Incentives for Helping on the Job:

Theory and Evidence

Robert Drago

University of Wisconsin-Milwaukee

Gerald T. Garvey

Australian National University

February, 1993

The order of authorship is purely alphabetical. The authors thank the Business Council of Australia and Australian Research Council for funding the research upon which the analysis is based, and thank Bruce Bender, John S. Heywood, M.L. Higgins, Debashis Pal and Byron Yaffe for valuable discussions. *Comments appreciated.*

Incentives for Helping on the Job:

Theory and Evidence

ABSTRACT

Recent advances in incentive theory stress the multi-dimensional nature of agent effort and particularly the case where workers can improve the performance of others through 'helping' efforts. This paper provides a simple model of an agent's incentive to help depending on the compensation package, the cost of monitoring, and the allocation of tasks. We then analyze the determinants of reported helping efforts within workgroups for a sample of Australian workers. As expected, workers are less likely to help one another when promotion incentives are strong. Subsidiary results are consistent with our 'contest' interpretation of this finding and not with a 'gift exchange' theory whereby pay inequality is demotivating *per se*. Also as predicted, a wide range of job tasks amplifies the negative effect of promotional incentives, while monitoring of help mitigates the negative effect. We find an unexpected positive effect of piece rates on helping effort for long-term employees which we show is consistent with repeated game effects between workers. These considerations do not overturn our findings about the effects of tournaments.(JEL J33)

I. Introduction

Recent work in incentive theory has explicitly recognized that agents can allocate their time and attention in many different directions. Drago and Turnbull (1988; 1991), Lazear (1989), Itoh (1991, 1992) and Ramakrishnan and Thakor (1991) allow each member of a productive team to devote costly effort to their own task *and* to helping their fellows with their tasks. Holmstrom and Milgrom (1991; 1992) and Baker (1992) extend this approach to the case where each agent performs an arbitrary number of tasks. A major contribution of these models an explanation for the low-powered incentive schemes which are often used by firms but pose a puzzle for the standard principal-agent approach (Baker, Jensen and Murphy 1988). The basic idea is that low-powered incentives increase the agent's motivation to take productive actions which are difficult to measure and hence explicitly reward. Examples are maintaining quality or friendly customer relations, as well as direct helping actions such a providing constructive comments on colleagues' working papers.

This paper develops and tests a model of how commonly used incentive schemes alter the extent of helping by workers. Rather than deriving optimal compensation contracts, we examine the effect of exogenously given pay schemes on workers' incentive to help. While this approach does not provide a complete account of workplace incentives, it allows us to confront the theory directly with data and therefore to provide some of the first available evidence on multi-dimensional agency problems.

A major feature of the analysis is that we take explicit account of the incentive effects of promotion. The importance of promotion-based incentives is highlighted by recent empirical research which finds that rank *per se* is a critical determinant of worker earnings (Lazear 1992; Baker, Gibbs and Holmstrom 1993; Main, O'Reilly and Wade 1993) and that contests have predictable effects on agent performance (Ehrenberg and Bognanno 1990). Lazear (1989) predicts that in such settings, the strength of promotional incentives will be inversely related to helping efforts. Our data tend to support this hypothesis.

Lazear's prediction rests in part on the assumption that helping others never directly enhances one's own performance ranking and indeed hurts it by increasing the productivity of one's rivals for promotion. In fact, supervisors can often gather some information, albeit imperfect, permitting them to account for a worker's helping effort in determining performance rankings. For example, Whyte's (1956) study of General Electric's highly competitive management training program concluded that winning trainees "must co-operate with the others -- but co-operate *better* than they do."(p. 124) Incorporating this possibility into the model leads us to predict that the negative effect of promotional prizes on helping effort is reduced when supervisors have better information about such behavior.

Previous research also suggests that individual piece rates should negatively affect helping efforts while sharing schemes such as profit sharing and employee stock ownership plans should enhance such behavior (Drago and Turnbull 1988).

Finally, the work of Holmstrom and Milgrom (1991), Itoh (1992) and Ramakrishnan and Thakor (1991) shows how task allocation and job design alter workers' effort choices in multi-dimensional effort settings. We therefore distinguish between cases where workers have a narrow as opposed to a broad range of assigned tasks. As argued in Itoh (1992), narrow task assignments may reduce the cost that a worker bears in helping others; for example, helping efforts may simply relieve boredom or otherwise make use of idle assets. By the same token, workers engaging in a variety of tasks may find helping effort more burdensome. Incorporating this insight into the model through the agent's utility function leads us to predict that a wide variety of task assignments will reduce the level of helping effort and alter the effects of compensation schemes. In particular, the model suggests that broad task assignments increase the negative effect on helping for promotional prizes and individual piece rate incentives, and reduce the positive effect of sharing schemes as well.

For the empirical analysis, we employ a recent survey of 839 Australian employees. The survey is unique in that it permits us to assign respondents to particular workgroups and provides information on the helping efforts of others in these groups. The data thereby circumvents the difficulty of measuring helping effort directly and allows us to avoid the moral hazard problem implicit in requesting individuals to evaluate their own provision of help to others. We then use this data to test for the direct effects of tournaments, piece rates, share schemes, monitoring and task variety on helping efforts, and also for expected interaction effects.

The paper is organized as follows. Section II presents the theoretical model. Section III introduces the data set used to test the model's predictions. Section IV provides an analysis of the data, while Section V presents conclusions and suggestions for further research.

II. A Simple Model of Helping on the Job

We analyze the helping choice of a single, risk-neutral, representative agent in a single period game. In order to analyze the incentive effects of tournaments we introduce a second, identical worker who may compete with the representative agent for a promotional prize. Each agent selects only two types of effort. First, there is own effort which directly increases his own value marginal product. Second there are helping efforts which increase the value marginal product of the other, given perfect information regarding systems for performance evaluation and compensation by the principal.

The representative worker, designated number one, exhibits value marginal product $q_1 = a_1 + h_2$, where a_1 is worker one's own effort and h_2 is help received from worker two. Similarly, worker two's value marginal product is $q_2 = a_2 + h_1$, where a_2 is worker two's own effort and h_1 is help received from worker one. Worker one's performance rating takes the form $R_1 = q_1 + (s/2)h_1 + (1\text{-}s/2)h_2 + m/2$, and worker two's rating is $R_2 = q_2 + (s/2)h_2 + (1\text{-}s/2)h_1 - m/2$. The term s parameterizes the firm's ability to credit helping efforts to the party that actually exerted them. Lazear's (1989) model assumes $s=0$, and perfect performance attribution would imply $s=2$. The random variable m represents the 'pure' noise in performance ratings that is standard in the tournament literature. Worker one is promoted and receives a premium of *p* prize dollars if he has a superior performance measure such that $R_1 > R_2$. Denoting the cumulative distribution of the random variable *m* by *F*, and the density by *f*, worker one is promoted with probability $F(R_1 - R_2)$. We assume that $f(\cdot)$ has a unique mode at zero with $f(0) = 1$. The last assumption is merely for notational convenience and see McLaughlin (1988) on the role of unimodality in contest models. Note also that measurement error need only affect the helping element in the performance rating, so individual value marginal product can be measured without error.

The agent may additionally be subject to an individual piece rate scheme that gives him a fraction *i* of his output q_1, or may participate in a share scheme which provides him a fraction *g* of total output $(q_1 + q_2)$. While this is formally a revenue sharing scheme, we interpret it as a proxy for incentives of the sort associated with profit sharing systems or employee stock ownership plans. The important feature of all these systems is that each permits worker one to capture part of the product attributable to each type of effort by all workers in the firm.

As in any incentive model, we assume the representative agent values leisure. We introduce this assumption through a 'cost of effort' function of the following form: $a^2/2 + h^2/2 + \Delta ah$, where *a* and *h* are efforts selected by agent one, and $0 \leq \Delta \leq 1$ is a parameter described shortly. The quadratic form is chosen purely to produce simple closed-form expressions for helping effort choices while permitting us to alter the potential interrelationship among type of efforts as suggested by Holmstrom and Milgrom (1991). The final term reflects the degree to which the two types of effort interfere with one another as uses of the worker's time. If $\Delta = 0$, then own and helping effort do not interfere with each other. No matter how much individual effort the worker is exerting, the first unit of helping effort is costless at the margin (as in Garvey and Swan 1992; Itoh 1992). If $\Delta = 1$, then the cost of effort function is $(a+h)^2/2$, so the worker cares only about the total amount of both individual and helping efforts (as in Drago and Turnbull 1988; 1991).[1] We interpret Δ as indicating the range of tasks to which the worker is primarily assigned or the variety of tasks subsumed in *a*. If worker one's tasks are sufficiently broadly defined then own and helping efforts are very similar and should have much the same effort cost. By the same token, if the agent confronts a narrow range of tasks then helping could be a very different activity from individual effort and not affect its marginal cost much. Stated differently, we associate high values of Δ with interesting jobs, where help would not be viewed as an activity to alleviate boredom, while low values of Δ are associated with monotonous jobs where helping others would be viewed as a welcome opportunity.[2] Hence, we will say that a broader definition of tasks increases Δ.

Worker one, parallel to two, chooses own and helping effort to maximize expected utility of the form:

$$w + pF(R_1 - R_2) + iq_1 + g(q_1 + q_2) - (a^2/2 + h^2/2 + \Delta ah)\ , \qquad (1)$$

where w is the worker's flat wage payment (the term is safely ignored here as in Holmstrom and Milgrom 1991, or Itoh 1992). Assuming conditions for interior effort solutions, the first-order condition characterizing the choice of own effort is:

$$pf(R_1 - R_2) + i + g - (a + \Delta h) = 0\ . \qquad (2)$$

The first-order condition for the choice of helping effort is:

$$pf(R_1 - R_2)(s-1) + g - (h + \Delta a) = 0\ . \qquad (3)$$

In symmetric equilibrium, $R_1 = R_2$. Using our simplifying assumptions regarding risk-neutrality and quadratic costs we can simultaneously solve (2) and (3) to yield expressions for the agent's optimal effort choices given incentive, monitoring and task design parameters:

$$a^* = [p(1 + \Delta(1-s))+i]/(1-\Delta^2) + g/(1+\Delta)\ , \text{ and} \qquad (4)$$

$$h^* = [p(s-1-\Delta) - i\Delta]/(1-\Delta^2) + g/(1+\Delta)\ . \qquad (5)$$

Partially differentiating (5) with respect to the parameters p, s, i, g and Δ provides our first set of hypotheses. First of all, a larger promotional prize reduces helping:

$$\partial h^*/\partial p = (s - 1 - \Delta)/(1-\Delta^2) < 0 \text{ since } s < 1 . \tag{6}$$

The interpretation of (6) is the same as in Lazear (1989); increasing the prize raises the relative cost of helping by increasing the returns to own effort, assuming the firm cannot attribute help to its proper source (i.e., $s < 1$).

Similarly, an increase in the individual piece rate i will increase the marginal returns to own effort, so increase the relative cost of help. The relationship between the piece rate and help is therefore predicted to be negative. Formally,

$$\partial h^*/\partial i = -\Delta/(1-\Delta^2) < 0 , \tag{7}$$

noting that the term cannot go to zero due to restrictions on the task variety term (i.e., $\Delta > 0$).

Share schemes allow the worker to recoup some of the increased product of the other that was in fact due to help. As intuition suggests, this incentive mechanism increases the motivation to provide helping effort:

$$\partial h^*/\partial g = 1/(1+\Delta) > 0 . \tag{8}$$

An improvement in the firm's ability to measure help (s) reduces the degree to which worker two (one) receives credit for worker one's (two's) help in the promotional tournament. Therefore, the extent of help should be positively related to monitoring:

$$\partial h^*/\partial s = p/(1+\Delta^2) > 0 \text{ for } p > 0 , \tag{9}$$

noting that if there is no promotional tournament ($p = 0$), monitoring will have no effect on the selection of helping efforts.

Additionally, a broader variety of tasks increases the extent to which own efforts interfere with helping efforts. For interior effort solutions, task variety therefore increases the cost of helping so that:

$$\partial h^*/\partial\Delta = -(p + i)/(1+\Delta^2) - g/(1+\Delta^2)^2 + 2\Delta[p(s-1-\Delta) - \Delta i)/(1-\Delta^2)^2 < 0 \; . \qquad (10)$$

Relationships (6) to (10) constitute the primary testable implications of the model. We can also generate and test predictions for the effects of the measurement and task variety terms on the marginal effectiveness of the pay incentive schemes. Formally, a greater variety of tasks increases the disincentive effects of promotional prizes such that:

$$\partial/\partial\Delta(\partial h^*/\partial p) = -1/(1+\Delta^2) + 2\Delta(s-1-\Delta)/(1-\Delta^2)^2 < 0 \; . \qquad (11)$$

This prediction largely reflects the fact that as task variety increases, the individual effort incentives provided by a promotional prize become stronger (see (4)), thus making helping effort relatively more costly.

Better measurement of helping effort has the opposite effect, reducing the disincentive effects of promotional prizes since the agent knows any help he provides is more likely to be attributed to him. Therefore,

$$\partial/\partial s(\partial h^*/\partial p) = 1/(1-\Delta^2) > 0 \; . \qquad (12)$$

Since the degree of helping effort monitoring, *s*, only alters the worker's relative ranking and not physical output, it has no direct effect on the piece rate or share terms. A broader task definition, however, increases the degree of interference between own and helping effort, in turn increasing the disincentive effect of piece rates on helping:

$$\partial/\partial\Delta(\partial h^*/\partial i) = -(1+\Delta^2)/(1-\Delta^2)^2 < 0 \; . \qquad (13)$$

The share term motivates workers towards equality of own and helping efforts, while task variety induces agents to select own efforts only. Therefore, it is not surprising to find that increasing task variety undercuts the effects of share schemes on helping effort:

$$\partial/\partial\Delta(\partial h^*/\partial g) = -1/(1+\Delta^2) < 0 \ . \tag{14}$$

In sum, our major predictions are that helping efforts will be negatively associated with the promotional prize, piece rates and task variety, but will be positively associated with share schemes and monitoring of helping efforts. Predictions concerning cross-effects are that the negative effect of the prize will be amplified by an increase in task variety but reduced by any enhancement in helping effort monitoring, while a broad range of tasks should reduce (increase) the positive (negative) effects of share schemes (piece rates) on helping effort. We now turn to an empirical test of these relationships.

III. Data and Methodology

The data used here are from a 1988 survey of non-supervisory employees at 23 workplaces in Australia, described more completely by Drago, Wooden and Sloan (1992, Ch. 4). The questionnaire was designed to complement cross-national case study work concerning workplaces operated by members of the Business Council of Australia, an organization composed of large corporations in that country. The case study research resulted in samples of employees from eight different Australian workplaces.[3] Because this sample was restricted to large corporations, it was supplemented by surveys of employees at 15 smaller manufacturing workplaces located in Adelaide, Melbourne and Sydney.

A total of 2,066 Australian employees received the survey, and 839 of these individuals returned the survey in usable form, yielding a response rate of 40.6%. While the response rate is respectable for this type of survey, it is possible that respondents systematically diverge from non-respondents, thereby introducing selection bias into the data. A test for this possibility suggests such bias is relevant with respect to union members, who were far less likely to respond than their non-union counterparts (see Drago, et al 1992, Appendix C). Fortunately, we do not deal with the role of unions in this work, so ignore the issue here. Note also that the sample is skewed towards manufacturing. While 16% of Australian employment is in manufacturing, 82% of respondents are employed in this industry. Despite this skew, there is no obvious *ex ante* reason to suppose that results for a more random sample would significantly diverge from those reported here.

An important feature of the survey was that a member of the research team visited each workplace and gathered information permitting the classification of individual respondents into workgroups. The criteria for workgroup membership were that individuals must be employed at the same workplace, engage in most tasks while in physical proximity to other workgroup members, and be employed in similar or closely related occupations. Using these criteria, the main analysis presumes that individuals asked about the helping efforts of fellow employees will respond with information concerning behavior within their specific workgroup. While plausible, this supposition can be and is later tested against the null that such information refers to the average workplace employee.

Workgroup membership criteria were used to classify a majority of respondents (e.g., clerical workers, factory shopfloor workers, planning department, shipping, welders, painters, cashiers, etc.). For individuals who had no single physical job location, classification was by workplace and occupation only (e.g., for janitors, delivery truck drivers, and store detectives). In total, 765 of the 839 respondents were categorized into 86 distinct workgroups, with the 74 remaining respondents being either individuals whose occupation was relatively unique or for whom workgroup assignment was otherwise ambiguous. The minimum and maximum size of these groups was two and 80 respectively with a median membership of five respondents.

The sample analyzed is slightly smaller. For independent variables, we have complete information from 604 respondents in 82 workgroups. However, since workgroup level data is used for independent variables, and individual level data only for the dependent variable (see below), we have available 723 respondents from the 82 workgroups for the main analysis. A comparison of results for this sample against those for the restricted sample of 604 respondents will provide some indication of the extent to which response bias affects the results.

The basic strategy employed is to regress individual perceptions of whether other workgroup members engage in helping efforts against average measured workgroup attributes. Thus we test whether workgroup attributes are linked to perceived workgroup behaviors. While this strategy is less direct than measuring incentives and helping effort at the individual level, it has the advantage of avoiding the perceptual biases inherent in requesting individuals to gauge their own performance (Myer 1975), and circumvents the measurement difficulties involved in gathering direct information on individual helping efforts.

Variable Specification

The questionnaire included eleven items addressing the behavior of fellow employees. The question most clearly related to the issue of helping effort asks whether fellow employees refuse "to let other workers use their equipment, tools or machinery."[4] For the working sample, 405 respondents answered "never," 185 "seldom," 70 "occasionally," 36 "frequently," and 27 claimed that helping occurred "very frequently."[5] We reverse score these answers along a zero to four scale to obtain an ordinal indicator of helping efforts within the workgroup. This variable, *Helping effort* (h^* in the model), along with the independent variables, is described in Table 1.

Independent variables follow the theoretical model with indicators for the three incentive systems, for task variety, and for the monitoring of helping effort. The variable *Piece rate* (i in the model) measures the proportion of workgroup members receiving regular payments based on individual performance. Similarly, the variable *Share scheme* (g in the model) captures the proportion of workgroup members either receiving bonuses based on company performance or owning stock in the firm. In both cases, superior proxies for the theoretical variables would indicate the extent of payments involved in the systems or, more precisely, marginal rewards. Since these indicators only tell us where marginal rewards are positive, we anticipate somewhat noisy results on the relevant coefficients.

We now turn to construction of a proxy for the importance of promotional opportunities. While our model employed the assumption $f(0) = 1$, our predictions concerning prizes (equations (6), (11) and (12)) concern the joint effects of $pf(0)$. To proxy p we assume prize earnings take the form of *ex post* rents above value marginal product (Lazear and Rosen 1981) while the proportion of respondents in the workgroup receiving such rents proxies the marginal expectation value ($f(0)$ in the model). Clearly this strategy dictates backward-looking variable construction for cross-sectional data, forecasting expected future rewards on the basis of current experience. Nonetheless, this strategy is consistent with our comparative static approach. If the contest begins anew each period with a fixed number of employees and prizes, then in equilibrium the proportion of previous winners will equal the probability of winning and the prize size should be constant over time. However, for relatively simple examples from more dynamic models, such as that of Rosen (1986), our strategy might under- or over-state either term.

Contest winnings are generated from positive residuals for a log-linear weekly earnings equation (relatedly, see Levine 1993). The time period is chosen because prizes may be paid out over an extended period. The earnings equation should then capture the respondent's value marginal product, so we employ conventional human capital variables for explanatory purposes, including indicators for gender, marital status, dependents, hours of work, job tenure, shiftwork, schooling and occupation. The equation accounts for most of the variance in earnings differences.[6] It would therefore be difficult to attribute any findings associated with the prize variable to tenure, age or schooling effects.

For each workgroup, contest winnings are calculated as the average of the anti-log of the residuals for those experiencing a positive residual in the workgroup. To incorporate the marginal probability of winning, contest winnings are multiplied by the proportion of workgroup members with positive residuals, yielding the variable *Prize*.

Our proxies for *Task variety* (Δ in the model) and helping effort *Monitoring* (*s* in the model) are more straightforward. In each case we consider a single item from the survey which seems closely linked to the respective phenomena -- a question addressing whether the worker performs a "wide variety" of things on the job, and another concerning whether the workgroup and supervisor "meet frequently" to discuss work targets. While the task variety question is simple, the logic for selecting the helping effort monitoring question is that in circumstances where the workgroup meets frequently to discuss performance, this might signal that supervisors are concerned with observing helping efforts during working hours. Further, supervisors may gather information from peers on helping efforts at such meetings, and may observe helping efforts directly during such meetings (both are suggested by Whyte's story of General Electric). Because both variables are ordinal, they are converted to dummy variables such that the largest possible minority of respondents are classified as positive on each.[7] These dummy variables are averaged over each workgroup to obtain the proportional indicators *Task variety* and *Monitoring*.

The Empirical Model

Given rank-order data on helping efforts, the appropriate specification for regression purposes is the ordered probit (Zavoina and McElvey 1975). The major predictions of the model provided earlier in equations (6) through (10) then suggest the following empirical model:

$$z = B'(pf(0), i, g, s, \Delta) + \varepsilon \text{ , with} \qquad (15)$$

$$\varepsilon \sim N[0,1] \text{ , and}$$

$$h = 0 \text{ if } z \leq \mu_0 \text{ , } \quad h = 1 \text{ if } \mu_0 \leq z \leq \mu_1 \text{ ,}$$

$$h = 2 \text{ if } \mu_1 \leq z \leq \mu_2 \text{ , } \quad h = 3 \text{ if } \mu_2 \leq z \leq \mu_3 \text{ ,}$$

$$h = 4 \text{ if } \mu_3 \leq z \text{ ,}$$

where *h, pf(0), i, g, s* and [illegible] represent the variables *Helping effort, Prize, Piece rate, Share Scheme*, and *Task variety* respectively, B is a vector of coefficients, *z* is the latent measure of helping effort, ε is a normally distributed error, and μ_1 through μ_3 are estimated cut-offs for the latent variable in the model with μ_0 normalized to zero.

To expand the model to incorporate cross-effects (equations (11) through (14)), we later add to the list of independent variables the interaction terms *Prize x Task Variety*, *Prize x Monitoring*, *Piece rate x Task variety*, and *Share scheme x Task variety*, and accordingly expand the B vector.

As outlined above, the model requires two dubious assumptions. First, collinearity between the independent variables is excluded yet, as the matrix of correlation coefficients provided at the bottom of Table 1 suggests, this assumption is not accurate. Collinearity is particularly severe in terms of the positive association between the *Piece rate* and *Monitoring* variables. Given the conventional argument that piece rates conserve on effort monitoring costs, this relationship is somewhat surprising and suggests we test particularly for whether the effects of one variable are masking those of the other.

The empirical model also assumes homoskedasticity. Given the data yields diverse numbers of observations on helping within workgroups, it seems likely that this assumption is violated. If the expected value of the error on each individual's observation of helping effort was constant, then weighting the regression by the number of observations per workgroup would be appropriate; this would account for our having more and hence less noisy information on larger workgroups. However, it is possible that workgroup size is positively correlated with the error variance since it is more difficult for a single agent in a large workgroup to obtain accurate information on the behavior of all others in the group. We therefore apply the multiplicative approach to correcting for heteroskedasticity suggested by Greene (1992, p. 526), such that the variance of the error is given the form $[e^{\Upsilon w}]$, where *w* is the number of individuals in the workgroup and ϒ is an estimated parameter which can be either negative or positive.

IV. Results

The model in (15), corrected for heteroskedasticity, yields results as shown in regression (1) of Table 2. Contrary to predictions, *Piece rate* is positively, and *Share scheme* is negatively related to helping efforts. More consistent with the theoretical model, the *Prize* variable is negatively and significantly related to helping efforts, suggesting tournaments indeed discourage helping efforts. The *Task variety* variable attracts an unexpected positive and significant coefficient, while that for *Monitoring*, predicted to be positive, is insignificant. The heteroskedasticity correction is significant as expected and the positive sign implies information from larger workgroups is in fact noisier than that for their smaller counterparts.

We next test for cross-effects, performing separate Log-likelihood χ^2 tests for the additional explanatory power of the *Prize* variable interacted with *Task variety* and *Monitoring*, for *Piece rate* with *Task variety*, and for *Share scheme* with *Task variety*. Only the joint effect of the *Prize* interaction terms was significant.[8] Results including these two additional terms are reported in regression (2). While coefficients and t-statistics are similar for variables included in both regressions (1) and (2), the interaction terms in the latter attract signs as predicted and significance at conventional levels. This supports the theoretical argument that where tasks are more varied, the negative effect of promotional tournaments on helping efforts will be even stronger, but that monitoring of helping effort can mitigate the adverse effect of tournaments.

While these results support our interpretation of the effects of promotional contests, the piece rate, task variety and share scheme results are less consistent with the model. The unexpected positive coefficient on *Task variety* is obtained for virtually all specifications of the helping effort equation considered (see below), so we cannot reject the finding out of hand. An explanation which is consistent with our other findings is that individuals who perform a variety of tasks on the job are more productive when engaged in helping efforts; these workers have a lower cost of helping and may even receive more requests for help from other workers. Relatedly, the result may be an artifact of data construction: workers performing a wide variety of tasks may use any given tool infrequently, so have little reason to refuse others use of those tools. The difference between these explanations for the apparently positive task variety effect is, however, central to understanding whether task variety generally increases helping efforts. If the first explanation is correct, then we have indeed uncovered a general finding, while if the second explanation is true, the result is specific to our study.

Several specification tests were undertaken to check the robustness of our results.[9] First, the model of regression (2) was applied to the smaller sample of 604 respondents for which we have complete information, and results remained virtually the same as before, although the *Piece rate* coefficient only attracts significance at the 10% level, and significance for the *Prize x Task variety* coefficient is only at the 5% level. Second, to ascertain whether the indicator of help is picking up workplace rather than workgroup effects, 22 workplace level dummy variables for the 23 workplaces were added to the specification reported in regression (2). This fixed effects approach provides a very conservative test of the model since the workplace dummies not only control for the level at which help is measured by respondents, but will also overshadow any independent variables which tend to be constant within a given workplace. The main results were found to be reasonably robust, with the *Prize* coefficient achieving significance at the 1% level, and the *Prize x Monitoring* coefficient being positive and significant at the 5% level. Both terms including *Task variety* lose significance, but the evidence also suggests task variety is largely a workplace level phenomenon, so the loss of significance on *Task variety* does not clearly invalidate the relevant findings reported in Table 2.[10]

Another check on the results is suggested by Akerlof's (1982) model of 'gift exchange,' in which intra-workgroup pay dispersion is viewed as 'unfair' by employees and hence reduces work effort in general. This notion could provide an alternative explanation for why helping efforts decline as the prize increases. If this explanation is correct, however, it further implies that own effort will be decreasing in the prize, while ours and other tournament models consistently predict a positive correlation (see equation (4)). As a test of these competing hypotheses, we employed the aggregated independent variables as in regression (2) to predict self-reported respondent absenteeism. This strategy provides a stringent test of the prize effect since absenteeism is generally difficult to predict and is conventionally viewed as a highly individualistic form of shirking (Drago and Wooden 1992). Nonetheless, the *Prize* coefficient is negative and significant at the 1% level in the absence regression, consistent with our claim that the prize is positively correlated with individual effort, and contradicting the gift exchange argument.[11] Further evidence consistent with the tournament as opposed to gift exchange approach is found when we replicate regression (2) after replacing the prize variable with an indicator of wage dispersion *per se*, using either the standard deviation of the log wage or the core width of intra-group wages (as in Demsetz 1993). In both cases the wage dispersion coefficient fails to attract significance, again suggesting we reject the gift exchange approach.

While the piece rate and share scheme results are noisy (as expected given the nature of the data), it is odd that where coefficients on these schemes are significant, the sign opposes predictions. We therefore sought some explanation for these phenomena in the theory, and an obvious place to look was the potential for reputation effects in repeated games. In our one-shot model, workers rationally neglect the effect of their actions on their fellow workers. This assumption may be inaccurate when workers interact repeatedly, since this opens up the prospect for reputational forces to help internalize any externalities between workers. If reputations are sufficiently effective, it is possible for the piece rate term to actually increase helping, a possibility suggested by Burawoy's (1979) case study of workers performing under piece rates. In the Appendix we show how helping efforts can be positively related to i if reputation effects are sufficiently strong, and that share schemes should have an even stronger positive effect, but that reputations will not overcome the disincentive effects of the tournament. As an empirical matter, we would expect the disincentive effects of tournaments to be greater for long-term employees because they may have greater promotion prospects.

To examine reputation effects empirically, we average job tenure within each workgroup and split the sample at the median.[12] The logic for this approach is that even if a workgroup has some relatively new members, more experienced members can relay information to novices on past plays of the effort game and hence engender rational expectations for the rewards and penalties of helping efforts.[13] Mean tenure in the low tenure subsample is 2.852 years, while that in the high tenure group is 7.374.

Replications of regression (2) after splitting on tenure yield a Log-likelihood χ^2 statistic of 25.3 for the additional explanatory power of the approach (1% s.l. with 9 d.f.), consistent with the general notion that reputation effects matter. Results for the two regressions are reported in Table 3, where we find similar task variety results across the equations, but other results changing. As suggested by our discussion of reputation effects, we find the positive effect of piece rates on helping efforts only holds for the high tenure subsample. Similarly, both the direct and indirect prize effects are stronger in the high tenure subsample. Our interpretation is simply that short-term employees have a far smaller chance of participating in any lucrative tournament that our data may indicate. Indeed, the size of the *Prize* coefficient rises by over a hundred-fold in the high tenure subsample run compared to that found in Regression (2).

The *Share scheme* results also fit the reputational interpretation in that the probability of helping efforts is projected to rise for high as opposed to low tenure workgroups subject to the schemes. Nonetheless, the immediate negative effect of share schemes does not match predictions. We conjecture that the negative effect reflects free-riding of the sort discussed by Holmstrom (1982). Our model does not yield free-riding because we do not endogenize the choice of incentives, and we suspect, though cannot test in this data set, that positive share scheme effects in the long run might emerge if we controlled for such endogeneity.

To gauge the economic salience of these results, simulations were undertaken using significant results for the high tenure subsample. Where all variables are evaluated at their mean values for the subsample, we identify a base probability of .515 that workers will be located in the highest helping effort category (such workers "never" refuse to help others). The direct effect of increasing task variety by one standard deviation is to increase the probability to .636, but the probability only rises to .554 after accounting for the negative prize interaction term. Increasing piece rate coverage by one standard deviation, such that the percentage under piece rates rises from 16.5% to 30.1%, increases the probability to .632. Finally, increasing the prize by one standard deviation such that the expected prize value rises from $30.25 to $62.83 per week per workgroup member, reduces the probability to .416 directly, although the incorporation of indirect effects yields a less severe decline, to .473. The latter finding implies that, for this sample, the positive mediating effect of monitoring on prize effects tends to override the negative mediating effect of task variety. While we cannot directly estimate the marginal revenue associated with helping effort, the size of these effects strikes us as large enough to inhibit at least some firms from increasing prizes to the level which would be optimal in terms of individual performance alone, just as Lazear (1989) suggests.

As with the single equation approach, the results reported in Table 3 were subjected to a series of specification tests. The joint significance of the *Prize* interaction terms, and insignificance of the *Piece rate* and *Share scheme* interactions with *Task variety* hold for both the high and low tenure subsamples as before. Results for the smaller sample of 604 observations for which we have complete information are similar to, though slightly weaker, than those reported in Table 3. Adding company dummies again drives the task variety results to insignificance; indeed, virtually all coefficients lose significance excepting a negative prize effect in the low tenure subsample which is significant at the 1% level. Finally, we replicated the absence rate regression after splitting the sample. In the low tenure subsample, all coefficients excepting the constant failed to achieve significance. In the high tenure subsample, however, we find absence rates inversely related to the *Prize*, *Piece rate* and *Share scheme* variables, consistent with the notion that these schemes function to reduce shirking and again contradicting

Akerlof's gift exchange hypothesis.[14]

V. Discussion

The key finding of this paper is that worker decisions to help one another have economic content and are strongly influenced by promotion-based incentives. As Lazear (1992) and Baker, Gibbs and Holmstrom (1993) argue in related contexts, this finding has the immediate implication that attempts to assess the incentive effects of explicit schemes such as profit sharing or piece rates may suffer from neglect of an essential component of work incentives for many employees: promotion opportunities.

While our major result was predicted using a tournament or contest model of promotions, similar hypotheses can be generated by an Akerlof (1982) model of gift exchange wherein wage dispersion reduces motivation in general. Subsidiary tests are consistent with the contest approach and do not support gift exchange predictions since wage dispersion measures *per se* do not significantly influence reported helping efforts and our indicator of expected contest winnings is positively correlated with a measure of individual or 'own' effort (i.e., the prize is negatively related to absenteeism).

Two further predictions from our model of contests are also supported by the data. First, we find that the negative effect for a large expected promotion prize on helping efforts is attenuated when the firm is better able to credit a worker for help provided to others. Second, we find the negative prize effect is accentuated by job designs which provide workers a substantial degree of task variety. Overall, these results support the basic insight of multi-task agency models which stress that rational workers in complex environments will react in subtle but predictable ways to the incentives they face.

A surprising possibility raised by the findings is that workers who perform a broad range of tasks possess a greater quantity of inputs (such as tools or human capital) which can be applied to helping other workers, though further studies are needed to ascertain whether this result is general. An important and related point raised by the empirical analysis is the relevance of reputation effects in repeated games. The first hint of such effects was the fact that piece rates had unexpected effects on helping efforts. In response to this finding, we reexamined the model after incorporating the potential for repeated effort games. That exercise suggests that piece rates can motivate helping efforts among long-term employees, but not otherwise. The negative effects of tournaments, however, should exist regardless of the time frame.

Our empirical attempt to address reputation effects relies upon splitting the sample into low and high tenure groups. As expected, the relevant regressions find the adverse effects of tournaments are stronger for long-term employees. We also find that piece rates may indeed increase helping efforts over long periods of time as workers recognize potential utility gains from mutual help and are able to develop and sustain equilibria supportive of such behavior. The evidence further supports the expected qualitative effect of share schemes motivating relatively greater help among long-term employees, but suggests the short-run effect of such schemes is to promote free-riding, consistent with Holmstrom's (1982) results for environments where incentives are endogenous.

Obviously, the research presented here could be improved and extended in many directions. On the theoretical front, it would be useful to follow existing models and endogenize the choice of incentive schemes. We suspect that such an exercise will mainly confirm the theoretical approach taken here. For example, as Garvey and Swan (1992) show, firms in which helping is relatively important will optimally choose a small prize for promotion and will exhibit relatively low levels of individual effort and high levels of helping, consistent with our approach and findings.

An implication of such endogeneity, however, is that the regression results presented here are subject to simultaneity bias. Such simultaneity could provide an attractive explanation for the profit sharing results reported here, but might also affect the task variety results as well.

Specifically, it seems possible that the degree of task variety confronting employees is positively correlated with the productivity of helping efforts (as suggested earlier) but also dictated by or constrained by the firm's production technology. If this is true, then firms may view task variety and the related productivity of helping efforts as parameters in their choice of incentives.[15] Unfortunately, further studies are required to address these issues since we have relatively few observations at the workplace level in this data set.

We would also be remiss if we did not mention the possibility that efficiency wage approaches other than Akerlof's gift exchange version are not obviously inconsistent with our results. For example, in a Shapiro and Stiglitz (1984) setting, monitors might view helping efforts as a form of shirking. If our prize variable is then viewed as a proxy for the efficiency wage, one might also predict the negative prize effect on help located in this data. We, however, leave the formal development and testing of an efficiency wage model of helping for others.

A final caveat is that empirical researchers might desire a more "objective" measure of help relative to that employed here. Although we are sympathetic to this view, the search for improved indicators is likely to be problematic since a key assumption of the multi-task agency literature is precisely that such aspects of worker behaviour are difficult to measure objectively. Indeed, our findings are consistent with this assumption, while others argue that difficulties in verifying effort levels largely explain the widespread incidence of promotion systems among actual firms (Malcomson 1984).

Regardless of caveats, this paper has provided one of the first explicit tests of worker incentive models for multi-task environments. The results suggest such models hold a great deal of promise for enhancing our understanding of payment systems and their effects.

APPENDIX: Helping Choices in a Simple Repeated Game

The purpose of this appendix is to show how reputation effects alter our predictions about the effect of the incentive terms *i*, *g*, and *p*. We will set the task assignment variable Δ to zero. This has no material effect on our conclusions and also helps to highlight the key changes that repeated games do introduce. We now formally assume that agents expect to interact over a potentially unlimited number of periods, which they discount at rate δ ($0 \preceq \delta \preceq 1$). Hence $\delta=0$ corresponds to the one-shot game analyzed in the main body of the paper and $\delta=1$ captures the case where workers are infinitely patient. 'Patience' should be understood as the product of inherent time-discounting and the probability that the workers will in fact interact in the next period. For concreteness, we characterize the effect of reputation as the maximal level of helping, h^r, that can be implemented in a repeated game supported by Nash-reverting trigger strategies.

We assume that *g* is sufficiently small that the short-run optimal choice of helping is zero since (2) reduces to $-pf(0) - h + g$ (for convenience only we neglect the possibility of outright sabotage, $h < 0$). Note also, however, that worker two would receive an additional *i* dollars if worker one were to exert one unit of h_1 and similarly for worker one. We now allow the workers to observe each others' past helping and to condition future helping actions on this information (it is conceivable that future own efforts would also be so conditioned, but this only strengthens our results).

Workers now promise to exert some particular *h* each period if the other worker also does so, and to revert to the short-run optimum of zero helping forever after if the other one puts in less than that level of *h*. Since the game is still symmetric, each worker wins the prize with probability $F(a_1-(1-s)h_1-a_2+(1-s)h_2) = F(0) = 1/2$. Hence, if both workers cooperate, worker one receives $p/2 + i(a_1+h_2) + g(a_1+a_2+h_1+h_2) - (h_1)^2/2 - (a_1)^2/2$ in each period. This term converts to the present value of cooperation for all time by dividing through by 1-δ.

If instead worker one cheats by putting in zero helping efforts, he wins the prize with probability $F(a_1-a_2+(1-s)h_2) = F((1-s)h) > 1/2$, since worker two's current helping choice cannot be conditioned on his defection. He also receives $i(a_1+h_2)$ and $g(a_1+a_2+h_2)$ while bearing no effort cost for helping worker two. As punishment for this defection, both will revert to $h=0$ in all future periods, resulting in a present value of:

$$[\delta/(1-\delta)][ia_1 + g(a_1+a_2) + p/2 - (a_1)^2/2] \qquad \text{(A.1)}$$

Clearly, the incentive to defect increases in h. Equating the present value of defecting and cooperating, and rearranging, allows us to express the maximal helping effort that workers can be induced to provide without defection, h^r, as satisfying:

$$[\delta/(1-\delta)][ih^r + 2gh^r] - (h^r)^2/2 - p[F((1-s)h^r) - 1/2] = 0. \qquad \text{(A.2)}$$

The first result is that reputations strictly increase helping:

$$\partial(A.2)/\partial\delta = [1/(1-\delta)^2][ih^r + 2gh^r] > 0 \text{ provided } h^r > 0 . \qquad \text{(A.3)}$$

Under our assumption that $\hat{\iota}=0$, helping in the one-shot game is unaffected by i (see (7)). In the repeated game, however, piece-rate incentives strictly increase helping:

$$\partial(A.2)/\partial i = [\delta/(1-\delta)]h^r > 0 . \qquad \text{(A.4)}$$

This result suggests the more general result that piece rate incentives are more conducive to help as reputational forces become more powerful. Formally,

$$(\partial/\partial\delta)\partial(A.2)/\partial i = [1/(1-\delta)^2]h^r > 0 . \qquad \text{(A.5)}$$

Note that g plays the identical role as i in (A.3), except that it is multiplied by two. Hence the same comparative static results apply. The presence of reputation does *not* affect our key predictions about the effect of promotion. A larger prize spread still discourages helping since:

$$\partial(A.2)/\partial p = -[F((1-s)h^r) - 1/2] < 0 . \qquad \text{(A.6)}$$

Finally, as in the one-shot game, better monitoring of help reduces the disincentive effect of promotional prizes:

$$(\partial/\partial s)\partial(A.2)/\partial p = h^r f((1-s)h^r) > 0 \,. \qquad \text{(A.7)}$$

References

Akerlof, George A. "Labor Contracts as Partial Gift Exchange." *Q.J.E.* 97 (November 1982): 543-69.

Baker, George P. "Incentive Contracts and Performance Measurement." *J.P.E.* 100 (June 1992): 598-614.

Baker, George P., Gibbs, Michael, and Holmstrom, Bengt. "Hierarchies and Compensation." *European Econ. Rev.* 37 (April 1993): 366-78.

Baker, George P., Jensen, Michael C., and Murphy, Kevin J. "Compensation and Incentives: Practice Vs. Theory." *J. Finance* 43 (July 1988): 593-616.

Burawoy, Michael. *Manufacturing Consent*. Chicago: University of Chicago Press, 1979.

Cox, D.R. *Analysis of Binary Data*. London: Chapman and Hall, 1970.

Demsetz, Rebecca S. "Voting Behavior in Union Representation Elections: The Influence of Skill Homogeneity and Skill Group Size." *Indus. and Labor Relations Rev.* 47 (October 1993): 99-113.

Drago, Robert, and Turnbull, Geoffrey K. "Individual and Group Piece Rates Under Team Technologies." *J. Japanese and Internat. Economies* 2 (March 1988): 1-10.

_______. "Competition and Cooperation in the Workplace." *J. Econ. Behav. and Org.* 15 (March 1991): 347-64.

Drago, Robert, and Wooden, Mark. "The Determinants of Labor Absence: Economic Factors and Workgroup Norms." *Indus. and Labor Relations Rev.* 45 (July 1992): 764-78.

Drago, Robert, Wooden, Mark, and Sloan, Judith. *Productive Relations? Australian Industrial Relations and Workplace Performance*. Sydney: Allen & Unwin, 1992.

Ehrenberg, Ronald G., and Bognanno, Michael L. "The Incentive Effects of Tournaments Revisited: Evidence from the European PGA Tour." *Indus. and Labor Relations Rev.* 43 (February 1990): 74S-88S.

Garvey, Gerald T., and Swan, Peter L. "Managerial Objectives, Capital Structure, and the Provision of Worker Incentives." *J. Labor Econ.* 10 (October 1992): 357-79.

Greene, William H. *Limdep Version 6, User's Manual and Reference Guide*. Bellport, NY: Econometric Software, 1992.

Holmstrom, Bengt. "Moral Hazard in Teams." *Bell J. Econ.* 13 (Autumn 1982): 324-40.

Holmstrom, Bengt, and Milgrom, Paul. "Multitask Principal-Agent Analyses: Incentive Contracts, Asset Ownership, and Job Design." *J. Law, Econ., and Org.* 7 (Special Issue, 1991): 24-52.

_______. "Measurement Costs and Organization Theory: The Firm as a Cluster of Attributes." Working paper no. D-69, New Haven, CT: Yale School of Organization and Management, 1992.

Itoh, Hideshi. "Incentives to Help in Multi-Agent Situations." *Econometrica* 59 (May 1991): 611-36.

_______. "Cooperation in Hierarchical Organizations: An Incentive Perspective." *J. Law, Econ., and Org.* 8 (April 1992): 321-45.

Kreps, David M. "Corporate Culture and Economic Theory." Mimeo. Stanford, CA: Stanford University Graduate School of Business, 1984.

Lazear, Edward P. "Pay Equality and Industrial Politics." *J.P.E.* 87 (December 1989): 1261-84.

_______., "The Job as a Concept." in *Performance Measurement, Evaluation, and Incentives.* edited by William F. Bruns, Jr. Cambridge, MA: Harvard Business School Press, 1992.

Lazear, Edward P., and Rosen, Sherwin. "Rank-Order Tournaments as Optimum Labor Contracts." *J.P.E.* 89 (October 1981): 841-64.

Levine, David I. "What Do Wages Buy?" *Admin. Sci. Q.* 38 (September 1993): 462-83.

Main, Brian G.M., O'Reilly III, Charles A., and Wage, James. "Top Executive Pay: Tournament or Teamwork?" *J. Labor Econ.* 11 (October 1993): 606-28.

Malcomson, James M. "Work Incentives, Hierarchy, and Internal Labor Markets." *J.P.E.* 92 (June 1984): 486-507.

McLaughlin, Kenneth J. "Aspects of Tournament Models: A Survey." *Res. Labor Econ.* 9 (1988): 225-56.

Myer, H. "The Pay for Performance Dilemma." *Org. Dynamics* 3 (Winter 1975): 39-50.

Ramakrishan, Ram T.S., and Thakor, Anjan V. "Cooperation versus Competition in Agency." *J. Law, Econ., and Org.* 7 (Fall 1991): 248-83.

Rosen, Sherwin. "Prizes and Incentives in Elimination Tournaments." *A.E.R.* 76 (September 1986): 701-15.

Seigel, S. *Nonparametric Statistics for the Behavioral Sciences*. New York: McGraw-Hill, 1956.

Whyte, William H., Jr. *The Organization Man.* New York: Simon and Schuster, 1956.

Zavoina, R., and McElvey, W. "A Statistical Model for the Analysis of Ordinal Level Dependent Variables." *J. Math. Sociology* 3 (Summer 1975): 103-20.

Footnotes

1. Shifting between the Garvey and Swan or Itoh as opposed to the Drago and Turnbull cost functions causes effort costs to rise as the job becomes more 'interesting.' We could instead relate effort costs inversely to task variety, as in, e.g., $a^2/2 + h^2/2 - \Delta(a(1-h))$ (for the case $h < 1$). This function yields results qualitatively identical to those reported below except the sign of the effect of task variety on help ($\partial h/\partial\Delta$) becomes ambiguous, as does the effect of task variety on the relationship between help and piece rates ($\partial/\partial\Delta(\partial h/\partial i)$). While this alternative is quite specific, its predictions are more consistent with our empirical findings.

2. In traditional terms, $\Delta = 1$, $\Delta = 0$, and $\Delta = -1$, correspond to cases where helping and own efforts are perfect substitutes, independent, and perfect complements. While the main results hold for sufficiently small negative values of Δ, the form does not permit the case of perfect complements, since in that case effort at any level becomes costless so long as $a = h$.

3. Data from six workplaces outside of Australia and four workplaces where the survey was pretested are ignored here due to lack of comparability in the data.

4. Other questions mainly concerned individual behavior such as coming to work late, taking days off when not sick, trying to get out of work, not paying attention to work or details, sticking to rules, doing irrelevant things to seem busy or doing work badly. Further questions addressed discouraging others from working too hard, and refusing to do work which is not part of a worker's regular job duties. While the latter two questions address employee interactions, their relationship to helping effort is unclear *ex ante*.

5. An additional 79 respondents answered the question but are excluded from the working sample. According to a Mann-Whitney U test (Seigel 1956), these responses do not diverge significantly from those in the working sample on this variable.

6. The adjusted R^2 for the equation is .820. Complete results are available in an optional appendix to this paper.

7. *Ex ante*, it seemed likely that creating dummies such that categorizing mid-range responses as positive on the variables would introduce considerable ambiguity and hence noise into the indicators, while using only responses where individuals reported "strongly agree" would (in the case of *Task variety*) yield insufficiently variation on that variable. Indeed, results using alternative cut-offs for these variables are considerably weaker than those reported below.

8. χ^2 statistics for the joint contribution of *Prize x Task variety* and *Prize x Monitoring* is 8.96, significant at the 5% level with 2 d.f. For the additional contribution of *Piece rate x Task variety*, the statistic is 2.1, insignificant at the 10% level with 1 d.f. For the term *Share scheme x Task variety*, the statistic is 0.14, also insignificant at the 10% level with 1 d.f.

9. Results mentioned below are available from the authors in an optional appendix to this paper.

10. This claim is tested by performing a log-odds regression of the *Task variety* term on the 22 company dummy variables plus a constant after applying the Cox (1970, p. 33) correction. The adjusted R^2 for the equation is .519, suggesting a majority of the variation in task variety occurs at the workplace level.

11. Using a log-odds formulation, the *Prize* variable generated the only significant coefficient in the regression aside from the constant and a correction term for heteroskedasticity. A more complete analysis of absenteeism using this data appears in Drago and Wooden (1992).

12. Note that job tenure is skewed, so it is not surprising that mean job tenure for all respondents is 5.344 years (standard deviation 6.251) with a median of 3.0 while, after averaging tenure within each workgroup, the median rises to 5.0 years (standard deviation 2.878). We split just below the latter median figure (at 4.9).

13. See Kreps (1984) for a formal model of this generational idea. The data seem to confirm this argument and the parallel argument that it is not simply the tenure of the most senior workgroup member which determines the extent of reputation effects. Splitting the sample on indicators of either minimum or maximum within-workgroup job tenure does not yield significant additional explanatory power for the regressions.

14. The *Piece rate* and *Share scheme* coefficients are significant at the 5% level, that for the *Prize* is significant at the 1% level.

15. Note the mild positive correlation between *Share scheme* and *Task variety* reported in Table 1 is consistent with this possibility.