. The importance of status as a non-pecuniary incentive to elicit the desired outcome has been studied in an influential and growing literature (see Frank (1985), Fehr and Schmidt (1999), Dubey and Geanakoplos (June, 2004), Moldovanu et al (2007), Brown et al (2007) Besley and Ghatak (2008), Auriol and Renault (2008), Dhillon and Herzog-Stein (2009)). Huberman, Loch and Öncüler (2004) through a psychological experiment have shown that individuals are also willing to trade off some material gain to obtain status. Besley and Ghatak (2008) have shown that to expend effort status incentive works as partial substitute of monetary incentive, whereas; according to Auriol and Renault (2008) agent's preference exhibits complementarities between status incentive and monetary incentive. But in the above papers status has been modeled as incentive to motivate the agent whereas, here we design the optimal incentive scheme given the status that agents enjoy out of their rank in formal hierarchy of the organization. Even though, similar to Auriol and Renault (2008), in this paper status influences the incentive constraints but it should be noted that the objectives of both the papers are not aligned. Auriol and Renault (2008) made an important contribution to the literature by finding the optimal levels of hierarchy and corresponding monetary incentive in presence of a long term perspective, whereas, our objective is to determine the optimal monetary payoff given the levels of hierarchy (status). Thus, unlike the above discussed papers, in our paper status is not captured 'as' an incentive but we focus on interplay between incentives 'and' status.

The rest of the paper is organized as follows. To start with in Section 1 we describe the model when the agents are incentive conscious. The corresponding optimal form of the contract is analyzed in Section 2. In Section 3 we extend our baseline model and discuss correlation between status and motivation. Section 4 derives the optimal contract for the more general case, where the agent's valuation of both the fixed wage and monetary incentive changes with status. Section 5 provides some concluding remarks and throws some light on intended future works.

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<sup>8</sup>For details, see Robert H. Frank (1985).

## 1. The Model: “Incentive Conscious” Agent:

Our objective is to structure an optimal incentive scheme that a principal should offer to agents, when the monetary incentive is valued differently across agents with different status. To derive the optimal contract we use a modified version of the moral hazard structure with limited liability a la Innes (1990), Besley and Ghatak (2005), Banerjee (2011).

Let us assume that a firm consists of risk –neutral principal and a risk- neutral status conscious agent. The principal hires the agent to carry out a project. The project can either succeed or fail. A contract is signed between the principal and the agent, which specifies that the agent will get a fixed wage, ‘ $F$ ’ and a bonus, ‘ $b$ ’ where the bonus is paid only if the project succeeds. The agent is ‘status conscious’ and ‘incentive conscious’ in the following way: agents of higher status value the same bonus  $b$  less than the agents of lower status. Put differently an agent of status level indexed by  $\alpha$  values the monetary incentive by  $\alpha b$ , where,  $\alpha \in (0,1]$ <sup>9</sup> and lower  $\alpha$  means higher status and thus an agent with higher status values a same monetary incentive lesser.  $\alpha$  is assumed to be common knowledge. We will relax this assumption of incentive consciousness later and will consider the more general case, where the agent’s valuation of both the fixed wage and monetary incentive changes with status. Now the final outcome of the project is assumed to be verifiable by any third party and hence it is contractible. Outcome is high when the project succeeds and we denote it by  $q_H = 1$ . When the project fails the outcome is low which is denoted by  $q_L = 0$ . Therefore, without loss of generality we focus on a  $0-1$  outcome. If the project succeeds principal gets a fixed payoff of  $\pi$  and  $0$  if the project fails. The agent puts in a non-verifiable effort denoted by  $e \in [0,1]$  which can be taken as the probability of success. Therefore the project can succeed with probability  $e$  and fail with probability  $1 - e$  and this is in the sense of first order stochastic dominance. The effort is costly and therefore the cost of effort is assumed to be  $C(e) = \frac{e^2}{2}$ . The effort which is supplied by the agent is not verifiable and hence it is not contractible. We assume that the agent has no wealth, thus a limited liability constraint operates. This implies that agent has to be given a minimum consumption level of  $\underline{F} \geq 0$  every period, irrespective of the project outcome. The agent is assumed to have an outside option

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<sup>9</sup>  $\alpha$  basically indicates that differing valuation of monetary incentive across status. One can also assume  $\alpha$  to be greater than 1 but the interpretation will remain unchanged, i.e. higher  $\alpha$  would mean lower status and the qualitative aspect of our paper will go through. Therefore, the current range of  $\alpha$  is assumed without loss of generality.

(reservation utility),  $u^0$ . In addition we also assume that the agent is intrinsically motivated, i.e. the agent derives a non-pecuniary benefit (or pleasure) ‘M’ from carrying out the project. For simplicity we assume that intrinsic motivation is independent of the level of status implying that M and  $\alpha$  are uncorrelated<sup>10</sup>. To derive the optimal contract we need to make the following two technical assumptions:

**Assumption 1:**

$$\pi + M < I$$

**Assumption 2:**

$$\frac{1}{4}(\alpha\pi + M)^2 - \underline{F} > 0$$

Assumption 1 ensures that there exists an interior solution in effort and the second assumption guarantees the existence of an optimal contract under moral hazard.

Considering all the above assumptions we can now proceed to derive the optimal contract between the principal and the status conscious agent.

**1.1. Optimal Contracts:**

As a benchmark, at first we consider the first- best case where effort is observable and hence contractible. To find out the first best effort level we maximize the expected joint surplus of the principal and the agent. Therefore under the first-best the optimization problem becomes

$$Max_{e \in [0,1]} S^* = e(\pi + M) - \frac{e^2}{2} \tag{1}$$

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<sup>10</sup> This assumption can be justified on the ground that since the motivation is assumed to be ‘intrinsic’ it might not have any correlation with the status achieved by an individual. Alternative specifications are also possible. One might assume that a person with higher intrinsic motivation might climb up the ladder (status) quickly vis-a-vis others pointing to a positive correlation. Also one can specify that a person who has achieved higher status might show a reduction in intrinsic motivation assuming that ‘intrinsic motivation’ is not constant throughout life. In both the cases perfect correlation makes the intrinsic motivation element redundant. We will explore some alternative specifications in section 3.

Therefore, the optimal first best effort will be  $e^{FB} = \pi + M$  and the maximum expected joint surplus is  $S^{FB} = \frac{(\pi+M)^2}{2}$ .

Now we look into the case where effort is unobservable and hence non-contractible. To obtain the optimal contract under unobservability we have to perform the following optimization exercise.

$$\text{Max}_{\{b,F\}} U^P = (\pi - b)e - F \quad (2)$$

subject to the following constraints:

- a) *Perceived Limited liability constraint* requiring that the agent's perceived payment should be at least  $\underline{F}$  as the minimum fixed wage :

$$F \geq \underline{F} , F + \alpha b \geq \underline{F} \quad (3)$$

- b) *Individual Rationality constraint* stating that for participation in the job it is necessary that the agent is offered at least her outside option (reservation utility)

$$U^A = e (\alpha b + M) + F - \frac{e^2}{2} \geq u^0 \quad (4)$$

- c) *Incentive compatibility constraint* which shows that the effort level maximizes the private payoff of the agent<sup>11</sup>:

$$e = \arg \max_{e \in [0,1]} [ e(\alpha b + M) ] + F - \frac{e^2}{2}$$

Applying first order approach after simplification the above incentive constraint becomes

$$e = M + \alpha b \quad (5)$$

where  $e \in [0,1]$ . The assumption of risk neutrality along with limited liability makes the incentive compatibility constraint costly and hence gives rise to moral hazard incentive for the agent. It should be noted that the agent should be provided with a minimum fixed wage of  $\underline{F}$  when the outcome of the project is bad, whereas, when the outcome is good even though she receives a payoff of  $F + b$  but her perceived valuation of the payoff, which is  $F + \alpha b$  should at

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<sup>11</sup> The status within the organization affects the expected payoff of the agent and hence influences the incentive constraints. Similar kind of modeling has been adopted by Auriol and Renault (2008).



least exceed  $\underline{F}$ . Notice, both the limited liability constraints cannot bind at the same time and when  $F \geq \underline{F}$  it also implies that  $F + \alpha b \geq \underline{F}$ , since  $b \geq 0$ . Therefore,  $F \geq \underline{F}$  is the relevant limited liability constraint and the other one is a slack constraint. Now substituting the incentive compatibility constraint in the principal's utility function, the optimization exercise becomes

$$\text{Max}_{b,F} U^P = (\pi - b)(M + \alpha b) - F$$

subject to

Limited liability constraint:  $F \geq \underline{F}$ .

Individual Rationality constraint:  $U^A = \frac{(M+\alpha b)^2}{2} + F \geq u^0$ .

In the modified optimization problem there are two choice variables 'F' and 'b'. We should mention that the objective function is concave and constraints are convex.

To characterize the optimal contract completely we need to focus our attention to the range of reservation payoffs for the agent in which the principal earn a non-negative payoff. Let us define  $\bar{u}$  as the reservation payoff of the agent for which the principal's expected payoff is zero. But if the reservation payoff is very low then in the presence of the limited liability constraint the participation constraint of the agent may not bind. Therefore we need to define  $\underline{u}$  such that for all  $u^0 \geq \underline{u}$  the agent's individual rationality constraint binds. Now, under this structure the limited liability may or may not bind depending upon the status that the agent is holding. To explain this explicitly we proceed through a methodical proof and provide the following lemmas which will help to characterize the optimal contract.

**LEMMA 1:** *Under the optimal incentive contract at least one of the participation constraint and limited liability constraint will bind.*

**Proof:** See appendix.

Therefore, it is impossible that both the constraints will not bind. The next lemma shows the influence of status on the optimal effort.

**LEMMA 2:** *When status is incorporated in the system in such a way that the worth of the bonus is not valued to its full extent by the agents (i.e. when  $\alpha < 1$ ) then  $e$  is always less than the first best.*

**Proof:** See appendix.

This lemma shows an important result that in the presence of status is sufficient for a risk neutral agent to deliver inefficient<sup>12</sup> effort. The following lemma shows the effect of status on limited liability constraint.

**LEMMA 3:** *The limited liability constraint will bind if the agent's status in the firm is sufficiently low (i.e.,  $\alpha$  is high).*

**Proof:** See appendix.

The above lemma can be explained as follows. Agents with sufficiently low status (high  $\alpha$ ) values monetary bonus highly and therefore the principal can afford to pay the minimum possible fixed wage and still get the agent to accept the contract and elicit high effort. Whereas, for the agent with sufficiently higher status (low  $\alpha$ ) the valuation of monetary incentive is low and therefore the principal optimally needs to increase the fixed wage component over  $\underline{F}$  to satisfy the agent's participation constraint. Therefore the limited liability might not bind for agents with sufficiently high status. But, for the time being, for tractability of solutions we consider the case of agents with not very high status ( $\alpha$  sufficiently high) such that the limited liability constraint binds. Later we will relax this assumption in section 2.2 and show how the analysis changes.

**Assumption 3:**  *$\alpha$  is sufficiently high such that the limited liability constraint binds.*

In our analysis, we will concentrate on that range of reservation utility of the agent for which the payoff of the principal is non-negative and for that we need to take into account the following two lemmas:

**LEMMA 4:** *Let assumption 2 holds, then  $\exists \bar{u} \in (0, S^*)$ .*

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<sup>12</sup> This is a departure from the standard principal- agent literature where with risk neutral agents limited liability constraint needs to bind to generate inefficiency.

**Proof:** See appendix.

**LEMMA 5:** *Suppose assumption 2 holds then  $\exists \underline{u} \in (0, \bar{u})$*

**Proof:** See appendix.

Given the above Lemmas we can now put forward the following proposition which states the characteristics of the optimal contract under this structure.

**PROPOSITION 1:**

*If assumption (1), (2) and (3) hold and reservation payoff of the agent  $u^0 \in [0, \bar{u}]$  then an optimal contract  $(b^*, F^*)$  between a principal and agent can be characterized as follows*

- I. *The fixed wage is set at the subsistence level, i.e.,  $F^* = \underline{F}$*
- II. *The bonus payment is characterized as follows*

- A. *When outside option is low i.e.,  $u^0 \in [0, \underline{u}]$  then the optimal bonus*

$$b^* = \begin{cases} 0 & \text{when } M \geq \alpha\pi \\ \frac{\alpha\pi - M}{2\alpha} & \text{otherwise} \end{cases}$$

*Note that for  $M < \alpha\pi$  optimal monetary incentive falls with increased status (lower  $\alpha$ ).*

- B. *When outside option of the agent is sufficiently high i.e.,  $u^0 \in [\underline{u}, \bar{u}]$  then the*

*optimal bonus is given by  $b^* = \frac{1}{\alpha} \left[ \sqrt{2(u^0 - \underline{F}) - M} \right] > 0$ . Interestingly increased*

*status (lower  $\alpha$ ) leads to an increased optimal monetary incentive.*

- III. *The optimal effort is given by*

$$e^* = M + \alpha b^*$$

**Proof:** See appendix.

The first part of the proposition shows that it is optimal for the principal to set the fixed wage  $F$  at the minimum level since increasing  $F$  won't affect effort and also the agent is risk neutral and cares only about minimum fixed wage and doesn't care about the distribution of payoffs across

states. The second part of the proposition tells us about the optimal incentive. Given assumption 3 limited liability constraint always binds and hence the fixed wage is set at the minimum level. So to motivate the agent to elicit desirable effort,  $b$  is the only instrument. By ensuring higher  $b$  principal can provide incentives to the agent to exert more effort. But higher  $b$  reduces the expected return of the principal and thus  $b$  is a costly instrument to elicit effort. If the agent is highly motivated in the sense that  $M \geq \alpha\pi$  then there is no need to provide any incentive to elicit costly effort from the agent. But if the agent is not that highly motivated in the sense that  $M < \alpha\pi$ , then incentives has to be given to elicit costly effort and therefore incentive bonus should be strictly positive. Moreover, it should be noted that in this situation optimal  $b = \frac{\alpha\pi - M}{2\alpha} > 0$  and thus  $\frac{db^*}{d\alpha} = \frac{M}{2\alpha^2} > 0$ , which implies that when the bonus is more valuable to the agent, it is optimal to provide more incentive. Put differently when bonus is less valuable to the agent i.e. with an increase in status optimal incentive payment falls. The logic behind this result can be explained from the agent's effort function which shows that for a given  $b$  lower  $\alpha$  leads to lower optimum effort elicited by the agent<sup>13</sup> and this leads to reduced expected payoff of the principal. Therefore it is optimal for the principal to reduce the incentive pay  $b$  and this is possible since the outside option of the agent is sufficiently low and the participation constraint is non-binding and thus the principal can optimally reduce  $b$  and yet get the agent to accept the contract. Thus, under this situation, we observe that higher is the status of the agent lower is the optimal incentive bonus. This results is too some extent different from Auriol and Renault (2008)<sup>14</sup> where they show that high performance reward goes to the agent with higher status. Also note that agent motivation and  $b$  are imperfect substitutes in the model and therefore higher intrinsic motivation of the agent leads to lower optimal incentive bonus. Now when the outside option of the agent is high (i.e., the participation constraint binds) then the principal needs to provide sufficient incentive to the agent to compensate for the forgone outside option and this is irrespective of the status of the agent and the degree of motivation. Again it is interesting to note that the effect of an increased status on optimal incentive pay is diametrically opposite in this case. When the outside option of the agent is high increased status leads to greater incentive payment. This is due to the fact that with an exogenous increase in status the effective valuation

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<sup>13</sup> In other words, when the status of the agent is higher for a given  $b$  more is the tendency of the agent to shirk.

<sup>14</sup> See their part (iii) of proposition 1.

of bonus  $\alpha b$  falls leading to a fall in the optimal effort. Given that both the limited liability and the participation constraint binds, increasing  $b$  is the only way by which the principal can elicit desirable effort from the agent and at the same time to make her accept the contract. Therefore for higher outside option we get the Auriol and Renault (2008) result that that high performance reward goes to the agent with higher status, but we should once again remember the fundamental difference that in our paper status is not conferred as an incentive whereas in their paper status is conferred as a non-monetary incentive.

The third part of the proposition gives the optimal effort that the agent should choose. It shows that optimal effort is a function of agent status, intrinsic motivation and optimal bonus.

## 2.2. Agents of very high status such that limited liability doesn't bind:

Here we relax assumption 3 and derive the optimal contract when the status of the agent is high (i.e.,  $\alpha$  is low) such that limited liability does not bind. We know from lemma 1 that when limited liability does not bind then the IR constraint must bind. Therefore, this is the case of a standard moral hazard without limited liability and risk neutral agents. The only difference in this framework is that the presence of status makes the optimal effort less than the first best. This has already been proved in lemma 2 and this holds irrespective of whether limited liability binds or not. In this situation it is optimal for the principal to push the agent to her reservation payoff and appropriate the entire surplus. Henceforth we will concentrate on the ranges of  $\underline{F}$  and  $M$  such that an optimal contract between the agent and the principal exists even when the limited liability constraint is not binding.

Now, incorporating the incentive compatibility constraint the optimal contracting problem for the principal in this case becomes:

$$\text{Max}_{b,F} U^P = (\pi - b)(M + \alpha b) - F$$

subject to the participation constraint (IR constraint)

$$U^A = \frac{(\alpha b + M)^2}{2} + F = u^0$$

From the participation constraint we can solve for  $F$  and we can replace that  $F$  in the principal's utility function. Now maximizing  $U^P$  with respect to  $b$  we get the optimal  $b$  and from that we can derive the optimal  $F$ . Under this situation the optimal contract can be stated in the following proposition.

**PROPOSITION 2:**

*Given the assumptions 1 and 2 and higher the status of the agents an optimal contract  $\{F^{**}, b^{**}\}$  can be characterized as follows:*

(i). *If  $M \geq \frac{\alpha}{1-\alpha} \pi$  then  $b^{**} = 0$*

(ii). *If  $M < \frac{\alpha}{1-\alpha} \pi$ , then  $b^{**} = \frac{\alpha\pi - (1-\alpha)M}{\alpha(2-\alpha)} > 0$ .*

*Also an increase in agent's status leads to a decrease in the optimal incentive pay.*

(iii) *The optimal fixed wage is given by  $F^{**} = u_0 - \frac{(M + \alpha b^{**})^2}{2} > \underline{F}$*

(iv). *The optimal effort is given by  $e^{**} = M + \alpha b^{**} = \sqrt{2(u_0 - F^{**})}$*

**Proof:** See appendix.

The above proposition can be explained as follows: when agents are sufficiently intrinsically motivated then explicit incentives are not needed to elicit costly effort. Contrary to that when agents are not sufficiently motivated then explicit incentives are needed to elicit costly effort and this is irrespective of the range of the reservation utility of the agent. Noteworthy is the fact that the optimal incentive pay decreases with an increase in agent-status. The intuition is that when  $\alpha$  falls the optimum effort falls and this leads to a fall in the principal's expected payoff. Now the principal can optimally reduce  $b$  such that  $(\pi - b)$  increases and since the limited liability doesn't bind, increase  $F$  optimally such that the participation constraint binds. Thus increased status leads to an unambiguous fall in the optimal incentive payment for agents with sufficiently high status such that the limited liability doesn't bind. Again this result runs contrary to the prediction made in Auriol and Renault (2008).

### 3. Extension: Correlation between Motivation and Status

In our analysis we have assumed that motivation of the agent is truly intrinsic in the sense that it is uncorrelated with status. But one can relax this assumption and assume that motivation depends on the status level and therefore we can identify two possible cases:

#### Case I: Positive Correlation between Status and Motivation:

One can assume that motivation is positively correlated with status in the sense that higher is the status level the more motivated the agent becomes and might expend increased level of effort (given a fixed bonus). To model this for simplicity one can assume a simple linear relationship  $M = a - m\alpha$  where  $a$  can be interpreted as true intrinsic part of motivation that remains unaltered with the change in other parameters but  $\alpha m$  reflects the change in motivation with the change in status<sup>15</sup>. An increase in status that is a fall in  $\alpha$  leads to an increase in the motivation level of the agent. With this changed specification one can calculate the optimal bonus for varying level of outside options. For lower outside option  $u^0 \in [0, \underline{u}]$  and sufficiently high intrinsic motivation in the sense  $a > \alpha(m + \pi)$  the optimal monetary incentive is again zero. For not so high intrinsic motivation  $a < \alpha(m + \pi)$  we get  $b^* = \frac{\alpha\pi - a + \alpha m}{2\alpha} > 0$ . One can check that increased status leads to a decrease in the optimal monetary incentive and our result of the baseline model goes through for lower outside option. For higher outside option  $u^0 \in [\underline{u}, \bar{u}]$  we get the optimal incentive as  $b^* = \frac{1}{\alpha} \left[ \sqrt{2(u^0 - \underline{F})} - a + \alpha m \right]$ . Again we get back our baseline result that increased status (i.e. a fall in  $\alpha$ ) leads to an increase in optimal  $b^*$  and thus all our baseline results go through with this changed specification. For agents of very high status such that limited liability doesn't bind the optimal bonus turns out to be  $b^{**} = \frac{\alpha\pi - (1-\alpha)(a - \alpha m)}{\alpha(2-\alpha)}$  which is again positive only if the intrinsic motivation of the agent is not so high i.e.  $a < \frac{\alpha\pi}{(1-\alpha)} + m\alpha$ , otherwise it is zero. One can again check that increased status leads to a fall in optimal bonus

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<sup>15</sup> One can interpret  $\alpha m$  as extrinsic part of motivation (see Benabou and Tirole (2003)).

which is again similar to the result of our baseline case, since we can write  $b^{**} = \frac{\pi - (\frac{1}{\alpha} - 1)(a - \alpha m)}{(2 - \alpha)}$  and a fall in  $\alpha$  leads to a fall in optimal  $b^{**}$ .

### Case II: Negative Correlation between Status and Motivation:

One can also assume that motivation is negatively correlated with status in the sense that higher the status level the more lax the agent becomes and thus the level of motivation dips leading to a decreased level of effort (given a fixed bonus). Technically put without loss of generality one can assume  $M = a + m\alpha$  where  $a$  and  $\alpha m$  are as explained earlier. Therefore an increase in status that is a fall in  $\alpha$  leads to a decrease in the motivation level of the agent. Again one can calculate the optimal bonus as for varying level of outside options. For lower outside option  $u^0 \in [0, \underline{u}]$  and sufficiently high intrinsic motivation in the sense  $a > \alpha(\pi - m)$  the optimal monetary incentive is again zero. For not so high intrinsic motivation  $a < \alpha(\pi - m)$  we get  $b^* = \frac{\alpha\pi - a - \alpha m}{2\alpha} > 0$ . One can again check that increased status leads to a decrease in the optimal monetary incentive and our result of the baseline model goes through for lower outside option.

For higher outside option  $u^0 \in [\underline{u}, \bar{u}]$  we get the optimal incentive as  $b^* = \frac{1}{\alpha} \left[ \sqrt{2(u^0 - \underline{F})} - a - \alpha m \right]$  and again increased status leads to increased monetary incentive and thus the result of our baseline model goes through unambiguously. Again for agents of very high status such that limited liability doesn't bind the optimal bonus in this case turns out to be  $b^{**} = \frac{\alpha\pi - (1 - \alpha)(a + \alpha m)}{\alpha(2 - \alpha)}$

which is again positive only if the intrinsic motivation of the agent is not so high i.e.  $a < \frac{\alpha\pi}{(1 - \alpha)} - m\alpha$ , otherwise it is zero. Similar to our baseline case one can again check that increased status leads to a fall in optimal bonus since with slight rearrangement of terms we can write  $b^{**} = \frac{\pi - (1 - \alpha)(\frac{a}{\alpha} + m)}{(2 - \alpha)}$  and a fall in  $\alpha$  leads to a fall in optimal  $b^{**}$ . Therefore all the results of our baseline model go through even if we assume correlation between status and motivation which stands testimony to the robustness of our baseline structure.

### 4. Relaxing Incentive Consciousness:



In this section we discuss the more general case, where the agent is status conscious in such a way that she values the same payment of ‘ $F$ ’ and ‘ $b$ ’ differently with differing status. So here the agent holding the status of ‘ $\alpha$ ’ values the monetary payoff of  $F + b$  as  $\alpha(F + b)$  where  $\alpha \in (0,1]$ . Under this situation the following optimization problem has to be solved to derive the optimal contract the under non-observability.

$$\text{Max}_{\{b,F\}} U^P = (\pi - b)e - F \quad (6)$$

subject to the following constraints:

- a) *Perceived Limited liability constraint* ensuring that the agent at least perceives to experience  $\underline{F}$  as the minimum fixed wage :

$$\alpha F \geq \underline{F}, \alpha(F + b) \geq \underline{F} \quad (7)$$

- b) *Individual Rationality constraint:*

$$U^A = e(\alpha b + M) + \alpha F - \frac{e^2}{2} \geq u^0 \quad (8)$$

- c) *Incentive compatibility constraint:*

$$e = \text{argmax}_{e \in [0,1]} [e(\alpha b + M)] + \alpha F - \frac{e^2}{2} \quad (9)$$

Now substituting the incentive compatible effort level  $e = M + \alpha b$  in the expected utility function of the principal and then maximizing it subject to the participation constraint and the relevant perceived limited liability constraint  $\alpha F \geq \underline{F}$  we can derive the optimal  $F$  and  $b$ .

Before putting forward the proposition which characterizes the optimal contract we need to mention that other than lemma 3 all other lemmas goes through even in this changed structure. So the modified lemma 3 is given below which will help us characterize the optimal contract.

**Lemma 6:** *When an agent is status-conscious in such a way that the valuation of both the fixed wage and bonus decreases with the increase in status, then the perceived limited liability constraint always binds.*

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<sup>16</sup> The presence of status alters the valuation of the payoff. Thus, even if the absolute value of the payoff is greater than the minimum fixed wage, yet in the agent’s mind it may not be exceed  $\underline{F}$ . Hence, Perceived Limited liability ensures that the agent at least feels like enjoying  $\underline{F}$ .

**Proof:** Suppose there exists an optimal contract  $(b^0, F^0)$  such that  $b^0 \leq \pi$  and  $F^0 \geq \frac{F}{\alpha}$ . By lemma 1 we know that the participation constraint will always bind when the perceived limited liability doesn't. Now, let principal increases  $b$  and decreases  $F$  in such a way that the expected payoff of the agent remains the same. i.e.,  $dU^A = e \alpha db + \alpha dF = 0$ , implying  $dF = -e db$  (ignoring the effect of changes in  $b$  and  $F$  on her payoff via  $e$  which is nothing but the envelope theorem). Now, the change in principal's utility is given by  $dU^P = (\pi - b) de - (e db + dF)$ . Substituting the value of  $dF$  we get  $dU^P = (\pi - b)de > 0$  [since,  $\pi > b$  and  $de > 0$ ]. Therefore, the principal is better-off increasing  $b$  and reducing  $F$  in such a way and this will continue as long as the perceived limited liability binds. But if perceived limited liability constraint does not bind, then it must be that  $b = \pi$ . Since  $F \geq \frac{F}{\alpha}$  and  $\underline{F} > 0$ , substituting  $b = \pi$  in the principal's expected payoff we get  $U^P = -F < 0$ . Therefore in equilibrium the perceived limited liability constraint must bind. **QED.**

Therefore, in this structure perceived limited liability will always bind but by lemma 1 participation constraint may or may not bind.

Now, the optimal contract when agent's incentive consciousness is relaxed is stated in the following proposition.

**Proposition 3:**

*If assumptions similar to (1), (2) holds and incentive consciousness of the agent is relaxed then the optimal contract  $(b^*, F^*)$  between a principal and agent can be characterized as follows:*

- I. *The bonus payment is characterized as follows*
  - A. *For low outside option such that agents' outside option doesn't bind*
    - i) *If  $M \geq \alpha\pi$  then the optimal monetary incentive is  $b^{***} = 0$ .*
    - ii) *If  $M < \alpha\pi$  then optimal  $b^{***} = \frac{\alpha\pi - M}{2\alpha}$  and therefore increased status leads to a decrease in the optimal monetary incentive.*
  - B. *If the agent's outside option binds then*

$$b^{***} = \frac{1}{\alpha} \left[ \sqrt{2(u^0 - \underline{F})} - M \right] > 0 \text{ and therefore increased status leads to an increase in optimal monetary incentive.}$$

II. The fixed wage is set at the subsistence level, i.e.,  $F^{***} = \frac{F}{\alpha}$ . Observe, with the increase in status higher optimal fixed wage has to be offered.

III. The optimal effort is given by

$$e^{***} = M + \alpha b^{***}$$

Unlike the “incentive conscious” case, the optimal fixed wage is an inverse function of  $\alpha$  indicating that with binding perceived limited liability constraint agents with higher status should be provided with higher fixed wage such that the agent at least feels like experiencing the minimum payment of  $\underline{F}$ .

## 5. Conclusion:

In this paper we have made an attempt to analyze and interpret the interplay between status ‘and’ monetary incentives. Specifically we have shown how the optimal monetary incentive differs for persons with varying differences in status. Using a simple moral hazard model with limited liability we consider two cases, a) incentive conscious agents such that status affects the valuation of monetary incentives only and b) the general case where status affects both the fixed payment and the monetary incentive component. We have shown that in the first case the optimal incentive structure changes for group of agents with low outside option and group of agents with high outside option. It is optimal for the principal to offer high incentive to agents with low status, when the outside option of the agent is low; otherwise, it is optimal to pay higher incentive to agent with high status. Similar results hold for the general case also. We have also examined how the degree of motivation alters the optimal incentive scheme. It is observed that no incentive is required for the agent who is highly motivated and has low outside option. But when the agent belongs to high outside option group then irrespective of the degree of motivation the principal needs to provide strictly positive incentive as a compensation for the forgone reservation payoff.

An emerging literature on contract theory has focused on the importance of status as a non-pecuniary incentive and how status might relax the burden on monetary incentives to elicit the desired outcome (see Frank (1985), Dubey and Geanakoplos (June, 2004), Moldovanu et al.

(2007), Fehr and Schmidt (1999), Besley and Ghatak (2008), Dhillon and Herzog-Stein (2009)). But according to our knowledge the role of monetary incentive in an organization with varying differences in status has not been studied much. This paper provides an analytical framework to address this issue.

There are other several issues which are to be addressed in the future. In this framework we have assumed the intrinsic motivation of the agents to be exogenously given to the agent. But social norms, dimension of relationship with the principal, etc. can act as a proxy instrument to generate motivation among the agent. Thus endogenous motivation can affect the optimal contract to an extent. Again, the notion of fairness, while incentivizing the agents has remained unaddressed in this paper. In future, we intend to analyze the structure when the incentive is not reached to the deserving agent due to favoritism of the principal or assessment problem of the performance of the agent.

## APPENDIX:

### Proof of LEMMA 1:

Let us examine the situation where both the constraints do not bind in the equilibrium. Then the principal can maximize his payoff with respect to 'b' unconstrained. We know that,  $U^P = (\pi - b)(M + \alpha b) - F$ , then the optimal  $b^* = \text{Max} \left\{ \frac{\alpha\pi - M}{2\alpha}, 0 \right\}$  and the effort will be  $e^* = \text{Max} \left\{ \frac{1}{2}[\alpha\pi + M], M \right\}$ . We can observe that fixed wage  $F$  is not a component of the optimal effort level, so if the principal can reduce  $F$  by a small amount without affecting effort taken by the agent and at the same time the payoff of the principal increases. Hence, the principal will continue to cut down the fixed component of the wage in such a way that either limited liability constraint binds or individual rationality constraint binds. **QED**

### Proof of LEMMA 2:

When the effort is contractible then we can get the first-best effort level as  $e^{FB} = \pi + M$ . But under moral hazard  $e^{SB} = \alpha b + M$ . Even if  $b = \pi$  (the maximum value that  $b$  can take), then also  $e$  is less than first-best, since  $\alpha < 1$ . Thus, due to the presence of status the effort level is always less than the first best. **QED**

### Proof of LEMMA 3:

Suppose we assume that there exists an optimal contract  $(b^0, F^0)$  such that  $b^0 < \pi$  and  $F^0 > \underline{F}$ . We will show that the limited liability will bind only if  $\alpha$  is sufficiently high, i.e. for agents with sufficiently low status. By lemma 1 we know that the Participation constraint will always bind when the limited liability doesn't. Now, let principal increase  $b$  and decrease  $F$  in such a way that the expected payoff of the agent remains the same. i.e.,  $dU^A = e \alpha db + dF = 0$ <sup>17</sup>, implying  $dF = -e \alpha db$ . Now, the change in principal's utility function is given by  $dU^P = (\pi - b) de - (e db + dF)$ . Substituting the value of  $dF$  in the change in principal's utility function we can write  $dU^P = (\pi - b) de - (1 - \alpha) e db$ . When  $\alpha$  is sufficiently high then  $(1 - \alpha)$  is sufficiently low, therefore the term  $(1 - \alpha)e db$  is also sufficiently low, indicating

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<sup>17</sup> Since the agent chooses  $e$  to maximize his own payoff envelope theorem suggests that we can ignore effects of changes in  $b$  and on her payoff via  $e$ .

$dU^P = (\pi - b)de - (1 - \alpha)e db > 0$  [since,  $\pi > b$  and also  $de > 0$ ]. Therefore, the principal is better-off increasing  $b$  and reducing  $F$  in such a way and this will continue as long as the limited liability binds. Thus if  $b < \pi$  and  $\alpha$  sufficiently high a contract  $(b^0, F^0)$  such that  $b^0 < \pi$  and  $F^0 > \underline{F}$  cannot exist implying that if  $b < \pi$  then the limited liability must bind. But if limited liability constraint does not bind, then it must be that  $b = \pi$ . Since  $F > \underline{F}$  and  $\underline{F} > 0$ , putting  $b = \pi$  in the principal's expected payoff we get  $U^P = -F < 0$ . This shows that for high  $\alpha$  when limited liability constraint doesn't bind the principal's expected payoff is negative. Therefore in equilibrium with high  $\alpha$  i.e. for low status the limited liability constraint must bind. But for sufficiently higher status, i.e. low  $\alpha$ , a contract  $(b^0, F^0)$  might exist such that  $b^0 < \pi$  and  $F^0 > \underline{F}$ , i.e. the limited liability constraint might not bind for agents with sufficiently high status. **QED.**

**Proof of LEMMA 4:**

On the basis of our assumption that  $\alpha$  is sufficiently high, indicating agents are of lower status (values the bonus substantially more) and using lemma 3 we know that the limited liability must bind and the principal's payoff would be non-negative. Thus, we have  $F = \underline{F}$ . We have defined  $\bar{u}$  as the reservation payoff for which expected payoff of the principal is zero. Therefore, to find the value of  $\bar{u}$ , we need to solve  $U^P = (\pi - b)(M + \alpha b) - \underline{F} = 0$ . This quadratic equation in  $b$

has two roots,  $b = \frac{-M + \alpha\pi \pm \sqrt{(\alpha\pi - M)^2 + 4\alpha\underline{F}}}{2\alpha}$ . But since the agent's payoff increases with an increase

in  $b$  we can concentrate on the higher root only, i.e.,  $b = \frac{-M + \alpha\pi + \sqrt{(\alpha\pi - M)^2 + 4\alpha\underline{F}}}{2\alpha}$ . Substituting

this is agent's payoff  $U^A = \frac{(\alpha b + M)^2}{2}e + \underline{F} = \bar{u}$  we get,  $\bar{u} = \frac{1}{2} \left[ \frac{(\alpha\pi + M) + \sqrt{(\alpha\pi + M)^2 - 4\alpha\underline{F}}}{2} \right]^2 + \underline{F}$ .

Given assumption 2 we can observe that  $\bar{u}$  is strictly a positive real number. Now, putting  $\alpha = 1$

in the equation of  $\bar{u}$  we can write,  $\bar{u} = \frac{1}{2} \left[ \frac{(\pi + M) + \sqrt{(\pi + M)^2 - 4\underline{F}}}{2} \right]^2 + \underline{F} = \frac{(\pi + M)^2}{2} - \frac{1}{8} [(\pi + M) -$

$\sqrt{(\pi + M)^2 - 4\underline{F}}]^2 < \frac{(\pi + M)^2}{2} = S^*$ . Now, since  $\alpha < 1$  and  $\bar{u}$  falls with decrease in  $\alpha$  then

definitely  $\bar{u} < S^*$ . **QED.**

**Proof of LEMMA 5:**

Let  $\underline{u}$  denotes the value of the agents' payoff such that for all  $u^0 \geq \underline{u}$  the participation constraint binds. But if individual rationality constraint does not bind then limited liability should bind by lemma 1. The optimal bonus is given by  $b^* = \max\{\frac{\alpha\pi - M}{2\alpha}, 0\}$ . Now, we consider the following cases:

**Case I:  $M < \alpha\pi$**

In this case  $b^* = \frac{\alpha\pi - M}{2\alpha} > 0$  and the corresponding  $e^* = \frac{\alpha\pi + M}{2}$ . Substituting the value of the optimal bonus and effort level in the agent payoff function we get,  $U^A = \frac{1}{8}(\alpha\pi + M)^2 + \underline{F}$ . Thus, from the definition of  $\underline{u}$  we can write  $\underline{u} = \frac{1}{8}(\alpha\pi + M)^2 + \underline{F} > 0$ . For  $\bar{u} > \underline{u}$ , we need to

show  $\frac{1}{2} \left[ \frac{(\alpha\pi + M) + \sqrt{(\alpha\pi + M)^2 - 4\alpha\underline{F}}}{2} \right]^2 + \underline{F} > \frac{1}{8}(\alpha\pi + M)^2 + \underline{F}$  holds. This holds if  $(\alpha\pi + M)^2 - 4\alpha\underline{F} > 0$  which is ensured by assumption 2. So, in this situation there exists  $\underline{u} \in (0, \bar{u})$ .

**Case II:  $M > \alpha\pi$**

In this situation  $b^* = 0$  and the agent's utility is  $U^A = \frac{M^2}{2} + \underline{F}$ . Again from the definition we get

$\underline{u} = \frac{M^2}{2} + \underline{F}$ . For  $\underline{u} < \bar{u}$  we need to show  $\frac{M^2}{2} + \underline{F} < \frac{1}{2} \left[ \frac{(\alpha\pi + M) + \sqrt{(\alpha\pi + M)^2 - 4\alpha\underline{F}}}{2} \right]^2 + \underline{F}$ . This

condition can be reduced to  $\left[ \frac{(\alpha\pi + M) + \sqrt{(\alpha\pi + M)^2 - 4\alpha\underline{F}}}{2} \right]^2 > M^2$ . Now, putting  $\alpha = 0$  on left hand side

of the expression we get  $M^2$  and given assumption 2 the left hand side is increasing in  $\alpha$  and therefore for a positive  $\alpha$  it must be that  $\underline{u} < \bar{u}$ . **QED.**

**Proof of PROPOSITION 1:**

Using Lemma 1 and 3 we consider two relevant cases:

- a) When participation constraint does not bind and limited liability constraint binds.
- b) When both participation constraint and limited liability constraint bind.

From the proof of Lemma 5 we can split case (a) into following two cases:

- i.  $M \geq \alpha\pi$
- ii.  $M < \alpha\pi$

Therefore, we will study the following 3 cases.

CASE 1: In this situation the participation constraint does not bind and  $M \geq \alpha\pi$ . Following Lemma 1 we know that in this case the limited liability constraint must bind and we get the following:

$$b^* = \max\left(0, \frac{\alpha\pi - M}{2\alpha}\right) = 0 \quad [\text{Since } M \geq \alpha\pi]$$

$$F^* = \underline{F}$$

$$e^* = M + \alpha b^* = M$$

The agent's payoff can be calculated as  $U^A = \frac{M^2}{2} + \underline{F}$ . The principal's payoff can be given as  $U^P = \pi M - \underline{F} > 0$  [by assumption 2]. Since participation constraint does not bind, therefore  $U^A = \frac{M^2}{2} + \underline{F} > u^0$

CASE II: Let us concentrate on the situation where the participation constraint does not bind and  $M < \alpha\pi$ . Since the limited liability constraint binds we get

$$b^* = \max\left(0, \frac{\alpha\pi - M}{2\alpha}\right) = \frac{\alpha\pi - M}{2\alpha} > 0.$$

$$F^* = \underline{F}.$$

$$e^* = M + \alpha b^* = \frac{\alpha\pi + M}{2}.$$



The agent's utility function becomes  $U^A = \frac{1}{8}(\alpha\pi + M)^2 + \underline{F}$  and the principal's payoff is  $U^P = \frac{1}{4\alpha}(\alpha\pi + M)^2 - \underline{F} > 0$  [by assumption 2]. Since participation constraint does not bind  $\frac{1}{8}(\alpha\pi + M)^2 + \underline{F} > u^0$ .

**CASE III: Both participation constraint and limited liability constraint bind.** From these two constraints we can solve for the unique values of the choice variables. In particular from incentive compatibility constraint we get  $e = \alpha b + M$ . Since the individual rationality constraint binds we can write  $e(\alpha b + M) + \underline{F} - \frac{e^2}{2} = u^0$ . Substituting the incentive compatibility in the participation constraint we get  $\frac{(\alpha b + M)^2}{2} + \underline{F} = u^0$ . From this we can solve for  $b^* = \frac{1}{\alpha} [\sqrt{2(u^0 - \underline{F})} - M]$ . Since, participation constraint binds we get  $u^0 - \underline{F} > \frac{M^2}{2} > 0$ , this indicates that  $b^* > 0$ . From the limited liability constraint we get  $F = \underline{F}$ . The corresponding  $e^* = \sqrt{2(u^0 - \underline{F})}$ . In this context we should note that  $\sqrt{2(u^0 - \underline{F})} \leq \pi + M$ <sup>18</sup> implying  $(u^0 - \underline{F}) \leq \frac{(\pi + M)^2}{2} = e^{FB}$ . The payoff of the agent in this case becomes  $U^A = u^0 = \bar{u}$  (as the participation constraint binds). Principal's payoff is  $U^P = \sqrt{2(u^0 - \underline{F})} \left[ \pi + \frac{M}{\alpha} - \frac{1}{\alpha} \sqrt{2(u^0 - \underline{F})} \right] - \underline{F}$ . As proved in lemma 3 when  $u^0 = \bar{u}$ , the payoff of the principal is zero. Therefore, we get  $U^P \geq 0 \forall u^0 \in [0, \bar{u}]$

For the existence of optimal contract we proceed in the following way:

1. When  $u^0 = 0$  and  $M > \alpha\pi$

$$U^P = \pi M - \underline{F} > 0 \text{ [by assumption 2]}$$

$$U^A = \frac{M^2}{2} + \underline{F} > 0$$

2. When  $u^0 = 0$  and  $M < \alpha\pi$

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<sup>18</sup> As  $b \leq \pi$  this implies  $\alpha b \leq \pi$  [since,  $\alpha < 1$ ; by assumption 3]. Therefore  $\alpha b + M \leq \pi + M$ . From this we can write  $e \leq \pi + M \Rightarrow \sqrt{2(u^0 - \underline{F})} \leq \pi + M$

$$U^P = \frac{1}{4\alpha}(\alpha\pi + M)^2 - \underline{F} > 0 \quad [\text{by assumption 2}]$$

$$U^A = \frac{1}{8}(\alpha\pi + M)^2 + \underline{F} > 0$$

On the extreme situation, if the expected payoff of the principal is set equal to zero and provided the participation constraint binds then agents get a payoff of amount  $\bar{u} > 0$  as proved in lemma 5. Thus,  $\forall u^0 \geq \underline{u}$  the participation constraint binds. But  $\forall u^0 \in [0, \bar{u}]$  there exists an optimal contract. Note, the principal's expected payoff is continuous and is decreasing function of  $u^0$ . **QED.**

### Proof of PROPOSITION 2:

The principal's payoff is given by  $U^P = (\pi - b)(M + \alpha b) - F$ . Substituting the participation constraint in the principal's utility function we can write  $U^P = (\pi - b)(M + \alpha b) - u^0 + \frac{(\alpha b + M)^2}{2}$ . Now, maximizing the principal's utility function with respect to  $b$  we get the optimal  $b^{**} = \text{Max}\{0, \frac{\alpha\pi - (1-\alpha)M}{\alpha(2-\alpha)}\}$ . When  $M > (\frac{\alpha}{1-\alpha})\pi$ ,  $b^{**} = 0$  otherwise,  $b^{**} = \frac{\alpha\pi - (1-\alpha)M}{\alpha(2-\alpha)}$ . The optimal  $F$  can be easily solved from the participation constraint as  $F^{**} = u^0 - \frac{(\alpha b^{**} + M)^2}{2} > \underline{F}$  since the limited liability doesn't bind in this case. It can be shown that  $\frac{\delta b^{**}}{\delta \alpha} = \frac{[\alpha^2\pi + \alpha^2M + 2M(1-\alpha)]}{\alpha^2(2-\alpha)^2} > 0$ .

To show the existence of the optimal contract we consider the following two mutually exclusive cases:

**Case 1:**  $M \geq (\frac{\alpha}{1-\alpha})\pi$

When  $M > (\frac{\alpha}{1-\alpha})\pi$  we get  $b^{**} = 0$  and therefore  $F^{**} = u^0 - \frac{M^2}{2} > \underline{F}$  (suppose, LL doesn't bind). The agent receives her reservation payoff and the principal gets  $U^P = \frac{(2\pi + M)M}{2} - u_0$ . Now fix  $\underline{F} = 0$  and one can easily show the existence of an optimal contract for all  $u_0 \in [\frac{M^2}{2}, \frac{(2\pi + M)M}{2}]$ .

**Case 2:**  $M < \left(\frac{\alpha}{1-\alpha}\right)\pi$

Now consider the case where  $M > \left(\frac{\alpha}{1-\alpha}\right)\pi$  and therefore we get  $b^{**} = \frac{\alpha\pi - (1-\alpha)M}{\alpha(2-\alpha)} > 0$ . The

optimal fixed payment can be calculated as  $F^{**} = u_0 - \frac{1}{2}\left(\frac{M+\alpha\pi}{(2-\alpha)}\right)^2 > \underline{F}$  (assume such that LL

doesn't bind) and the principal receives  $U^P = \frac{(\alpha\pi+M)^2}{2\alpha(2-\alpha)} - u_0$ . The agent is again pushed to her

reservation utility level. Again for simplicity fix  $\underline{F} = 0$  and one can easily show the existence of

an optimal contract for all  $u_0 \in \left[\frac{1}{2}\left(\frac{M+\alpha\pi}{(2-\alpha)}\right)^2, \frac{(\alpha\pi+M)^2}{2\alpha(2-\alpha)}\right]$ . One can easily show that  $\frac{(\alpha\pi+M)^2}{2\alpha(2-\alpha)} >$

$\frac{1}{2}\left(\frac{M+\alpha\pi}{(2-\alpha)}\right)^2$  since  $(2-\alpha) > \alpha \forall \alpha \in [0,1]$ . This completes the proof. **QED.**

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