MORAL HAZARD WITH OTHER-REGARDING PRINCIPAL AND AGENTS ♠

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Abstract:

We analyze a principal two-agent interaction where the agents and the principal have other-regarding preferences. We show that with discrete effort and outcomes, both team contracts and relative performance contracts can be optimal if the principal is 'status-seeking' or 'not too inequity-averse'. But an extreme independent contract can also be optimal when the principal is sufficiently inequity-averse. Similar results hold when the projects of the agents are correlated as well. Also the agents are generally (weakly) better-off under a 'sufficiently inequity-averse' principal compared to a 'status-seeking' or 'moderately inequity-averse' principal. With a 'fair' principal, ceteris paribus, team contracts are more likely over relative performance contracts, but relative performance contract can also be optimal with other-regarding agents. Finally, we explore a general setting with continuous output and efforts and find sufficient conditions for team contract to be optimal and necessary conditions for the relative performance and independent contracts to be optimal depending on the principal's other-regardingness and the 'direct wage incentive' effect.

Keywords: *Other-regarding preferences, self-regarding preferences, inequity-averse, status-seeking, optimal contract*.

JEL: D86, D63, M52.

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1. Introduction:

What will be the optimal contractual structure within an organization when the principal and the agents have other-regarding preferences amongst each other? This is of paramount importance in order to study the optimal organizational structure along with the employer-employee relationship within an organization. Standard theories have studied the above with self-regarding principal and agents, and some with other regarding agents. But no study have focused on the other-regarding preferences of the principal and its impact on the optimal organizational incentive structure when the principal interacts with more than one agents. This paper is a step in plugging that gap where we analyze the optimal contract design of an other-regarding principal interacting with two other-regarding agents, first using the closed form structure with discrete effort and outcomes similar to Itoh (2004) and then we extend our analysis with continuous effort and outcomes with general functional forms a la Englmaier and Wambach (2010).

Specifically, in our closed form structure, we have an other-regarding principal who is other-regarding vis-a-vis the agents. The principal can be 'inequity-averse' or 'status-seeking'. To keep things simple and reasonably tractable we assume the agents to be ex-ante symmetric, therefore the nature and extent of other-regardingness of the principal is similar towards both the agents.[1] For the sake of tractability, in our closed from structure, we assume the principal to be 'never behind' the agents. The agents are also other-regarding but among themselves. They are not other-regarding vis-a-vis the principal. Although, technically, the agents might care about the principal's wellbeing, we abstract from this in our closed form analysis.[2] Although this sounds a bit restrictive at this stage, we will allow the agents to have other-regarding preferences vis-à-vis the principal in our general analysis with continuous effort and outcomes.[3] Thus, our discrete model has both 'vertical' and 'lateral' other-regarding preferences with some restrictions, but our general model will have all kinds of 'vertical' and 'lateral' other-regarding preferences.

[1] We will relax this in our general structure, section 6.

[2] This can be supported from a large body of sociological literature which proposes that people are more likely to compare themselves with persons who are similar in terms of personal characteristics and similar in positions/hierarchy in an organization. Baron (1998) also opined that it is more likely that agents will go for 'lateral' comparison compared to a 'vertical' one.

[3] In section 6 we allow the agents to be other-regarding both among themselves and vis-à-vis the principal.

Given above, in our discrete structure, we show that with ‘not so high inequity-averse’ agents and/or ‘status-seeking’ agents, a moderately inequity-averse or status-seeking principal will optimally offer an ‘extreme relative performance contract’, whereas she will offer an ‘extreme team contract’ if the agents are ‘sufficiently inequity-averse’. These optimal contracts mentioned above are similar to what we get in Itoh (2004) with self-regarding principal. The interesting change comes where the principal is ‘sufficiently inequity-averse’. In that case the principal will optimally offer an ‘extreme’ independent contract that minimizes her ex-ante welfare loss from being ahead, at the same time keeping the work incentives intact. Therefore with other-regarding principal, along with team contracts and relative performance contracts, an independent contract can also be optimal which was not the case in Itoh (2004) and other papers with other-regarding agents and self-regarding principal. This alerts us to the importance of the social preferences that the principal might have and its impact on the optimal incentive design within organizations. In fact we get similar results qualitatively if we assume the project outcomes of both the agents to be correlated. We extend our analysis and consider the case of a ‘fair’ principal who experiences a reduction in utility when the agents get different wages. We show that team contracts are more likely compared to relative performance contracts under a ‘fair’ principal compared to the standard case where the principal is other-regarding vis-a-vis the agents. But interestingly relative performance contracts can also be optimal when a fair principal interacts with inequity-averse agents but is never optimal when a fair principal interacts with self-regarding agents. This analysis on ‘fair’ principal is novel and is new to the literature with more than two agents.

Next we focus on continuous efforts and outcomes where the principal is other-regarding vis-à-vis the agents and the agents are other-regarding vis-à-vis the principal and among themselves. We allow agents to be asymmetric in the sense that the principal can have differing other-regardingness with respect to agents. Thus, this structure is more general in the sense that we allow the agents to be other-regarding vis-à-vis the principal and also asymmetric which is not there is our discrete structure. We use general functional forms similar to Englmaier and Wambach (2010). We show that with continuous efforts and outcomes, ‘team contracts’ are optimal when the principal is inequity-averse and not too status-seeking. But if the principal is sufficiently status-seeking and the agents’ wages are far apart optimality of relative performance contracts and also independent contracts are a possibility. The above results hold when the ‘direct wage incentive’ effect is not that high. In addition to this we also try and characterize the changes in the optimal contracts with changes in other-regarding parameters of the principal and the agents. Thus our analysis in this section is different from Englmaier and Wambach (2010) in the sense that we consider other-regarding principal whereas they considered self-regarding principal. Also their paper is mainly on single agent interaction with a small section on two agents.[4] We, on the contrary, focus on detailed two-agent interaction and provide detailed characterization of contracts offered by an other-regarding principal. This completes our analysis in all respects; with discrete efforts and outcomes throwing up both ‘team’, ‘relative performance’ and even ‘extreme independent’ contracts and then a continuous structure where we get ‘team’ and ‘independent’ and ‘relative performance’ contracts depending on the principal’s other-regardingness. Thus, even in the continuous case, even without correlation, one can show the possibility of the existence of relative performance contracts with an other-regarding principal. Note that throughout our analysis we assume other-regardingness of agents and principal to be intrinsic, i.e. we assume away strategic other-regardingness. Other-regardingness as a choice variable is outside the purview of this paper.

An example of principal’s ‘vertical’ comparison vis-à-vis the agents (in this example negative other-regardingness or spite) can be shown from the following case: Recently, Fletcher Building Limited, one of the largest listed companies in New Zealand proposed a seventy percent pay cut for the staff under the situation of economic slowdown of 2019-20 caused by Coronavirus (SARS-CoV-2). This makes thousands of workers out of money for many weeks. Negotiation specialist Joe Gallagher on behalf of the worker’s union stated "It’s frankly unbelievable that they want workers to take such a gigantic pay cut while the higher-ups, who earn up to half a million dollars a year, will take just a 15 per-cent cut in their pay. It shows a lack of respect for the workforce that keeps their company moving".[5] This statement clearly shows the prevalence of vertical comparison (in this case ‘spite’) that

[4] In their working paper version Englmaier and Wambach (2005) discuss inequity-averse principal in their appendix section but with single agent.

[5] Quinlivan, M. (2020). “Coronavirus: Fletcher Building proposes huge staff pay cuts, union claims executives will keep earning 'megabucks'” (https://www.newshub.co.nz/home/money/2020/04/coronavirus-fletcher-building-proposes-huge-staff-pay-cuts-union-claims-executives-will-keep-earning-megabucks.html)

higher-ups might have vis-à-vis their employees.[6] The workers' union's grudge also shows the discontent that the workers might have on getting a raw deal from its employers.

Related Works:

Quite a few papers have analyzed optimal incentive design in a two-agent framework with other-regarding agents. Itoh (2004) analyzed the interaction of a self-regarding principal with two other-regarding agents. The agents can be inequity-averse or status-seeking. He shows that the principal can exploit the other-regarding nature of the agents by designing appropriate interdependent contracts, viz. team and relative performance contracts. He also considers the case where the agents' projects are affected by a common shock, i.e. when the projects are correlated and show that team contracts can be optimal under certain situations.

Apart from Itoh (2004) handful of other papers have addressed optimal incentive design with multiple (specifically two) other-regarding agents but with self-regarding principal. Englmaier and Wambach (2010), as we already mentioned earlier, has an extension section with two agents where they show that for inequity-averse agents team incentives can be optimal even if the tasks that the agents perform are technologically independent. Grund and Sliwka (2005) study rank-order tournaments among inequity-averse agents and show that inequity-averse agents exert more effort compared to self-regarding agents for a given contract. They also show that first best effort is not implementable if prizes are endogenous. Bartling and Siemens (2010) analyze the impact of envy on optimal incentive contracts in a standard moral hazard model but with a fairly general structure. They show that with risk-averse agents and without limited liability, envy leads to a tendency towards offering flat wage contracts within firms. Dur and Sol (2010) construct a principal agent model where agents in addition to productive activities also engage in social interaction that leads to co-worker altruism. They examine how both team incentives and relative performance incentives help in creating a good work climate. Bartling (2011) use a principal two-agent model where the agents can be both inequity-averse or status-seeking. He shows that team contracts can be optimal even if the agents' performance measures are positively correlated.

[6] Also, technically put, since the principal doesn't have anyone 'lateral' in our model, she is assumed to be other-regarding vis-a-vis the agents.

The paper also shows that optimal incentive contracts for other-regarding agents can be low-powered as compared to contracts offered to purely self-regarding agents. Other papers that address the effect of social comparison in two-agent setting are Dernougin and Fluet (2006), Goel and Thakor (2006), Neilson and Stowe (2010) and Rey Biel (2008). Whereas Dernougin and Fluet (2006) and Neilson and Stowe (2010) assume risk neutral agents, Goel and Thakor (2006) considers risk averse agents. Neilson and Stowe (2010) focus on piece rate contracts only and show conditions under which inequity aversion leads to higher optimal effort exerted by workers and firms set lower piece rates than they would otherwise. Goel and Thakor (2006) show that envy among agents can lead to low-powered optimal team incentives. Rey Biel (2008) in a two-agent framework show that even with contractible effort inequity aversion of workers can justify the optimality of team production. But all the above mentioned papers assume principal to be self-regarding whereas this paper specifically focuses on an other-regarding principal and her interaction with agents who are other-regarding among themselves.

Comments on our approach:

Our discrete model can be regarded as a two-agent generalization of Banerjee and Sarkar (2017) and Itoh (2004)'s two-agent model where we incorporate principal's other-regarding preferences. Banerjee and Sarkar (2017) analyzed optimal incentive design when an other-regarding principal interacts first with a self-regarding and then an other-regarding agent. That paper focused on a principal-single agent interaction whereas here we have multiple, specifically two agents. Itoh (2004)'s two-agent model can be viewed as a special case of our model. Put differently our discrete part generalizes Itoh (2004) with an other-regarding principal. Our model with continuous effort and outcomes is a generalization of Englmaier and Wambach (2010)'s two-agent section with other-regarding principal and is also a two-agent generalization of Banerjee and Chakraborty (2023).

Two comments on the modeling choice in the first part that we employ a la Itoh (2004) are warranted. First, the structure is simple and brings out the principal-agent interactions and the impact of the interdependent preferences on optimal incentive design clearly. Second, almost all existing results and more can be generated using this parsimonious structure which is to some extent corroborated when we do our continuous model. The discrete framework leads to much sharper prediction and distinct results relative to the continuous structure. The continuous structure provides similar directions to our results of the discrete framework and provides robustness to our overall findings.

To state the organization of the paper we first specify that section-2 to section-5 deals with discrete effort and outcomes. Section-6 proposes a general structure with continuous efforts and outcomes. Specifically, the rest of the paper is organized as follows: In section 2 we examine the interaction of an other-regarding principal and two other-regarding agents where the project outcomes are independent. In section 3 we analyze optimal contracts when the project outcomes of the agents are correlated. Section 4 provides an alternative specification where we incorporate effort costs while comparing payoffs of principal and agents. In section 5 we re-interpret other-regarding principal as a 'fair' principal who hates inequity among agents and analyze optimal contracts. Section 6 explores a general model with continuous efforts and outcomes with sufficiently general functional forms. Finally, section 7 provides concluding remarks and throws some light on possible future works.

2. Other-regarding Principal and Other-Regarding Agents:

2.1: A model with discrete effort and outcomes:

Assume an other-regarding principal who hires two other-regarding agents 1 and 2. The principal is other-regarding with respect to the agents but the agents are other-regarding among themselves. Thus for the time being we assume that the principal doesn't belong to the agents' reference group. This is in line with Itoh (2004). Therefore currently each agent cares about the payoff of the other agent. Both the principal and agents are assumed to be risk-neutral. Each agent engages in a project separately. The agents can choose either high or low effort denoted by e_1 and e_0 respectively where $e_1 > e_0$.[7] Effort is unobservable and hence non-verifiable. Cost of putting e_1 is d and 0 for e_0. Each project can either succeed or fail. Each project returns b in case of success and 0 in case of failure which are verifiable. In case the agent puts e_i the project succeeds with probability p_i, $i = 0,1$ and it is assumed that $1 > p_1 > p_0 > 0$. Denote $\Delta p = p_1 - p_0$. For the time being we assume that

[7] We will consider continuum of effort choices as we proceed.

there is no correlation. The timing of the game is as follows: the principal simultaneously offers a contract to both the agents which is defined below. The agents simultaneously decide whether to accept or reject the contract. If rejected by at least one agent the game ends and each agent receives her reservation utility which is normalized to zero. If both agents accept the contract, they choose actions simultaneously. The outcomes of the projects are realized and transfers are made according to the terms of the contract. Since our discrete framework follows the structure of Itoh (2004) we follow Itoh's notation henceforth.

Let w_{jk}^n be the payment scheme offered to agent n where the outcome of his project is j and the outcome of the other agent's project is k, $j,k = s,f$ where s denotes success and f denotes failure. Thus for agent n the feasible set of contract looks like $w^n = \{w_{ss}^n, w_{sf}^n, w_{fs}^n, w_{ff}^n\}$ where the following limited liability constraint is satisfied

$$w_{jk}^n \geq 0, \quad j,k = s,f, \; n = 1,2. \tag{1}$$

Following the distributional approach a la Fehr and Schmidt (1999), the utility function of agent n is given as

$$U_n = \begin{cases} w_{jk}^n - d_i - \alpha_n \gamma_n v_n (w_{jk}^n - w_{kj}^m); & when\ w_{jk}^n \geq w_{kj}^m \quad (Agent\ n\ ahead) \\ w_{jk}^n - d_i - \alpha_n v_n (w_{kj}^m - w_{jk}^n); & when\ w_{jk}^n \leq w_{kj}^m \quad (Agent\ n\ behind) \end{cases} \tag{2}$$

where $i = 0,1$, $j,k = s,f$, $n,m = 1,2$ and $n \neq m$.[8]

$\alpha_n \geq 0$ is the other-regarding parameter. $\alpha_n = 0$ implies that the agents are self-regarding among themselves. We also make the standard assumption that $v_n'(z) > 0 \quad \forall z$ and $v_n(0) = 0$. The constant γ_n captures situations where the n^{th} agent is 'inequity-averse' or 'status-seeking'. If $\gamma_n < 0$, the agent is 'status-seeking' whereas when $\gamma_n > 0$ the agent is 'inequity-averse'.[9] Also when an agent is behind then she is always 'inequity-averse'. Again in line with Fehr and Schmidt (1999) and Itoh (2004) we assume that $|\gamma_n| < 1$ implying that 'inequity-averse agent dislikes inequity at least as much when he is behind as when he is ahead' (Fehr and Schmidt (1999)). For a status-seeking agent this implies that a

[8] For a different approach to modeling inequity aversion see Bolton and Ockenfels (2000).
[9] This terminology is due to Neilson and Stowe (2003).

'status-seeking agent likes to be ahead no better than he likes to avoid being ahead' (Itoh (2004)).

We assume b to be sufficiently high so that the principal would like to implement high effort from both the agents. Now the principal is other-regarding vis-à-vis both the agents. To fix ideas we assume that the principal is always ahead (at least weakly) of the agents. In line with Fehr and Schmidt (1999) we assume the principal's utility function with respect to agent n to be of the following form:

$$U^P = b_j - w_{jk}^n - \pi\rho f(b_j - 2w_{jk}^n); \quad \sin ce\, b_j - w_{jk}^n \geq w_{jk}^n \tag{3}$$

where the outcome of the n^{th} agent is j and of the other agent is k.

Note that the principal compares what she gets from a particular agent and what she gives to a particular agent. The parameter $\pi > 0$, a constant, captures the extent to which the principal cares about any agent's material payoff. $\pi = 0$ implies that the principal is self-regarding. ρ, another constant, captures situations where the principal is either 'inequity-averse' or 'status-seeking'. If $\rho < 0$, the principal prefers to increase the difference in payoffs vis-à-vis an agent when he is ahead, i.e. the principal is 'status-seeking'.[10] If $\rho > 0$, the principal's utility is decreasing in the difference in payoffs between the principal and the agent and therefore the principal is said to be 'inequity-averse', even if he is ahead. Along with this we make the standard assumptions that $f(0) = 0$ and $f'(z) > 0$ for $z > 0$.

Again to keep things simple and tractable we make the following simplifying assumptions (similar to Itoh (2004)):

Assumption 1:

(a). We assume the agents to be symmetric, i.e. $\alpha_1 = \alpha_2 = \alpha$, $\gamma_1 = \gamma_2 = \gamma$ *and* $v_1(.) = v_2(.) = v(.)$. *Also* $b_s^1 = b_s^2 = b$ *and* $b_f^1 = b_f^2 = 0$.

(b). We assume $v(.)$ *to be linear, i.e.* $v(z) = z, \forall z \geq 0$.

(c). We assume $f(.)$ *to be linear, i.e.* $f(z) = z, \forall z \geq 0$.

(d). We focus on symmetric contracts, i.e. $w^1 = w^2$.

(e). $\alpha\gamma \leq 1$.

[10] This terminology is due to Neilson and Stowe (2003).

(f). $\pi\rho \leq 1$.

For tractability of our model we focus on symmetric agents. Assumption 1(b) and 1(c) assumes the agents and the principal to be linearly other-regarding. This is in line with Fehr and Schmidt (1999)'s original specification. Since agents are assumed to be symmetric, without loss of generality we focus on symmetric contracts (assumption 1(d)). Finally assumption 1(e) rules out the case that the agent who is ahead and inequity-averse transfers some of his income to the other agent who is behind which seems implausible. 1(f) rules out the trivial case of an inequity-averse principal transferring some of her income to the agents who are behind such that payoff differences are eliminated <u>always</u>.

Given above, the principal will maximize her expected utility subject to the participation constraint and the Nash incentive compatibility constraints of the agents. Since we focus on symmetric contracts, henceforth, we will suppress the superscripts. Again in line with Itoh (2004) without loss of generality we focus on contracts where the limited liability binds, i.e. $w_{fs} = w_{ff} = 0$. The expected utility of the principal, therefore, can be written as

$$E(U^P) = 2p_1^2[b - w_{ss} - \pi\rho(b - 2w_{ss})] + 2p_1(1 - p_1)[b - w_{sf} - \pi\rho(b - 2w_{sf})] \quad \sin ce\, b_j - w_j \geq w_j \tag{4}$$

The principal will maximize the above subject to the following Nash incentive compatibility and the participation constraints respectively

$$p_1 w_{ss} + (1 - p_1)w_{sf} + [p_1 - (1 - p_1)\gamma]\alpha w_{sf} \geq \frac{d}{\Delta p} \tag{5}$$

$$p_1 w_{ss} + (1 - p_1)w_{sf} - (1 - p_1)\alpha(1 + \gamma)w_{sf} \geq \frac{d}{p_1} \tag{6}$$

We next define 'team contract', 'relative performance contract' and 'independent contract' in technical terms.

Definition 1: *A contract* w *is a 'team contract' if* $w_{ss} > w_{sf}$. *If* $w_{ss} < w_{sf}$ *then* w *is a 'relative performance contract'. If* $w_{ss} = w_{sf}$ *then w is referred to as an 'independent contract'.*

Before we proceed we reiterate that the principal is always ahead (at least weakly) implying that b is sufficiently high such that it is optimal for the principal to elicit high effort from both the agents and $\frac{b}{2}$ will exceed both the extreme team and the relative performance wages. As we proceed we will put forward a technical exposition once we define extreme team and relative performance wages.

Similar to Itoh (2004) one can easily state the following benchmark result:

Result 1 (Itoh 2004)**:**

For self-regarding principal and agents the independent contract $w_{ss} = w_{sf} = d/\Delta p$ *is an optimal contract.*

At the optimum the incentive compatibility constraint will bind. If $\alpha = 0$ and $\pi = 0$, the binding incentive constraint becomes $p_1 w_{ss} + (1 - p_1) w_{sf} = \frac{d}{\Delta p}$. One can easily check that $w_{ss} = w_{sf} = \frac{d}{\Delta p}$ solves the incentive constraint and also satisfies the participation constraint and therefore the above contract is an optimal contract. Needless to point out that one can find other multiple optimal contracts as well which satisfies both the incentive compatibility and the participation constraint with $\alpha = 0$ and $\pi = 0$. Next we explore optimal contracts with other-regarding principal and agents.

2.2: Analysis of Optimal Contracts:

To fix ideas we start by analyzing the behavior of an inequity-averse principal, i.e. $\rho > 0$. One can rewrite the principal's objective function given in (6) in the following way:

$$E(U^P) = 2p_1 b(1 - \pi\rho) - 2p_1(1 - 2\pi\rho)\left[p_1 w_{ss} + (1 - p_1) w_{sf}\right] \tag{6a}$$

If $\pi\rho < \frac{1}{2}$ implying that the principal is not sufficiently inequity-averse, the principal is effectively minimizing her expected payment and therefore is better-off paying lower wages. Thus taking into account the binding Nash incentive compatibility for other-regarding agents (given in (5)) re-written as $p_1 w_{ss} + (1 - p_1) w_{sf} \geq \frac{d}{\Delta p} + \left[(1 - p_1)\gamma - p_1\right]\alpha w_{sf}$, if $(1-p_1)\gamma > p_1$ implying $p_1 < \dfrac{\gamma}{1+\gamma}$ the principal will optimally set $w_{ss} > 0$ and $w_{sf} = 0$.

Otherwise when $(1-p_1)\gamma < p_1$ holds implying $p_1 > \dfrac{\gamma}{1+\gamma}$ the principal will optimally set $w_{sf} > 0$ and $w_{ss} = 0$. In line with Itoh (2004) we define the extreme team wage $\hat{w}_{ss}$ and the extreme relative performance wage $\hat{w}_{sf}$ as follows:

$$\hat{w}_{ss} = \frac{d}{\Delta p}.\frac{1}{p_1} \tag{7}$$

$$\hat{w}_{sf} = \frac{d}{\Delta p}.\frac{1}{(1-p_1)+\alpha\left[p_1-(1-p_1)\gamma\right]} \tag{8}$$

$\hat{w}_{ss}$ is found by putting $w_{sf} = 0$ in (5) and $\hat{w}_{sf}$ is found by replacing $w_{ss} = 0$ in (5). Also we define the team wage and the relative performance wage when both (5) and (6) binds and is given below:

$$\overline{w}_{ss} = \frac{d}{\Delta p}.\frac{p_0(1-p_1)}{p_1^{\ 2}}\left[\frac{p_1 / p_0}{(1-p_1)/(1-p_0)} - \frac{1-\alpha\gamma}{\alpha}\right] \tag{9}$$

$$\overline{w}_{sf} = \frac{d}{\Delta p}.\frac{p_0}{\alpha p_1} \tag{10}$$

Given that we have defined the extreme team wage and the extreme relative performance wage we clarify the following technical point. Since the principal is always ahead (at least weakly) this implies that $\dfrac{b}{2} \geq \dfrac{d}{\Delta p}.\dfrac{1}{p_1}$ and $\dfrac{b}{2} \geq \dfrac{d}{\Delta p}.\dfrac{1}{(1-p_1)+\alpha\left[p_1-(1-p_1)\gamma\right]}$ holds. One can make specific assumptions on the relative magnitude of $\hat{w}_{ss}$ and $\hat{w}_{sf}$, in that case only one condition is needed which is not necessary at this stage. It can be shown that the previous conditions automatically imply that the principal will optimally implement high effort from both the agents and therefore we do not need any additional restriction on b.

Given above we state our next proposition which is in some sense a generalization of Itoh (2004).

Proposition 1:

If the Principal is inequity-averse ($\rho > 0$) and $\pi\rho < \frac{1}{2}$ holds then

(i). The extreme team contract $(\hat{w}_{ss}, 0)$ *is optimal if* $(1-p_1)\gamma > p_1 \Rightarrow \gamma > \frac{p_1}{(1-p_1)} \Rightarrow$ *holds.*

The principal's payoff is independent of the agents' other-regardingness.

(ii).The extreme relative performance contract $\{0, \hat{w}_{sf}\}$ *is optimal if both* $(1-p_1)\gamma < p_1$ *and* $\frac{p_1/p_0}{(1-p_1)/(1-p_0)} \leq \frac{1-\alpha\gamma}{\alpha}$ *holds. The principal benefits the more other-regarding the agents are.*

(iii). $\{\overline{w}_{ss}, \overline{w}_{sf}\}$ *is optimal if both* $p_1 > \frac{\gamma}{1+\gamma}$ *and* $\frac{p_1/p_0}{(1-p_1)/(1-p_0)} > \frac{1-\alpha\gamma}{\alpha}$ *holds. The principal is better-off dealing with more other-regarding the agents.*

(iv). If $\rho > 0$ and $\pi\rho = \frac{1}{2}$ *holds then any contract that satisfies equation (5) is optimal.*

Proof:

We proceed in line with Itoh (2004).

(i). If $(1-p_1)\gamma > p_1$ (implying $p_1 < \frac{\gamma}{1+\gamma}$) the incentive compatibility constraint binds at $\{\hat{w}_{ss}, 0\}$. Also since $p > \Delta p$, $\{\hat{w}_{ss}, 0\}$ satisfies the participation constraint (given in (5)) and therefore is an optimal contract. $\frac{b}{2} > \frac{d}{\Delta p}.\frac{1}{p_1}$ ensures that $E(U^P) > 0$ under $\{\hat{w}_{ss}, 0\}$.

(ii). If $(1-p_1)\gamma < p_1$ (implying $p_1 > \frac{\gamma}{1+\gamma}$) holds, then incentive compatibility constraint binds at $\{0, \hat{w}_{sf}\}$. For $\{0, \hat{w}_{sf}\}$ to satisfy the participation constraint we need $\frac{d}{\Delta_P} \frac{(1-p_1)[1-\alpha(1+\gamma)]}{(1-p_1)+\alpha[p_1-(1-p_1)\gamma]} \geq \frac{d}{p_1}$ to hold which can be calculated as $\frac{p_1/p_0}{(1-p_1)/(1-p_0)} \leq \frac{1-\alpha\gamma}{\alpha}$.

Also $E(U^P) > 0$ under $\{0, \hat{w}_{sf}\}$ if $b > \frac{d}{\Delta p} \cdot \frac{(1-2\pi\rho)}{(1-\pi\rho)} \cdot \frac{1}{1+\alpha[p_1 - (1-p_1)\gamma]/(1-p_1)}$ holds which is ensured since $\frac{b}{2} > \frac{d}{\Delta p} \cdot \frac{1}{(1-p_1)+\alpha[p_1-(1-p_1)\gamma]}$ and $(1-p_1)\gamma < p_1$ holds.

(iii). If $(1-p_1)\gamma < p_1$ and $\frac{p_1 / p_0}{(1-p_1)/(1-p_0)} > \frac{1-\alpha\gamma}{\alpha}$ holds then both the incentive compatibility and the participation constraints bind with equality and solving those we get $\{\overline{w}_{ss}, \overline{w}_{sf}\}$ as the optimal contract.

(iv). When $\pi\rho = \frac{1}{2}$ holds, the principal needs to ensure that the agents put in high effort and any wage profile that will ensure this happens will be optimal. **QED**

The principal has the following two incentive effects. First, if the principal pays a reduced wage she is better-off through the 'direct' effect. But since the principal is inequity-averse and also is ahead, she suffers from being ahead and experiences a reduction in utility and therefore would optimally want to reduce wage inequality by paying an increased wage. This is the 'indirect' effect. If the principal is not sufficiently 'inequity-averse' the direct effect dominates the indirect effect and therefore the principal would like to pay as less as possible. Put differently the principal effectively minimizes her expected wage payment and we get back the Itoh (2004) case. Suppose the principal is 'not sufficiently inequity-averse'. Given this we consider the incentive effects of the agents. Note that the agents are other-regarding vis-à-vis themselves and not the principal. An agent falls behind if she fails and the other agent succeeds. If she is behind she is inequity-averse and therefore suffers a utility loss. Therefore the agent will try and reduce the probability of falling behind and this is a 'positive incentive effect'. But if she is successful and the other agent fails, she is ahead. Now if she is 'inequity-averse' ($\gamma > 0$) then she suffers from being ahead and would again suffer a utility loss and would like to reduce her probability of success. This acts as a 'negative incentive effect' for 'inequity-averse' agents. If $(1-p_1)\gamma > p_1$ holds implying γ is sufficiently high then the 'negative incentive effect' dominates and therefore the optimal wage scheme offered by the principal have to be such that the impact of inequity aversion is minimized and this is done through the extreme 'team contract'. This is stated in part (i) of proposition 1. Under the team contract both agents always get the same amount and therefore is ‘fair’ in some sense. Because of this feature the principal’s payoff is independent of the extent to which the agents are other-regarding towards each other.

When $(1-p_1)\gamma < p_1$ holds, i.e. γ is sufficiently low, the first ‘positive incentive effect’ dominates the ‘negative’ one. Here the principal will optimally adopt the relative performance contract and will thus generate the possibility of inequity. When the participation constraint does not bind then the principal will optimally offer a tournament-type extreme relative performance contract thus exploiting the positive incentive effect. This is part (ii) of proposition (1). Note that when the agents are status-seeking while ahead ($\gamma < 0$), both the incentive effects are ‘positive’ and therefore an extreme relative performance contract will be optimum.

When both $(1-p_1)\gamma < p_1$ and $\frac{p_1 / p_0}{(1-p_1)/(1-p_0)} > \frac{1-\alpha\gamma}{\alpha}$ holds implying that the project outcomes are sufficiently informative in terms of effort choice and the agents are sufficiently other-regarding implying high α, the participation constraint binds and the principal will optimally offer wages such that both the participation constraint and the incentive compatibility constraint binds. Put differently positive amounts will be paid to the agents irrespective of whether the project succeeds or fails. The principal will not offer the extreme relative performance contract anymore. Finally when $\pi\rho = \frac{1}{2}$ holds the principal’s payoff becomes independent of the wages that she pays. In that case she only needs to ensure that the agents put in high effort. Thus any wage combination that satisfies the Nash incentive compatibility will be optimum. The previous analysis is done for a ‘moderately inequity’ averse principal. The following result talks about a ‘status-seeking’ principal.

Result 2: *If the principal is status-seeking, i.e.* $\rho < 0$ *holds then the optimal contracts characterized in (i), (ii) and (iii) in proposition 1 are optimal.*

The intuition of the above result is not difficult to comprehend. Since a status-seeking principal always wants to be ahead, she is better off paying as less as possible and therefore will pay enough such that the incentive compatibility constraint of the agents are satisfied.

In other words the principal will be minimizing expected wage payment and given the incentive effects of the agents as discussed above are present, similar intuition (as above) suggests that the optimal contracts given in (i), (ii), and (iii) of proposition1 depending on the parametric ranges will be optimal.

Next we consider the case where the principal is sufficiently inequity-averse. The result is stated in the next proposition:

Proposition 2:

(A). If the principal is sufficiently inequity-averse in the sense that $\rho > 0$ *and* $\pi\rho > \frac{1}{2}$ *holds, then the extreme independent contract* $w_{ss} = w_{sf} = \frac{b}{2}$ *is optimal and unique. This holds irrespective of the degree of other-regardingness of the agents.*

One can again explain the above result through the interaction of the 'direct' and the 'indirect' effects. If the principal pays less then she is better off through the 'direct effect' of paying less. But at the same time remember that she is ahead and being 'inequity-averse' she hates to be ahead. Therefore if she pays less she is worse off since she is now 'more ahead' which she hates. This second 'indirect effect' dominates if the principal is sufficiently 'inequity-averse' and therefore the principal will optimally increase the wage such that at the optimum no inequity remains. Therefore if $\pi\rho > \frac{1}{2}$, irrespective of the parametric ranges, the principal will offer $w_{ss} = w_{sf} = \frac{b}{2}$ which is nothing but an 'elevated' independent contract. The feasibility and optimality of the extreme independent contract is ensured by the assumption that the principal is never behind, implying both $\frac{b}{2} > \frac{d}{\Delta p} . \frac{1}{p_1}$ and $\frac{b}{2} > \frac{d}{\Delta p} . \frac{1}{(1-p_1) + \alpha[p_1 - (1-p_1)\gamma]}$. Interestingly this contract is also unique and is different to what we get in Itoh (2004) with self-regarding principal and other-regarding agents.

3. Correlated Outcomes:

We now extend our analysis to the case where the project returns are correlated. It is pretty well known in the standard principal-agent literature that with purely self-interested principal and agents relative performance evaluation is optimal when the agents' performances are positively correlated (Holmstrom (1982), Mookherjee (1984), Che and Yoo (2001)). This is due to the fact that the relative performance contracts helps in filtering out the 'common shock' (Holmstrom (1982)). But the analysis of the previous section points to the fact that team contracts or even independent contracts might turn out to be optimum in the correlated environment. This motivates us to examine the case where the agents' projects are correlated. Specifically, now the project outcomes of each agent not only depend on their respective efforts and the idiosyncratic shock, but also on a common shock that affects the outcome of both projects. The common shock is good with probability q and bad with probability $(1-q)$. If the common shock is good then both projects succeed irrespective of the agents actions. If the common shock is bad then the project outcome depends on the agents' actions and the idiosyncratic shock, i.e. each agents' project succeeds with probability p_1 if she puts high effort and succeeds with probability p_0 if she puts in low effort. Taking everything together now effectively each agent's project succeeds with probability $q+(1-q)p_i$.[11] The principal is other-regarding as in the previous section. Internalizing the binding limited liability constraints one can write the expected payoff function of the principal as

$$E(U^P) = 2q[b - w_{ss} - \pi\rho(b - 2w_{ss})] + (1-q)[2p_1^2(b - w_{ss} - \pi\rho(b - 2w_{ss})) + 2p_1(1-p_1)(b - w_{sf} - \pi\rho(b - 2w_{sf}))] \tag{11}$$

$\sin ce\, b_j - w_j \geq w_j$ holds.

Now the above expected payoff can also be expressed as

$$E(U^P) = 2b(1-\pi\rho)[q + (1-q)p_1] - 2(1-2\pi\rho)[qw_{ss} + (1-q)p_1(p_1 w_{ss} + (1-p_1)w_{sf})] \tag{12}$$

The principal will maximize the above expected payoff subject to the following incentive compatibility and the participation constraints respectively given as (similar to Itoh (2004))

[11] Given this framework Che and Yoo (2001), with self-regarding principal and agents, show that the extreme relative performance contract is optimal.

$$(1-q)\left[p_1 w_{ss} + (1-p_1)w_{sf} + (p_1 - (1-p_1)\gamma)\alpha w_{sf}\right] \geq \frac{d}{\Delta p} \quad \text{(NIC2)}$$

$$(1-q)\left[p_1 w_{ss} + (1-p_1)w_{sf} - (1-p_1)\alpha(1+\gamma)w_{sf}\right] \geq \frac{d - q w_{ss}}{p_1} \quad \text{(PC2)}$$

Similar to the previous section one can define the extreme team wage w'_{ss} and the extreme relative performance wage w'_{sf} as

$$w'_{ss} = \frac{d}{\Delta p} \cdot \frac{1}{(1-q)p_1} \quad (13)$$

$$w'_{sf} = \frac{d}{\Delta p} \cdot \frac{1}{(1-q)\left[(1-p_1) + \alpha(p_1 - (1-p_1)\gamma)\right]} \quad (14)$$

Thus $\{w'_{ss}, 0\}$ and $\{0, w'_{sf}\}$ will be the extreme team and relative performance contracts such that the above incentive compatibility constraint (NIC2) binds. Given this we can therefore state the following proposition that corresponds to this correlated environment:

Proposition 3:

(A). If the Principal is status-seeking ($\rho < 0$) or inequity-averse ($\rho > 0$) with $\pi\rho < \frac{1}{2}$ then

(i). The extreme team contract $\{w'_{ss}, 0\}$ is optimal if $\gamma > \frac{p_1}{(1-p_1)} \Rightarrow p_1 < \frac{\gamma}{1+\gamma}$ holds.

(ii).The extreme relative performance contract $\{0, w'_{sf}\}$ is optimal if both $\gamma < \frac{p_1}{(1-p_1)}$ and $\frac{p_1 / p_0}{(1-p_1)/(1-p_0)} \leq \frac{1-\alpha\gamma}{\alpha}$ holds.

(iii). $\{\overline{\overline{w}}_{ss}, \overline{\overline{w}}_{sf}\}$ is optimal if both $\gamma < \frac{p_1}{(1-p_1)} \Rightarrow p_1 > \frac{\gamma}{1+\gamma}$ and $\frac{p_1 / p_0}{(1-p_1)/(1-p_0)} > \frac{1-\alpha\gamma}{\alpha}$ holds.

(B). If the principal is sufficiently inequity-averse ($\rho > 0$) in the sense that $\pi\rho > \frac{1}{2}$ holds then the independent contract $w_{ss} = w_{sf} = \frac{b}{2}$ is optimal.

(C). If $\rho > 0$ and $\pi\rho = \frac{1}{2}$ *holds then any contract that satisfies (IC2) are optimal.*

In the above proposition $\{\overline{\overline{w}}_{ss}, \overline{\overline{w}}_{sf}\}$ are the team and the relative performance wages such that (NIC2) and (PC2) binds. Note that the principal's expected payment is independent of the common shock when she offers the relative performance contract, i.e. the principal is able to filter out the common shock through the relative performance contract as in Holmstrom (1982). The team contract is still optimum even with a small but positive shock. The intuition of the above proposition will be similar to that of proposition 1 and 2.

Interestingly when the principal is sufficiently inequity-averse then the 'extreme' independent contract is still optimal in the correlated environment as well. This is different from what we get in Holmstrom (1982), Mookherjee (1984) and Che and Yoo (2001) with self-regarding preferences and with Itoh (2004) with other-regarding preferences. In this situation the expected payment of the principal does depend on the common shock and therefore is not filtered out.

4. Incorporating Effort Costs:

One can extend the previous analysis by assuming that the principal and the agents compare their payoffs net of the cost of effort. The agents might be able to observe their actions (if they work closely) and the principal might be able to monitor the agents and judge each agents actions correctly and therefore both the principal and agents might take into account effort costs while comparing payoff differences. Given above the n^{th} agents' payoff function will look like

$$U_n = \begin{cases} w_{jk}^n - d_i - \alpha_n \gamma_n v_n (w_{jk}^n - d_i - w_{kj}^m + d_h); & when\ w_{jk}^n - d_i \geq w_{kj}^m - d_h\ \ (Agent\, n\, ahead) \\ w_{jk}^n - d_i - \alpha_n v_n (w_{kj}^m - d_h - w_{jk}^n + d_i); & when\ w_{jk}^n - d_i \leq w_{kj}^m - d_h\ \ (Agent\, n\, behind) \end{cases} \tag{15}$$

where $h, i = 0,1$, $j,k = s, f$, $n,m = 1,2$ and i and h are the index of agent n^{th} and m^{th} actions respectively, given $n \neq m$.

Again the principal's payoff function with respect to the n^{th} agent will be

$$U^P = b_j - w_{jk}^n - \pi\rho(b_j - 2w_{jk}^n + d_i); \quad \sin ce\, b_j - w_{jk}^n \geq w_{jk}^n - d_i$$

where d_i is the effort cost of the n^{th} agent. Once again the principal will be ahead if we take into account the agents' effort cost. Imposing symmetry and assuming $d_i = d$ for $e = e_1$ and $d_i = 0$ for $e = e_0$ the principal's expected payoff can be written as

$$E(U^P) = 2p_1 b(1-\pi\rho) - 2p_1(1-2\pi\rho)\left[p_1 w_{ss} + (1-p_1)w_{sf}\right] - 2p_1\pi\rho d$$

A necessary condition for an optimal contract to exist under this changed specification is $b(1-\pi\rho) > \pi\rho d$ i.e. $b > \frac{\pi\rho d}{(1-\pi\rho)}$. Similar to our previous approach we analyze the case where $\pi\rho < \frac{1}{2}$ and the principal is effectively minimizing expected payment. Following Itoh (2004) one can write the incentive compatibility conditions of the agents (under symmetric contracts) as:

$$p_1 w_{ss} + (1-p_1)w_{sf} + \left[p_1 - (1-p_1)\gamma\right]\alpha w_{sf} \geq (1-\alpha\gamma)\frac{d}{\Delta p} + (1-p_0)p_1\alpha(1+\gamma)\frac{w_{sf}}{\Delta p} \quad \text{if } w_{sf} < d$$

(NIC3a)

$$p_1 w_{ss} + (1-p_1)w_{sf} + \left[p_1 - (1-p_1)\gamma\right]\alpha w_{sf} \geq \left[1 - \alpha\gamma + (1-p_0)p_1\alpha(1+\gamma)\right]\frac{d}{\Delta p} \quad \text{if } w_{sf} \geq d$$

(NIC3b)

The participation constraint of the agents remain the same as in the original specification. We follow the approach by Itoh for $\pi\rho < \frac{1}{2}$. Under the extreme team contract $(w_{ss}, 0)$, since $w_{sf} < d$, equation (NIC3a) will apply and the simplified incentive compatibility becomes $p_1 w_{ss} \geq (1-\alpha\gamma)\frac{d}{\Delta p}$. Under $(w_{ss}, 0)$ if an agent is sticking to e_1 the other agent becomes ahead by d if she deviates from e_1 to e_0. Now when the deviating agent is status-seeking she will enjoy this deviation whereas when she is 'inequity-averse' she will not enjoy this deviation. Thus the principal needs to provide stronger incentive for a status-seeking agent compared to an inequity-averse agent. For an inequity-averse agent, the principal is better-off the more inequity-averse the agent is (the expected payment falls with increased α) and therefore in this changed specification with the extreme team contract the principal's expected payoff depends on the extent of other-regardingness of the agents, which was not the case under the original specification. Also note that if α is sufficiently high in the sense $\alpha\gamma > p_0 / p_1$, then $\frac{d}{p_1} > (1-\alpha\gamma)\frac{d}{\Delta p}$ implying that at the optimum under the extreme contract the participation constraint will bind and the incentive compatibility will not bind. Thus if $\alpha\gamma > p_0 / p_1$ holds then the extreme team wage will be $\tilde{w}_{ss} = d / p_1^2$ participation constraint will bind and the incentive compatibility will not bind, otherwise $\hat{w}_{ss} = (1-\alpha\gamma)\frac{d}{p_1 \Delta p}$.

When $\pi\rho > \frac{1}{2}$ holds, then the independent contract $w_{ss} = w_{sf} = \frac{b+d}{2}$ will be optimal if $w_{sf} \geq d$. Otherwise the non-extreme 'team' contract $\left\{w_{ss} = \frac{b+d}{2}, w_{sf} = d\right\}$ will be the optimal contract. If $\pi\rho = \frac{1}{2}$ holds, any contract that satisfies (NIC3a) and (NIC3b) will be optimal if $w_{sf} < d$ and $w_{sf} \geq d$ holds respectively.

5. The Case of 'Fair' Principal:

We extend our previous analysis and consider the case of a 'fair' principal who experiences a reduction in utility when the agents get different wages. Put differently the principal is 'inequity-averse' in the sense that she hates inequity among agents. Specifically we assume that the principal's utility function to be:

$$U^P = b_j - w_{jk}^n - \pi\left|w_{jk}^n - w_{kj}^m\right|, \text{ where } n \neq m$$

where $\pi > 0$ is the inequity aversion parameter. The agents are assumed to be other-regarding among themselves in the sense of equation (2). Given above the principal will maximize her expected payoff

$$\begin{aligned} E(U^P) &= p_1^2[2b - 2w_{ss}] + 2p_1(1-p_1)\left[b - w_{sf} - \pi w_{sf}\right] \qquad (16) \\ &= 2p_1\left[b - p_1 w_{ss} - (1-p_1)(1+\pi)w_{sf}\right] \end{aligned}$$

subject to the Nash-Incentive compatibility given in (5) and the participation constraint given in (6). Maximizing above is effectively minimizing $[p_1 w_{ss} + (1-p_1)(1+\pi)w_{sf}]$ subject to (5) and (6). At the optimum the incentive compatibility (given in (5)) will bind and therefore replacing $p_1 w_{ss} + (1-p_1) w_{sf} + [p_1 - (1-p_1)\gamma]\alpha w_{sf} = \frac{d}{\Delta p}$ in $[p_1 w_{ss} + (1-p_1)(1+\pi) w_{sf}]$ the problem effective becomes minimization of $\frac{d}{\Delta p} + [(1-p_1)(\alpha\gamma + \pi) - p_1\alpha] w_{sf}$. If $[(1-p_1)(\alpha\gamma+\pi) - p_1\alpha] \geq 0$ then minimization requires $w_{sf} = 0$, otherwise $w_{sf} > 0$. Therefore we can characterize the optimal contracts as follows:

Proposition 4:

(i). The extreme team contract $\{\hat{w}_{ss}, 0\}$ *is optimal if* $p_1 < \frac{\alpha\gamma + \pi}{\alpha\gamma + \pi + \alpha}$ *holds. The principal's payoff is independent of the agents' other-regardingness.*

(ii).The extreme relative performance contract $\{0, \hat{w}_{sf}\}$ *is optimal if both* $p_1 > \frac{\alpha\gamma + \pi}{\alpha\gamma + \pi + \alpha}$ *and* $\frac{p_1 / p_0}{(1-p_1)/(1-p_0)} \leq \frac{1-\alpha\gamma}{\alpha}$ *holds. The principal benefits the more other-regarding the agents are.*

(iii). $\{\overline{w}_{ss}, \overline{w}_{sf}\}$ *is optimal if both* $p_1 > \frac{\alpha\gamma + \pi}{\alpha\gamma + \pi + \alpha}$ *and* $\frac{p_1 / p_0}{(1-p_1)/(1-p_0)} > \frac{1-\alpha\gamma}{\alpha}$ *holds. The principal is better-off dealing with more other-regarding agents.*

(iv). When agents are self-regarding ($\alpha = 0$)*, the extreme relative performance contract is never optimal.*

(v). The independent contract $w_{ss} = w_{sf} = \frac{b}{2}$ *is never optimal.*

Note that $\frac{\alpha\gamma + \pi}{\alpha\gamma + \pi + \alpha} > \frac{\gamma}{1+\gamma}$ for $\pi > 0$ and therefore under a 'fair' principal the range for which team contract is optimal expands and therefore a 'team contract' is more likely under a 'fair' principal compared to the original specification.

Under a 'fair' principal when agents are self-regarding, i.e. when $\alpha = 0$, $\frac{\alpha\gamma + \pi}{\alpha\gamma + \pi + \alpha} = 1$ and therefore $\{\hat{w}_{ss}, 0\}$ is optimal for all $p_1 < 1$ and the extreme relative performance contract

$\{0, \hat{w}_{sf}\}$ is never optimal. But even if the principal is 'fair', with other-regarding agents the extreme relative performance contract can be optimal since the principal can benefit from the tournament type relative performance contract when agents are other-regarding, especially when agents are status-seeking. With an increase in α the critical value $\frac{\alpha\gamma+\pi}{\alpha\gamma+\pi+\alpha}$ falls implying that with more other-regarding agents, ceteris paribus, team contract is less likely. Again with a fall in γ (from positive to negative) the critical value $\frac{\alpha\gamma+\pi}{\alpha\gamma+\pi+\alpha}$ falls and therefore for status-seeking agents the range for which team contract is optimal shrinks and relative performance contract becomes more likely. But with self-regarding agents, the relative performance contract is never optimal since with self-regarding agents the principal doesn't benefit from the tournament type relative performance contract and 'fairness' is the only concern. Finally, the independent contract $w_{ss} = w_{sf} = \frac{b}{2}$, although 'fair', is not optimal since the expected payoff of the principal will be strictly lower under such an 'elevated' independent contract.

6. Model with Continuous Efforts and Outcomes:

In this extension we make use of the structure similar to that of Englmaier & Wambach (2010) with similar notations. In this setup the principal hires two agents to work for her in two separate projects. The output of the project i is x_i, $i = \{1, 2\}$ and the outputs of the projects are technologically independent, verifiable and are continuously distributed in the interval $[\underline{x}_i, \overline{x}_i]$. The output follows density function $f_i(x_i|e_i)$ which depends on the effort level denoted by e_i exerted by the agent i working on that specific project. The effort level is non-verifiable and hence non-contractible. Each agent receives wage $w_i(x_1, x_2)$ for working in project i. The agents are risk-averse with respect to own wage, i.e. i.e. $u_i''(w_i(x_1, x_2)) \leq 0$ (This also incorporates the possibility of risk-neutrality). The effort gives disutility to the agent and the cost being $c_i(e_i)$ with the restriction that $c_i'(e_i) > 0$ and $c_i''(e_i) > 0$. Following the distributional approach a la Fehr and Schmidt (2003) we assume the agents to be inequity-averse vis-à-vis the principal. The principal's gross payoff is $(x_1 +$

x_2). Subtracting the wage payments for the two agents combined $(w_1(x_1, x_2) + w_2(x_1, x_2))$ from $(x_1 + x_2)$ gives her net-payoff. Agent i compares the principal's net payoff $(x_1 + x_2 - w_1(x_1, x_2) - w_2(x_1, x_2))$ to her own payoff $w_i(x_1, x_2)$ and the more is the difference between the two i.e. $(x_1 + x_2 - 2w_i(x_1, x_2) - w_j(x_1, x_2))$ the more is the disutility for agent i. This disutility due to inequity aversion for agent i is given by $G_i\left(x_1 + x_2 - 2w_i(x_1, x_2) - w_j(x_1, x_2)\right)$.[12] The function $G(.)$ is assumed to be convex with the properties $G_i'(.) > 0, G_i''(.) > 0$, $G_i'(0) = 0$, $G_i''(0) = 0$. Following Dur and Glazer (2008), we focus on the case where the principal is always weakly ahead of the agent and this is a difference with Englmaier & Wambach (2010). This is to fix ideas without losing much of economic intuition. Agent i also compares her payoff with her peer's payoff (Holmstrom (1982**),** Itoh (2004)). If agent j is ahead of agent i then a rise in payoff difference $\left(w_j(x_1, x_2) - w_i(x_1, x_2)\right)$ leads to utility loss for agent i. This disutility function is given by $H_i\left(w_j(x_1, x_2) - w_i(x_1, x_2)\right)$ with the following assumptions:

If $w_j(x_1, x_2) > w_i(x_1, x_2)$ then $H_i'(.) > 0$

If $w_i(x_1, x_2) > w_j(x_1, x_2)$ then $H_i'(.) < 0$

$H_i''(.) > 0$, $H_i'(0) = 0$ and $H_i''(0) = 0$.

Thus we assume agents to be only inequity-averse among themselves which is different to our discrete model (in previous sections) where they were status-seeking among themselves as well. The utility function of agent i is additively separable in utility from wealth $(u_i(w_i(x_1, x_2)))$, inequity functions $G_i(.)$, $H_i(.)$ and effort cost $c_i(e_i)$. That is mathematically,

$$U_A^i = u_i\big(w_i(x_1, x_2)\big) - \alpha_{Pi} G_i\left(x_1 + x_2 - 2w_i(x_1, x_2) - w_j(x_1, x_2)\right)$$
$$- \alpha_{Ai} H_i\left(w_j(x_1, x_2) - w_i(x_1, x_2)\right) - c_i(e_i)$$

Here $\alpha_{Pi} (\geq 0)$ is the inequity aversion parameter of agent i vis-à-vis the principal and $\alpha_{Ai} (\geq 0)$ is the inequity aversion parameter of agent i vis-a-vis the other agent. One can envisage α_{Pi} and α_{Ai} to be embedded in $G_i(.)$ and $H_i(.)$ respectively, but for the sake of

[12] Thus, in this continuous structure, the principal does not treat the agents' projects separately.

comparative statics we write it separately. **For notational convenience we denote $\boldsymbol{w_i} = \boldsymbol{w_i(x_1, x_2)}$ and $\boldsymbol{w_j} = \boldsymbol{w_j(x_1, x_2)}$ where $\boldsymbol{i, j = \{1, 2\}, i \neq j}$.**

Expected utility of agent i:

$$EU_A^i = \int_{\underline{x}_1}^{\overline{x}_1} \int_{\underline{x}_2}^{\overline{x}_2} f_1(x_1|e_1)\, f_2(x_2|e_2) \{u_i(w_i) - \alpha_{Pi} G_i(x_1 + x_2 - 2w_i - w_j) - \alpha_{Ai} H_i(w_j - w_i)\} dx_1 dx_2 - c_i(e_i)$$

The outside option for agent i is u_i. Therefore, the principal must offer a wage that makes the agent atleast as well off as his outside option in terms of utility so the participation constraint is

$$EU_A^i \geq u_i$$

The principal is assumed to be risk neutral with respect to the project net return, interested in maximizing expected net payoff. The principal's payoff function is given as:

$$U_p = x_1 + x_2 - w_1 - w_2 + \pi_1 S_1(x_1 + x_2 - 2w_1 - w_2) + \pi_2 S_2(x_1 + x_2 - w_1 - 2w_2)$$

where π_i is the other-regarding parameter for the principal vis-à-vis agent i, $i = 1{,}2$. If $\pi_i > 0$, the principal is 'status-seeking' vis-à-vis both agents in the sense that she likes being ahead of the agents. The more is the value of $(x_1 + x_2 - 2w_i - w_j)$ the more is the principal ahead of agent i and the more is the utility for the principal. On the other hand, if $\pi_i < 0$ then that captures the case of inequity-averse principal vis-à-vis agent i who likes to reduce the difference between their payoffs otherwise an increased payoff difference would lead to a loss of utility for the principal in that case. $S_i(x_1 + x_2 - 2w_i - w_j)$ is the other-regarding function with the restrictions that $S_i'(.) > 0,\ S_i''(.) > 0,\ S_i'(0) = 0,\ S_i''(0) = 0$. As the principal is 'never behind' the agents, she gains utility (or loses in case she is inequity-averse) equal to $\pi_1 S_1(x_1 + x_2 - 2w_1 - w_2)$ from agent 1 and $\pi_2 S_2(x_1 + x_2 - w_1 - 2w_2)$ from agent 2 respectively if she is status-seeking. There are various possibilities like the principal being status-seeking with respect to on agent and inequity-averse with respect to the other. All possibilities can be accommodated and analyzed in this framework without much difficulty. But unless otherwise specified when we say that the principal is status-seeking, we would mean that the principal is status-seeking vis-à-vis both. Same holds for principal's inequity-aversion. One can easily assume $\pi_1 = \pi_2 = \pi$ and $S_1(.) = S_2(.) = S(.)$ for both agents, i.e. symmetric agents in which case the previous multiplicity of possibilities will not arise. Similar to the agent's objective function, one can envisage π_i to be embedded in $S_i(.)$, but for the sake of comparative statics we write it separately.

The objective function of the other-regarding principal can be expressed as:

$$EU_p = \int_{\underline{x}_1}^{\overline{x}_1}\int_{\underline{x}_2}^{\overline{x}_2} f_1(x_1|e_1)\, f_2(x_2|e_2)\{x_1 + x_2 - w_1 - w_2 + \pi_1 S_1(x_1 + x_2 - 2w_1 - w_2) + \pi_2 S_2(x_1 + x_2 - w_1 - 2w_2)\}dx_1 dx_2$$

We further assume that the monotone likelihood property holds which says that the more is the output realized the more is the possibility that high effort was exerted.

$$\frac{\partial\left(\frac{f_{ie_i}(x_i|e_i)}{f_i(x_i|e_i)}\right)}{\partial x} = \left(\frac{f_{ie_i}(x_i|e_i)}{f_i(x_i|e_i)}\right)' > 0, \forall\, i = 1,2$$

Incentive compatibility constraint for agent i is given by

$$e_i = arg \max_{e_i} EU_A^i$$

$$\Rightarrow \frac{\partial EU_A^i}{\partial e_i} = \int_{\underline{x}_1}^{\overline{x}_1}\int_{\underline{x}_2}^{\overline{x}_2} f_{i_{e_i}}(x_i|e_i)\, f_j(x_j|e_j)\{u_i(w_i) - \alpha_{Pi}G_i(x_1 + x_2 - 2w_i - w_j) - \alpha_{Ai}H_i(w_j - w_i)\}dx_1 dx_2 - c_i'(e_i) = 0$$

Thus we have a sufficiently general structure with two agents. A priori we do not assume symmetric agents anywhere. All special cases can be deduced from this general structure by applying appropriate restrictions.

Given the above structure, under non-contractibility, the principal's problem will be

Max

$$EU_p = \int_{\underline{x}_1}^{\overline{x}_1}\int_{\underline{x}_2}^{\overline{x}_2} f_1(x_1|e_1)\, f_2(x_2|e_2)\{x_1 + x_2 - w_1 - w_2 + \pi_1 S_1(x_1 + x_2 - 2w_1 - w_2) + \pi_2 S_2(x_1 + x_2 - w_1 - 2w_2)\}dx_1 dx_2$$

Subject to the incentive compatibility constraints for both the agents

$$\int_{\underline{x}_1}^{\overline{x}_1}\int_{\underline{x}_2}^{\overline{x}_2} f_{i_{e_i}}(x_i|e_i)\, f_j(x_j|e_j)\{u_i(w_i) - \alpha_{Pi}G_i(x_1 + x_2 - 2w_i - w_j) - \alpha_{Ai}H_i(w_j - w_i)\}dx_1 dx_2 - c_i'(e_i) = 0; \quad i = 1,2$$

And the Participation constraints for both the agents

$$u_i(w_i) - \alpha_{Pi} G_i(x_1 + x_2 - 2w_i - w_j) - \alpha_{Ai} H_i(w_j - w_i) - c_i(e_i) \geq u_i \; ; \quad i = 1, 2.$$

The optimal wage schedules, w_1(i.e. $w_1(x_1, x_2)$) and w_2 (i.e. $w_2(x_1, x_2)$) are found using the first order approach. Define $w = \{w_1, w_2\}$. But before going into the optimal contracts, we define 'team', 'relative performance' and 'independent' contracts in this general framework:

Definition 2:

A contract W *is a 'team contract' if* $\frac{\partial w_i}{\partial x_j} > 0 \; \forall i \neq j$. *If* $\frac{\partial w_i}{\partial x_j} < 0 \; \forall i \neq j$ *then* W *is a 'relative performance contract'. If* $\frac{\partial w_i}{\partial x_j} = 0 \; \forall i \neq j$ *then w is referred to as an 'independent contract'.*

Given the above definition we proceed to characterize the optimal contracts in this two-agent framework.

We state the following result:

Proposition 5:

If $\frac{\partial w_j}{\partial x_i} < \frac{1}{2}$, *the optimal contracts for both agents are increasing in own output if the principal is inequity-averse or not highly status-seeking vis-a-vis both the agents.*

Proof: See Appendix.

One primary objective while offering contracts under non-contractibility is to provide incentives to elicit costly effort from the agents. Thus, given that the monotone likelihood ratio property holds, the wages offered should increase in own output which is an imperfect signal of one's own effort. So overall there are two effects. First, the incentive effect calls for an increased wage as own output increases. Second, if the cross-wage effects are positive, then that increases the wage of both the agents and this takes care of the inequity concern of an inequity-averse principal. Thus, these forces reinforce each other if the principal is inequity-averse (not highly status-seeking) with respect to both agents and also the agents are inequity-averse vis-à-vis the principal and among themselves. Also $\frac{\partial w_j}{\partial x_i} < \frac{1}{2}$

ensures that the cross wage effect is not too high so that the principal can profitably employ the incentive effect (own wage effect) without getting behind. Thus given $\frac{\partial w_j}{\partial x_i} < \frac{1}{2}$, own wage should certainly increase with an increase in own output for the sake of eliciting the desired effort. Note that principal's inequity-aversion and $\frac{\partial w_j}{\partial x_i} < \frac{1}{2}$ is sufficient but not necessary for own wage to increase with own output.

Holmstrom (1982) showed that when the agents' project outcomes are correlated (affected by a common shock) then relative performance contracts are optimal and it helps in filtering out the common shock and hence exposes agents to less risk. When projects are technologically independent then perceived knowledge says that an agents' pay should not depend on other agents' output. But this doesn't hold if the agents and also the principal are other-regarding. To fix ideas suppose the agents are inequity-averse among themselves. Since the agents compare their payoffs and have interest in each other's payoffs then conditioning one agent's payoff on other agents output might help in reducing inequity among agents. This interrelatedness leads to a different outcome vis-à-vis our perceived knowledge. Specifically, if the principal and the agents are inequity-averse, their fairness motives provide rationale for the widespread use of team contracts. But if the principal is status-seeking there can be a possibility of relative performance contract becoming optimal. Let us analyze the situation when the principal is status-seeking vis-à-vis both agents but the incentive effect is such that $\frac{\partial w_i}{\partial x_i} < \frac{1}{2}$ holds implying that the incentive or the 'own-wage effect' is not that strong. Then an increase in x_i leads to an increase in w_i, but not much. The principal gains directly from increased $(x_i - w_i)$ and also is ahead of both agent i and agent j. Since the principal is status-seeking vis-à-vis both agents, she gets an additional utility from being ahead from both the agents. This is the principal's 'overall' status-seeking effect. But since the 'incentive effect' is weak the principal does not gain much from the agent i's efforts. This would induce the principal to optimally reduce the wage of the other agent, i.e. w_j so that she gains both directly and also from the 'status-seeking effect'. But this reduction of w_j has its negative effects through reduced incentive and effort for agent j. If the agents are far apart and suffer from high-inequity, then it might be optimal for the principal to induce a tournament among the agents through a 'relative performance contract' in which both agents would not like to fall too far behind of the other and get a reduced wage from other's relatively better performance. This takes care of the 'weak' incentive effect. Thus a status-seeking principal and far-apart agents might tilt the optimal contract towards a 'relative performance contract'. Thus far apart agents, weak incentive effects $\left(\frac{\partial w_i}{\partial x_i} < \frac{1}{2}\right)$ and a sufficiently status-seeking principal are necessary for the optimality of relative performance contract but not sufficient. Note that if the above opposing effects exactly cancels each other which is a special case, then we get independent contract to be optimal. This is a special case and can happen under the same necessary conditions stated above. If the own-wage effect is sufficiently strong then the cross-wage effects described above might weaken. Keeping in mind the above discussion, the following proposition shows that in the presence of fairness concerns among agents and the principal's 'other-regardingness' leads to the possibility of 'team' and 'relative performance' contracts being offered at the optimum, if the direct wage incentive is not so high :

Proposition 6:

(a). If projects are technologically independent then an 'inequity-averse' or a 'self-regarding' principal will certainly offer 'team contracts' to agents who are 'not too inequity-averse' amongst themselves if $\frac{\partial w_i}{\partial x_i} < \frac{1}{2}$.

(b). Given $\frac{\partial w_i}{\partial x_i} < \frac{1}{2}$, *optimality of relative performance and independent contracts can be optimal if and only if the principal is sufficiently status-seeking and the agents' are sufficiently inequity-averse amongst themselves and their wages are far apart.*

Proof: See Appendix.

This proposition also supports the empirically observed phenomenon of the pervasiveness of team contracts in reality. The first part of the proposition is also similar to what Englmaier & Wambach (2010) found out in the context of a 'self-regarding' principal and inequity-averse agents but add an additional condition. But for a sufficiently status-seeking principal, relative performance and independent contracts can be optimal and this is a notable change even without any correlation in project outcomes.

Our next set of results attempt to further characterize the nature of the optimal contracts.

Proposition 7:

(a). $w_i(.)$ *falls with a ceteris paribus increase in* π_i*, certainly if* $\pi_j < 0$.

(b). $w_j(.)$ *falls with a ceteris paribus increase in* π_i *, certainly if* α_{Pj} *is not that large.*

(c). $w_i(.)$ *increases with a ceteris paribus increase in* α_{Pi}*, certainly if* $\pi_j < 0$.

Proof: See Appendix.

The first part of the above proposition is straightforward. As the principal becomes more status-seeking (or relatively less inequity-averse) with respect to i^{th} agent, she will optimally offer lower w_i to agent i since the principal enjoys being ahead. The principal also has a second option. She can reduce the other agent's wage, i.e. w_j and have a similar satisfaction. But interesting is that if the principal is inequity-averse (even weakly) with respect to agent j, this move will hurt her. So if $\pi_j < 0$, the principal is better-off reducing w_i and keep w_j untouched. Thus $\pi_j < 0$ will reinforce $\frac{\partial w_i}{\partial \pi_i} < 0$. Similarly a more inequity-averse principal will offer higher wages since she hates being ahead. The above is a sufficient condition, not necessary. Even with $\pi_j > 0$, $\frac{\partial w_i}{\partial \pi_i} < 0$ might still hold.

The effect of π_i on w_j, $i \neq j$ is more interesting and to fix ideas assume that agent j is ahead of the agent i. By the direct effect of an increase in $\pi_i > 0$, ceteris paribus, w_i falls since the principal wants to be ahead. Now the j^{th} agent is more ahead of the i^{th} agent and being inequity-averse among themselves j^{th} agent will suffer a utility loss. To compensate for that the principal can optimally reduce the wage of agent j. The principal can optimally do so if α_{Pj} is not that large, that is the j^{th} agent is not that inequity-averse vis-à-vis the principal. So a ceteris paribus increase in π_i will lead to a fall in w_j certainly if α_{Pj} is not that large and this is a sufficient condition. If agent j is behind of the agent i then a fall in w_i reduces inequity among the agents and therefore the agent j is already better-off. The principal once again can profitably optimally reduce w_j, certainly if α_{Pj} is not that large and this situation is less restrictive for the principal compared to when agent j is ahead. Thus the intuition for sufficiency of α_{Pj} being not that large works both ways.

If α_{Pi} increases then agent i becomes more inequity-averse vis-à-vis the principal. This leads to a loss in agent i's utility since the agents are always behind. This creates a perverse impact on agent i's effort and to compensate for that, ceteris paribus, the principal needs to provide higher wage to agent i. Now suppose that agent i is ahead of agent j. Now this makes agent j relatively more behind agent i and the agents being inequity-averse among themselves, will impact agent j's effort negatively. To counter that the principal needs to increase agent j's wage. If the principal is inequity-averse vis-a-vis agent j then this leads to an increase in the principal's utility, since the principal is now less ahead of agent j, and therefore increasing agent j's wage is not a problem for the principal. Therefore, if $\pi_j < 0$ then certainly it is optimal for the principal to increase w_i when α_{Pi} increases ceteris paribus. Thus $\pi_j < 0$ is sufficient for $\frac{\partial w_i}{\partial \alpha_{Pi}} > 0$ to hold. If agent j is ahead of agent i then certainly $\frac{\partial w_i}{\partial \alpha_{Pi}} > 0$ irrespective of $\pi_j < 0$. Hence $\pi_j < 0$ is sufficient (not necessary) for $\frac{\partial w_i}{\partial \alpha_{Pi}} > 0$ in all situations. This completes the intuitions of the above proposition.

It is interesting to note whether agents prefer a more inequity-averse principal or not. Since wages fall with a ceteris paribus increase in π_i, the agents lose on two accounts. First is the direct effect of getting reduced wage and also the inequity between the agents and the principal rises. The effect of intra-agent inequity depends on the relative position of the agents' wages. The relative strengths of these three effects will determine the overall impact and whether agents will prefer a relatively more inequity-averse principal (a less status-seeking principal) or not.

As the agents become more inequity-averse among themselves then the principal optimally reduces the agents' wage-gap and reduces the adverse effect of agents' inequity. The next proposition talks about that.

Proposition 8:

An increase in α_{Ai} reduces the gap between $w_i(.)$ and $w_j(.)$, $i = 1,2;\ j = 1,2;\ i \neq j$.

Proof: See Appendix.

If the agents become more inequity-averse among themselves then both suffer from a loss in utility, more so if their wage difference is high. This makes it costly for the principal to induce the agents to participate as well as to incentivize them to provide higher effort. Therefore as α_{Ai} increases the principal will find it optimal to reduce the wage gap such that the loss due to increased inequity suffered by the agents are minimized.

This is also implies that as the inequity-concern among agents increases indefinitely then in the limit the wages will be equal.

Corollary 1:

As $\alpha_{Ai} \to \infty$ *we get* $w_i(.) = w_j(.),\ i = 1,2;\ j = 1,2;\ i \neq j.$

7. Conclusion:

In this paper we provide a comprehensive analysis of an interaction of an other-regarding principal with two other-regarding agents. First we analyze the case of discrete efforts and outcomes a la Itoh (2004) with different alternative specifications. We analyze both independent production technology and correlated project outcomes. We find that with 'status-seeking' and 'not so high inequity-averse' agents, a moderately inequity-averse or a status-seeking principal will offer an 'extreme relative performance contract', whereas she will offer an 'extreme team contract' if the agents are 'sufficiently inequity-averse' and this is similar to what we get in Itoh (2004) with self-regarding principal. Contrary to this, a 'sufficiently inequity-averse' principal will offer an 'extreme' independent contract that minimizes her ex-ante expected payoff loss from being ahead keeping the work incentives intact. This is contrary to what we get in papers with other-regarding agents and self-regarding principal. Similar results hold in essence when the projects of the agents are correlated as well. In addition to this we consider the case of a 'fair' principal who experiences a reduction in utility when the agents get different wages. We show that relative performance contracts are never optimal when a fair principal interacts with a self-regarding agent. Also team contract is more likely under a 'fair' principal compared to the standard case where the principal is other-regarding vis-a-vis the agents, but a relative performance contract can also be optimal.

Then to complete our analysis we venture into the continuous effort and outcome case using a structure similar to Englmaier & Wambach (2010) and we generalize it with an other-regarding principal. We show that with continuous efforts and outcomes ‘team contracts’ are optimal when the principal is inequity-averse or not too status-seeking. But if the principal is sufficiently status-seeking optimality of ‘relative performance contracts’ is a possibility when the agents’ payoffs are far apart. While characterizing the nature of the optimal contracts, we provide sufficient conditions for team contract to be optimal. We also provide necessary conditions for the independent and relative performance contracts to be optimal in terms of the ‘direct wage incentive’ effect, principal’s other-regardingness and the relative positions of the agents. Thus a comprehensive analysis is done where the interaction of an other-regarding principal and two other-regarding agents are modeled using various structures and alternative specifications and we get that with other-regarding principal and agents both team contracts, relative performance contracts and even independent contracts are a possibility across structures. The entire analysis is done in a two agent framework. One way forward can be an analysis with n agents. Formalizing other-regarding preferences with other-regarding principal and n agents can be tricky and demanding, but we conjecture that the essence of our results might go through, although it is an open question.

APPENDIX

We approach the proofs denoting agents as agent 1 and agent 2.

Proof of Proposition 5:

Given the principal's maximization problem we can set the Lagrangian as

$$\mathcal{L} = \int_{\underline{x}_1}^{\overline{x}_1} \int_{\underline{x}_2}^{\overline{x}_2} f_1(x_1|e_1)\, f_2(x_2|e_2)\{x_1 + x_2 - w_1 - w_2 + \pi_1 S_1(x_1 + x_2 - 2w_1 - w_2)$$
$$+ \pi_2 S_2(x_1 + x_2 - w_1 - 2w_2)\} dx_1 dx_2$$
$$+ \lambda_1 \left[\int_{\underline{x}_1}^{\overline{x}_1} \int_{\underline{x}_2}^{\overline{x}_2} f_1(x_1|e_1)\, f_2(x_2|e_2)\{u_1(w_1) - \alpha_{P1} G_1(x_1 + x_2 - 2w_1 - w_2) \right.$$
$$\left. - \alpha_{A1} H_1(w_2 - w_1)\} dx_1 dx_2 - c_1(e_1) - u_1 \right]$$
$$+ \lambda_2 \left[\int_{\underline{x}_1}^{\overline{x}_1} \int_{\underline{x}_2}^{\overline{x}_2} f_1(x_1|e_1)\, f_2(x_2|e_2)\{u_2(w_2) - \alpha_{P2} G_2(x_1 + x_2 - w_1 - 2w_2) \right.$$
$$\left. - \alpha_{A2} H_2(w_1 - w_2)\} dx_1 dx_2 - c_2(e_2) - u_2 \right]$$
$$+ \mu_1 \left[\int_{\underline{x}_1}^{\overline{x}_1} \int_{\underline{x}_2}^{\overline{x}_2} f_{1_{e_1}}(x_1|e_1)\, f_2(x_2|e_2)\{u_1(w_1) - \alpha_{P1} G_1(x_1 + x_2 - 2w_1 - w_2) \right.$$
$$\left. - \alpha_{A1} H_1(w_2 - w_1)\} dx_1 dx_2 - c_1'(e_1) \right]$$
$$+ \mu_2 \left[\int_{\underline{x}_1}^{\overline{x}_1} \int_{\underline{x}_2}^{\overline{x}_2} f_1(x_1|e_1) f_{2_{e_2}}(x_2|e_2)\, \{u_2(w_2) - \alpha_{P2} G_2(x_1 + x_2 - w_1 - 2w_2) \right.$$
$$\left. - \alpha_{A2} H_2(w_1 - w_2)\} dx_1 dx_2 - c_2'(e_2) \right]$$

Maximizing with respect to w_1 we get the first First Order Conditions as

$$\frac{\partial \mathcal{L}}{\partial w_1} = -f_1(x_1|e_1) f_2(x_2|e_2)\{1 + 2\pi_1 S_1'(.) + \pi_2 S_2'(.)\}$$
$$+ \lambda_1 [f_1(x_1|e_1) f_2(x_2|e_2)\{u_1'(w_1) + 2\alpha_{P1} G_1'(.) + \alpha_{A1} H_1'(.)\}]$$
$$+ \lambda_2 [f_1(x_1|e_1) f_2(x_2|e_2)\{\alpha_{P2} G_2'(.) - \alpha_{A2} H_2'(.)\}]$$
$$+ \mu_1 \left[f_{1_{e_1}}(x_1|e_1) f_2(x_2|e_2)\{u_1'(w_1) + 2\alpha_{P1} G_1'(.) + \alpha_{A1} H_1'(.)\} \right]$$
$$+ \mu_2 \left[f_1(x_1|e_1) f_{2_{e_2}}(x_2|e_2)\{\alpha_{P2} G_2'(.) - \alpha_{A2} H_2'(.)\} \right] = 0$$

Dividing both sides by $f_1(x_1|e_1) f_2(x_2|e_2)$ we get the following (FOC1)

$$\{1 + 2\pi_1 S_1'(.) + \pi_2 S_2'(.)\} = \left\{ \lambda_1 + \mu_1 \frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)} \right\} \{u_1'(w_1) + 2\alpha_{P1} G_1'(.) + \alpha_{A1} H_1'(.)\} +$$
$$\left\{ \lambda_2 + \mu_2 \frac{f_{2_{e_2}}(x_2|e_2)}{f_2(x_2|e_2)} \right\} \{\alpha_{P2} G_2'(.) - \alpha_{A2} H_2'(.)\} \qquad \text{(FOC1)}$$

Similarly, from $\frac{\partial \mathcal{L}}{\partial w_2} = 0$ and manipulating we get the second first order condition (FOC2) as

$$\{1 + \pi_1 S_1'(.) + 2\pi_2 S_2'(.)\} = \left\{\lambda_1 + \mu_1 \frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\}\{\alpha_{P1} G_1'(.) - \alpha_{A1} H_1'(.)\} + \left\{\lambda_2 + \mu_2 \frac{f_{2_{e_2}}(x_2|e_2)}{f_2(x_2|e_2)}\right\}\{u_2'(w_2) + 2\alpha_{P2} G_2'(.) + \alpha_{A2} H_2'(.)\} \tag{FOC2}$$

The following conditions imply that the participation constraints will be satisfied and incentive compatibility constraints will bind at the optimum.

$$\frac{\partial \mathcal{L}}{\partial \lambda_1} = \int_{\underline{x}_1}^{\overline{x}_1} \int_{\underline{x}_2}^{\overline{x}_2} f_1(x_1|e_1)\, f_2(x_2|e_2)\{u_1(w_1) - \alpha_{P1} G_1(x_1 + x_2 - 2w_1 - w_2) - \alpha_{A1} H_1(w_2 - w_1)\} dx_1 dx_2 - c_1(e_1) - u_1 \geq 0$$

$$\frac{\partial \mathcal{L}}{\partial \lambda_2} = \int_{\underline{x}_1}^{\overline{x}_1} \int_{\underline{x}_2}^{\overline{x}_2} f_1(x_1|e_1)\, f_2(x_2|e_2)\{u_2(w_2) - \alpha_{P2} G_2(x_1 + x_2 - w_1 - 2w_2) - \alpha_{A2} H_2(w_1 - w_2)\} dx_1 dx_2 - c_2(e_2) - u_2 \geq 0$$

$$\frac{\partial \mathcal{L}}{\partial \mu_1} = \int_{\underline{x}_1}^{\overline{x}_1} \int_{\underline{x}_2}^{\overline{x}_2} f_{1_{e_1}}(x_1|e_1)\, f_2(x_2|e_2)\{u_1(w_1) - \alpha_{P1} G_1(x_1 + x_2 - 2w_1 - w_2) - \alpha_{A1} H_1(w_2 - w_1)\} dx_1 dx_2 - c_1'(e_1) = 0$$

$$\frac{\partial \mathcal{L}}{\partial \mu_2} = \int_{\underline{x}_1}^{\overline{x}_1} \int_{\underline{x}_2}^{\overline{x}_2} f_1(x_1|e_1) f_{2_{e_2}}(x_2|e_2)\{u_2(w_2) - \alpha_{P2} G_2(x_1 + x_2 - w_1 - 2w_2) - \alpha_{A2} H_2(w_1 - w_2)\} dx_1 dx_2 - c_2'(e_2) = 0$$

For a well-defined maximum, we assume that the following second order conditions are satisfied:

$$\begin{aligned}\mathcal{L}_{11} = \frac{\partial^2 \mathcal{L}}{\partial w_1^2} &= \left\{\lambda_1 + \mu_1 \frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\}\{u_1''(w_1) + 2\alpha_{P1} G_1''(.)(-2) + \alpha_{A1} H_1''(.)(-1)\} \\ &\quad + \left\{\lambda_2 + \mu_2 \frac{f_{2_{e_2}}(x_2|e_2)}{f_2(x_2|e_2)}\right\}\{\alpha_{P2} G_2''(.)(-1) - \alpha_{A2} H_2''(.)(+1)\} \\ &\quad - 2\pi_1 S_1''(.)(-2) - \pi_2 S_2''(.)(-1) \\ &= -\left[\left\{\lambda_1 + \mu_1 \frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\}\{4\alpha_{P1} G_1''(.) + \alpha_{A1} H_1''(.) - u_1''(w_1)\}\right. \\ &\quad \left. + \left\{\lambda_2 + \mu_2 \frac{f_{2_{e_2}}(x_2|e_2)}{f_2(x_2|e_2)}\right\}\{\alpha_{P2} G_2''(.) + \alpha_{A2} H_2''(.)\} - 4\pi_1 S_1''(.) - \pi_2 S_2''(.)\right] \\ &= -A < 0\end{aligned}$$

So for the second order condition to go through we need $A > 0$.

Thus, $A = \left[\left\{\lambda_1 + \mu_1 \frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\}\{4\alpha_{P1}G_1''(.) + \alpha_{A1}H_1''(.) - u_1''(w_1)\} + \left\{\lambda_2 + \mu_2 \frac{f_{2_{e_2}}(x_2|e_2)}{f_2(x_2|e_2)}\right\}\{\alpha_{P2}G_2''(.) + \alpha_{A2}H_2''(.)\} - 4\pi_1 S_1''(.) - \pi_2 S_2''(.)\right] > 0$

Again,

$$\mathcal{L}_{22} = \frac{\partial^2 \mathcal{L}}{\partial w_2^2} = -\left[\left\{\lambda_1 + \mu_1 \frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\}\{\alpha_{P1}G_1''(.) + \alpha_{A1}H_1''(.)\} + \left\{\lambda_2 + \mu_2 \frac{f_{2_{e_2}}(x_2|e_2)}{f_2(x_2|e_2)}\right\}\{4\alpha_{P2}G_2''(.) + \alpha_{A2}H_2''(.) - u_2''(w_2)\} - \pi_1 S_1''(.) - 4\pi_2 S_2''(.)\right] = -C < 0$$

Once again for the second order condition to go through we need $C > 0$.

Therefore

$C = \left[\left\{\lambda_1 + \mu_1 \frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\}\{\alpha_{P1}G_1''(.) + \alpha_{A1}H_1''(.)\} + \left\{\lambda_2 + \mu_2 \frac{f_{2_{e_2}}(x_2|e_2)}{f_2(x_2|e_2)}\right\}\{4\alpha_{P2}G_2''(.) + \alpha_{A2}H_2''(.) - u_2''(w_2)\} - \pi_1 S_1''(.) - 4\pi_2 S_2''(.)\right] > 0$

Also

$$\begin{aligned}\mathcal{L}_{12} = \frac{\partial^2 \mathcal{L}}{\partial w_2 \partial w_1} &= \left\{\lambda_1 + \mu_1 \frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\}\{2\alpha_{P1}G_1''(.)(-1) + \alpha_{A1}H_1''(.)(+1)\} \\ &+ \left\{\lambda_2 + \mu_2 \frac{f_{2_{e_2}}(x_2|e_2)}{f_2(x_2|e_2)}\right\}\{\alpha_{P2}G_2''(.)(-2) - \alpha_{A2}H_2''(.)(-1)\} \\ &- 2\pi_1 S_1''(.)(-1) - 2\pi_2 S_2''(.)(-1) \\ &= -\left[\left\{\lambda_1 + \mu_1 \frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\}\{2\alpha_{P1}G_1''(.) - \alpha_{A1}H_1''(.)\} \right. \\ &+ \left\{\lambda_2 + \mu_2 \frac{f_{2_{e_2}}(x_2|e_2)}{f_2(x_2|e_2)}\right\}\{2\alpha_{P2}G_2''(.) - \alpha_{A2}H_2''(.)\} - 2\pi_1 S_1''(.) \\ &\left. - 2\pi_2 S_2''(.)\right] \\ &= -B\end{aligned}$$

Where

$$
\begin{aligned}
B = \Bigg[& \left\{\lambda_1 + \mu_1 \frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\}\{2\alpha_{P1}G_1''(.) - \alpha_{A1}H_1''(.)\} \\
& + \left\{\lambda_2 + \mu_2 \frac{f_{2_{e_2}}(x_2|e_2)}{f_2(x_2|e_2)}\right\}\{2\alpha_{P2}G_2''(.) - \alpha_{A2}H_2''(.)\} - 2\pi_1 S_1''(.) \\
& - 2\pi_2 S_2''(.)\Bigg]
\end{aligned}
$$

We need not know the sign of B but what we need is that $\mathcal{L}_{11}\mathcal{L}_{22} - \mathcal{L}_{12}^2 = AC - B^2 > 0$ should hold along with $\mathcal{L}_{11} < 0$ and $\mathcal{L}_{22} < 0$.

Now, Differentiating FOC1 with respect to x_1 we get

$$
\begin{aligned}
& 2\pi_1 S_1''(.)\left(1 - 2\frac{\partial w_1}{\partial x_1} - \frac{\partial w_2}{\partial x_1}\right) + \pi_2 S_2''(.)\left(1 - \frac{\partial w_1}{\partial x_1} - 2\frac{\partial w_2}{\partial x_1}\right) \\
& = \left\{\lambda_1 + \mu_1 \frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\}\left\{u_1''(w_1)\frac{\partial w_1}{\partial x_1} + 2\alpha_{P1}G_1''(.)\left(1 - 2\frac{\partial w_1}{\partial x_1} - \frac{\partial w_2}{\partial x_1}\right)\right. \\
& \left. + \alpha_{A1}H_1''(.)\left(\frac{\partial w_2}{\partial x_1} - \frac{\partial w_1}{\partial x_1}\right)\right\} \\
& + \left\{\mu_1 \left(\frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right)'\right\}\{u_1'(w_1) + 2\alpha_{P1}G_1'(.) + \alpha_{A1}H_1'(.)\} \\
& + \left\{\lambda_2 + \mu_2 \frac{f_{2_{e_2}}(x_2|e_2)}{f_2(x_2|e_2)}\right\}\left\{\alpha_{P2}G_2''(.)\left(1 - \frac{\partial w_1}{\partial x_1} - 2\frac{\partial w_2}{\partial x_1}\right)\right. \\
& \left. - \alpha_{A2}H_2''(.)\left(\frac{\partial w_1}{\partial x_1} - \frac{\partial w_2}{\partial x_1}\right)\right\}
\end{aligned}
$$

$$
\Rightarrow \frac{\partial w_1}{\partial x_1}
$$

$$
= \frac{\begin{aligned}
& \left\{\lambda_1 + \mu_1 \frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\}\left\{2\alpha_{P1}G_1''(.)\left(1 - \frac{\partial w_2}{\partial x_1}\right) + \alpha_{A1}H_1''(.)\frac{\partial w_2}{\partial x_1}\right\} \\
& + \left\{\lambda_2 + \mu_2 \frac{f_{2_{e_2}}(x_2|e_2)}{f_2(x_2|e_2)}\right\}\left\{\alpha_{P2}G_2''(.)\left(1 - 2\frac{\partial w_2}{\partial x_1}\right) + \alpha_{A2}H_2''(.)\frac{\partial w_2}{\partial x_1}\right\} \\
& + \left\{\mu_1\left(\frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right)'\right\}\{u_1'(w_1) + 2\alpha_{P1}G_1'(.) + \alpha_{A1}H_1'(.)\} - 2\pi_1 S_1''(.)\left(1 - \frac{\partial w_2}{\partial x_1}\right) - \pi_2 S_2''(.)\left(1 - 2\frac{\partial w_2}{\partial x_1}\right)
\end{aligned}}{A}
$$

The denominator $A > 0$ from second order condition for maximization. If $\frac{\partial w_2}{\partial x_1} < \frac{1}{2}$, then $\frac{\partial w_1}{\partial x_1} > 0$ certainly if $\pi_i < 0 \;\; \forall i = 1,2$. So for inequity-averse principal (vis-à-vis both

agents) all terms are positive if $\frac{\partial w_2}{\partial x_1} < \frac{1}{2}$. Even if $\pi_i > 0\ \forall i = 1,2$ and $\frac{\partial w_2}{\partial x_1} < \frac{1}{2}$ holds, we can still have $\frac{\partial w_1}{\partial x_1} > 0$, certainly for $\pi_i \approx 0$ and/or $S_i''(.)$ not too high, $\forall i = 1,2$.
Similar analysis holds for $\frac{\partial w_2}{\partial x_2} > 0$. Note that these are sufficient conditions, not necessary.
Hence the result. **QED**

Proof of Proposition 6:

Differentiating FOC1 with respect to x_2 we get

$$
\begin{aligned}
&2\pi_1 S_1''(.)\left(1 - 2\frac{\partial w_1}{\partial x_2} - \frac{\partial w_2}{\partial x_2}\right) + \pi_2 S_2''(.)\left(1 - \frac{\partial w_1}{\partial x_2} - 2\frac{\partial w_2}{\partial x_2}\right)\\
&\qquad = \left\{\lambda_1 + \mu_1 \frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\}\left\{u_1''(w_1)\frac{\partial w_1}{\partial x_2} + 2\alpha_{P1}G_1''(.)\left(1 - 2\frac{\partial w_1}{\partial x_2} - \frac{\partial w_2}{\partial x_2}\right)\right.\\
&\qquad \left. + \alpha_{A1}H_1''(.)\left(\frac{\partial w_2}{\partial x_2} - \frac{\partial w_1}{\partial x_2}\right)\right\}\\
&\qquad + \left\{\lambda_2 + \mu_2 \frac{f_{2_{e_2}}(x_2|e_2)}{f_2(x_2|e_2)}\right\}\left\{\alpha_{P2}G_2''(.)\left(1 - \frac{\partial w_1}{\partial x_2} - 2\frac{\partial w_2}{\partial x_2}\right)\right.\\
&\qquad \left. - \alpha_{A2}H_2''(.)\left(\frac{\partial w_1}{\partial x_2} - \frac{\partial w_2}{\partial x_2}\right)\right\} + \left\{\mu_2\left(\frac{f_{2_{e_2}}(x_2|e_2)}{f_2(x_2|e_2)}\right)'\right\}\{\alpha_{P2}G_2'(.) - \alpha_{A2}H_2'(.)\}\\
&\Rightarrow \frac{\partial w_1}{\partial x_2}\left[\left\{\lambda_1 + \mu_1 \frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\}\{4\alpha_{P1}G_1''(.) + \alpha_{A1}H_1''(.) - u_1''(w_1)\}\right.\\
&\qquad \left. + \left\{\lambda_2 + \mu_2 \frac{f_{2_{e_2}}(x_2|e_2)}{f_2(x_2|e_2)}\right\}\{\alpha_{P2}G_2''(.) + \alpha_{A2}H_2''(.)\} - 4\pi_1 S_1''(.) - \pi_2 S_2''(.)\right]\\
&\qquad = \left\{\lambda_1 + \mu_1 \frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\}\left\{2\alpha_{P1}G_1''(.)\left(1 - \frac{\partial w_2}{\partial x_2}\right) + \alpha_{A1}H_1''(.)\frac{\partial w_2}{\partial x_2}\right\}\\
&\qquad + \left\{\lambda_2 + \mu_2 \frac{f_{2_{e_2}}(x_2|e_2)}{f_2(x_2|e_2)}\right\}\left\{\alpha_{P2}G_2''(.)\left(1 - 2\frac{\partial w_2}{\partial x_2}\right) + \alpha_{A2}H_2''(.)\frac{\partial w_2}{\partial x_2}\right\}\\
&\qquad - 2\pi_1 S_1''(.)\left(1 - \frac{\partial w_2}{\partial x_2}\right) - \pi_2 S_2''(.)\left(1 - 2\frac{\partial w_2}{\partial x_2}\right)\\
&\qquad + \left\{\mu_2\left(\frac{f_{2_{e_2}}(x_2|e_2)}{f_2(x_2|e_2)}\right)'\right\}\{\alpha_{P2}G_2'(.) - \alpha_{A2}H_2'(.)\}
\end{aligned}
$$

$$\Rightarrow \frac{\partial w_1}{\partial x_2} = \frac{\begin{aligned}&\left\{\lambda_1 + \mu_1 \frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\}\left\{2\alpha_{P1}G_1''(.)\left(1 - \frac{\partial w_2}{\partial x_2}\right) + \alpha_{A1}H_1''(.)\frac{\partial w_2}{\partial x_2}\right\} \\ &+ \left\{\lambda_2 + \mu_2 \frac{f_{2_{e_2}}(x_2|e_2)}{f_2(x_2|e_2)}\right\}\left\{\alpha_{P2}G_2''(.)\left(1 - 2\frac{\partial w_2}{\partial x_2}\right) + \alpha_{A2}H_2''(.)\frac{\partial w_2}{\partial x_2}\right\} \\ &+ \left\{\mu_2 \left(\frac{f_{2_{e_2}}(x_2|e_2)}{f_2(x_2|e_2)}\right)'\right\}\{\alpha_{P2}G_2'(.) - \alpha_{A2}H_2'(.)\} - 2\pi_1 S_1''(.)\left(1 - \frac{\partial w_2}{\partial x_2}\right) - \pi_2 S_2''(.)\left(1 - 2\frac{\partial w_2}{\partial x_2}\right)\end{aligned}}{A}$$

The denominator is positive from the second order condition for maximization. If the principal is inequity-averse with respect to both agents ($\pi_i < 0, \forall i = 1,2$) and $\frac{\partial w_i}{\partial x_i} < \frac{1}{2}$ holds then all terms except $-\alpha_{A2}H_2'(.)$ in the numerator is positive. If the agents are not 'too inequity-averse' among themselves implying $\alpha_{A2} \approx 0$ then certainly $\frac{\partial w_1}{\partial x_2} > 0$ and therefore the optimal contract will be a team contract. Similar result holds if $\pi_i = 0$, i.e. the principal is self-regarding vis-à-vis both agents. But if $\pi_i > 0, \forall i = 1,2$ then there are three negative terms $-2\pi_1 S_1''(.)\left(1 - \frac{\partial w_2}{\partial x_2}\right)$, $-\pi_2 S_2''(.)\left(1 - 2\frac{\partial w_2}{\partial x_2}\right)$ and $-\alpha_{A2}H_2'(.)$ and if π_i's and $\alpha_{A2}(> 0)$ are sufficiently large then it is possible that $\frac{\partial w_1}{\partial x_2} < 0$ implying the optimality of a relative performance contract. In addition to this, if $H_2'(.)$ is sufficiently high implying a large gap between the agents' wages, then it might be optimal for the principal to offer a relative performance contract. If the above negative terms are such that the numerator goes to zero then we get the independent contract to be optimal, i.e. $\frac{\partial w_1}{\partial x_2} = 0$.

Similarly, by differentiating FOC2 by x_1 we get

$$\Rightarrow \frac{\partial w_2}{\partial x_1} = \frac{\begin{aligned}&\left\{\lambda_1 + \mu_1 \frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\}\left\{\alpha_{P1}G_1''(.)\left(1 - 2\frac{\partial w_1}{\partial x_1}\right) + \alpha_{A1}H_1''(.)\frac{\partial w_1}{\partial x_1}\right\} \\ &+ \left\{\lambda_2 + \mu_2 \frac{f_{2_{e_2}}(x_2|e_2)}{f_2(x_2|e_2)}\right\}\left\{2\alpha_{P2}G_2''(.)\left(1 - \frac{\partial w_1}{\partial x_1}\right) + \alpha_{A2}H_2''(.)\frac{\partial w_1}{\partial x_1}\right\} \\ &+ \left\{\mu_1 \left(\frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right)'\right\}\{\alpha_{P1}G_1'(.) - \alpha_{A1}H_1'(.)\} - \pi_1 S_1''(.)\left(1 - 2\frac{\partial w_1}{\partial x_1}\right) - 2\pi_2 S_2''(.)\left(1 - \frac{\partial w_1}{\partial x_1}\right)\end{aligned}}{C}$$

Once again from the second order condition $C > 0$. Same rationale as above holds in this case also.
Hence, the result. **QED**

Proof of Proposition 7:

(a). By differentiating FOC1 by π_1 we get

$$2\pi_1 S_1''(.)\left(-2\frac{\partial w_1}{\partial \pi_1}-\frac{\partial w_2}{\partial \pi_1}\right)+2S_1'(.)+\pi_2 S_2''(.)\left(-\frac{\partial w_1}{\partial \pi_1}-2\frac{\partial w_2}{\partial \pi_1}\right)$$
$$=\left\{\lambda_1+\mu_1\frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\}\left\{u_1''(w_1)\frac{\partial w_1}{\partial \pi_1}+2\alpha_{P1}G_1''(.)\left(-2\frac{\partial w_1}{\partial \pi_1}-\frac{\partial w_2}{\partial \pi_1}\right)\right.$$
$$\left.+\alpha_{A1}H_1''(.)\left(\frac{\partial w_2}{\partial \pi_1}-\frac{\partial w_1}{\partial \pi_1}\right)\right\}$$
$$+\left\{\lambda_2+\mu_2\frac{f_{2_{e_2}}(x_2|e_2)}{f_2(x_2|e_2)}\right\}\left\{\alpha_{P2}G_2''(.)\left(-\frac{\partial w_1}{\partial \pi_1}-2\frac{\partial w_2}{\partial \pi_1}\right)\right.$$
$$\left.-\alpha_{A2}H_2''(.)\left(\frac{\partial w_1}{\partial \pi_1}-\frac{\partial w_2}{\partial \pi_1}\right)\right\}$$
$$\Rightarrow \frac{\partial w_1}{\partial \pi_1}\left[\left\{\lambda_1+\mu_1\frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\}\{4\alpha_{P1}G_1''(.)+\alpha_{A1}H_1''(.)-u_1''(w_1)\}\right.$$
$$\left.+\left\{\lambda_2+\mu_2\frac{f_{2_{e_2}}(x_2|e_2)}{f_2(x_2|e_2)}\right\}\{\alpha_{P2}G_2''(.)+\alpha_{A2}H_2''(.)\}-4\pi_1 S_1''(.)-\pi_2 S_2''(.)\right]$$
$$+\frac{\partial w_2}{\partial \pi}\left[\left\{\lambda_1+\mu_1\frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\}\{2\alpha_{P1}G_1''(.)-\alpha_{A1}H_1''(.)\}\right.$$
$$+\left\{\lambda_2+\mu_2\frac{f_{2_{e_2}}(x_2|e_2)}{f_2(x_2|e_2)}\right\}\{2\alpha_{P2}G_2''(.)-\alpha_{A2}H_2''(.)\}-2\pi_1 S_1''(.)$$
$$\left.-2\pi_2 S_2''(.)\right]=-2S_1'(.)$$

$$\Rightarrow A\frac{\partial w_1}{\partial \pi_1}+B\frac{\partial w_2}{\partial \pi_1}=-2S_1'(.) \tag{A1}$$

Similarly, from FOC2 we get

$$\frac{\partial w_1}{\partial \pi_1}\left[\left\{\lambda_1+\mu_1\frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\}\{2\alpha_{P1}G_1''(.)-\alpha_{A1}H_1''(.)\}\right.$$
$$+\left\{\lambda_2+\mu_2\frac{f_{2_{e_2}}(x_2|e_2)}{f_2(x_2|e_2)}\right\}\{2\alpha_{P2}G_2''(.)-\alpha_{A2}H_2''(.)\}-2\pi_1 S_1''(.)$$
$$\left.-2\pi_2 S_2''(.)\right]$$
$$+\frac{\partial w_2}{\partial \pi_1}\left[\left\{\lambda_1+\mu_1\frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\}\{\alpha_{P1}G_1''(.)+\alpha_{A1}H_1''(.)\}\right.$$
$$+\left\{\lambda_2+\mu_2\frac{f_{2_{e_2}}(x_2|e_2)}{f_2(x_2|e_2)}\right\}\{4\alpha_{P2}G_2''(.)+\alpha_{A2}H_2''(.)-u_2''(w_2)\}-\pi_1 S_1''(.)$$
$$\left.-4\pi_2 S_2''(.)\right]=-S_1'(.)$$

$$\Longrightarrow B\frac{\partial w_1}{\partial \pi_1} + C\frac{\partial w_2}{\partial \pi_1} = -S_1'(.) \tag{A2}$$

Solving (A1) and (A2) we get,

$$\frac{\partial w_1}{\partial \pi_1} = \frac{\begin{vmatrix} -2S_1'(.) & B \\ -S_1'(.) & C \end{vmatrix}}{\begin{vmatrix} A & B \\ B & C \end{vmatrix}} = \frac{S_1'(.)(2C - B)}{B^2 - AC}$$

$$= S_1'(.)\frac{\left[\begin{array}{c} 3\alpha_{A1}H_1''(.)\left\{\lambda_1 + \mu_1\frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\} + \\ \left\{\lambda_2 + \mu_2\frac{f_{2_{e_2}}(x_2|e_2)}{f_2(x_2|e_2)}\right\}\{6\alpha_{P2}G_2''(.) + 3\alpha_{A2}H_2''(.) - 2u_2''(w_2)\} - 6\pi_2 S_2''(.) \end{array}\right]}{B^2 - AC}$$

The denominator is negative from the second order condition. If $\pi_2 \leq 0$ then the numerator is certainly positive. This along with risk averse agents we will certainly get $\frac{\partial w_1}{\partial \pi_1} < 0$. Therefore a more status-seeking principal (less inequity-averse principal) will offer lower wage, certainly if the principal is (weakly) inequity-averse with respect to the other agent, i.e. $\pi_2 \leq 0$. This is a sufficient condition, not necessary. A more inequity-averse principal will therefore offer higher wage.

Even with $\pi_2 > 0$ we can get $\frac{\partial w_1}{\partial \pi_1} < 0$ since the only negative term $-6\pi_2 S_2''(.)$ is likely to be outweighed by the other positive terms.

Similar analysis will hold for $\frac{\partial w_2}{\partial \pi_2}$ which we omit for brevity.

(b). Next we check for $\frac{\partial w_2}{\partial \pi_1}$.

$$\frac{\partial w_2}{\partial \pi_1} = \frac{\begin{vmatrix} A & -2S_1'(.) \\ B & -S_1'(.) \end{vmatrix}}{\begin{vmatrix} A & B \\ B & C \end{vmatrix}} = \frac{S_1'(.)(A - 2B)}{B^2 - AC}$$

$$= \frac{S_1'(.)\left[\begin{array}{c} \left\{\lambda_1 + \mu_1\frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\}\{3\alpha_{A1}H_1''(.) - u_1''(w_1)\} \\ + \left\{\lambda_2 + \mu_2\frac{f_{2_{e_2}}(x_2|e_2)}{f_2(x_2|e_2)}\right\}\{3\alpha_{A2}H_2''(.) - 3\alpha_{P2}G_2''(.)\} + 3\pi_2 S_2''(.) \end{array}\right]}{B^2 - AC}$$

Once again the denominator is negative. The sign of $\frac{\partial w_2}{\partial \pi_1}$ will depend on π_2 and α_{P2}. If $\pi_2 > 0$, then $\frac{\partial w_2}{\partial \pi_1} < 0$ certainly for not so high α_{P2}. Implying a more status-seeking principal (lower inequity-averse) will certainly offer lower cross-wage if the other-agent's inequity aversion vis-à-vis the principal is not so high. These are sufficient conditions.

If $\pi_2 < 0$, i.e. the principal is inequity-averse with respect to the other agent, then there is a 'cross inequity-aversion' effect of the principal that affects the sign of $\frac{\partial w_2}{\partial \pi_1}$. If π_2 is not sufficiently negative along with α_{P2} not too high we can still get $\frac{\partial w_2}{\partial \pi_1} < 0$.

Once again similar analysis will hold for $\frac{\partial w_1}{\partial \pi_2}$.

(c). By differentiating FOC1 by α_{P1} we get

$$
\begin{aligned}
&2\pi_1 S_1''(.)\left(-2\frac{\partial w_1}{\partial \alpha_{P1}} - \frac{\partial w_2}{\partial \alpha_{P1}}\right) + \pi_2 S_2''(.)\left(-\frac{\partial w_1}{\partial \alpha_{P1}} - 2\frac{\partial w_2}{\partial \alpha_{P1}}\right) \\
&\qquad = \left\{\lambda_1 + \mu_1 \frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\}\left\{u_1''(w_1)\frac{\partial w_1}{\partial \alpha_{P1}} + 2\alpha_{P1}G_1''(.)\left(-2\frac{\partial w_1}{\partial \alpha_{P1}} - \frac{\partial w_2}{\partial \alpha_{P1}}\right)\right. \\
&\qquad \left. + 2G_1'(.) + \alpha_{A1}H_1''(.)\left(\frac{\partial w_2}{\partial \alpha_{P1}} - \frac{\partial w_1}{\partial \alpha_{P1}}\right)\right\} \\
&\qquad + \left\{\lambda_2 + \mu_2 \frac{f_{2_{e_2}}(x_2|e_2)}{f_2(x_2|e_2)}\right\}\left\{\alpha_{P2}G_2''(.)\left(-\frac{\partial w_1}{\partial \alpha_{P1}} - 2\frac{\partial w_2}{\partial \alpha_{P1}}\right)\right. \\
&\qquad \left. - \alpha_{A2}H_2''(.)\left(\frac{\partial w_1}{\partial \alpha_{P1}} - \frac{\partial w_2}{\partial \alpha_{P1}}\right)\right\}
\end{aligned}
$$

$$
\begin{aligned}
\Rightarrow \frac{\partial w_1}{\partial \alpha_{P1}} &\left[\left\{\lambda_1 + \mu_1 \frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\}\{4\alpha_{P1}G_1''(.) + \alpha_{A1}H_1''(.) - u_1''(w_1)\}\right. \\
&\left. + \left\{\lambda_2 + \mu_2 \frac{f_{2_{e_2}}(x_2|e_2)}{f_2(x_2|e_2)}\right\}\{\alpha_{P2}G_2''(.) + \alpha_{A2}H_2''(.)\} - 4\pi_1 S_1''(.) - \pi_2 S_2''(.)\right] \\
&+ \frac{\partial w_2}{\partial \alpha_{P1}}\left[\left\{\lambda_1 + \mu_1 \frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\}\{2\alpha_{P1}G_1''(.) - \alpha_{A1}H_1''(.)\}\right. \\
&+ \left\{\lambda_2 + \mu_2 \frac{f_{2_{e_2}}(x_2|e_2)}{f_2(x_2|e_2)}\right\}\{2\alpha_{P2}G_2''(.) - \alpha_{A2}H_2''(.)\} - 2\pi_1 S_1''(.) \\
&\left. - 2\pi_2 S_2''(.)\right] = 2G_1'(.)\left\{\lambda_1 + \mu_1 \frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\} \\
&\Rightarrow A\frac{\partial w_1}{\partial \alpha_{P1}} + B\frac{\partial w_2}{\partial \alpha_{P1}} = 2G_1'(.)\left\{\lambda_1 + \mu_1 \frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\}
\end{aligned}
$$

Similarly, from FOC2 we get

$$
\begin{aligned}
&\pi_1 S_1''(.)\left(-2\frac{\partial w_1}{\partial \alpha_{P1}}-\frac{\partial w_2}{\partial \alpha_{P1}}\right)+2\pi_2 S_2''(.)\left(-\frac{\partial w_1}{\partial \alpha_{P1}}-2\frac{\partial w_2}{\partial \alpha_{P1}}\right) \\
&=\left\{\lambda_1+\mu_1\frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\}\left\{\alpha_{P1}G_1''(.)\left(-2\frac{\partial w_1}{\partial \alpha_{P1}}-\frac{\partial w_2}{\partial \alpha_{P1}}\right)+G_1'(.)\right. \\
&\left.-\alpha_{A1}H_1''(.)\left(\frac{\partial w_2}{\partial \alpha_{P1}}-\frac{\partial w_1}{\partial \alpha_{P1}}\right)\right\} \\
&+\left\{\lambda_2+\mu_2\frac{f_{2_{e_2}}(x_2|e_2)}{f_2(x_2|e_2)}\right\}\left\{u_2''(w_2)\frac{\partial w_2}{\partial \alpha_{P1}}+2\alpha_{P2}G_2''(.)\left(-\frac{\partial w_1}{\partial \alpha_{P1}}-2\frac{\partial w_2}{\partial \alpha_{P1}}\right)\right. \\
&\left.+\alpha_{A2}H_2''(.)\left(\frac{\partial w_1}{\partial \alpha_{P1}}-\frac{\partial w_2}{\partial \alpha_{P1}}\right)\right\}
\end{aligned}
$$

$$
\begin{aligned}
&\Rightarrow \frac{\partial w_1}{\partial \alpha_{P1}}\left[\left\{\lambda_1+\mu_1\frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\}\{2\alpha_{P1}G_1''(.)-\alpha_{A1}H_1''(.)\}\right. \\
&+\left\{\lambda_2+\mu_2\frac{f_{2_{e_2}}(x_2|e_2)}{f_2(x_2|e_2)}\right\}\{2\alpha_{P2}G_2''(.)-\alpha_{A2}H_2''(.)\}-2\pi_1 S_1''(.) \\
&\left.-2\pi_2 S_2''(.)\right] \\
&+\frac{\partial w_2}{\partial \alpha_{P1}}\left[\left\{\lambda_1+\mu_1\frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\}\{\alpha_{P1}G_1''(.)+\alpha_{A1}H_1''(.)\}\right. \\
&+\left\{\lambda_2+\mu_2\frac{f_{2_{e_2}}(x_2|e_2)}{f_2(x_2|e_2)}\right\}\{4\alpha_{P2}G_2''(.)+\alpha_{A2}H_2''(.)-u_2''(w_2)\}-\pi_1 S_1''(.) \\
&\left.-4\pi_2 S_2''(.)\right]=G_1'(.)\left\{\lambda_1+\mu_1\frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\}
\end{aligned}
$$

$$
\Rightarrow B\frac{\partial w_1}{\partial \alpha_{P1}}+C\frac{\partial w_2}{\partial \alpha_{P1}}=G_1'(.)\left\{\lambda_1+\mu_1\frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\}
$$

From here by solving these we get,

$$
\frac{\partial w_1}{\partial \alpha_{P1}}=\frac{\begin{vmatrix} 2G_1'(.)\left\{\lambda_1+\mu_1\frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\} & B \\ G_1'(.)\left\{\lambda_1+\mu_1\frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\} & C \end{vmatrix}}{\begin{vmatrix} A & B \\ B & C \end{vmatrix}}=\frac{(2C-B)G_1'(.)\left\{\lambda_1+\mu_1\frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\}}{AC-B^2}
$$

The denominator is positive from the second order condition.

Now,

$$(2C-B)=\left[3\alpha_{A1}H_1''(.)\left\{\lambda_1+\mu_1\frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\}\right.$$
$$+\left\{\lambda_2+\mu_2\frac{f_{2_{e_2}}(x_2|e_2)}{f_2(x_2|e_2)}\right\}\{6\alpha_{P2}G_2''(.)+3\alpha_{A2}H_2''(.)-2u_2''(w_2)\}$$
$$\left.-6\pi_2S_2''(.)\right]$$

$(2C-B)>0$ certainly for $\pi_2<0$.

Even if $\pi_2>0$, $-6\pi_2S_2''(.)$ is likely to be be outweighed by other positive terms and therefore we might get $\frac{\partial w_1}{\partial\alpha_{P1}}>0$.

Similarly we can show that $\frac{\partial w_2}{\partial\alpha_{P2}}>0$ certainly for $\pi_1<0$. **QED**

Proof of Proposition 8:

Differentiating FOC1 by α_{A1} we get

$$2\pi_1S_1''(.)\left(-2\frac{\partial w_1}{\partial\alpha_{A1}}-\frac{\partial w_2}{\partial\alpha_{A1}}\right)+\pi_2S_2''(.)\left(-\frac{\partial w_1}{\partial\alpha_{A1}}-2\frac{\partial w_2}{\partial\alpha_{A1}}\right)$$
$$=\left\{\lambda_1+\mu_1\frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\}\left\{u_1''(w_1)\frac{\partial w_1}{\partial\alpha_{A1}}+2\alpha_{P1}G_1''(.)\left(-2\frac{\partial w_1}{\partial\alpha_{A1}}-\frac{\partial w_2}{\partial\alpha_{A1}}\right)\right.$$
$$\left.+\alpha_{A1}H_1''(.)\left(\frac{\partial w_2}{\partial\alpha_{A1}}-\frac{\partial w_1}{\partial\alpha_{A1}}\right)+H_1'(.)\right\}$$
$$+\left\{\lambda_2+\mu_2\frac{f_{2_{e_2}}(x_2|e_2)}{f_2(x_2|e_2)}\right\}\left\{\alpha_{P2}G_2''(.)\left(-\frac{\partial w_1}{\partial\alpha_{A1}}-2\frac{\partial w_2}{\partial\alpha_{A1}}\right)\right.$$
$$\left.-\alpha_{A2}H_2''(.)\left(\frac{\partial w_1}{\partial\alpha_{A1}}-\frac{\partial w_2}{\partial\alpha_{A1}}\right)\right\}$$

$$\Rightarrow\frac{\partial w_1}{\partial\alpha_{A1}}\left[\left\{\lambda_1+\mu_1\frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\}\{4\alpha_{P1}G_1''(.)+\alpha_{A1}H_1''(.)-u_1''(w_1)\}\right.$$
$$\left.+\left\{\lambda_2+\mu_2\frac{f_{2_{e_2}}(x_2|e_2)}{f_2(x_2|e_2)}\right\}\{\alpha_{P2}G_2''(.)+\alpha_{A2}H_2''(.)\}-4\pi_1S_1''(.)-\pi_2S_2''(.)\right]$$
$$+\frac{\partial w_2}{\partial\alpha_{A1}}\left[\left\{\lambda_1+\mu_1\frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\}\{2\alpha_{P1}G_1''(.)-\alpha_{A1}H_1''(.)\}\right.$$
$$+\left\{\lambda_2+\mu_2\frac{f_{2_{e_2}}(x_2|e_2)}{f_2(x_2|e_2)}\right\}\{2\alpha_{P2}G_2''(.)-\alpha_{A2}H_2''(.)\}-2\pi_1S_1''(.)$$
$$\left.-2\pi_2S_2''(.)\right]=H_1'(.)\left\{\lambda_1+\mu_1\frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\}$$
$$\Rightarrow A\frac{\partial w_1}{\partial\alpha_{A1}}+B\frac{\partial w_2}{\partial\alpha_{A1}}=H_1'(.)\left\{\lambda_1+\mu_1\frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\}$$

Similarly, from FOC2 we get

$$\pi_1 S_1''(.)\left(-2\frac{\partial w_1}{\partial \alpha_{A1}}-\frac{\partial w_2}{\partial \alpha_{A1}}\right)+2\pi_2 S_2''(.)\left(-\frac{\partial w_1}{\partial \alpha_{A1}}-2\frac{\partial w_2}{\partial \alpha_{A1}}\right)$$
$$=\left\{\lambda_1+\mu_1\frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\}\left\{\alpha_{P1}G_1''(.)\left(-2\frac{\partial w_1}{\partial \alpha_{A1}}-\frac{\partial w_2}{\partial \alpha_{A1}}\right)\right.$$
$$\left.-\alpha_{A1}H_1''(.)\left(\frac{\partial w_2}{\partial \alpha_{A1}}-\frac{\partial w_1}{\partial \alpha_{A1}}\right)-H_1'(.)\right\}$$
$$+\left\{\lambda_2+\mu_2\frac{f_{2_{e_2}}(x_2|e_2)}{f_2(x_2|e_2)}\right\}\left\{u_2''(w_2)\frac{\partial w_2}{\partial \alpha_{A1}}+2\alpha_{P2}G_2''(.)\left(-\frac{\partial w_1}{\partial \alpha_{A1}}-2\frac{\partial w_2}{\partial \alpha_{A1}}\right)\right.$$
$$\left.+\alpha_{A2}H_2''(.)\left(\frac{\partial w_1}{\partial \alpha_{A1}}-\frac{\partial w_2}{\partial \alpha_{A1}}\right)\right\}$$

$$\Rightarrow \frac{\partial w_1}{\partial \alpha_{A1}}\left[\left\{\lambda_1+\mu_1\frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\}\{2\alpha_{P1}G_1''(.)-\alpha_{A1}H_1''(.)\}\right.$$
$$+\left\{\lambda_2+\mu_2\frac{f_{2_{e_2}}(x_2|e_2)}{f_2(x_2|e_2)}\right\}\{2\alpha_{P2}G_2''(.)-\alpha_{A2}H_2''(.)\}-2\pi_1 S_1''(.)$$
$$\left.-2\pi_2 S_2''(.)\right]$$
$$+\frac{\partial w_2}{\partial \alpha_{A1}}\left[\left\{\lambda_1+\mu_1\frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\}\{\alpha_{P1}G_1''(.)+\alpha_{A1}H_1''(.)\}\right.$$
$$+\left\{\lambda_2+\mu_2\frac{f_{2_{e_2}}(x_2|e_2)}{f_2(x_2|e_2)}\right\}\{4\alpha_{P2}G_2''(.)+\alpha_{A2}H_2''(.)-u_2''(w_2)\}-\pi_1 S_1''(.)$$
$$\left.-4\pi_2 S_2''(.)\right]=-H_1'(.)\left\{\lambda_1+\mu_1\frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\}$$
$$\Rightarrow B\frac{\partial w_1}{\partial \alpha_{A1}}+C\frac{\partial w_2}{\partial \alpha_{A1}}=-H_1'(.)\left\{\lambda_1+\mu_1\frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\}$$

From here by solving these we get,

$$\frac{\partial w_1}{\partial \alpha_{A1}}=\frac{\begin{vmatrix} H_1'(.)\left\{\lambda_1+\mu_1\frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\} & B \\ -H_1'(.)\left\{\lambda_1+\mu_1\frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\} & C \end{vmatrix}}{\begin{vmatrix} A & B \\ B & C \end{vmatrix}}=\frac{(B+C)H_1'(.)\left\{\lambda_1+\mu_1\frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\}}{AC-B^2}$$

$$\frac{\partial w_2}{\partial \alpha_{A1}} = \frac{\begin{vmatrix} A & H_1'(.)\left\{\lambda_1 + \mu_1 \frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\} \\ B & -H_1'(.)\left\{\lambda_1 + \mu_1 \frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\} \end{vmatrix}}{\begin{vmatrix} A & B \\ B & C \end{vmatrix}} = \frac{-(A+B)H_1'(.)\left\{\lambda_1 + \mu_1 \frac{f_{1_{e_1}}(x_1|e_1)}{f_1(x_1|e_1)}\right\}}{AC - B^2}$$

In case if $w_2 > w_1$ then $H_1'(.) > 0$ therefore $\frac{\partial w_1}{\partial \alpha_{A1}} > 0$ and $\frac{\partial w_2}{\partial \alpha_{A1}} < 0$. The result holds for both status-seeking and inequity-averse principals.

This implies that as α_{A1} increases the gap between $w_2(.)$ and $w_1(.)$ falls.

Similar result can be shown in case of α_{A2} as well.

Proof of Corollary-1:

Participation constraint for agent i:

$$EU_A^i = \int_{\underline{x}_1}^{\overline{x}_1}\int_{\underline{x}_2}^{\overline{x}_2} f_1(x_1|e_1)\, f_2(x_2|e_2)\{u_i(w_i) - \alpha_{Pi}G_i(x_1 + x_2 - 2w_i - w_j) - \alpha_{Ai}H_i(w_j - w_i)\}dx_1dx_2 - c_i(e_i) \geq u_i$$

Now we divide both side of PC by α_{Ai} to get,

$$\int_{\underline{x}_1}^{\overline{x}_1}\int_{\underline{x}_2}^{\overline{x}_2} f_1(x_1|e_1)\, f_2(x_2|e_2)\left\{\frac{u_i(w_i)}{\alpha_{Ai}} - \frac{\alpha_{Pi}G_i(x_1 + x_2 - 2w_i - w_j)}{\alpha_{Ai}} - H_i(w_j - w_i)\right\}dx_1dx_2 - \frac{c_i(e_i)}{\alpha_{Ai}} \geq \frac{u_i}{\alpha_{Ai}}$$

Now consider the case when α_{Ai} is so large so that $\alpha_{Ai} \to \infty$

$$\lim_{\alpha_{Ai}\to\infty}\left[\int_{\underline{x}_1}^{\overline{x}_1}\int_{\underline{x}_2}^{\overline{x}_2} f_1(x_1|e_1)\, f_2(x_2|e_2)\left\{\frac{u_i(w_i)}{\alpha_{Ai}} - \frac{\alpha_{Pi}G_i(x_1 + x_2 - 2w_i - w_j)}{\alpha_{Ai}} - H_i(w_j - w_i)\right\}dx_1dx_2 - \frac{c_i(e_i)}{\alpha_{Ai}}\right] \geq \lim_{\alpha\to\infty}\frac{u_i}{\alpha_{Ai}}$$

$$\Rightarrow \int_{\underline{x}_1}^{\overline{x}_1}\int_{\underline{x}_2}^{\overline{x}_2} f_1(x_1|e_1)\, f_2(x_2|e_2)\{-H_i(w_j - w_i)\}dx_1dx_2 \geq 0$$

This can only hold if $H_i(w_j - w_i) = 0$. Therefore $w_1(x_1, x_2) = w_2(x_1, x_2)$ as $\alpha_{Ai} \to \infty$.

References:

Banerjee, S. and Chakraborty, S. (2023). Optimal Incentive Contracts with a Spiteful Principal: Single Agent, *Mathematical Social Sciences*, 122, 29-41.

Banerjee, S. and Sarkar, M. (2017). Other-regarding Principal and Moral Hazard: The Single Agent Case, *International Journal of Economic Theory*, 13, 313–326.

Bartling, B., (2011), "Relative performance or team evaluation? Optimal contracts for other-regarding agents", *Journal of Economic Behaviour and Organization*, 79, 183-93.

Bartling, B., von Siemens, F., (2010). The intensity of incentives in firms and markets: moral hazard with envious agents. *Labour Economics* 17 (2), 598–607.

Bolton, G. E. and A. Ockenfels (2000) "ERC: A Theory of Equity, Reciprocity, and Competition", *American Economic Review*, Vol. 90, pp. 166–193.

Camerer, C. F., (2003), *Behavioral Game Theory*, Princeton, NJ: Princeton University Press.

Che, Y.-K. and S.-W. Yoo (2001) "Optimal Incentives for Teams", *American Economic Review*, Vol. 91, pp. 525–541.

Demougin, D., Fluet, C., (2006). Group vs. individual performance pay when workers are envious. In: Demougin, D., Schade, C. (Eds.), Contributions to Entrepreneurship and Economics. Duncker and Humblot Verlag.

Demougin, D., Fluet, C., Helm, C., (2006). Output and wages with inequity-averse agents. *Canadian Journal of Economics* 39, 399–413.

Dur, R., and A. Glazer, (2008), Optimal incentive contracts when workers envy their bosses, *Journal of Law Economics and Organization* **24** (1), 120–137.

Englmaier, F. (2005), A survey on moral hazard, contracts, and social preferences. In: Agarwal, B., Vercelli, A. (Eds.), *Psychology, Rationality and Economic Behaviour: Challenging Standard Assumptions*, Palgrave-MacMillan, Hampshire, UK, 125–139.

Englmaier, F., and S. Leider, (2008), Contractual and organizational structure with reciprocal agents, CESifo Working Paper 2415.

Englmaier, F., and F. Wambach, (2010), Optimal incentive contracts under inequity aversion, *Games and Economic Behaviour* **69**, Issue-2, 312–328.

Fehr, E., and K. M. Schmidt, (1999), A Theory of Fairness, Competition and Cooperation, *Quarterly Journal of Economics,* **114** (3), 817-68.

Fehr, E., and K. M. Schmidt, (2003), Theories of Fairness and Reciprocity: Evidence and Economic Applications. In: Dewatripont, M., Hansen, L. P., Turnovsky, S. J. (Eds), *Advances in Economics and Econometrics: Theory and Applications*, Eighth World Congress, Vol. I. Cambridge: Cambridge University Press, 208–257.

Forsythe, R., J. L. Horowitz, N. E. Savin and M. Sefton, (1994), Fairness in Simple Bargaining Experiments, *Games and Economic Behaviour* **6**, 347–369.

Goel, A.M., Thakor, A.V., 2006. Optimal contracts when agents envy each other. Discussion Paper, DePaul University.

Grund, C., Sliwka, D., (2005). Envy and compassion in tournaments. *Journal of Economics and Management Strategy* 14, 187–207.

Holmström, B., 1982. Moral hazard in teams. *Bell Journal of Economics* 13, 324–340.

Itoh, H., (2004), Moral Hazard and Other-Regarding Preferences, *Japanese Economic Review* **55**, No.1, 18-45.

Mookherjee, D. (1984) “Optimal Incentive Schemes with Many Agents”, *Review of Economic Studies*, Vol. 51, pp. 433–466.

Neilson, W. S., and J. Stowe, (2003), Incentive Pay for Other-Regarding Workers. mimeo.

Neilson, W.S., Stowe, J., (2010). Piece-rate contracts for other-regarding workers. *Economic Inquiry* 48 (3), 575–586.

Rey Biel, P., (2008). Inequity aversion and team incentives. *Scandinavian Journal of Economics* 110 (2), 297–320.

Quinlivan, M. (2020). “Coronavirus: Fletcher Building proposes huge staff pay cuts, union claims executives will keep earning 'megabucks'”
(https://www.newshub.co.nz/home/money/2020/04/coronavirus-fletcher-building-proposes-huge-staff-pay-cuts-union-claims-executives-will-keep-earning-megabucks.html Accessed on 15/04/2020)