Contingent and Non-Contingent Rewards in the Employment Relationship[*]

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Abstract

Recent developments in game theory have greatly expanded the scope for formal analysis of employment relationships characterized by incomplete contracts (i.e. in which "contested exchange" conditions involving a *strategic* distinction between "labor" and "labor power" arise). However, these developments have largely been built on the presumption that individuals respond solely to *contingent* incentives, understood as material rewards or punishments which vary directly with the behavior being motivated (as, for example, when a worker increases labor effort in response to a potential bonus or the threat of firing). This presumption rules out the plausible case of *noncontingent* incentives, defined as those which flow from nature of the transactional relationship rather than the provision of material incentives at the margin. This paper explores the logic of employment relationships in which these alternatives are substitutes in motivating worker effort. Toward this end, the multi-task principal-agent model due to Holmström and Milgrom is adapted to reflect the possibility that a worker's marginal cost of supplying effort depends in part on the context of the employment relationship structured by the employer, in particular through the balance of incentive pay and and a "gift" provided to the employee in the form of an economic rent. Implications for the structure of pay, labor market segmentation, degradation of work, and the social efficiency of profit-maximizing employment contracts are considered.

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1. Introduction

Mainstream economic analyses of employment relationships and labor market outcomes typically proceed on the assumption that preferences for work are exogenous to given market and production relations. In particular, this assumption has informed the literature on incentive provision under imperfect information (e.g., analyses based on principal-agent and efficiency wage models), with the consequence that incentives are understood solely in the sense of rewards which vary directly with effort, at least in expected terms. I refer to incentives understood in this sense as *contingent*.

There is, however, a body of evidence which suggests that the incentive to work depends as well on the *nature of the relationship* within which work effort is provided, the key distinction being that in this case rewards to the worker may perhaps not vary at the margin with changes in effort. Incentives of the latter type I label *noncontingent*. The scope and relative power of contingent and non-contingent rewards has long been a subject of interest to social psychologists (see, for example, Deci (1975)).

There has been some attention paid to non-contingent rewards in the labor economics literature. Akerlof's interpretation of high wages as a form of "gift exchange" (1984), for example, was anticipated by Reynolds (1951, p. 232) in his in-depth case study of the New Haven labor market. In a somewhat different context, Dorman (1996, p. 126) summarizes evidence suggesting that workers' willingness to bear occupational risk depends in part on their participation in production decisions, and perhaps more strongly so than on the provision of "compensating differentials" in pay.

This paper takes the argument a step further by considering political economic consequences of the possibility that contingent and noncontingent rewards are *substitutes* in motivating worker effort. This possibility is suggested by Lane (1991) in his assessment of the "hidden costs" of exclusive reliance on contingent rewards:

> Noncontingent rewards by themselves not only fail to produce hidden costs but may enhance performance. Pittman et al. [1982] found that compared to the contingently rewarded *and to the unrewarded* controls, those who were *rewarded irrespective of their performances* showed the greatest interest in more complex work on a second trial....By itself, then, noncontingent pay is very likely favorable to performance. [p. 394; emphasis in original]

Prompted by such considerations, this paper explores the consequences for labor market outcomes of incorporating both contingent and noncontingent incentives in a model of employment relationships characterized by asymmetric information. Toward this end, I adapt an analytically rich version of the well-known principal-agent model to accomodate both forms of incentive provision. A key feature of the model is that the equilibrium mix of contingent and noncontingent incentives is determined *endogenously* by the employer, giving rise to potentially testable hypotheses about the structure of employment relationships. These results are then applied in explaining phenomena such as labor market segmentation, job queues, and the incentive structure of compensation.

2. Analytical Framework

The paper's formal argument is based on the *multi-task* principal-agent model due to Holmström and Milgrom (1991). In allowing that workers potentially undertake a number of distinct production tasks, this approach is arguably more descriptively appropriate than the standard single-task model, and allows for a much broader range of hypotheses about the structure of employment relations. Holmström and Milgrom's framework also has the signal advantage of relative tractability.

The initial context of the model is an employment relationship between a principal P and a single agent A. The activity of production involves a vector of tasks $t = t_1, t_2, ..., t_n$, each element of which is non-negative. Production tasks are undertaken by the agent at cost $C(t, R)$, understood to be strictly convex and continuously differentiable (to whatever degree required) in its arguments. The term R, defined more precisely below, denotes the level of *economic rent* received by the agent. The agent's effort vector choice yields a gross benefit $V(t)$ to the principal, understood to be at least twice continuously differentiable and strictly concave. Partial derivatives are denoted by subscripts on the relevant functions, with C_i (V_i) representing the derivative of cost (gross benefit) with respect to effort level in the *i*th production task (with a similar interpretation for higher-order partial derivatives).

The principal cannot observe t. However, the agent's efforts generate a vector of information signals

$x = \boldsymbol{m}(t) + \boldsymbol{e}$,

where $m(\cdot)$ is increasing and concave in its argument and e is normally distributed with mean vector zero and covariance matrix Σ. One possible interpretation of $m(\cdot)$ is that it represents the production function linking the agent's effort vector to net output.

Given these informational restrictions, the principal can only base gross compensation y on the signals received. For a given compensation scheme $y(x)$, the agent's utility satisfies

$$u(CE) = E\{u[y(x) - C(t,R)]\},$$

where $u(z) = -e^{-rz}$, CE denotes the agent's "certainty equivalent" pecuniary payoff and r measures the agent's (constant) level of absolute risk aversion. In contrast, the principal is assumed to be risk neutral in net benefit $V(t) - E\{y(x)\}$.

Let's simplify the analysis by stipulating that the compensation scheme is linear in x, thus taking the form $y(x) = a^T x + b$, where a is a column vector of incentive payments (that is, piece rates attached to corresponding array of observable outcomes x) and b is a scalar representing the fixed component of pay. Then given normal distribution of the errors and the exponential form of the agent's utility over net compensation, this simplification implies that

$CE = a^T m(t) + b - C(t,R) - \frac{1}{2} r a^T \Sigma a$, or expected total compensation minus cost of effort and a risk premium depending on the agent's degree of risk aversion and the variance of the agent's income. Under these conditions, then, the agent seeks to maximize CE. The principal's net payoff is correspondingly $V(t) - a^T m(t) - b$.

Recall that *contingent* incentives to the agent are defined as those which increase at the margin as (any dimension of) effort increases. In the present context, such incentives are clearly provided through the piece rate vector a. *Noncontingent* incentives, in contrast, are those

which don't vary with effort, yet induce the agent to offer a higher level of effort than that which would obtain in the absence of such an inducement.

The key difference of the present approach from that of Holmström and Milgrom (and most other treatments of the principal-agent problem) lies in the assumption that noncontingent incentives are relationship-specific and thus endogenous. To put it another way, Holmström and Milgrom countenance (indeed, some of their results depend upon) the possibility that workers would willingly choose positive effort levels even in the absence of contingent rewards. In this paper, I assume that these effort levels depend on the *nontingent* reward, in the form of economic rent, provided to workers by the firm.

To capture the role of noncontingent incentives, assume that there is some value $t = \underline{t}$ such that $C_i(\underline{t}, \bullet) = 0$ for all i, and furthermore that $\underline{t}$ is strictly increasing in R. [Note that strict convexity of C implies that $C_i(t, \bullet) < 0$ for $t < \underline{t}$.] Without loss of generality we can also assume that $C_i(\mathbf{0}, 0) = 0$. The idea here is that the provision of a "gift" in the form of economic rent induces the agent to provide a strictly positive effort vector even in the absence of incentives which vary at the margin.

I also impose the non-trivial condition of *No Free Gifts*, which requires that $C_R(t, R) + 1 > \mathbf{t} > 0$ for all non-negative t, R. This says that the principal's marginal cost (net of incentive effects) of offering the agent an economic rent is always positive and bounded away from zero. This condition is required for simplicity. In its absence, we'd simply have to distinguish "free" from "costly" gifts in equilibrium compensation.

The goal of the principal is to maximize expected net benefit from the employment relationship subject to two constraints: the agent must be guaranteed at least a reservation utility

of $\underline{U}$ (the "participation constraint"), and the agent must be induced to provide effort via the principal's choice of the compensation scheme, since effort cannot be directly observed by the principal and thus cannot be elicited by contractual means.

3. The agent's optimization problem

The principal-agent problem is a form of Stackelberg game. Consequently, we must begin the analysis by considering the agent's choice of effort levels for a *given* payment scheme. For a given specification of $(\boldsymbol{a}, \boldsymbol{b})$ by the principal, the agent in effect solves

$$Max_{\tilde{t} \geq 0} \ \ CE = \boldsymbol{a}^T \boldsymbol{m}(\tilde{t}) + \boldsymbol{b} - C(\tilde{t}, R) - \tfrac{1}{2} r \boldsymbol{a}^T \Sigma \boldsymbol{a},$$

with the following first-order necessary conditions for an optimum at t:

$$CE_i = \boldsymbol{a}_i \boldsymbol{m}_i(t) - C_i(t, R) \leq 0; t_i \geq 0; CE_i \cdot t_i = 0, \ \ i = 1, 2, \ldots, n. \tag{1}$$

(Second-order conditions for a global maximum are guaranteed by the convexity of C.)

Note that, in the presence of noncontingent incentives, neither positive nor even non-negative piece rates are required to induce the agent to perform positive effort. In particular, the agent will provide effort even given zero piece rates as long as $\boldsymbol{b}$ is sufficient to yield positive rent to the agent.

4. The principal's optimization problem

Armed with the results of the agent's optimization problem, let's now consider the constrained net benefit maximization problem confronting the principal. The employer faces two

constraints: any desired effort vector of the agent must be induced through the appropriate

balance of incentives (given (1)), and the agent must receive at least her reservation utility. It is

convenient to express this constraint by defining $R = CE - \underline{U}$,

where CE is defined as above, and then restricting R to be non-negative.

At this point we introduce some additional simplifying assumptions to avoid fruitless

complications in an already difficult optimization problem. In particular, assume $m(t) = t$ and

that for all i and t_{-i}, $V_i(t_i, t_{-i})$ approaches infinity as $t_i \to 0^+$. (The latter condition rules out the

possibility of corner solutions in effort levels.)

In light of the preceding, the principal solves the optimization program

$$\underset{a,t,b,R \geq 0}{Max}$$

$$L = V(t) - \boldsymbol{a}^T \cdot t - \boldsymbol{b} + \sum_i l_i [\boldsymbol{a}_i - C_i(t, R)] + m[\boldsymbol{a}^T \cdot t + \boldsymbol{b} - C(t, R) - \tfrac{r}{2}\boldsymbol{a}^T \Sigma \boldsymbol{a} - R],$$

where $(l_1, l_2, ..., l_n, m)$ are the Lagrangian multipliers associated with the incentive

compatibility constraints and modified participation constraint, respectively.

The first-order necessary conditions for $(t^*, \boldsymbol{a}^*, \boldsymbol{b}^*, R^*)$ to constitute a constrained

optimum are as follows (second-order conditions are guaranteed by the assumptions detailed

above):

$$L_{l_i} = \boldsymbol{a}_i - C_i(t^*, R^*) = 0 \quad \forall i \tag{2}$$

$$L_m = \boldsymbol{a}^{*T} t^* + \boldsymbol{b}^* - C(t^*, R^*) - \tfrac{1}{2}r\boldsymbol{a}^{*T}\Sigma\boldsymbol{a}^* - R^* = 0 \tag{3}$$

$$L_{t_i} = V_i(t^*) - \boldsymbol{a}_i^* - \sum_j \boldsymbol{l}_j^* C_{ji}(t^*, R^*) = 0 \tag{4}$$

$$L_{a_i} = -t_i^* + \boldsymbol{l}_i^* + \boldsymbol{m}^* t_i^* - r(\sum_j \boldsymbol{a}_j \boldsymbol{s}_{ji}) = 0 \text{ (where the } \boldsymbol{s}_{ij} \text{ are the elements of } \Sigma) \tag{5}$$

$$L_b = -1 + \boldsymbol{m}^* = 0 \tag{6}$$

$$L_R = -\sum_i \boldsymbol{l}_i^* C_{iR}(t^*, R^*) - \boldsymbol{m}^*(C_R(t^*, R^*) + 1) \leq 0; \ R^* \geq 0; \ L_R \cdot R^* = 0. \tag{7}$$

Conditions (2) and (3) merely restate the constraints, evaluated at the optimum. Condition (4) indicates that effort levels will diverge from Pareto-efficient levels unless the incentive constraint is non-binding for all dimensions of effort (i.e., $\boldsymbol{l}_i^* = 0$ for all i).

Together with (6), condition (5) says that $\boldsymbol{l}_i^* = r(\sum_j \boldsymbol{a}_j \boldsymbol{s}_{ji})$, the positive marginal impact on the risk premium of increasing the ith piece rate (which guarantees that the incentive constraints are all binding).

An element of indeterminacy is introduced through (7). Since the term multiplied by $\boldsymbol{m}^*$ (i.e. the marginal direct cost to the principal of providing a rent) is strictly positive by the *No Free Gift* assumption, the complementary slackness condition indicates that R* >0 only if the first term on the right-hand side of (7) is sufficiently high. The significance of this, in tandem with the remaining conditions, is considered in the next section.

5. Implications for the Employment Relationship

We're now ready to consider the primary implications of incorporating opportunities for both contingent and noncontingent incentives in the multi-task principal-agent relationship. In particular we would like to know the conditions under which the principal chooses to provide the agent with noncontingent incentives in the form of economic rent. As discussed below, these conditions will have particular theoretical significance with respect to the nature of labor market outcomes. [Proofs of the following propositions are omitted here, but available from the author.]

Intrinsic Incentives and Market Segmentation

The first result establishes the conditions under which the employer will forego providing the worker an economic rent, despite its incentive properties.

Proposition 1 $R^* = 0$ for r or Σ sufficiently close to zero.

In other words, so long as first-best conditions are approximated sufficiently closely, the principal never offers the agent a rent. Conversely, $R^* > 0$ only occurs if the agent's risk aversion or the elements of the variance-covariance matrix (representing the basic riskiness of the transaction to the agent) are sufficiently high. The intuition behind this result is that, for sufficiently low risk or agent risk-aversion, the principal incurs very little cost in motivating the agent solely by contingent means; in particular, the marginal cost of contingent incentive provision falls below that of offering the agent a rent.

This result is significant because of its implications for the dual structure of labor markets. It has long been argued that labor markets are *segmented* in the sense that there are "good"

(high-wage, long-tenure, low-risk, etc.) and "bad" (low-wage, high-turnover, messy and/or dirty, etc.) jobs separated by mobility barriers sufficient to preclude the formation of compensating differentials in pay. The present model suggests that the fault line for such segments is established by differences in workplace information conditions.

For given risk preferences, the "primary sector" jobs are characterized by relatively noisy informational conditions, while supervision of "secondary sector" yields comparatively precise signals about underlying effort. [One might imagine, for example, that "McJobs" have the characteristic that a fixed monitoring cost allows almost perfect information about worker effort, due possibly to advanced automation in such settings.] In a related paper presented in this session, Steve Burks fleshes out this result to provide an intriguing analysis of segmentation in the trucking industry.

Of particular interest in the present context is the case considered by Holmström and Milgrom in which at least one production task is virtually unobservable by the principal (equivalent to the variance on its corresponding signal approaching infinity) and tasks are reasonably close substitutes in the agent's cost function. In this case, it is readily shown that $a^* = 0$, so that incentives are generated *solely* by non-contingent means. Such a result is observationally equivalent to the provision of "efficiency wages" which do not vary directly with (expected) output. Thus, the model suggests a theory concerning the *form* of compensation in which forms of pay are correlated with market segments.

Before leaving this subsection, it should be noted that the provision of economic rent implies that markets for "primary" jobs do not clear, with the consequence of involuntary unemployment

or "job queues" specific to the primary sector. Evidence for the existence of such phenomena is considered by Dickens and Lang (1992).

Inefficiency of Incentive Provision

The next key result concerns the social welfare implications of the principal's choice of incentive provision.

Proposition 2 The principal offers the agent an inefficiently low level of economic rent.

The reason for this result is that from a social standpoint only the cost-reducing and incentive aspects of *R* matter, while the principal also cares about the distributional aspect, limiting his willingness to offer the agent an economic rent. In particular, some level of gift is always desirable from a social standpoint, but as seen from Proposition 1, the principal is not always willing to tender this gift to the agent.

Otherwise, the model yields the standard result that the agent's effort levels are inefficiently low given imperfect information and agent risk aversion.

Proposition 3 If $r > 0$ and $\Sigma > \mathbf{0}$, the agent's effort level $t*$ is below the first-best full-information level.

This is an immediate consequence of (4), given that the incentive compatibility constraint is binding for all dimensions of effort.

An example

To illustrate these results, consider an example drawn from Holmström and Milgrom's

analysis of "low-powered incentives" arising in multi-task agency relationships (section 3.3). As

in that section of their paper, I'll assume that the there are two tasks which are perfect

substitutes in the agent's utility function. Specifically, consider the following:

$$V(t) = \tfrac{1}{2}\left(\ln t_1 + \ln t_2\right); \quad C(t,R) = \tfrac{1}{2}\left(T-R\right)^2 \text{, where } T = t_1 + t_2$$

$$\Sigma = \left[\boldsymbol{s}_{ij}\right]_{i,j=1,2}, \text{ such that } \boldsymbol{s}_{ij} = 0 \text{ for } i \neq j \text{ and } r > 0 \text{ (strict risk aversion).}$$

If the principal had perfect information about the agent's effort levels (i.e., $\boldsymbol{s}_{ii} = 0$ for all i),

there no cost to the principal of providing first-best incentives through the choice of piece rates,

and thus the agent is not given a rent. The first-best full-information solution has

$\boldsymbol{a}_1^* = \boldsymbol{a}_2^* = T^* = 1 = 2t_i^*, i = 1,2$. The fixed payment, $\boldsymbol{b}^*$, is set by the principal so as to

guarantee that the agent receives just her reservation utility level.

In the presence of uncertainty about the agent's effort levels, it becomes costly to provide

the agent with efficient incentives, and consistent with Proposition 3, the principal induces the

agent to undertake inefficiently low effort: $t_i^* = \left[2(T^* - R^*)(1 + r\boldsymbol{s}_{ii})\right]^{-1}, i = 1,2$. As promised

by Proposition 1, when $r(\boldsymbol{s}_{11} + \boldsymbol{s}_{22})$ (which determines the principal's marginal cost of

providing high-powered incentives) is sufficiently low, $R^* = 0$ (no rent is provided), and

$$T^* = \sqrt{\frac{2 + r(\boldsymbol{s}_{11} + \boldsymbol{s}_{22})}{2(1 + r\boldsymbol{s}_{11})(1 + r\boldsymbol{s}_{22})}} = \boldsymbol{a}_1^* = \boldsymbol{a}_2^* < 1.$$

We might consider this result to describe the "secondary" segment of a segmented labor

market: agents are given no rent and high-powered effort incentives (although the latter take the

form of piece rates in this specific model, they might also take the form of firing threats given full employment).

If, conversely, the variance associated with monitoring worker effort is sufficiently high, the agent is given a rent, so as to provide risk-free noncontingent incentives and thus alleviate the relatively high costs associated with risky contingent rewards. Provision of an economic rent, which requires the existence of job queues in market equilibrium, corresponds to outcomes usually associated with the "primary" segment of a segmented labor market. Workers in the primary segment are paid primarily on the basis of "low-powered" incentives (salary) if at least one dimension of their jobs is extremely difficult to measure. In terms of the mathematics of this example, when the rent constraint is binding, $\boldsymbol{a}_1^* = \boldsymbol{a}_2^* = T^* - R^* = \left(1 + r(\boldsymbol{s}_{11} + \boldsymbol{s}_{22})\right)^{-1}$; thus, as either of the variance terms approaches infinity, both piece rates approach 0, and in the limit the agent is motivated solely through the provision of economic rent.

6. Conclusion

The nature of employment relationships characterized by potential incentive problems changes dramatically when the standard principal-agent analysis is modified to reflect the existence of noncontingent incentives as well as the more familiar contingent form of motivation. In this paper, I've shown that the possibility of noncontingent incentive provision may help to

explain the existence of labor market segmentation as well as differential payment structures across segments. Normatively, profit-maximizing employment relationships are inefficient if noncontingent incentives are provided by economic rents, since self-interested employers provide insufficient rents to workers.

The model examined in this paper can also be adapted to study employer incentives in structuring the workplace environment. One interesting issue, currently under investigation, is the possibility that the considerations introduced here increase the tendency of employers to "degrade" the labor process (in the sense discussed by Braverman (1974)) so as to minimize the rent that must be supplied to employees.

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