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# 'Making a Difference': Labor Donations in the Production of Public Goods

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## Abstract

Despite the potential for free-riding, workers motivated by 'making a difference' to the mission or output of an establishment may donate labor to it. When the establishment uses performance related compensation (PRC), these labor donations closely resemble a standard private provision of public goods problem. When PRC is not used, the establishment will favor setting low wages. High wages can induce an adverse selection problem; individuals without concern for the mission or output, take the job and knowingly underperform because they will not be financially penalized. Low wages help to select a labor force driven by concern for the firm's output. Without PRC the problem differs significantly from a standard private provision of public goods situation: there need not be free-riding, contributions are non-monotonic in valuations, and contribution incentives are significant even in large populations. Even when an establishment is able to introduce perfect PRC, it may choose not to, as its impact on output may be negligible. It thus explains why firms producing public goods, or output that tends to be socially valued, may choose both low compensation, and payment that is not related to performance.


**Keywords:** privately provided public goods, voluntarism, incentive schemes, public sector employment

**JEL Classification:** J45, H41, H11, H83

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# 1 Introduction

A commonly reported motivation for individuals who donate time and effort to worthy causes is a desire to "make a difference".[1] Donations of labor come in many forms: some are purely voluntary - the amount of labor volunteered in advanced economies is a large and growing phenomenon (44% of the US adult population, or 83.9 million individuals volunteered in 2001); with almost all doing so to non-profit firms;[2] others involve individuals working for wages perceived to be below the market rate for the opportunity to advance causes in which they believe. Estimates of the amount of labor receiving reduced pay are less clear since the estimates require determining precise opportunity costs. But the existence of such donations is difficult to dispute. The non-profit sector is widely perceived as requiring workers to take pay cuts for the privilege of meaningful work.[3] A recent (2002) survey conducted by the Brookings Institution found that nearly half of all paid charity workers believe they could make more money elsewhere but take the work because they are driven by mission not money. The same survey of over 1200 nonprofit workers found that 97% feel they accomplish something worthwhile with their job, and are happy to take the lower pay in order to have a chance to "help people and make a difference". This was the case even though 81% of all workers agreed that it was easy to burn out in their work, 70% agreed they had too much work to do, 75% described their work as frustrating, and 67% said their pay was low, see Light (2003).[4]

Such donations of effort are almost surely not limited to the non-profit sector; for-profit firms may also receive labor donations when involved in activities perceived to be in the social interest (for example pro bono work in law agencies) and a literature has argued for such motivations playing a critical role in working for the public sector; Le Grand (1997), Francois (2000), and recently, Besley and Ghatak (2003).

Labor donations are readily understandable if they arise as a warm-glow, in the sense used by Cornes and Sandler (1986) and Andreoni (1990), or for personal investment reasons as in Menchik and Weisbrod (1987). With warm glow giving, the act of donation itself increases the donors utility, independently of the outcome or its effect. However a reported desire to "make a difference" is a distinct motivation from warm

[1] There is a substantial non-economic literature on non-pecuniary motivations for employees, particularly in public and non-profit settings. A small sample are Mahoney, Huff and Huff (1992), Kirton (2001), Williams and Windebank (2001), Coyle-Shapiro (2003), Perry (2000), Naff and Crum (1999), Rhoades and McFarland (1999). The general emphasis of these authors, and most others in this field, is that, though pecuniary considerations play an inescapable part, when establishments produce output that is socially valued, altruistic and civic minded considerations also motivate workers.

[2] This estimate is taken from the most recent biennial estimate commissioned by the Independent Sector, Independent Sector (2003). See Hodgkinson and Weitzman (1996) for a broad statistical analysis of the non-profit sector, Murnighan and Kim (1993) for a specific focus on non-economics factors motivating people to volunteer, and Menchik and Weisbrod (1987) for an early economic analysis of voluntarism. Segal and Weisbrod (2002) provide a recent investigation of volunteer contributions and their variation with observable individual characteristics.

[3] We survey later the evidence on wages, but the perception of a penalty is widespread. For example, a prominent Bay Area non-profit placement agency, "BANJO", states that "As a general rule of thumb, total nonprofit compensation tends to be 25% to 50% lower than similar positions in the private sector". They go on to claim that benefits, and especially bonuses, generally represent a large share of this difference, (see http://www.ynpn.org/banjo/ol_book/app2.htm). Note also that the numbers employed in this sector are large, recent estimates suggest it to be about 9.5% of the paid workforce.

[4] It should be noted however, that econometric studies attempting to estimate this nonprofit wage penalty do not regularly confirm the existence of labor donations. We discuss this literature, and the implications of the present paper for it, after the main results.

glow giving, as it is outcome, not action, oriented. Individuals with this motivation care about the effects their efforts have in bringing about desired social change; a motivation which many like-minded people may share. To the extent that many people share this concern, the benefit generated can have a public good aspect. This contrasts with warm glow benefits which accrue directly to individuals performing the actions themselves.

In economies with millions of workers, many of whom may have similar desired societal goals, outcome oriented giving has the potential to lead to severe free-riding problems. If a single worker does not take an opening in an organization that is widely perceived to affect positive social change, there are potentially many others who will, and the good or service of concern will be provided nonetheless. The problem can be conceived of as a standard private provision of public goods problem, and the insights obtained from analysis of such problems are clear. Equilibria of standard private provision of public goods problems imply: 1) there is free-riding in equilibrium - each individual donates less (often) than they would if there were no others; 2) individuals with high valuations donate more (often) than the low; 3) the extent of free-riding is increasing in population size.

In a multi-agent economy, workers wanting to "make a difference" will only be motivated to donate labor to a worthwhile cause if they understand that, were they to withdraw their donation, the cause would be adversely affected. The first part of this paper shows that the unique equilibrium of the labor donation game in such an economy involves less than full provision of the good. The free-riding, and induced expectation of less than full provision, serves an important motivating function for individuals who value the good to donate their effort. Without the free-riding, i.e., if all individuals were ready to donate upto their own personal valuations, any given individual would realize that, were he not to donate, someone else would, but since the benefits are shared by all, this would make it rational not to donate effort. In the limit then, as the potential pool of individuals who value the cause gets large, each individual's incentive to free-ride also becomes large, precisely as in a standard private provision of public goods problem.

However, the fact that, in reality, individuals do donate effort out of a purported desire to make a difference, even in large economies, suggests that the standard private provision of public goods perspective may be misleading. It is argued here that this is because labor donations are fundamentally different from standard donations, and thus different from the private provision of public goods problem. The main difference is that donations of labor may be subject to moral hazard. When labor effort is not readily supervised or directly contracted, filling a position need not correspond with performing the tasks required of that position. Thus labor donations differ form standard donations, and from the private provision of public goods problem, because the act of claiming to donate labor - that is, filling the job - is seperate from actually doing so, and taking such a position precludes donations from somebody else.

The difference highlighted here thus arises when firms are either unable to, or choose not to, use performance related compensation (PRC). The reason firms may wish to not use it is that the very potential of workers shirking serves to induce participation of workers who would otherwise not donate their effort. Without PRC, individuals who have little or no concern for the firm's output are able to take such positions and shirk. The participation of these shirkers induces individuals with a sincere concern for output, the non-shirkers, to also apply for such positions. By doing so, they are "making a difference", since if they obtain the job, they have ensured that a non-shirker did not, and thus ensured output is produced. Workers filling such positions are thus motivated by the desire to perform the job better than someone else, not by a belief that the job will remain unfilled. Thus the moral hazard problem, which may be deliberately constructed by the establishment, induces labor donations, and mitigates the free-riding problem. Adding moral hazard to the standard private provision of public goods problem leads to drastically different results. It is shown that: 1) there need not be free-riding in equilibrium; 2) applications for positions are non-monotonic in individual valuations; 3) individuals do donate effort out of a desire to make a difference, and such donations are rational even in arbitrarily large economies.

In addition to providing a rationale for why individuals can be motivated to work by pure public good considerations, even in large economies, the analysis also predicts that organizations providing public goods should be more likely to eschew the use of PRC. It is shown that even if perfect performance related compensation can be introduced, a public good producing establishment may produce virtually the same level of output without it.

The analysis also suggests that overall compensation levels in firms not using performance related compensation will tend to be lower than in those that do. This prediction helps understand two observations which have been previously difficult to reconcile. The first is the widespread perception, common amongst workers in sectors providing social services, that working in such sectors requires suffering a wage loss. The second is the evidence from econometric studies that workers in non-profit firms, which are predominately found in such sectors, though earning lower unadjusted wages, do not seem to suffer lower hourly wages, and may actually receive wage premia.

The paper proceeds as follows. The next section briefly relates strands of the literature relevant for the current research. Section 2 sets up the model and solves for equilibria in the labor donations game both with PRC (Section 2.1) and without it (Section 2.2). Section 3 considers an example which compares optimal wages, output and profits both with and without PRC for a tractable, uniform distribution, case. This section also discusses the paper's main findings in light of current empirical and theoretical literature. Section 4 concludes.

## 1.1 Previous Literature

Besley and Ghatak (2003) also explore the implications of an employee's concern for outcomes on contractual design. In their framework, this "mission motivation" takes the form of impure altruism, not the pure altruism assumed here. That is, the individual only obtains the benefit when working in provision of the good. Treating the motivation in this way solves the free-riding problem in their framework, whereas free-riding plays a central role here. They similarly allow for heterogeneity in valuation, but the heterogeneity explored in their model concerns the mission, e.g. some workers wish to work in childcare provision, others in education. Here, in contrast, heterogeneity involves variable valuations of a single public good.

There is a literature on non-profit firms that argues that, because they do not have a residual claimant, donations are provided to these when they would not be provided to for-profit firms; see for example, Hansmann (1980), Rose-Ackerman (1996), Francois (2003), and Grout and Yong (2003). This happens because for-profit firms are unable to credibly ensure that donated effort will be utilized for intended output, and not merely to enhance profit. This problem of firm commitment is assumed away here (as in Besley and Ghatak (2003)) so that the nature of the firm's ownership plays no role. Instead, the focus here is on the free-rider problem created even when establishments can credibly commit to convert donated effort to intended causes.[5]

The paper closest to the present one is Engers and Gans (1998) who also examine incentives to provide effort when concern for the output produced is a primary motivation. That paper provides an efficiency rationale for why referees may not be paid. Specifically, upon receipt of a paper to referee, if the accompanying payment for refereeing is sufficiently large, the referee correctly anticipates that, if he does not contribute effort, the next person asked will do so. If the accompanying payment is low, however, then the chance that the next referee will not perform the task is high. In that case, the referee who is motivated by his professional concern, prefers to accept the assignment. This is very similar to the present paper except in one crucial respect; the free-riding that is central to the private provision of public goods problem, is circumvented in thier paper by the direct targetting of referees that can occur through the editorial process. There, the participation problem of a referee differs from that of a worker ordinarily deciding on a labor donation because the editor of a journal is able to directly solicit the efforts of the referee, and this is done sequentially. To see this, note that, in Engers and Gans (1998) the arrival of a paper to referee from a non- (or low) paying journal, strictly lowers the referee's utility. A referee would never volunteer to be put into the position of having to decide on whether to accept an assignment or not. Thus, part of the free-riding problem inherent to the situation is solved by the editor's direct soliciation. This suggests their structure may be of limited applicability to the problem of labor donations in general. Firms are rarely able to directly

[5] That literature is also related to the issue of monetary donations for non-profit firms as explored, for example, by Bilodeau and Slivinski (1998).

solicit potential workers, instead, a notice of vacancy is placed with conditions advertised, applicants forward their services, and the firm chooses the required number for the job. This paper is discussed further after the main results are presented.

Duncan (1999) is also concerned with donations of worker effort, and specifically on whether such donations will be perfectly crowded out by government provision. However, the model there effectively assumes the use of perfect performance related compensation, as there is no moral hazard in labor supply, and then it is demonstrated that donations of effort are conceptually similar to monetary donations.

The paper is also related to a relatively large literature on the use of merit pay in the public sector. Many non-economists have been sceptical about the effects of such schemes on employee performance, e.g., Frant (1996), Deckop and Cirka (2000) and IRS (2000). The present paper adds another element of caution, though for more standard economic reasons. Lewin (2003) and Dixit (2002) provided upto date reviews of the literature on compensation schemes in the public sector. We further discuss merit-pay in the public sector after the main results, together with estimates of non-profit pay differentials.

# 2 The Model

There is a single firm. The firm provides a public good, the amount of which is denoted $g$. The population comprises $N$ heterogeneous individuals varying by their valuations of the good, which are non-observable. Individual $i's$ strength of valuation is denoted by the parameter $\gamma_i \geq 0$, which is private information. Each individual's parameter is independently drawn from a common distribution, $F(\gamma)$, with support $[0, \infty)$.[6] The distribution is common knowledge and it is continuous. Individuals with high $\gamma_i$ value the public good relatively more, and those with $\gamma_i = 0$ do not value it at all.[7] An individual of type $i's$ utility is given by:

$$u_i = w_i - e_i + \gamma_i g, \tag{1}$$

where $w_i$ denotes $i's$ consumption of a numeraire good and $e_i$ denotes $i's$ effort expended at work.

The firm requires one worker to produce output. The firm's production function is:[8]

$$g = g(e), \tag{2}$$

where $e$ is the amount of effort exerted by the firm's worker. For simplicity, we shall assume this production function takes a binary form - though qualitative results easily generalize to a more standard smooth

[6] It is not necessary to have an unbounded upper support, though the existence proof is simpler with it. An example developed further in the paper will, in fact, utilize a finite upper support.

[7] We shall not dwell on the reasons for variation in $\gamma$, which seem to be an indisputable feature of reality. These could arise directly from preferences; some individuals may care more for features like environmental quality, public health care, quality of public schooling, etc. Or they may arise from differences in income; demand for such public goods may have positive income elasticity.

[8] The nature of the firm , i.e., it's government, non-profit, or for-profit status, is not considered here. When the firm is unable to commit to output, for example if the firm controlled other inputs that could be adjusted in light of donated labor, an individual's desire to donate labor could be affected by it's for-profit status. This has been a factor used previously to argue for the existence of non-profit firms but will not be exploited here, as it is assumed that firms do not have a commitment problem.

production function, and to multiple employees. The production function is:

$$g(e) = \begin{cases} 0 \text{ for } e < \overline{e} \\ 1 \text{ for } e \geq \overline{e}. \end{cases}$$

Assume that all workers not working at the firm producing the public good receive a wage that just compensates for the disutitily of work, i.e., for all other workers, $w_i - e_i = 0$. We shall also assume that there is a minimum wage that the firm can set, denoted $\underline{w} \ll \overline{e}$. We impose such a minimum because we are interested in labor donations of paid employees, in contrast with pure volunteers, as for example studied by Menchik and Weisbrod (1987). It also does not make sense to analyze performance related compensation (which amounts to promising payment upon performance) with promised payments that are zero, although nothing in the analysis logically excludes applying the results to a case of $\underline{w} \to 0$.

We proceed by analyzing two distinct cases. In the first, the firm is able to perfectly reward workers for effort supplied. This may be because the worker can be easily monitored, or because it is possible to organize effort contingent compensation through some other means. We shall call this the case of performance related compensation (PRC). The second is a situation where labor cannot be directly compensated for effort, so that a moral hazard problem arises; the non-PRC case. In this case, a non-performing worker can reap a pecuniary gain by taking the job. We first treat the existence, or not, of PRC as exogenous, and discuss its choice in a later section.

## 2.1 Performance Related Compensation

Under PRC, the firm calls a wage/effort pair denoted $(w, e)$, where $w$ is the total payment received in return for $e$ units of effort. The wage effort pair is enforceable. All individuals then simultaneously choose whether to apply for the job or not. From the perspective of the firm, all workers are identical, since preferences cannot be observed. So if more than one worker applies for the job, the firm simply chooses amongst them randomly, selecting one with equal probability from the pool of applicants. All the others remain in the alternative occupation, receiving $w_i - e_i = 0$.

Clearly, any contracted payment $w \geq \overline{e}$ would induce participation, and ensure output $g = 1$ is produced. For such payments, there is no free-riding problem, but there are also no labor donations since workers receive more than necessary to compensate for the disutility of effort. Labor donations can only arise if the firm calls a contracted pair with $w < \overline{e}$. Suppose, for instance, that the firm advertises a minimally paid position, i.e. it calls $(\underline{w}, \overline{e})$. Would anyone participate? The problem now has a private provision of public goods structure. Individuals with high valuations; $\gamma_i > \overline{e}$, would strictly prefer to take such a position if they were the only ones in the population, but with others who also value it, individuals can have incentives to free-ride.

If the $\gamma_i$ were public information, this would lead to the possibility of many asymmetric Nash equilibria provided there exist individuals for whom $\gamma_i > \overline{e}$. For example, one equilibrium is for the individual with the highest valuation to be the unique applicant for the volunteer position. Given noone else is doing so, volunteering strictly dominates for this individual, and given one individual is volunteering, noone else will also do so. Such equilibria can also be constructed for any individual with high enough $\gamma$ playing the role of the unique volunteer.

But, as seems realistic, we have assumed here that private valuations of the public good remain private information, so that such asymmetric equilibria do not exist. In this case, when labor is contractible, the unique equilibrium of the labor donations game has a symmetric cut-off rule:

**Proposition 1**: *With PRC, for any payment/effort pair $(w, \overline{e})$, with $w < \overline{e}$, there is a unique Nash equilibrium of the labor donations game involving a symmetric cut-off rule $\gamma^*$ solving:*

$$F(\gamma^*)^{N-1} \gamma^* = (\overline{e} - w). \tag{3}$$

*In equilibrium, all individuals for whom $\gamma_i \geq \gamma^*$ apply for the job, all individuals for whom $\gamma^i < \gamma^*$ do not.*

**All proofs are in the appendix.**

The donating individual equates her personal cost to providing the effort - the right hand side of (3) $(\overline{e} - w)$, and her personal benefit to providing it, which is that the public good is produced for certain insted of with probability $1 - F(\gamma^*)^{N-1}$ (which occurs when at least one other population members exceeds the cut off). So the expected level of output is $1 - F(\gamma^*)^{N-1}$. Note that, here, what induces an individual with $\gamma$ above $\gamma^*$ to apply is the probability that none of the $N-1$ other individuals will be a type $\gamma$ above $\gamma^*$, that is, the probability $F(\gamma^*)^{N-1}$. The equilibrium features free-riding since it is immediate from (3) that $N > 1$ implies $\gamma^* > \overline{e} - w$. Individuals, $i$, for whom $\gamma^* > \gamma_i > \overline{e} - w$, do not apply because they conjecture that there is a good enough chance of someone with higher valuation, i.e. $\gamma > \gamma^*$ working instead. They thus optimally choose to risk provision of the good not occuring. The high $\gamma$ individuals, on the other hand, will not risk the possibility of non-provision, and thus apply for work. As in standard private provision of public goods problems, as $N$ increases, the amount of free-riding increases. That is, the probability of any one individual being a free-rider is given by $F(\gamma^*) - F(\overline{e} - w)$, and it is immediate from (3) that $\gamma^*$ increases with $N$. Individual contributions fall, on average, with $N$. This, however, need not imply that, for a given wage, the equilibrium level of expected output will fall.

In what follows, we shall be interested in computing output in this case for large economies, that is, as $N \to \infty$. It should be noted that nothing in this problem implies that as $N \to \infty$ expected output $\left(1 - F(\gamma^*)^{N-1}\right)$ approaches either 0 or 1, as it depends critically on how the value of $\gamma^*$ changes.

The labor donations problem with contractible labor thus closely resembles a standard private provision of public goods problem: the equilibrium level of donation is less than the optimal level, there is free-riding, and the extent of free-riding increases with $N$. Moreover, vacancies are endemic, at least probabilistically, as these provide incentives for labor to donate.

The firm's choice variable, $w$, which we shall analyze in a later section, simply adjusts the threshold for participation. Increasing $w$ monotonically increases the equilibrium level of provision upto $\overline{e}$. By choosing a high enough $w$, (limiting at $w = \overline{e}$) participation is ensured and output is produced with probability 1. Lower values of $w$ save on labor costs, but leave open the possibility of non-provision, as the expected number of applicants must be strictly less than one in equilibrium to induce participation.

## 2.2 Non-performance Related Compensation

It is not always the case that firms utilize performance related compensation. One reason is simply technological. Contracting for labor effort requires some means of supervising and verifying effort contributions. Contracting on output, as in a piece-rate, is more likely to be feasible. But to do this, one needs the output to be relatively homogeneous and, in order to administer individual piece-rates individual contributions should be readily discerned. Even where such contracting is technologically feasible, it seems reasonable that there are costs to doing so. In order to determine whether such costs are worth bearing it is first necessary to compute the outcomes that would occur when effort is not directly rewarded.

In standard models, where there is no public good element to the good being produced, or no inherent utility obtained by provision of effort, workers are motivated to contribute effort only when firms create a pecuniary incentive to doing so; through PRC or some other means. Here we will see that this need not be the case. We proceed here by analyzing a situation where labor effort is fundamentally non-contractible so that there is never a pecuniary incentive for a worker to provide effort. One way of interpreting the present set up is as developed by Macleod and Malcomson (1989), elaborated in Malcomson (1999). In this formulation, there is no observable signal of effort that is readily available on which the establishment can condition remuneration.[9] Specifically, a hired worker is paid an agreed upon wage independent of the firm's performance, and without any possibility of the firm observing the worker's performance. Once employed, the worker simply chooses the effort level she contributes, and this choice has no pecuniary impact.

Let $n(w, N)$ denote the total number of applicants that the single firm receives when offering payment of $w$, in a population of size $N$. The equilibrium of the labor donations game will be similar to that of the PRC version already analyzed, but now, in addition to motivated applicants, for whom $\gamma \geq \overline{e}$ as previously,

[9] Of course, the present formulation of the problem does have a direct measure of output that, in principle at least, is contractible - the level of public good, $g$. Moreover we shall explore outcomes in a later section where the firm producing the public good is paid for its output. Since this output is contractible, the firm could also contract for effort by conditioning payment on output, which is directly related to effort. We will see there though that even small costs to writing such output contingent contracts will lead the firm to leaving labor uncontracted, as we will model it here. Additionally, there are more fundamental reasons why such output contingent remuneration of labor may not be feasible. Firstly, the firm will usually control other inputs, so that the worker's effort is not as deterministic as modeled here, secondly, most goods require the contribution of more than one worker, which makes the problem of contracting less direct, thirdly output of the public good may not be verifiable even where the firm is compensated for it. That is, the firm's reputation with its buyer may discipline output production, but the same disciplining effect in the labor market may not operate. The addition of any of these features would provide a more fundamental reason for worker effort to be non-contractible while simultaneously the firm is rewarded for increased output. For simplicity, none of these are directly modeled here, as their addition would simply add complexity without altering qualitative results.

the firm may receive some for whom $\gamma < \overline{e}$. These individuals are not attracted by the possibility of making a difference, but by the very lack of performance related compensation.

Consider first the application decision for motivated individuals who have a high valuation of the good, i.e., a $\gamma_i \geq \overline{e}$. As before, these individuals apply if they expect that, by doing so, they affect the probability of provision highly enough to raise their own utility. If obtaining the job, such an individual would contribute effort to good provision since the benefit, $\gamma_i$, exceeds the cost, $\overline{e}$. If applying, since jobs are allocated randomly, the probability of obtaining the position is $\frac{1}{n(w,N)}$. If not applying, the probability of the good being produced is denoted $\sigma(w,N)$. Both of these probabilities are endogenously determined.

The decision to apply compares the expected net benefit to applying at wage $w$ with that to not applying, represented by the left and right hand sides, respectively, of the following expression

$$\frac{1}{n(w,N)}(w - \overline{e} + \gamma_i) + \left(1 - \frac{1}{n(w,N)}\right)\sigma(w,N)\gamma_i \gtreqless \sigma(w,N)\gamma_i.$$

This is similar to before, and re-arranging it yields the high values of $\gamma$ corresponding to individuals who both apply and donate effort to the firm:

$$\gamma_i \geq \frac{\overline{e} - w}{(1 - \sigma(w,N))}. \tag{4}$$

Apart from the difference in determination of $\sigma$, which we return to soon, this is identical to the determination of the cut-off in the PRC case, condition (3), and the intuition for it is the same. Individuals with high valuations are not willing to risk the good not being provided, and are thus willing to volunteer labor effort to ensure it is undertaken.

Now consider those with a low valuation of the good; $\gamma_i < \overline{e}$. If employed at the firm, such individuals would never contribute contractible effort. Moreover, if their decision to apply were to have no impact on expected output, they would always strictly prefer to take the job at any $w > 0$. The reason they do not all apply is that the level of output provision is affected by their taking the job. Their relative benefit to doing so is given by the two sides of the following expression:

$$\frac{1}{n(w,N)}w + \left(1 - \frac{1}{n(w,N)}\right)\sigma(w,N)\gamma_i \gtreqless \sigma(w,N)\gamma_i.$$

Individuals for whom the left hand side of the expression above is larger than the right, strictly prefer to apply for the job. Rearranging this yields:

$$\gamma_i \leq \frac{y}{\sigma(w,N)}. \tag{5}$$

Those individuals with valuations of $\gamma$ above the right hand side of (5) but below $\overline{e}$, do not apply for positions even though they would obtain a benefit to shirking. The reason is that their valuations, though not high enough to overcome the moral hazard problem, are still high enough for them to be better off if the good is provided by someone else. If $\sigma$ is high enough, and the payment, $w$, small enough, then by taking the job and shirking, this individual is (with high probability) displacing a worker who would have provided effort and produced the good. Consequently, output, about which the person cares, would fall in expectation, and this fall in expected output is more costly than the benefit obtained by receiving the payment; $w$.

We thus obtain two cutoffs for the application decision. From $(4)$, one for those who apply for the position with the intention of truly volunteering the requisite effort; $\gamma_i \geq \frac{\bar{e}-w}{(1-\sigma(w,N))}$, and from $(5)$ those lower valuation individuals attracted by the possibility of being paid for doing nothing; $\gamma_i \leq \frac{w}{\sigma(w,N)}$. Define these cutoffs respectively by

$$\gamma^H \equiv \frac{\bar{e}-w}{(1-\sigma(w,N))} \tag{6}$$

$$\gamma^L \equiv \frac{w}{\sigma(w,N)}. \tag{7}$$

Using these, we obtain an implicit expression for $\sigma$ as follows:

$$\sigma(w,N) = \frac{\int_{\gamma^H}^{\infty} f(\gamma)\,d\gamma}{\left(\int_{\gamma^H}^{\infty} f(\gamma)\,d\gamma + \int_0^{\gamma^L} f(\gamma)\,d\gamma\right)}\left[1-\left(\int_0^{\gamma^H} f(\gamma)\,d\gamma + \int_0^{\gamma^L} f(\gamma)\,d\gamma\right)^{N-1}\right] \tag{8}$$

$$\text{or equivalently} = \frac{1-F\left(\gamma^H\right)}{1-F\left(\gamma^H\right)+F\left(\gamma^L\right)}\left[1-\left(F\left(\gamma^H\right)-F\left(\gamma^L\right)\right)^{N-1}\right]. \tag{9}$$

Intuitively, the probability of the good being produced, for given cutoffs $\gamma^H$ and $\gamma^L$ depends firstly on the applicant pool being non-empty, the term in square brackets above, and the probability that a randomly chosen member of the applicant pool is a non-shirker, the first term. Substituting for $\sigma(w,N)$ into $(6)$ and $(7)$, yields two expressions that implicitly define the equilibrium cutoffs, $\gamma^H$ and $\gamma^L$ :

$$\gamma^H = \frac{\bar{e}-w}{\left(1-\frac{1-F(\gamma^H)}{1-F(\gamma^H)+F(\gamma^L)}\left[1-\left(F\left(\gamma^H\right)-F\left(\gamma^L\right)\right)^{N-1}\right]\right)}$$

$$\gamma^L = \frac{w}{\frac{1-F(\gamma^H)}{1-F(\gamma^H)+F(\gamma^L)}\left[1-\left(F\left(\gamma^H\right)-F\left(\gamma^L\right)\right)^{N-1}\right]}.$$

For $N$ small, analytical treatment of these cut-offs is exceedingly complex, and it is not even clear that solutions are well defined for all possible distributions. However, when considering labor donations in modern economies, it makes sense to consider a large $N$ case. For $N \to \infty$, the problem becomes tractable. Specifically, the term in square brackets $\to 1$ so that we are left with:

$$\gamma^H = \frac{(\bar{e}-w)\left(1-F\left(\gamma^H\right)+F\left(\gamma^L\right)\right)}{F\left(\gamma^L\right)}, \tag{10}$$

$$\gamma^L = \frac{w\left(1-F\left(\gamma^H\right)+F\left(\gamma^L\right)\right)}{1-F\left(\gamma^H\right)}. \tag{11}$$

Intuitively, the assumption of large $N$ ensures that, for any $\gamma^H, \gamma^L$ in the interior of $F(\gamma)'s$ support there exists at least one member of the applicant pool. In a large enough population, essentially all types are represented. Note that, nothing about $N \to \infty$ necessitates either cutoff approaching the extremes. In fact, we shall characterize the values of these cutoffs in this large $N$ case shortly.

Even in the case of large $N$, uniqueness of these two cutoffs is not generally guaranteed. This is because there arises a complementarity between the actions of those who do not value the good highly, i.e. the $\gamma_i < \overline{e}$, as follows. If most other applicants are true volunteers, that is, individuals who would provide the required effort if employed, then, by taking the job and shirking, an individual with low $\gamma$ significantly lowers expected output. This is because, were he not to obtain the job, one of the committed others would have, and output would have been produced. But suppose there is a large increase in the number of other low $\gamma$ individuals ($\gamma < \overline{e}$) applying, so that these individuals constitute the bulk of the applicant pool. If a given low $\gamma$ individual applies and shirks now, output will not be adversely affected. This is because, with high probability, this worker is simply displacing another shirker from the position, so that the expected level of output is relatively unchanged. Consequently, the possibility of complementarity in the application decisions of those with low valuations can lead to multiple cut-off levels. Though this multiplicity may be of some interest, it is not the focus here, and can be easily ruled out in the continuous distribution case by the following assumption which ensures that the density at all points is sufficiently "thin", that is:

**Assumption:** *The density $f(\gamma)$ is such that*:

$$\gamma f(\gamma) < 1, \text{ for all } \gamma. \tag{12}$$

The assumption effectively ensures that the direct effect of a higher cut off, $\gamma^L$, which is to move the margin to individuals with higher valuations of the good, is not outweighed by the indirect effect, which is that inducing more participation by shirkers, the marginal individual's expectation of output falls. Under this assumption, a unique equilibrium outcome ensues:

**Proposition 2**: *For given $w : \underline{w} < w < \overline{e}$, and $N$ large, the unique equilibrium to the labor donations game, without PRC, is characterized by a pair of cut-offs $\gamma^H(w), \gamma^L(w)$, with $\gamma^H(w) \geq \overline{e} \geq \gamma^L(w)$. All $\gamma_i \geq \gamma^H(w)$ apply at wage $w$ and contribute $\overline{e}$, if receiving the job. All $\gamma_i \leq \gamma^L(w)$ apply at wage $w$ and contribute zero effort if receiving the job. All $\gamma_i$ with $\gamma^L(w) < \gamma_i < \gamma^H(w)$ do not apply.*

The equilibrium conditions can be more easily understood using the distribution functions rather than the densities:

$$\frac{F(\gamma^L)}{1 - F(\gamma^H) + F(\gamma^L)}\gamma^H = \overline{e} - w \tag{13}$$

$$\frac{1 - F(\gamma^H)}{1 - F(\gamma^H) + F(\gamma^L)}\gamma^L = w. \tag{14}$$

Equation (13) is derived from the marginal non-shirker. The right hand side can be interpreted as the cost to obtaining the job, which is the disutility of the effort net of its monetary compensation, $\overline{e} - w$. This is equated to the left hand side which is the expected cost of not taking the position; i.e., with probability $\frac{F(\gamma^L)}{1-F(\gamma^H)+F(\gamma^L)}$ the good is not produced, and the lost output is valued at $\gamma^H$. Similarly, condition (14) is derived from the marginal shirker. A shirker obtains $w$ when taking a position, since no effort is expended and no output is produced; this is the right hand side. This is equated to the benefit of not taking the position, which is that, with probability $\frac{1-F(\gamma^H)}{1-F(\gamma^H)+F(\gamma^L)}$ output is produced and valued at $\gamma^L$; the left hand side of (14).

Equilibrium actions are non-monotonic in valuations. Though the decision to shirk is monotonic, the decision to apply for work is not. Individuals with high valuations apply and donate labor if employed, individuals with low valuations apply and shirk if hired. Individuals that are in between do not apply. At all wages less than $\overline{e}$ there are some labor donations, but there may also be free-riding. It is possible, however, for high enough values of the wage that though there remain labor donations, there is no free-riding in equilibrium. Specifically

**Proposition 3**: *If $w$ satisfies:*

$$\overline{e} > w > \left(1 - \int_0^{\overline{e}} f(\gamma)\, d\gamma\right) \overline{e}, \tag{15}$$

*then, in equilibrium, labor is donated, but there is no free-riding.*

Thus, another unusual feature of this equilibrium is that, for sufficiently high values of the wage, even though individuals would be strictly better off if someone else were to provide effort for the firm, nobody chooses to free ride. The reason free-riding disappears here is that the participation of individuals with low valuations, who will shirk, provides incentives for individuals with higher valuations to apply. With some small, but positive, probability a high $\gamma$ applicant will be accepted. This probability approaches zero as $N$ gets large. However, if accepted, there is a non-small probability that they will have displaced a shirker. Note that, unlike the selection probability, this probability is invariant with respect to $N$, and it ensures that, if selected, their application is worthwhile. If not selected for the job, they are no worse off, so they continue to apply independently of $N$.

Recall that free-riding had to occur under PRC, because it was the possibility of free-riding by others that induced an individual with high enough valuation to apply. Here, however, the inducement comes from the individuals who will take the job and shirk, i.e. it arises directly from the lack of PRC, so that free-riding need not occur in equilibrium. The interesting possibility arises that firms may wish to induce the moral hazard problem, by avoiding PRC in order to induce participation of the good workers. This is explored in the next section.

Both Andreoni (1990) and Vicary (2000) have developed models where individuals' contributions to a public good need not go to zero as the population becomes large, but for entirely different reasons. In Andreoni (1990) the reason is that the good is not a pure public good. Individuals receive personal benefit from the act of participating which persists, and motivates contribution, even in large economies. Vicary's finding depends critically on public good levels being directly affected by consumption as well as individual donations - an example is driving a car (worsening the environment) while simultaneously contributing to Greenpeace.

# 3 The Effect of PRC on Output and Profits

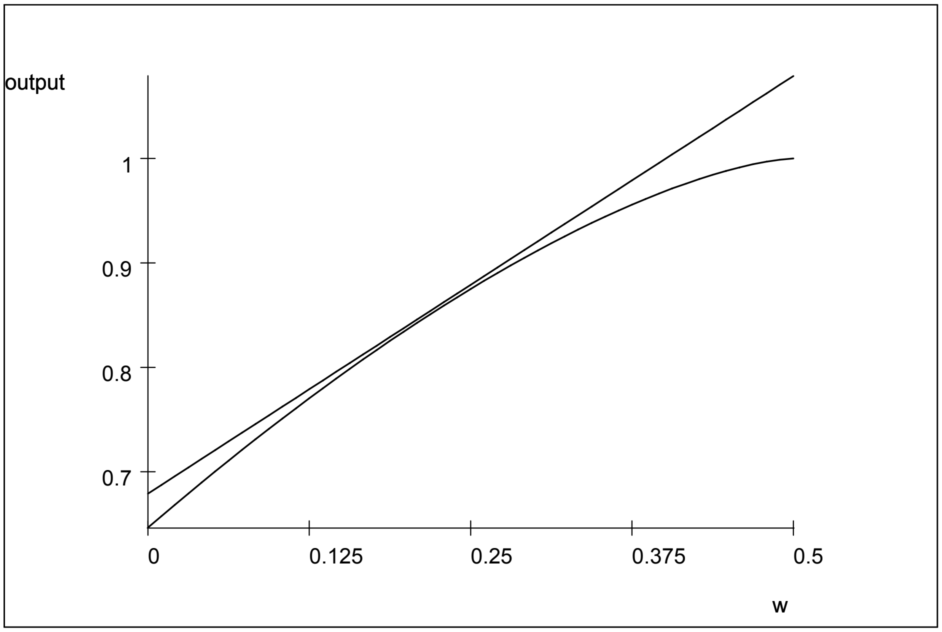
Upto now, wages in both the PRC and non-PRC cases have been taken as given. Here we briefly discuss the wage setting decision under each type of compensation scheme. It turns out that a full characterization is not possible, as expected output in each case varies non-uniformly with the wage. The final part of this section compares profits in PRC compared with non-PRC for a particular example where the $\gamma$ are uniformly distributed.

In order to undertake a comparison of profits we must introduce two additional parameters. Firstly, assume that the cost of introducing PRC is a fixed amount denoted $\kappa$. These costs could arise for a number of reasons, they could correspond to the costs of supervision, the costs of writing the contract or the costs of verifying them. The second additional parameter is the price that an establishment receives for producing the public good. We assume a constant per unit price, $p$. Since the establishment either produces the good or not, the price $p$ is also a lump-sum payment for services or good, which the public good purchaser, perhaps the government, transfers upon completion. Since establishments are assumed risk neutral, expected payment will be considered in what follows.

## 3.1 Optimal wages

**Without PRC**

When setting wages without performance related compensation, the firm faces the following tradeoff. The cost side is obvious - paying a higher wage costs more. The benefit to a higher wage is that the upper cut-off, $\gamma^H$ falls (provided $\gamma^H > \overline{e}$) - there will be less free-riding because the amount of donation asked from individuals who value the good is lower. Mitigating this is the corresponding rise in $\gamma^L$; the higher wage induces more shirkers to apply for the position. The firm's profits are: $\frac{1-F\left(\gamma^H\right)}{1-F(\gamma^H)+F(\gamma^L)}p - w$, where the cut-off $\gamma$ values are both affected by wages according to (10) and (23) , so that the expected value of output, $\frac{1-F\left(\gamma^H\right)}{1-F(\gamma^H)+F(\gamma^L)}$, is also a function of the wage. If expected output were to behave in a nice, concave fashion, the firm's optimal wage could be simply solved by equating the marginal product to the wage, as in the standard problem sketched below.




However, it turns out that the behavior of these cut-off $\gamma$ values with variations in the wage is, in general, highly irregular, as they depend critically on the precise form of the distribution of the $\gamma$s and thus do not ensure a straightforward relationship. Specifically, consider the marginal impact of a wage increase for a wage, $w_1$, with two corresponding to cut-offs $\gamma_1^H$ and $\gamma_1^L$. A marginal increase in the wage induces a relatively large increase in output when $f\left(\gamma_1^H\right) \gg f\left(\gamma_1^L\right)$. Intuitively, a small increase in the wage would induce a relatively large influx of good workers, and thus have relatively great impact on output, implying a convex region in the wage output function. The shape of the output function thus depends sensitively on the precise form of $F(\gamma)$ so that general results are not available.

**Performance Related Compensation**

A firm using PRC faces an entirely different problem. The moral hazard problem disappears since the firm has paid the fixed amount $\kappa$, but at wages less than $\overline{e}$, the equilibrium level of provision will not generally be one. As shown in (3), the cut-off is:

$$F(\gamma^*)^{N-1}\gamma^* = (\overline{e} - w),$$

yielding expected level of output $1 - F(\gamma^*)^{N-1}$. In order to compare it to the non-PRC case which has only been solved for $N \to \infty$, we must also compute expected output at this limit. Though simpler than in the non-PRC case, this also depends on the precise form of the distribution, $F(\gamma)$, so that, once again, no general conclusions can be drawn.

## 3.2 A Comparison Example

We are thus left with expressions for profit in each case that may have highly irregular relationships to the wage. Since, under PRC, wages are only paid when output is produced, profits in that case are

$$(p - w)\left(1 - F\left(\gamma^*\right)^{N-1}\right) - \kappa \tag{16}$$

with $N \rightarrow \infty$.

Without PRC, wages are paid even if the worker shirks, but costs are not spent on PRC, so that profits are

$$\left[\frac{1 - F\left(\gamma^H\right)}{1 - F\left(\gamma^H\right) + F\left(\gamma^L\right)}\right] p - w, \tag{17}$$

where the large $N$ assumption is already used in computing expected output.

It is natural to ask whether it is always the case that a firm using PRC will do better. To answer this, optimal wages and a comparison of profits in the two cases are now examined for a particularly simple example where the $\gamma$ are distributed according to the uniform distribution over the interval $[0, 1]$. Under the uniform distribution, with support on the unit interval and without PRC, we have :

$$\frac{\gamma^L}{1 - \gamma^H + \gamma^L}\gamma^H = \overline{e} - w \tag{18}$$

$$\frac{1 - \gamma^H}{1 - \gamma^H + \gamma^L}\gamma^L = w. \tag{19}$$

Solving (18) and (19) yields the cut-offs without PRC:

$$\gamma^H = \frac{\overline{e} - w}{\overline{e}}$$

$$\gamma^L = \frac{w}{1 - \overline{e}}.$$

Substituting these into $\frac{1-F\left(\gamma^H\right)}{1-F(\gamma^H)+F(\gamma^L)}$ yields an expected value of output equal to $1 - \overline{e}$.

The unique property of the uniform distribution, constant density $f(\cdot)$, ensures that output is insensitive to the wage. Under this distribution, at all values of $\gamma$ in the support, the number of additional non-shirkers induced by a wage increase is exactly offset by the number of additional shirkers. Consequently the probability of provision is unaffected. Since provision probability is independent of $w$, the optimal wage for a firm using the non-supervision technology will be to set the lowest wage, $\underline{w}$. The optimal wage under PRC will not generally be the minimal wage, but the uniform distribution starkly demonstrates the relatively small output elasticity of the wage when both margins (that of shirkers and non-shirkers) move with wage setting. Since, with this distribution, they both move proportionately at all points, the optimal wage is as low as possible.

With the use of PRC we have:

$$\gamma^{*N-1}\gamma^* = \overline{e} - w \text{ with } N \rightarrow \infty. \tag{20}$$

Solving (20) yields cut-off:

$$\gamma^* = (\overline{e} - w)^{\frac{1}{N}}.$$

Thus the expected value of output equals $1 - (\overline{e} - w)^{\frac{N-1}{N}}$, yielding expected ouput as a convex function of the wage. As $N \to \infty$, the output function becomes linear in the wage, that is, expected output approaches: $1 - (\overline{e} - w)$.

Since the output function is convex under PRC, the optimal wage for the firm to set varies discretely with the rate at which it is rewarded for output. Denote this rate of reward, or price, by $p$. The table below compares optimal wages, output, and profits as a function of price received by the firm:

| | $p > 1$ | | | $p \leq 1$ | | |
|---|---|---|---|---|---|---|
| | PRC | | Non-PRC | PRC | | non-PRC |
| Wage | $\overline{e}$ | $>$ | $\underline{w}$ | $\underline{w}$ | $=$ | $\underline{w}$ |
| Expected Output | 1 | $>$ | $1 - \overline{e}$ | $1 - \overline{e} + \underline{w}$ | $=$ | $1 - \overline{e}$ |
| Expected Profit | $p - \overline{e} - \kappa$ | | $p(1 - \overline{e}) - \underline{w}$ | $p(1 - (\overline{e})) - \kappa$ | | $p(1 - \overline{e}) - \underline{w}$ |

If $p > 1$, a firm using PRC receives more of an increase in revenue for every additional expected worker than this costs in higher wages. It thus chooses to set a wage that will induce participation for sure, $w = \overline{e}$. All individuals apply for work and the firm randomly picks one yielding output of one, and profit $p - \overline{e}$. Alternatively, if $p < 1$, inducing workers to participate with a higher wage is not sufficiently rewarded with higher output. Consequently, the optimal wage under PRC is the minimal one, $\underline{w}$. This is the same as the optimal wage chosen by a firm that does not use PRC. Note that, without PRC, the minimal wage induces participation for certain, since the high $\gamma$ individuals, i.e., those with $\gamma$ at, and close to, one have incentive to apply because individuals with low $\gamma$ i.e., at and close to zero, have incentive to apply in order to benefit from the moral hazard. With PRC, it is no longer true, as the upper-cut off rises to a point where equilibrium application numbers remain bounded below 1, i.e. to $1 - \overline{e} + \underline{w}$. When this minimal wage is low, i.e., suppose $\underline{w} \to 0$, expected output would be similar in the two cases, but for entirely different reasons. In the PRC case, it is driven by a low expected number of applicants. The establishment not using PRC, in contrast, is ensured to have enough applicants, but has similar expected output only because proportion $\overline{e}$ of them are, on average, going to be shirkers.

Comparing profits in the two cases. When $p > 1$, under the PRC, profit is $p - \overline{e} - \kappa$. The expected wage bill is lower without PRC, but expected output is so much lower that expected revenue is the smaller amount, $(1 - \overline{e})\, p$. This implies that, as long as $\kappa$, the costs of setting up PRC, are not too large, performance related compensation will be chosen. In contrast, with $p \leq 1$ under both types of compensation scheme, the firm would optimally set wages as low as possible. Provided $\underline{w}$ is small, expected output under either scheme does not differ greatly, but in one the costs of setting up PRC have been unnecessarily born. Consequently, as long as $\kappa$ is not trivial, which seems reasonable, the establishment will do better by utilizing performance related compensation.

The simple comparison above suggests,

**PRC is less likely to be used when:**

*Establishment rewards are not strongly related to output* ($p \leq 1$ in the example). A government bureaucracy, or manager, with little direct monetary concern for output will have less incentive to use PRC than a firm who is being rewarded directly for provision, by for example selling their output at a market price. It is also the case that the more difficult it is to measure output performance, and thus the weaker the mapping from output to revenue, the less we should expect to see PRC used.

*Optimal wages without PRC are low.* Specifically, if it is optimal for an establishment without PRC to pay a wage approaching $\overline{e}$, then using PRC is likely to dominate (provided the costs of implementing PRC, $\kappa$, are not prohibitively high). By relating compensation to performance, high wages ensure output, but they do not do so in the absence of PRC, where the possibility of shirking always bounds expected output. Conversely, when a lower wage is optimal, the reduced probability of provision without PRC can be more than offset by the wage savings. As in the example, without PRC, increasing wages is not worthwhile as it induces more workers who are unmotivated to take the positions (i.e., shirkers), leaving expected output relatively unaffected.

Thus, since it is possible for a firm without PRC to have higher expected profit, it also follows that, even if the firm were able to perfectly implement PRC at a small but non-trivial cost, $\kappa$, they may choose not to. Specifically, the example demonstrates that a firm producing output about which workers *may* care, may produce similar output and have higher expected profit, if it simply pays workers for participating without paying careful attention to what these workers do.

## 3.3 Implications

**Performance Related Pay**

A large literature has explored reasons for why public sector firms may have lower-powered incentives than those in the private sector. It has generally emphasized the difficulties that may arise in implementing PRC. Specifically some have emphasized difficulties arising from multiple principals in the public sector, as developed by Bernheim and Winston (1986), or difficulties of measurement and monitoring when output is multifacted, not traded or not easily observable, as in Holmstrom and Milgrom (1991). Corneo and Rob (2003) incorporate socializing activity into a multi-task model, and show that public firms will have less incentive intensity. Besley and Ghatak (2003) similarly to here find that organizations producing output that is also valued by their workers will tend to have lower powered incentives. In their framework, successful organizations achieve an alignment between the motivations of workers and principals, and free-riding plays no role. With well aligned objectives, agents have strong personal incentives to provide effort and the need for additional pecuniary motivation is lessened. The ability to condition payment directly upon effort would not lead to reduced performance in their setting. Here, in contrast, the free-riding problem plays a critical role. By not conditioning payment on effort, the firm effectively solves the free-riding problem, though, by doing so, it introduces an adverse selection problem. It is possible that this may lead to no less output, so that not using PRC is optimal.

The finding that firms may choose to pay low wages (which do not even cover opportunity costs) is similar to that found in Engers and Gans (1998), but arises for entirely different reasons. The reasoning behind their result is tied strongly to the editor/referee context in which their model is set, and unlike here, does not depend on moral hazard. Suppose an editor solicits a referee's report and offers an accompanying payment for timeliness. If the referee shares with the editor a concern for journal quality, then a cost to rejecting the assignment is that refereeing is delayed, lowering the referee's utility. If the accompanying payment is increased, this increases the direct benefit a referee receives to doing the report, but it also increases the willingness of a subequent referee to undertake the assignment, were the current referee to reject it. Consequently, this lowers the cost to the current referee of rejecting the assignment, which mitigates the incentive providing effect of the payment. In the present paper, an entirely different mechanism is at work. A higher monetary payment has the direct effect of increasing the incentive for well motivated non-shirking workers to participate. However, another effect is that this also attracts workers who are not interested in the firm's mission or output, but instead would like to obtain a salary for minimal effort. These workers shirk. Consequently the beneficial impact of raising wages in inducing participation of the "good" workers is mitigated by also inducing shirkers to apply. This is a concern that has been raised by the use of monetary incetives for teachers. Jacobson (1995) surveys the debate on teacher compensation reform in the US and argues the dilemma of monetary incentives leading to the influx of individuals primarily motivated by money is a key issue.

The model predicts less use of performance related pay in the public sector or in non-profit firms, since these sectors are most heavily engaged in production of public goods. Although this seems anecdotally suppored, formal comparisons of the public sectors' propensity to use performance related pay, relative to the private sector, for similar occupations, is sparse. Burgess and Metcalfe (1999) using cross-sectional establishment data from 1990 find that establishments in the public sector are less likely to operate an incentive scheme than comparable ones in the private sector, and that this difference arises only amongst non-manual workers, which are the workers more likely to be involved in discretionary practices.[10] Roomkin and Weisbrod (1999) report finding greater use of performance related compensation in for-profit than nonprofit hospitals amongst top managerial positions, even though overall earnings were similar.

**Earnings Penalties in Non-profit Firms**

[10] See also Brugess and Ratto (2003) for an upto date survey of theory and evidence on incentive provision and its relation to the public sector, and Proper and Wilson (2003) for discussion of the effectiveness of mandated PRC schemes introduced in both the US and UK.

Almost all studies comparing non-profit wages with those of for-profits find penalties when considering raw earnings. For example, an early study by Johnston and Rudney (1987) found average annual earnings of nonprofit employees in service industries to be 21.5% lower. Preston (1989) found a nonprofit wage penalty of about 20% for managers and professionals in the US Survey of Job Characteristics. However, findings often change substantially when better controls for individual and workplace characteristics are introduced. Goddeeris (1988) found that public interest lawyers earned 37% less than those in private firms, but that the difference disappeared once characteristics were controlled for. Holtmann and Idson (1993) found a slight wage premium for nurses in non-profit institutions but this became a lower wage when quality was controlled for. Leete (2001) found no systematic non-profit wage differential using the 1990 US census using the finest possible, three digit industry, partition. Mocan and Viola (1997) using extensive controls for human capital and center characteristics found no significant nonprofit wage differential amongst child care workers. Ruhm and Borkoski (2003) find, using the CPS, that the raw non profit penalty all but disappears when hours and workplace characteristics are taken into account. Though some studies with controls still find non-profit wage penalties in some sectors, for example Mocan and Tekin (2003) in US childcare, the consensus view seems to be that, though average earnings are clearly lower in NPOs, there does not seem to be a systematic penalty in earnings received per hour worked in non-profit firms, once the differences are controlled for.

A finding of lower average earnings, but no hourly wage penalty in NPOs, is consistent with the model presented here if NPOs are likely to have difficulties introducing performance related compensation. NPOs are overwhelmingly over-represented in the 'care' related sectors which administer to the vulnerable: health-care, child-care, care for the elderly and education. To the extent that citizens have a civic-minded interest in seeing these services well provided, these are sectors producing services which are public goods. The model predicts that public good producing firms in which PRC is difficult to introduce will tend to favor the use of relatively low wages, and low powered incentives. Consequently, average earnings in non-profit firms should tend to be low. However, since these firms will also select some workers who are not attracted by the mission, but by the opportunity to receive pay for little effort, hourly earnings, or earnings measures that appropriately control for effort contributed at work, may be similar or even higher.

# 4 Conclusions

This paper has considered a form of private provision of public goods problem that arises when individuals donate labor out of a concern for the mission or output produced by an establishment. When firms are either not able to, or choose not to, utilize performance related compensation (PRC), the outcome differs significantly from the standard private provision of public goods problem. Specifically, individuals with both low and high valuations of the firm's output will apply for work at the firm. The low intend to obtain work in order to benefit from the lack of performance compensation, the high are motivated by a desire to see the good produced. The analysis shows that not utilizing PRC can be a preferred strategy for a firm producing such goods, as it serves to induce the high valuation individuals to contribute their labor at wages below opportunity costs, because by displacing low valuation individuals, they ensure that correct labor effort is contributed. The paper finds that such jobs will also tend to be accompanied by relatively low wages, because without PRC the elasticity of expected output with the wage tends to be low. Low average wages and little use of PRC both seem to widely observed features of firms engaged in the production of socially valued output.

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# 6 Appendix

**Proof of Proposition 1:** Consider the utility of an individual $i$ applying for a job, given a cut-off rule, $\widehat{\gamma}$. Linearity of the preferences implies that expected values can be considered. The individual applies, if and only if:

$$\begin{aligned} \frac{1}{N\int_{\widehat{\gamma}}^{\infty} f(\gamma)\,d\gamma}(w-\overline{e}+\gamma_i)+\left(1-\frac{1}{N\int_{\widehat{\gamma}}^{\infty} f(\gamma)\,d\gamma}\right)\left(1-F(\widehat{\gamma})^{N-1}\right)\gamma_i &\geq \left(1-F(\widehat{\gamma})^{N-1}\right)\gamma_i \\ \Rightarrow F(\widehat{\gamma})^{N-1}\gamma_i &\geq (\overline{e}-w)\,. \end{aligned} \quad (21)$$

A symmetric equilibrium is a common cut off value of $\gamma^*$ such that the induced optimal decision under (21) yields only individuals with $\gamma_i \geq \gamma^*$ applying for the job. That is, an equilibrium is a fixed point solving $F(\gamma^*)^{N-1}\gamma^* = (\overline{e}-w)$. It is immediate that the left hand side of this condition is monotonic and, given continuity of $F$, continuous in $\gamma^*$. Also, clearly, $\lim_{\gamma\to\infty} F(\gamma)^{N-1}\gamma > \overline{e}-w$, and $\lim_{\gamma\to 0} F(\gamma)^{N-1}\gamma < \overline{e}-w$ for any, $N>1$, $w\geq 0$. Thus a point solving (3) exists. The monotonicity of the left hand side implies that such a fixed point is unique. Note finally that, given $F(\gamma)^{N-1}$, each individual's best response is uniquely determined by their own $\gamma_i$ according to (21). Consequently, there is no possibility of a non-symmetric equilibrium where individuals $i$ and $j$ choose to apply for the job under different critical values for $\gamma$. ■

**Proof of Proposition 2:** Assuming $N$ large we can use the conditions (10) and (11) which can be expressed as:

$$\frac{\int_0^{\gamma^L} f(\gamma)\,d\gamma}{\int_{\gamma^H}^{\infty} f(\gamma)\,d\gamma+\int_0^{\gamma^L} f(\gamma)\,d\gamma}\gamma^H = \overline{e}-w \quad (22)$$

$$\frac{\int_{\gamma^H}^{\infty} f(\gamma)\,d\gamma}{\int_{\gamma^H}^{\infty} f(\gamma)\,d\gamma+\int_0^{\gamma^L} f(\gamma)\,d\gamma}\gamma^L = w. \quad (23)$$

The right hand side of both expressions is constant, given $w$. For given $\gamma^L$, the left hand side of (22) is monotonic in $\gamma^H$. For given $\gamma^H$, the left hand side of (23) is not necessarily monotonic in $\gamma^L$, but if

$$\begin{aligned}
& \int_{\gamma^H}^{\infty} f(\gamma)\, d\gamma + \int_0^{\gamma^L} f(\gamma)\, d\gamma - \gamma^L \int_{\gamma^H}^{\infty} f(\gamma)\, d\gamma f\left(\gamma^L\right) > 0 \\
& or \\
& 1 - F\left(\gamma^H\right) + F\left(\gamma^L\right) - \gamma^L f\left(\gamma^L\right)\left(1 - F\left(\gamma^H\right)\right) > 0 \\
\Leftrightarrow \quad & F\left(\gamma^L\right) + \left[1 - \gamma^L f\left(\gamma^L\right)\right]\left(1 - F\left(\gamma^H\right)\right) > 0
\end{aligned}$$

then the left hand side of (23) is monotonically increasing in $\gamma^L$. A sufficient condition for this is condition (12). Consequently, the LHS of (23) is monotonic. Thus since the Left hand side is increasing in $\gamma^L$, define $\gamma^L\left(\gamma^H\right)$ as the value of $\gamma^L$ that solves (23) given $\gamma^H$ and $w$. Note that $\frac{\partial \gamma^L\left(\gamma^H\right)}{\partial \gamma^H} > 0$. Substitute the function $\gamma^L\left(\gamma^H\right)$ for $\gamma^L$ into the left hand side of (22) to obtain the expression $\frac{\int_0^{\gamma^L\left(\gamma^H\right)} f(\gamma) d\gamma}{\int_{\gamma^H}^{\infty} f(\gamma) d\gamma + \int_0^{\gamma^L\left(\gamma^H\right)} f(\gamma) d\gamma}\gamma^H$. Now use this to evaluate the expression (22):

$$\frac{\int_0^{\gamma^L\left(\gamma^H\right)} f(\gamma)\, d\gamma}{\int_{\gamma^H}^{\infty} f(\gamma)\, d\gamma + \int_0^{\gamma^L\left(\gamma^H\right)} f(\gamma)\, d\gamma}\gamma^H \gtreqless \overline{e} - w. \tag{24}$$

Note that the derivative of the LHS of this function in $\gamma^H$ is monotonically increasing, i.e.

$$\begin{aligned}
& \left(\int_{\gamma^H}^{\infty} f(\gamma)\, d\gamma + \int_0^{\gamma^L\left(\gamma^H\right)} f(\gamma)\, d\gamma\right)\left(1 + \frac{\partial \gamma^L\left(\gamma^H\right)}{\partial \gamma^H} f\left(\gamma^L\right)\right) - \\
& \left(\int_0^{\gamma^L\left(\gamma^H\right)} f(\gamma)\, d\gamma . \gamma^H\right)\left(-f\left(\gamma^H\right) + \frac{\partial \gamma^L\left(\gamma^H\right)}{\partial \gamma^H} f\left(\gamma^L\right)\right) \\
\equiv \quad & \left(\int_{\gamma^H}^{\infty} f(\gamma)\, d\gamma + \int_0^{\gamma^L\left(\gamma^H\right)} f(\gamma)\, d\gamma\right) + \int_{\gamma^H}^{\infty} f(\gamma)\, d\gamma \frac{\partial \gamma^L\left(\gamma^H\right)}{\partial \gamma^H} f\left(\gamma^L\right) + f\left(\gamma^H\right)\left(\int_0^{\gamma^L\left(\gamma^H\right)} f(\gamma)\, d\gamma . \gamma^H\right) \\
& +\left(1 - \gamma^H\right)\left(\int_0^{\gamma^L\left(\gamma^H\right)} f(\gamma)\, d\gamma\right)\frac{\partial \gamma^L\left(\gamma^H\right)}{\partial \gamma^H} f\left(\gamma^L\right) \\
> \quad & 0
\end{aligned}$$

Thus the value of $\gamma^H$ solving (24), if it exists, is unique, and therefore also is $\gamma^L$. We now show that, either a $\gamma^H$ solving (24) exists, in which case the equilibrium cut-offs are $\left(\gamma^H, \gamma^L\left(\gamma^H\right)\right)$ with $\gamma \leq \gamma^L\left(\gamma^H\right)$ applying and shirking if obtaining work, $\gamma$ such that $\gamma^L\left(\gamma^H\right) < \gamma < \gamma^H$ not applying, and $\gamma \geq \gamma^H$ applying and donating labor if hired. If a $\gamma^H$ solving (24) does not exist, then the corresponding equilibrium cut-offs are $\gamma^H = \overline{e}$ and $\gamma^L(\overline{e})$.

Clearly for $\gamma^H \to \infty$, LHS > RHS of (24). For $\gamma^H = \overline{e}$, there are 2 possibilities, either (i) LHS < RHS of (24) or (ii) LHS $\geq$ RHS of (24). Case (i): If for $\gamma^H = \overline{e}$, LHS < RHS of (24), then by the continuity and monotonicity of LHS (24) $\exists\ \gamma^H > \overline{e}$ which solves (24) with equality, and monotonicity implies this value is unique. The lower cut-off is then given by $\gamma^L = \gamma^L(\gamma^H)$ from (23), provided that a $\gamma^L$ can be found to solve (23) with equality. If not, then $\gamma^L = \overline{e}$. In the case where an equality exists, the two cut-offs $\gamma^H$ and

$\gamma^L\left(\gamma^H\right)$ correspond to the unique fixed point pair of the system given by (22) and (23). Given these cut-offs $\left(\gamma^H,\gamma^L\right)$, the induced optimal individual decisions yield aggregate probabilities which coincide with these cut-offs. In the case where $\gamma^L=\overline{e}$, given that all $\gamma\leq\overline{e}$ apply, $\gamma^H$ is the unique solution to (22) when setting $\gamma^L=\overline{e}$, so that the upper cut off for individuals is generated by individual decisions consistent with that optimum. The left hand side of (23) strictly exceeds the right hand side for this value of $\gamma^H$ and $\gamma^L=\overline{e}$, implying that all individuals with $\gamma\leq\overline{e}$ strictly prefer to apply.

Case (ii) For $\gamma^H=\overline{e}$, if LHS $\geq$ RHS of (24) then set $\gamma^H=\overline{e}$ and $\gamma^L=\gamma^L\left(\overline{e}\right)>0$ using equation (23) with $\gamma^H=\overline{e}$. The inequality can be seen directly from (23). Consider $\gamma^L$ more precisely, the two sides of expression (23) in this situation with $\gamma^H=\overline{e}$ yield:

$$\frac{\int_{\overline{e}}^{\infty}f\left(\gamma\right)d\gamma}{\int_{\overline{e}}^{\infty}f\left(\gamma\right)d\gamma+\int_0^{\gamma^L}f\left(\gamma\right)d\gamma}\gamma^L\gtreqless w. \tag{25}$$

There are two possibilities at $\gamma^L=\overline{e}$, either: (a) LHS $>$ RHS of (25) or (b) LHS $\leq$ RHS of (25). Case (a), if for $\gamma^L=\overline{e}$, LHS $>$ RHS of (25), then by the continuity and monotonicity of LHS (25) $\exists\ \gamma^L<\overline{e}$ which uniquely solves (25) with equality. The equilibrium cut-offs in this case are given by $\gamma^H=\overline{e}$ and $\gamma^L<\overline{e}$. Condition (23) holds, and the solution is unique, but the left hand side of (22) always exceeds the right. In this equilibrium, all motivated individuals apply, but not all shirkers do. Finally case (b) where for $\gamma^L=\overline{e}$, LHS $\leq$ RHS of (25). In that case $\gamma^L=\overline{e}=\gamma^H$, all $N$ individuals apply for the job, and neither (22) nor (23) hold as $\int_0^{\overline{e}}f\left(\gamma\right)d\gamma\overline{e}>\overline{e}-w$. Given all individuals are applying, both high and low $\gamma$ individuals strictly prefer to apply for the job.

Uniqueness: The uniqueness of the equilibrium cut-offs is guaranteed in the case of a $\gamma^H\left(w\right),\gamma^L\left(w\right)$ as characterized above. Qualitatively different equilibria cannot exist. Again, this follows from the fact that the $\gamma_i$ are private information. Since this is the case, in any equilibrium, all individuals condition their action on their own $\gamma_i$ and the expected aggregate actions of others induced by their equilibrium behaviors, the $\sigma$ defined in equation (8). Individual behavior must therefore be symmetric for given $\gamma$ values, in any candidate equilibrium. However, we have shown above, that the unique fixed points induced by such a problem correspond to $\gamma^H\left(w\right),\gamma^L\left(w\right)$ as characterized above.

■

**Proof of Proposition 3:** We demonstrate that when the wage satisfies the second inequality in (15), all apply for the job, thus there is no free-riding. A sufficient condition for all $\gamma\geq\overline{e}$ to apply, given that all $\gamma<\overline{e}$ are applying, is that the left hand side of condition (24) strictly exceeds the right hand side at $\gamma^H=\gamma^L=\overline{e}$. That is:

$$\begin{aligned}\frac{\int_0^{\overline{e}}f\left(\gamma\right)d\gamma}{\int_{\overline{e}}^{\infty}f\left(\gamma\right)d\gamma+\int_0^{\overline{e}}f\left(\gamma\right)d\gamma}\overline{e} &> \overline{e}-w\\ \Leftrightarrow\int_0^{\overline{e}}f\left(\gamma\right)d\gamma\overline{e} &> \overline{e}-w.\end{aligned} \tag{26}$$

A sufficient condition for all $\gamma < \overline{e}$ to apply given that all $\gamma \geq \overline{e}$ are applying is that the left hand side of (25) is strictly less than its right hand side under $\gamma^H = \gamma^L = \overline{e}$. That is:

$$
\begin{aligned}
\frac{\int_{\overline{e}}^{\infty} f(\gamma)\, d\gamma}{\int_{\overline{e}}^{\infty} f(\gamma)\, d\gamma + \int_{0}^{\overline{e}} f(\gamma)\, d\gamma}\overline{e} &< w \\
\Longleftrightarrow \int_{\overline{e}}^{\infty} f(\gamma)\, d\gamma \overline{e} &< w \\
\Longleftrightarrow \left(1 - \int_{0}^{\overline{e}} f(\gamma)\, d\gamma\right)\overline{e} &< w
\end{aligned}
$$

which is identical to (26) and identical to the second inequality in (15) . Thus, under this condition, all apply. The first inequality in (15) is necessary and sufficient to ensure that labor is being donated, as workers are not fully compensated for the disutility of effort.■