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Group vs. Individual Performance Pay When Workers Are Envious*

Dominique Demougin[†], Claude Fluet[‡]

Résumé / Abstract

Nous comparons les coûts salariaux des rémunérations incitatives par bonus de groupe et par bonus individuels. Quand les travailleurs ont une propension à l'envie, l'un ou l'autre de ces modes de rémunération peut s'avérer le moins coûteux étant donné l'arbitrage entre l'insatisfaction associée aux inégalités salariales et les incitations à l'effort qu'elles engendrent.

Mots clés : Bonus, salaire d'efficience, envie, équité, incitations.

We compare the wage costs of providing incentives through group versus individual bonus schemes. When workers are envious, either scheme may be the least cost one owing to the trade-off between the dissatisfaction with the prospect of unequal pay and the incentives it generates.

Keywords: Bonus, Efficiency Wage, Envy, Fairness, Incentives.

Codes JEL : D8, J4.

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1. INTRODUCTION

Workers resent being paid less than their peers when they work the same. This is often offered as an explanation for compressed salary structures. We show, to the contrary, that firms may favor reward systems with the prospect of unequal pay precisely because of the workers' distaste for wage inequality.

Assuming some form of performance pay is needed to align incentives, we compare the cost to the firm of group versus individual bonus schemes when employees are envious. With individual performance pay and imperfect performance measures, a worker faces a positive probability of earning less than his co-workers. If wage inequality is a source of dissatisfaction, workers may then require compensation through higher expected wages. By contrast, in a group scheme the wage outcome is the same for all and therefore the expected wage need not include an "inequality premium". We show that wage compression — as with the group bonus scheme — is nevertheless undesirable from the firm's point of view if performance measures have sufficiently poor information content or workers have poor outside opportunities. The reason is that the possibility of unequal pay allows envy to be used as motivator. This benefits the firm when workers earn rent, as in efficiency wage situations.

Although there is substantial evidence that workers attach importance to relative wages in addition to absolute payoffs¹, the extent to which such concerns explain reward systems remains controversial. However, the consensus seems to be that, if relevant, concerns for equity or fairness could explain wage compression or the absence of individual performance pay often observed in practice.² Our analysis shows that this prediction should be qualified. In our model, the firm would do as well with group or individual bonus schemes if workers were indifferent to relative payoffs. This is no

¹Numerous references can be found in Akerloff and Yellen (1990), Levine (1991) and Clark and Andrew (1996) among others. This view is also widely shared by practitioners in personnel management.

²See for instance Baker et al. (1988). Of course, there are other explanations for wage compression, as in Lazear (1989).

longer true when workers are assumed to have a propensity for envy. Which scheme leads to the lowest wage costs then depends on the workers' reservation utility and on the precision of available performance measures. When workers are envious, there is therefore a trade-off between the dissatisfaction associated with unequal pay and the incentives it generates .

2. THE MODEL

For simplicity, consider a firm employing only two workers. Borrowing from Fehr and Schmidt (1999), we write the utility of payoff π_i when the co-worker earns π_j as

$$U(\pi_i, \pi_j) = \pi_i - \alpha \max(\pi_j - \pi_i, 0), \quad i, j = 1, 2. \quad (1)$$

With $\alpha > 0$ the second term on the right hand side is the utility loss from disadvantageous inequality and reflects the worker's propensity for envy.³ The interpretation is that workers would be willing to sacrifice earnings to work in an environment where they would not be outperformed.

Although workers are otherwise risk neutral, envy implies the equivalent of risk aversion with respect to gambles with a positive probability of turning out either ahead or behind one's co-worker. To illustrate, suppose i faces equal chances of $\pi + \varepsilon$ or $\pi - \varepsilon$ while the co-worker gets π for sure. For ε positive, individual i 's expected utility is then

$$U = \pi - \frac{1}{2}\alpha\varepsilon. \quad (2)$$

Supposing instead that i gets π for sure while it is the co-worker who faces equal chances of $\pi + \varepsilon$ or $\pi - \varepsilon$, individual i 's utility is also as in (2). The second term on the right hand side of (2) will be referred to as the inequality premium.

Payoffs are $\pi = w - c(e)$ where w is the worker's wage and e is effort with cost $c(e)$, an increasing and strictly convex function with $c(0) = 0$. Effort is non contractible but it can be verified whether a worker's performance is good or bad. The probability

³See Mui (1995) and Bolton and Ockenfels (2000) for alternative specifications.

of good performance is $p(e_i)$, a strictly increasing and concave function. The realized performances of the two workers are independent events.

Workers are paid a base wage l with certainty and a bonus if performance is good. In the individual scheme, payment of the bonus depends only on the worker's performance. In the group scheme, a group bonus is shared equally between the workers when they are deemed to perform well collectively. This relies on an index of group performance aggregating the individual performance measures, which constitute here the only available information.

We analyze the cost to the principal of inducing arbitrary effort levels — that is, we characterize the wage cost function of effort — allowing the principal to choose between group and individual schemes. The first step is to minimize wage costs for each scheme, subject to implementing a given effort level and to participation and limited liability constraints. Workers have reservation utility $u \geq 0$ and they cannot be paid a negative wage, i.e. their wealth constraint imposes $l \geq 0$.

3. INDIVIDUAL BONUS

Workers observe each other's effort and wages. Let Δ_I denote the bonus in the individual scheme. When exerting e_i while his co-worker exerts e , worker i 's expected utility is

$$\bar{U}(e_i, e) = l + p(e_i)\Delta_I - c(e_i) - \varphi(e_i, e), \quad (3)$$

where $\varphi(e_i, e)$ is the inequality premium. The premium function has a kink at $e_i = e$. Writing $\varphi^-(e_i, e)$ for the value of the premium when $e_i \leq e$ and $\varphi^+(e_i, e)$ when $e_i > e$, it is easily checked that

$$\varphi^-(e_i, e) = \alpha p(e)(1 - p(e_i)) [c(e_i) + \Delta_I - c(e)] \quad (4)$$

and

$$\varphi^+(e_i, e) = \varphi^-(e_i, e) + \alpha [p(e_i)p(e) + (1 - p(e_i))(1 - p(e))] [c(e_i) - c(e)]. \quad (5)$$

To interpret (4), observe that the probability of worker i being outperformed is $p(e)(1 - p(e_i))$. When he supplies less effort than his co-worker, the individual suffers from envy only when the co-worker is the only one to obtain the bonus, hence the expression in (4).⁴ Note that supplying less effort reduces the dissatisfaction from “losing”. In (5), when he has exerted more effort than his co-worker, the individual experiences envy not only when the co-worker is the only one to get a bonus but also when both get paid the same wage. Although he earns the same, the individual then resents his net payoff being smaller due to his greater effort.

The effort level required by the principal is $e > 0$. Worker i 's expected utility in (3) is strictly concave in e_i . The scheme therefore induces worker i to supply effort e if

$$p'(e_i) \Delta_I - c'(e_i) - \frac{\partial \varphi^-(e_i, e)}{\partial e_i} = 0 \quad \text{at } e_i = e, \quad (6)$$

that is if

$$[1 + \alpha p(e)] \Delta_I p'(e) - [1 + \alpha p(e)(1 - p(e))] c'(e) = 0. \quad (7)$$

A propensity for envy magnifies the marginal benefits from more effort because it reduces the probability of being outperformed. At the same time it increases the marginal disutility of effort. The reason is that reducing effort reduces the dissatisfaction from being outperformed.

From (7) the bonus for implementing the required effort satisfies

$$\Delta_I = \lambda \frac{c'(e)}{p'(e)} \quad \text{where } \lambda = \frac{1 + \alpha p(e)(1 - p(e))}{1 + \alpha p(e)}. \quad (8)$$

In equilibrium the workers' expected utility is

$$\bar{U}_I = l + p(e) \Delta_I - c(e) - \varphi,$$

where the inequality premium is given by

$$\varphi = \alpha p(e)(1 - p(e)) \Delta_I. \quad (9)$$

⁴The expression inside the brackets is positive for any $e_i \leq e$ if $\Delta_I > c(e)$, as will in fact always be the case.

Wage costs per worker are $l + p(e) \Delta_I$. To minimize costs, the base wage must be the smallest consistent with $l \geq 0$ and $\bar{U}_I \geq u$. Obviously, $l = 0$ if the participation constraint is not binding in the solution. Otherwise, l is determined by the binding participation constraint. Substituting from (8) for the expected bonus and checking which constraint is binding, we get our first result.

RESULT 1: *In the individual bonus scheme, wage costs per worker are*

$$W_I(e) = \max \left[\lambda \frac{p(e)c'(e)}{p'(e)}, u + c(e) + \varphi \right] \quad (10)$$

where

$$\varphi = \alpha \lambda (1 - p(e)) \frac{p(e)c'(e)}{p'(e)}. \quad (11)$$

When workers earn rent, wage costs equal the expected bonus. When no rent is earned, wage costs are the sum of the worker's reservation utility and effort cost, plus the inequality premium.

4. GROUP BONUS

The best index of group performance is the one for which the group is deemed to perform well when both workers' performances are simultaneously good.⁵ Denoting the per worker bonus by Δ_G , the expected utility of exerting effort e_i when the co-worker exerts e is

$$\bar{U}(e_i, e) = l + p(e_i)p(e)\Delta_G - c(e_i) - \alpha \max [c(e_i) - c(e)]. \quad (12)$$

This is also strictly concave in e_i , so that worker i supplies effort e if

$$p'(e)p(e)\Delta_G - c'(e) = 0. \quad (13)$$

⁵To illustrate, suppose the individual performance measure is the worker's output $X_i \in \{0, 1\}$ with $p(e_i)$ as the probability that $X_i = 1$. Letting the group measure be the total output $Y = X_1 + X_2$, good performance for the group is $Y = 2$. An alternative is to associate good performance for the group with the event of at least one worker performing well (i.e. $Y \geq 1$), but wage costs are then never smaller and are strictly larger for some parameter values (this is due to the limited liability constraints since otherwise a first-best is feasible, as shown in Holmstrom (1982)).

In equilibrium the required per worker bonus is therefore

$$\Delta_G = \frac{c'(e)}{p(e)p'(e)}. \quad (14)$$

Expected utility is

$$\bar{U}_G = l + p(e)^2 \Delta_G - c(e) \quad (15)$$

and wage costs per worker are $l + p(e)^2 \Delta_G$. As in the preceding section, the base wage is the smallest consistent with the participation and limited liability constraints $\bar{U}_G \geq u$ and $l \geq 0$.

RESULT 2: *In the group scheme, wage costs per worker are*

$$W_G(e) = \max \left[\frac{p(e)c'(e)}{p'(e)}, u + c(e) \right]. \quad (16)$$

Again wage costs equal the expected bonus when workers earn rent. When no rent is paid, wage costs are the sum of reservation utility and effort cost. There is no inequality premium since workers are always paid the same wage.

5. COMPARISON

When $\alpha = 0$, $\lambda = 1$ and $\varphi = 0$. Hence the two schemes have identical wage costs if workers are not envious. λ is decreasing in α while φ is increasing, implying $\lambda < 1$ and $\varphi > 0$ when $\alpha > 0$. The individual scheme then has a smaller expected per worker bonus, but it is also characterized by a positive inequality premium. Under either scheme, workers clearly do not earn rent if their reservation utility is sufficiently large. When workers are envious, the group scheme is therefore unambiguously better for a sufficiently large reservation utility. By contrast, if rent is earned under both schemes, the individual bonus is better because of the smaller expected bonus. A propensity for envy generates greater incentives because workers attach importance to reducing the probability of being outperformed, hence the lower wage costs under the individual scheme. The remaining possibility is when rent is earned under the group bonus but not with the other scheme.

Whether rent is earned or not depends on the reservation utility and on how informative the performance measures are. A more informative performance measure is characterized by a larger value for $p'(e)/p(e)$. The intuition is that the probability of good performance is then more sensitive to the worker's effort.⁶ In the group scheme, rent is earned if

$$\frac{p(e)c'(e)}{p'(e)} > u + c(e). \quad (17)$$

RESULT 3: *The inequality (17) holds when performance measures are sufficiently poor or the reservation utility is sufficiently small.*

PROOF: The first part of the claim is obvious for $p'(e)/p(e)$ sufficiently small. To prove the second part, note that the strict convexity of $c(e)$ and the concavity of $p(e)$, together with $c(0) = 0$, imply $ec'(e)/c(e) > 1 \geq ep'(e)/p(e)$. Hence (17) holds for $u = 0$ and therefore for u small. ■

The individual scheme is better than the group bonus if

$$\max \left[\frac{p(e)c'(e)}{p'(e)}, u + c(e) \right] > \max \left[\lambda \frac{p(e)c'(e)}{p'(e)}, u + c(e) + \varphi \right]. \quad (18)$$

Given that $\lambda < 1$, the necessary and sufficient condition for (18) is

$$\frac{p(e)c'(e)}{p'(e)} > u + c(e) + \varphi. \quad (19)$$

The next result states that the preceding inequality is satisfied under conditions similar to that in result 3, provided the propensity for envy is not too strong.

RESULT 4: *If workers are envious but α is not too large, the individual bonus scheme is better when performance measures are sufficiently poor or the reservation utility is sufficiently small.*

⁶For the signal X , define the random variable $Z = f_e(X, e)/f(X, e)$ where $f(\cdot, e)$ is the probability distribution of the signal. From Kim (1995), the signal \hat{X} is more informative than X with respect to e if its associated likelihood ratio \hat{Z} is a mean preserving spread of Z . In the present model this implies a larger value for $p'(e)/p(e)$. See Demougin and Fluet (2001) for an application to endogenous monitoring in the risk neutral agency problem.

PROOF: Substituting for φ from (11), condition (19) is equivalent to

$$\frac{p(e)c'(e)}{p'(e)} [1 - \alpha\lambda(1 - p(e))] > u + c(e) \quad (20)$$

A sufficient condition for (20) is

$$\frac{p(e)c'(e)}{p'(e)} (1 - \alpha\lambda) > u + c(e) \quad (21)$$

If $\alpha\lambda < 1$, condition (21) holds for any given u if $p'(e)/p(e)$ is sufficiently small. Noting that $\alpha\lambda$ is increasing in α then proves the first part of the claim. For a given value of $p'(e)/p(e)$, (21) holds at $u = 0$ if

$$\alpha\lambda < 1 - \frac{c(e)p'(e)}{p(e)c'(e)} \quad (22)$$

where the right hand side is strictly positive by result 3. This proves the second part. ■

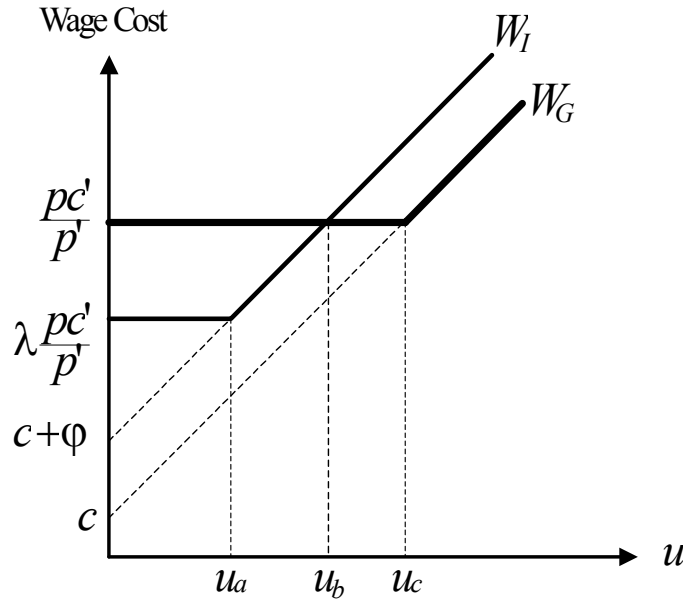


FIGURE 1. WAGE COSTS

Wage costs are as depicted in figure 1. In the group scheme, rent is earned when $u < u_c$. The critical u_c is larger the poorer the performance measure. The individual scheme is better when $u < u_b$. The possibility of rent with the individual bonus (as when $u < u_a$ in the figure) is not essential to the argument. A larger α reduces λ and increases φ , which means that rent may not arise in the individual scheme even with u small. However, the individual scheme remains better for a sufficiently small reservation utility as long as $p(e)c'(e)/p'(e) > c(e) + \varphi$. Moreover, as should be obvious from the figure, the principal would benefit from (marginally) more envious workers whenever rent is earned with the individual bonus.

6. CONCLUSION

With individual performance pay, identical workers face the possibility of unequal wages. A propensity for envy then increases incentives, other things equal. On the other hand, the workers' anticipated frustration from being outperformed may require compensation. There is therefore the possibility of a trade-off between reward systems that exploit the incentives generated by envy and those which reward workers as a group. We showed that individual performance pay is preferable, at least from the firm's point of view, if available performance measures have relatively poor information content or if workers have poor outside opportunities. Otherwise, group reward systems have lower wage costs.

REFERENCES

- Akerlof, G. A. and J. L. Yellen (1990), "The Fair Wage-Effort Hypothesis and Unemployment", *Quarterly Journal of Economics* 105, 255-283.
- Baker, G. P., M. C. Jensen and K. J. Murphy (1988), "Compensation and incentives: practice vs. theory", *Journal of Finance* 43, 593-616.
- Bolton, G. E. and A. Ockenfels (2000), "ERC - A Theory of Equity, Reciprocity and Competition." *American Economic Review*, 90, pp. 166-193.

- Clark, A. E. and O. Andrew J. (1996), "Satisfaction and Comparison Income", *Journal of Public Economics* 61, 359-381.
- Demougin, D. and C. Fluet (2001), "Monitoring versus Incentives", *European Economic Review* 45, 1741-1764.
- Fehr, E. and K. Schmidt (1999), "A Theory of Fairness, Competition, and Cooperation." *Quarterly Journal of Economics* 114(3), pp. 817-68.
- Holmstrom, B. (1982), "Moral hazard in Teams", *Bell Journal of Economics* 13, 324-40.
- Lazear, Edward (1989), "Pay Equality and Industrial Politics", *Journal of Political Economy* 97, 561-580.
- Levine, D. L. (1991), "Cohesiveness, Productivity, and Wage Dispersion", *Journal of Economic Behavior and Organization* 15, 237-255.
- Mui, V.-L. (1995), "The Economics of Envy", *Journal of Economic Behavior and Organization* 26, 311-336.