

Selfish Bakers, Caring Nurses?

A Model of Work Motivation

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Abstract

Work contributes to people's self-image in important ways. We propose a model in which individuals have a preference for *being important to others*. This leads to the following predictions: 1) In fully competitive markets with performance pay, behavior coincides with the standard model (bakers). 2) In jobs where effort is not rewarded according to its social marginal value, behavior is more socially beneficial than predicted by the standard model (nurses). 3) Even if unemployment benefits provide full income compensation, many workers' utility strictly decreases when losing their job. 4) Similarly, many workers will prefer to work rather than to live off welfare, even with full income compensation. 5) To keep shirkers out of the public sector, nurses' wages must be strictly lower than private sector income. At this wage level, however, the public sector will be too small. 6) It is possible to attract motivated workers to the public sector, without simultaneously attracting shirkers, through capital input improving nurses' opportunity to do a good job.

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"It is not from the benevolence of the butcher, the brewer, or the baker, that we expect our dinner, but from their regard to their own interest" (Smith 1776, par. I.2.2).

"How selfish soever man may be supposed, there are evidently some principles in his nature, which interest him in the fortune of others, and render their happiness necessary to him." (Smith 1759, par. I.I.I)

1 Introduction

The *Homo Oeconomicus* model, which assumes that individuals care only about their own access to goods and services while keeping their own efforts low, has long been the benchmark for economic analyses of labor markets and worker behavior. Recently, however, several researchers have explored the idea that workers may have various kinds of altruistic or social preferences (e.g. Benabou and Tirole 2006, Dur and Glazer 2005, Besley and Ghatak 2005, Francois 2000, 2005, Heyes 2004, Frank 2003). One reason for this interest is that empirical observation often seems hard to reconcile with the stark *Homo Oeconomicus* predictions: If *Homo Oeconomicus* is paid by a fixed wage, for example, and effort is unobservable, he will exert no effort above the absolute minimum required to keep his job. Anyone who has spent some time at a hospital, a school, or a university, knows that although this description might fit the behavior of some individuals, it definitely does not fit all. Indeed, within health economics, the assumption of altruistic physicians has become widely used in recent years, presumable since without it, model predictions are simply too difficult to reconcile with the empirical evidence.¹

Nevertheless, there are numerous cases in which the standard model appears to be perfectly adequate: Personally, we have yet to see, for example, economic analyses of altruistic stock market brokers, bakers, or butchers. If empirical observations seem to indicate that behavior is inconsistent with the *Homo Oeconomicus* model in some occupations, but not in others, it is unsatisfactory to "explain" this by simply *assuming* that certain occupations are populated by particularly nice individuals.

Our approach in the present paper is to propose a very general model of work motivation. We assume that every individual has the same preference structure, while allowing the strength of work motivation to vary between individuals. This model is then used to determine effort levels and self-selection into different types of jobs endogenously.

Our main proposal is that work is partially motivated by a desire to keep a *self-image as someone*

¹"A substantial part of the physician's satisfaction with practice is fulfilled by serving successfully as the patient's advocate. (...) The unifying hypothesis is that physicians do have personal utility for their patients' benefit" (Eisenberg 1986, pp. 57 and 61). See also Jack (2005), Ma (2004), Grytten and Sørensen (2001, 2003), De Jaegher and Jegers (2000), Chalkley and Malcomson (1998), Farley (1986), Woodward and Warren-Bolton (1984).

who is important to others. While self-image is not a standard ingredient in economic models, other social sciences provide strong arguments for including self-image as an object of preference. Aronson et al. (2005, p.166), for example, summarize as follows: "During the past half-century, social psychologists have discovered that one of the most powerful determinants of human behavior stems from our need to preserve a stable, positive self-image". While "being important" is hardly the only aspect of self-image that people care about, it is the only aspect we focus on here; note, in particular, that we abstract from any preferences for social approval from others.²

Introducing the preference for a self-image as important to others into an otherwise quite standard economic model has a number of implications. For jobs where effort is remunerated by its marginal productivity, our model is behaviorally equivalent to the *Homo Oeconomicus* model. In jobs where neither individual effort nor individual productivity is verifiable, however, workers will behave more altruistically than predicted by the *Homo Oeconomicus* model. Thus, the very same person may appear to be "selfish" if she works as a baker, but not if she switches jobs and becomes a nurse. Turning next to the issue of self-selection into different occupations, we show that under plausible conditions, those with intermediate preferences for being important will seek private market employment, while the "public" sector – that is, the sector in which neither individual effort nor individual productivity can be verified – will be attractive both for those with the *highest* and those with the *lowest* work motivation.³ The highly motivated are attracted by the opportunity to be important; the poorly motivated are attracted by the opportunity to shirk.

Since behavior in perfectly competitive market jobs is unaffected by the preference to be important, it is socially desirable that poorly motivated workers choose employment in the private sector. This can be achieved by keeping public sector wages low.⁴ Hence, while both the profit maximizing behavior of the baker and the other-regarding behavior of the nurse are consistent with exactly the same underlying preferences, self-selection could cause a higher concentration of strongly other-regarding individuals in the public sector.

Here, the regulator faces a difficult trade-off: If the wage is kept sufficiently low to keep all shirkers out, the size of the public sector will be strictly smaller than the first-best optimum. We show, however, that if the regulator improves nurses' opportunity to do a good job, by investing capital increasing their productivity, the public sector becomes more attractive for the highly motivated, while poorly motivated workers are unaffected. This provides, in fact, an argument for overinvestment of certain types of public sector capital.

²See Benabou and Tirole (2006). In their model, voluntary contributions can be used to signal, either to others or to oneself, that one is a "nice person".

³This is closely related to the findings of Prendergast (2006), Delfgaauw and Dur (2004) and Heyes (2004).

⁴For a related argument, see Frank (2003).

While our approach has much in common with several of the papers quoted above, it is distinct from each of them in important ways. The most important distinguishing feature of our analysis, we believe, is that the proposed preference structure is very general, not specifically linked to the type of employment or production that we study. In contrast to Francois (2000, 2003, 2005) and Besley and Ghatak (2005), for example, there is no implication that the most "altruistic" workers are those with a particularly strong preference for the specific good they are producing - in fact, we assume that everyone has the same preference for the public good.

The general nature of the self-image function implies that our model can also be used, for instance, for analyzing individuals' preferences between working – supporting themselves and paying taxes – or living off welfare (for example as a recipient of unemployment, sickness or disability benefits). Our model may explain the fact that even in the generous Scandinavian welfare states, substantial numbers of individuals do not exploit the opportunity to live off welfare to the extent they actually could. Below, we show that for most workers (although not all), becoming unemployed will be associated with a net loss of utility, even if unemployment benefits provide full income compensation. The model thus offers one possible explanation for the substantial evidence indicating that unemployment is a major cause of reduced happiness and life satisfaction (see, for example, Lane 1991, Oswald 1997, Theodossiou 1998).

2 The model

Assume that every individual $i = \{1, \dots, N\}$ has preferences of the following type:

$$U_i = u(b_i) - c(e_i) + \theta G + S_i \tag{1}$$

where b_i is i 's consumption of a (numeraire) private good (for example, bread); e_i is i 's effort; G is the level of a pure public good (for example, preventive public health care), and S_i is i 's self-image. u is a strictly concave and increasing function, while c , the cost function for effort, is strictly convex, increasing in e_i , satisfying $c(0) = 0$. Effort levels are unobservable. $\theta > 0$ is the fixed marginal utility of the public good. The functional form is chosen for simplicity.

We assume that individuals have identical skills. Each individual i either produces the private good and works in the *private* sector (denoted $\tau_i = B$; bakers, businessmen), or he is employed by the *public* sector to produce the public good ($\tau_i = P$; nurses, physicians, teachers).

Note, however, that the "public" and "private" labels are chosen for ease of reference. The crucial distinction between the two sectors is that *workers in the "private" sector are paid according to the value of their marginal productivity, while "public" employees are not*. Hence, the distinction relates

essentially neither to the fact that the public sector produces public goods, nor to ownership as such, but to whether or not they are paid by their marginal productivity. Our main results would hold also if public sector employees produced a publicly provided private good (for example individual health care), or if the "public" sector were privately owned (e.g. private nursing homes), as long as effort and productivity of its workers are non-verifiable. Below, we will sometimes use the terms "bakers" and "nurses" to refer to employees of the private and public sectors, respectively.

For bakers, individual output can be observed and verified, and performance pay can thus be used even if effort is unobservable. It may be instructive to think of self-employed businesspeople who produce and sell a homogeneous good of perfectly observable quality to consumers at the current market price (normalized here to 1). We assume that the consumption good market is perfectly competitive, implying that all producers and consumers take the price of consumer goods as exogenously given. Person i 's production of the consumption good (bread) is given by

$$\beta(e_i, \tau_i) = \begin{cases} 0 & \text{if } \tau_i = P \\ f(e_i) & \text{if } \tau_i = B \end{cases} \quad (2)$$

where $f' > 0$, $f'' < 0$ (primes denote derivatives), and $f(0) = 0$. The individual is paid the market value of his production, which is $f(e_i)$.⁵

For nurses, however, we assume that individual production cannot be observed by others: Only the aggregate level G can be measured, so even though the worker herself knows how much she contributed, this cannot be verified, because there is a large number of public employees.⁶ Person i 's production of the public good is

$$\gamma(e_i, \tau_i) = \begin{cases} 0 & \text{if } \tau_i = B \\ g(e_i) & \text{if } \tau_i = P \end{cases} \quad (3)$$

where $g' > 0$, $g'' < 0$, and $g(0) = 0$.⁷ Total supply of the public good equals $G = G^0 + \sum_i \gamma(e_i, \tau_i)$ for all i , where G^0 is an exogenous initial supply level. Individuals regard the public good provision by others, $G_{-i} = G^0 + \sum_{j \neq i} \gamma(e_j, \tau_j)$, as exogenously fixed. We will also assume that $\theta g'(0) < c'(0)$, implying that the marginal public good benefit to i herself is never large enough to outweigh her effort costs.

⁵For simplicity, this set-up presumes that the worker is, essentially, self-employed. The results would also hold, of course, if he were employed at a wage reflecting the value of his output.

⁶If the public sector employees produced, instead, a private good, the problem of individual output measurement could for example arise from limited verifiability of product quality (childcare), or from limited knowledge of the production function for people outside a specialized profession (advanced medicine).

⁷Note that a given employee's contribution depends only on her own effort, which simplifies the analysis.

Public sector employees are paid a fixed wage w . These wages are financed through a lump sum tax $t < w$, which is, for simplicity, assumed to be equal for everybody:

$$t = \frac{Mw}{N} \quad (4)$$

where N is the number of individuals in society, and M is the number of public sector employees.

The budget constraint for individual i is now

$$b_i + t = y(e_i, \tau_i), \text{ where } \begin{cases} y(e_i, \tau_i) = f(e_i) & \text{if } \tau_i = B \\ y(e_i, \tau_i) = w & \text{if } \tau_i = P. \end{cases} \quad (5)$$

Market clearing for the private good, $\sum_i b_i = \sum_i \beta(e_i, \tau_i)$, follows from (4) and (5).

Now, let us turn to the self-image preference. "Being important" must certainly mean being important to *someone*. In economics, the most common way to formalize importance is by means of a social welfare function. Since we will be considering a Nash equilibrium, we are interested in the effects of an agent's action when everybody else's actions are assumed to be fixed. Our basic assumption will thus be as follows: *Self-image is increasing in one's net contribution to others' welfare, taking others' behavior as fixed.*

To be operational, this criterion must be specified further. First, assume that every individual i agrees that *others'* welfare can be specified as

$$W_{-i} = \sum_{j \neq i} [u(b_j) - c(e_j) + \theta G] \quad (6)$$

Here, others' self-images are assumed not to be included in i 's judgement of their welfare. We believe that there exist very good arguments for including self-image in social welfare judgements, but also for excluding it. If i 's self-image is determined by i 's "good deeds", one may argue that the definition of "good" should not depend on self-image; on the other hand, it is hard to claim that self-image benefits are less "real" than other benefits. Assuming that $W_{-i} = \sum_{j \neq i} U_j$ would, however, complicate the analysis considerably; we have thus chosen to keep with the tractable specification.

Let $W_{-i}^0(e_i, \tau_i)$ denote others' welfare as a function of i 's choices when others' behaviors are kept fixed at their status quo levels $e_j = e_j^0$ and $\tau_j = \tau_j^0$ for every $j \neq i$. Next, note that a baker who consumes exactly his own production of bread, and who pays no taxes, contributes exactly nil to others' welfare; hence, this is a natural benchmark. Let the constant W_{-i}^{bm} denote others' welfare in the benchmark case, i.e. when i is a baker consuming exactly his own production, again assuming that $e_j = e_j^0$ and $\tau_j = \tau_j^0$ for every $j \neq i$.⁸ We are now in a position to formally define our self-image function:

⁸That is, $W_{-i}^{bm} = \sum_{j \neq i} [u(b_j) - c(e_j) + \theta G]$ s.t. $\tau_i = B$, $b_i = f(e_i)$, and $e_j = e_j^0$ and $\tau_j = \tau_j^0$ for every $j \neq i$.

$$S_i = \alpha_i(W_{-i}^0(e_i, \tau_i) - W_{-i}^{bm}) \quad (7)$$

Thus, self-image is proportional to the social value of i 's production, minus the social value of i 's private consumption. The subtraction of W_{-i}^{bm} in (7) secures that self-image is determined by i 's own contribution, and not by, for example, a policy change influencing others' welfare.⁹ The proportionality factor α_i is assumed to be exogenous, but may vary between individuals. To rule out the case in which people care more about others' welfare than their own, we impose the restriction $0 \leq \alpha_i < 1$. If $\alpha_i = 0$, our model corresponds to the standard Homo Oeconomicus model, while $\alpha_i = 1$ would imply that the individual behaved as a benevolent dictator, caring just as much for others' welfare as his own.

The desire to regard oneself as important to others is different from a preference for others' welfare as such. Several interpretations have previously been suggested in the literature. For example, Francois (2005) discusses the desire to "make a difference" assuming that workers care for the public good, corresponding to Andreoni's (1988) definition of pure altruism. In Francois' model, workers contribute labor to public good production because there is a probability that no-one else will provide it; however, in his model, workers have no preferences regarding their own role in the public good provision: Only final outcomes count. Dur and Glazer (2004, p.4) assume that "a person measures his impact of any action he may take by comparing output in the current period to what it would have been had he unexpectedly ceased to exist an instant before". In their approach, a worker feels important only to the extent that others cannot replace his effort. Although Dur and Glazer's approach is more explicitly directed at the worker's own role than Francois', as in models of impure altruism (Andreoni 1990), it shares Francois' (2005) emphasis on actual final outcomes.

We believe, however, that "importance" can also be conceived as "taking part in the functioning of society" in the sense that one fulfills an important, albeit not necessarily irreplaceable, function. Our approach is thus not related to the ease with which a worker can be replaced, but to his net contribution to others' welfare, given others' behavior. If the social value of his production exceeds the social value of the resources he claims for himself, we will assume that this makes him feel important, even if someone else could have replaced him. Our definition of "being important" thus differs from Francois' (2005) in our focus on the individual's *own* role, not just on aggregate outcomes. It differs from both Francois' (2005) and Dur and Glazer's (2004) in that importance is related to welfare, not to output, and in that we assume that importance relates only to the welfare of *others*. These distinctions imply that in our model, but in neither Francois' nor Dur and Glazer's, pure transfers to or from i will count in i 's perceived importance. Although transfers do not represent real costs for the economy as a whole, they do represent welfare changes for *others* if net transfers are different from zero. Note

⁹The subtraction of W_{-i}^{bm} in (7) does not affect behavior.

that this effect would be present even if we had used the alternative specification of others' welfare $W_{-i} = \sum_{j \neq i} U_j$ in the self-image function (7), although the behavioral implications would then be different.

3 Choosing effort levels

For a given type of employment τ_i , individuals maximize their utility with respect to effort e_i . Their preferred type of employment is determined by the maximum utility level attainable in the two sectors. Let $U_i(e_i, \tau_i)$ denote the utility individual i will get from choosing effort e_i given the type of employment τ_i .

Consider first the effort choice of private sector employees ($\tau_i = B$). To avoid unnecessary complications, we will assume in the following that the optimal effort level is sufficiently high to cover the lump-sum tax, so that the tax does not impose a binding restriction on the optimal choice of effort. For the private sector worker, $G_{-i} = G$, and utility is given by

$$U_i(e_i, B) = u(f(e_i) - t) + \theta G - c(e_i) + \alpha_i \left(\sum_{j \neq i} [u(y(e_j^0, \tau_j^0) - t) + \theta G - c(e_j^0)] - W_{-i}^{bm} \right) \quad (8)$$

Differentiation of this with respect to e_i gives the following first order condition for private sector workers' utility maximization:

$$u' f' = c' \quad (9)$$

This expression is independent of α_i ; indeed, it is exactly the same first order condition which would have emerged from the Homo Oeconomicus model, corresponding to $\alpha_i = 0$ in our model: For the private sector worker, a preference to be important to others does not affect the optimal effort level.

To see this, note that in the present model there is only one private good (bread), which is also the numeraire. Hence, any purchases of bread must be paid by an exactly equivalent amount of bread, implying necessarily just a barter of equally valued goods, producing no real transfer of resources. Consequently, the baker's production always just covers his own consumption and his tax payment, and on the margin, any changes in his production will be mirrored by corresponding changes in his consumption. This result is not an artifact of the assumption of a single private good. In a model with several consumer goods, a similar result would obtain: In competitive markets, where the baker takes prices as given, marginal values are equalized in equilibrium, ensuring that the market value of one's production equals its social value for consumers. On the margin, market exchanges are simply barter of resources of equal value, and the marginal transaction does not increase or decrease the

welfare of others.¹⁰

How about the public sector worker ($\tau_i = P$)? Utility is, in her case, given by

$$U_i = u(w - t) + \theta(G_{-i} + g(e_i)) - c(e_i) + \alpha_i \left(\sum_{j \neq i} [u(y(e_j^0, \tau_j^0) - t) + \theta(G + g(e_i)) - c(e_j^0)] - W_{-i}^{bm} \right) \quad (10)$$

Differentiation with respect to e_i thus yields the first order condition

$$\theta g'[1 + \alpha_i(N - 1)] = c' \quad (11)$$

For the nurse, the model with $\alpha_i > 0$ is obviously not behaviorally equivalent to *Homo Oeconomicus*. A nurse with $\alpha_i = 0$ will exert no effort at all: The only reason to do so would be the resulting extra public good benefits to herself, but since, by assumption, $\theta g'(0) < c'(0)$, this is not, for her, worth the required effort.

When $\alpha_i > 0$, however, she will attach a strictly positive weight to the marginal public good benefits accruing to others, since this stimulates her sense of being important; hence, her preferred effort level is higher than it would have been if $\alpha_i = 0$. However, due to the restriction $0 \leq \alpha_i < 1$, we can conclude that she will only partially internalize this externality: The nurse will exert (weakly) more effort than predicted by the *Homo Oeconomicus* model, but not enough to secure a socially optimal public good provision.¹¹

For future reference, denote the utility-maximizing effort for an individual with occupation τ_i and motivation strength α_i by $e^*(\tau_i, \alpha_i)$. In Lemma 9 in the Appendix, we show that $e^*(P, \alpha_i)$ is increasing in α_i . The baker's effort is independent of α_i , so we can also write $e^*(B, \alpha_i) = e^*B$. To summarize:

Proposition 1 *The baker's effort is independent of α_i , while the nurse's effort is increasing in α_i .*

We cannot say whether, in general, $e^*(P, \alpha_i) \geq e^*(B, \alpha_i)$, i.e whether a given individual will exert more effort when employed by the public or private sector. In the public sector there is no economic incentive to exert effort, so if α_i is low, effort can be negligible or even zero. On the other hand, if α_i is large, the desire to be important may push the individual to very high effort levels.

The conclusion so far is that even if businessmen and bakers – in general, those who are paid by their marginal productivity – behave in line with predictions from the standard *Homo Oeconomicus* model, while nurses and physicians do not, this need not imply that bakers and nurses, or businessmen and physicians, have different preferences. They might all prefer to keep a self-image as someone who

¹⁰See Kirchsteiger and Dufwenberg (2007). Note, however, that if taxes were increasing in income, α_i would enter the baker's first order condition for optimal effort. A formal analysis of this is outside the scope of the present paper. Nevertheless, if α_i is sufficiently small, the baker would still prefer to keep his income rather than paying taxes, and most of our results would be unchanged.

¹¹Here, "socially optimal" should be interpreted as the level maximizing $W = \sum_{j=1}^N [u(b_j) - c(e_j) + \theta G]$.

is important to others, but this preference has no behavioral consequences for those whose marginal effort is compensated by its marginal social value. As pointed out by Adam Smith, acting according to one's own material interests is also in society's interest in a perfectly competitive market; the preference to be important will hence not push the baker in a different direction than market incentives do. On the other hand, for those whose efforts are beneficial to society over and above the compensation they receive, the desire to be important gives an extra incentive to work hard.

4 Choosing type of employment

When considering which type of employment to seek, the worker will compare the maximum utility he can obtain in each type of job. Assume that i is employed in the private sector, that there is a vacancy in the public sector, and that he is considering whether to apply for it. If he switches jobs, he gets the opportunity to be important through producing the public good, to the benefit of everyone in society. He also, however, gets the opportunity to shirk. Finally, his income may of course change, depending on the public wage w and his productivity in the private sector.

Consider, first, the effects on self-image as important to others. We will show that self-image can either increase or decrease, depending on whether his effort in the new position will be sufficiently high to justify the increased tax burden he imposes on others.

Let $\Delta W_{-i}^0(\alpha_i)$ denote the increased welfare for others if i moves from the private to the public sector, all else given, i.e., $\Delta W_{-i}^0(\alpha_i) = W_{-i}^0(e^*(P, \alpha_i), P) - W_{-i}^0(e^*(B, \alpha_i), B)$. The gain in self-image for individual i by moving from the private to public sector is then given by

$$\Delta S_i = \alpha_i \Delta W_{-i}^0(\alpha_i) \quad (12)$$

If i moves to the public sector, the number of nurses M will increase by one, and public good production will weakly increase; by how much depends on α_i , the strength of his work motivation. On the other hand, taxes must finance wages for one more nurse. Recall that $t = \frac{Mw}{N}$, so $\frac{\Delta t}{\Delta M} = \frac{w}{N}$ is the tax increase required to finance i 's entry into the public sector.

Assume that Δt is marginal in the sense that the resulting change in utility Δu is approximately $-u' \Delta t$. Then, the increase in others' welfare due to i 's moving to the public sector can be written

$$\begin{aligned} \Delta W_{-i}^0(\alpha_i) &= \sum_{j \neq i} [u\{y(e_j^0, \tau_j^0) - t - \Delta t\} - u\{y(e_j^0, \tau_j^0) - t\} + \theta g(e^*(P, \alpha_i))] \\ &\approx (N-1)\theta g(e^*(P, \alpha_i)) - \Delta t \sum_{j \neq i} u' \end{aligned} \quad (13)$$

where u' is evaluated at $y(e_j^0, \tau_j^0) - t$.

This expression can be positive or negative, depending on the level of α_i . First, it can easily be shown that $\Delta W_{-i}^0(\alpha_i)$ is increasing in α_i (see Lemma 10 in the Appendix): The stronger i 's desire to be important, the harder he will work in the public sector, and the more useful it is to others that he moves there. Moreover, it is evident that $\Delta W_{-i}^0(0) < 0$: If a worker with no concern for being important ($\alpha_i = 0$) moves into the public sector, he will produce nothing, while still claiming his wage, which must be financed by others' increased tax payments; hence the change in others' welfare will be strictly negative. Consequently, there must be an $\hat{\alpha} \in [0, \infty]$ such that $\Delta W_{-i}^0(\alpha_i) > 0$ for $\alpha_i > \hat{\alpha}$, $\Delta W_{-i}^0(\alpha_i) = 0$ for $\alpha_i = \hat{\alpha}$, and $\Delta W_{-i}^0(\alpha_i) < 0$ for $\alpha_i < \hat{\alpha}$.¹² In the following, we will assume that $\hat{\alpha} < 1$, which we believe to be the most interesting case: If this did not hold, no-one, not even the most strongly motivated, would consider work in the public sector socially beneficial.

This leads to the following preliminary conclusion: Self-image increases when i moves to the public sector if his work motivation is strong ($\alpha_i > \hat{\alpha}$), but decreases if his motivation is weak ($\alpha_i < \hat{\alpha}$).

However, it is not only self-image which counts: An individual with work motivation α_i will prefer to work in the public sector if his maximum *utility* in the public sector exceeds the maximum utility he can attain in the private sector. Let $U^P = \max_{e_i} U_i(e_i, P)$, $U^B = \max_{e_i} U_i(e_i, B)$ and $\Delta U(\alpha_i) = U^P - U^B$. Then, i will prefer public employment if the following expression is positive:

$$\Delta U(\alpha_i) = u(w - t - \Delta t) - u(f(e^{*B}) - t) - c(e^*(P, \alpha_i)) + c(e^{*B}) + \theta g(e^*(P, \alpha_i)) + \alpha_i \Delta W_{-i}^0(\alpha_i) \quad (14)$$

Proposition 2 establishes that $\Delta U(\alpha_i)$ is U-shaped, and specifies the values of α_i for which $\Delta U(\alpha_i)$ is positive, implying that the individual prefers working in the public sector.

This is illustrated in Figure 1. The intuition is as follows: For a worker with very low motivation, working in the public sector is attractive because it enables him to shirk. The negative $\Delta W_{-i}^0(\alpha_i)$ is no substantial worry to him, since he cares little about others' welfare. If α_i is very high, a public job is attractive because it offers the opportunity to be important to others. For intermediate values of α_i , however, the private sector is most attractive: For low, intermediate values, $\Delta W_{-i}^0(\alpha_i)$ is negative, and this bothers the individual enough that he prefers the private sector. For high, intermediate values, his effort in the public sector would increase others' welfare and increase self-image, but the self-image gain is insufficient to justify the required effort costs.¹³

Proposition 2 *a) $\Delta U(\alpha_i)$ is declining in α_i for $\alpha_i < \hat{\alpha}$ and increasing in α_i for $\alpha_i > \hat{\alpha}$, while for $\alpha_i = \hat{\alpha}$, $\partial \Delta U(\alpha) / \partial \alpha_i = 0$. b) Moreover, there exist $\bar{\alpha} \geq \underline{\alpha} \geq 0$ such that $\Delta U(\alpha_i) < 0$ for $\alpha_i \in (\underline{\alpha}, \bar{\alpha})$, while $\Delta U(\alpha) \geq 0$ for $\alpha_i \in [0, \underline{\alpha}] \cup [\bar{\alpha}, 1]$.*

Proof. See the Appendix. ■

¹²Note that $\hat{\alpha}$ is a function of model parameters such as w and M . To simplify notation, we disregard this here.

¹³This corresponds to the findings of Dur and Delfgaauw (2004) and Prendergast (2006).

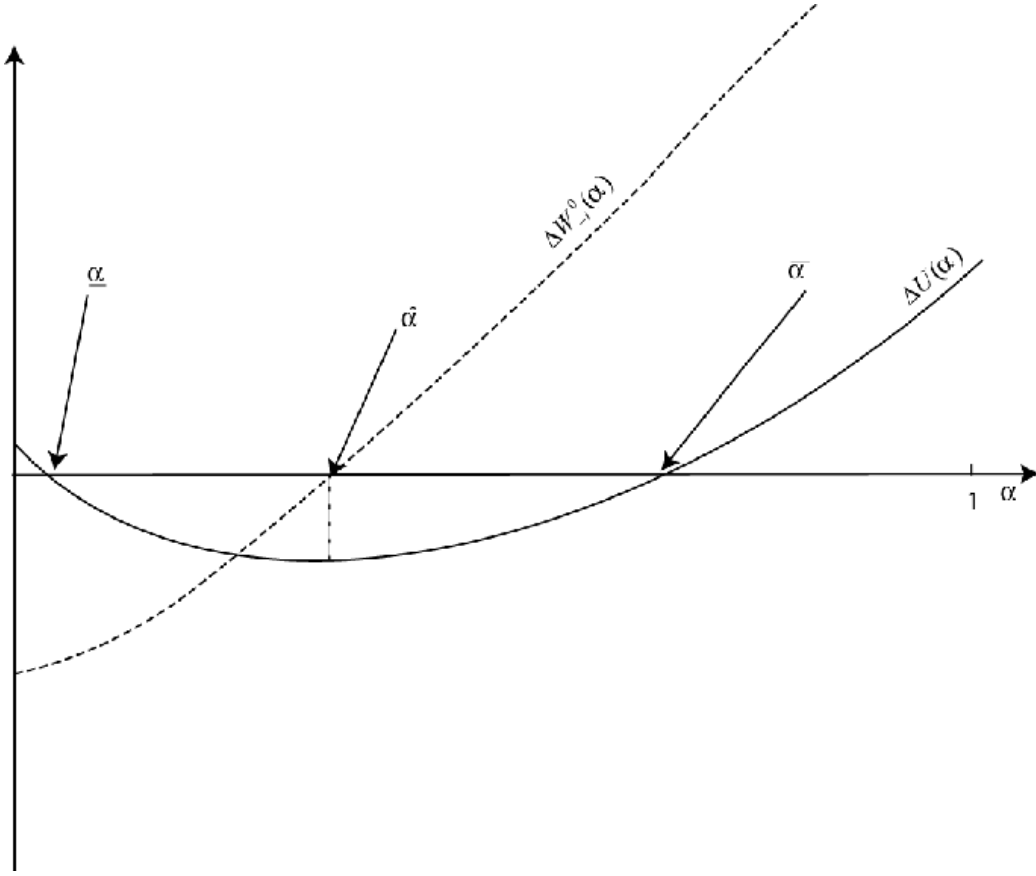


Figure 1: Differences in self-image and utility

Note that $\Delta U(\alpha_i)$ depends on the tax level t , which in turn depends on the number of nurses. A Nash equilibrium is then a tax level and corresponding $\underline{\alpha}, \bar{\alpha}$ such that all i with $\alpha_i \in [0, \underline{\alpha}] \cup [\bar{\alpha}, 1]$ are nurses and all others are bakers, and such that the tax level is consistent with these choices.¹⁴

5 The detrimental self-image effect of unemployment

Before turning to the question of how to attract the motivated nurses while avoiding the unmotivated ones, let us briefly point out one interesting implication of our model.

While it is well documented that there is a substantial negative correlation between unemployment and individuals' reported happiness and life satisfaction, as well as more objective measures like health and longevity (e.g. Lane 1991, Oswald 1997, Theodossiou 1998), the standard Homo Economicus model provides no explanation to this phenomenon: If unemployment benefits were sufficiently large,

¹⁴That this is a Nash equilibrium follows since self-image is defined taking others' behavior as fixed.

Homo Economicus' utility would in fact increase if he became unemployed, due to the reduced cost of effort.

With a preference structure like the one proposed here, however, unemployment can have a detrimental effect on utility through a reduced self-image, which is not necessarily outweighed by the reduced cost of effort. Indeed, a commonly heard complaint from unemployed people is that "no-one has a need for you"; a concern which seems to be closely related to a preference to be important to others.

Assume, for the moment, that in addition to employment in either the public or the private sector, there is a third possibility, namely unemployment; i.e. $\tau_i = \{B, P, Z\}$, where $\tau_i = Z$ denotes unemployment. Let $\beta(e_i, Z) = \gamma(e_i, Z) = 0$; that is, the effort of the unemployed has no productive use; and let the fixed unemployment benefit be $\lambda > 0$. We assume, for simplicity, that the unemployed do pay taxes, thus the net transfer to an unemployed is $\lambda - t$. Then public budget balance is

$$t = \frac{L\lambda + Mw}{N}$$

When a baker becomes unemployed, the tax increase is $\frac{\lambda}{N} > 0$. If a nurse get unemployed, $-\frac{w-\lambda}{N}$; in this case, the sign of the tax change depends on whether the unemployment benefit λ is higher or lower than the nurse's wage w . Moreover, when a nurse becomes unemployed, public production decreases.

It should be immediately obvious that the optimal effort of an unemployed person is $e^*(Z, \alpha_i) = 0$, since the unemployed's effort is of no social use in this model. Denoting the self-image change of a private sector worker who becomes unemployed ΔS_i^B , we can now show that

$$\Delta S_i^B = \alpha_i [W_{-i}^0(e^*(Z, \alpha_i), Z) - W_{-i}^0(e^*(P, \alpha_i), P)] \leq 0 \quad (15)$$

Using a linearization like in (13), with $\bar{u} = \frac{1}{N-1} \sum_{-i} u'$ denoting average marginal utility, we find

Proposition 3 *a) The change in self-image for a private sector employee who becomes unemployed is*

$$\Delta S_i^B \approx -\alpha_i \lambda \bar{u} \leq 0$$

b) The change in self-image for a public sector employee who becomes unemployed is

$$\Delta S_i^P \approx -\alpha [(N-1)\theta g(e^*(P, \alpha), P) + (\lambda - w)\bar{u}]$$

Proof. See the appendix. ■

Note that the baker's self-image is always reduced if he becomes unemployed (strictly reduced if $\alpha_i > 0$). If a baker were consuming exactly his own production of bread, his self-image would be zero

(by definition). Nevertheless, every private sector worker, while always consuming his own production on the margin, actually makes a strictly positive net contribution to society through his tax payments. An unemployed person's net contribution, however, is strictly negative: He produces nothing, while consuming $\lambda - t > 0$. His consumption must be financed by others' efforts.

For a public sector worker, the self-image impact of potential unemployment depends on how much effort she exerts, which depends, in turn, on α_i . If she exerts low effort, then it may well be the case that her net contribution to society is negative; this would be the case if

$$(N - 1)\theta g(e^*(P, \alpha_i), P) < (w - t)\bar{u}.$$

The net contribution as an unemployed is also negative, approximately equal to $-(\lambda - t)\bar{u}$. However, if the unemployment benefit is lower than the wage as a nurse, the nurse will be a larger burden for tax payers when employed than when unemployed, and if her effort is sufficiently low, her public good provision cannot compensate for the additional burden to other tax payers. In this case her self-image will in fact be higher as unemployed than as employed.

Hence, when losing his job, the only worker who does not experience a loss of self-image is the shirking nurse. Nevertheless, the Proposition below establishes that if the unemployment benefit provided exact income compensation, *every* nurse who provides a strictly positive effort would experience a utility loss if losing her job, and in this case no nurse will strictly benefit from unemployment. Moreover, highly motivated bakers would also lose utility if losing their job; but the most poorly motivated bakers can actually strictly gain.

Proposition 4 *a) Let $\lambda = w$. Then, every nurse for whom $e^*(P, \alpha_i) > 0$ would experience a utility loss if she lost her job. For a nurse with $e^*(P, \alpha_i) = 0$, utility is unaffected by becoming unemployed.*
b) Let $\lambda = f(e_B^)$. Then, a baker will lose utility when losing his job if α_i is sufficiently high, that is, if $\alpha_i > c(e_B^*)/\lambda\bar{u}$.*

Proof. See the Appendix. ■

In our model framework, being unemployed is formally equivalent to living off any kind of tax-financed social security payments, such as sickness or disability benefits. Hence, our model provides also one possible explanation to the fact that even in the Scandinavian countries, with their relatively generous social security systems, many individuals do not exploit the welfare state to the extent they actually could. In Norway, for example, employed workers can be absent for three working days, three times each calendar year, with no loss of income, if they claim being sick (without a sickness certificate from a physician). Nevertheless, although some individuals seem to exploit this system, it is obviously not the case that all workers take care to spend their entire "quota" of sick leave days

(nor does it, from casual observation, seem very common). Propositions 3 and 4 above, however, show that the self-image effect of making negative contributions to others' welfare can be sufficiently large to make many workers prefer not to exploit the welfare system by pretending to be sick – even when sickness benefits provide full income compensation and the expected penalty for making a false sickness claim is zero.¹⁵ This seems to fit nicely with the results of Aronsson et al. (2000), who asked almost 3801 Swedish respondents whether they had been at work recently at occasions when their health condition, in their own view, indicated that they ought to have stayed home: "Members of occupational groups whose everyday tasks are to provide care or welfare services, or teach or instruct, have a substantially increased risk of being at work when sick" (p. 502).

6 Attracting the devoted nurses

Assume, now, that $\alpha_i \in [0, 1)$ is drawn from an approximately continuous distribution¹⁶, and that α_i is unobservable. Different individuals then have different incentives to seek the two types of jobs. Since effort in the private sector is unaffected by work motivation, while effort is increasing in work motivation in the public sector, it would be socially preferable if the highly motivated could somehow be attracted into the public sector. However, since motivation is unobservable, and public jobs can also be attractive to poorly motivated shirkers, this is not trivial.¹⁷

The lower the public sector wage w , the less attractive are public jobs to shirkers. Denote by \bar{w} the wage for which the very least motivated ($\alpha_i = 0$) is exactly indifferent between the public and private sectors, i.e. a wage such that $\Delta U(0) = 0$. We will now explore whether the government can set the wage w such that public sector jobs are attractive only to the highly motivated, while keeping the poorly motivated in the sector with performance pay. In the following, we will focus on situations such that if $w = \bar{w}$, then $\bar{\alpha} < 1$.¹⁸

If one more person becomes a nurse, every member of society has to pay slightly more taxes, Δt . Assume that $\Delta t \cdot u' < c(e_B^*)$, which seems a very reasonable assumption. Then, it follows, as we show formally in Lemma 12 in the Appendix, that

$$\bar{w} < f(e_B^*). \tag{16}$$

¹⁵For an analysis of social interaction effects in norms to live off welfare, see Lindbeck et al. (1999).

¹⁶That is: the distribution covers the entire interval $[0, 1)$.

¹⁷For related analyses, see Frank 2003, Heyes 2004, Dur and Delfgaauw (2004), Brekke and Nyborg 2004.

¹⁸If $\bar{\alpha} < 1$ does not hold, the desire to be important, although present, is too weak to compensate workers for their effort, and no highly motivated worker will apply for a job as a nurse. Hence, this case reproduces the Homo Oeconomicus prediction that any nurse will be a shirker. While this is certainly conceivable, we will focus on the case where $\bar{\alpha} < 1$ for $w = \bar{w}$ precisely because this is when our approach differs from the standard model.

In words: To make the very least motivated indifferent between the two types of jobs, bakers' income must be *higher* than nurses' – to compensate bakers for the inconvenience of not being able to shirk, like they could have done in the public sector. Hence, in a world with only dedicated nurses, those nurses must necessarily earn less than employees in the private sector.

What happens if the government sets the wage equal to $w = \bar{w}$? For a person with $\alpha_i = 0$, the benefit of moving to the public sector, $\Delta U(0)$, is then, by definition, zero. According to Proposition 2, we know that as α_i increases, $\Delta U(\alpha_i)$ will then first be decreasing and then increasing. When α_i reaches $\bar{\alpha}$, $\Delta U(\alpha_i)$ is, again, zero. When α_i exceeds $\bar{\alpha}$, however, $\Delta U(\alpha_i)$ becomes strictly positive. Hence, when $w = \bar{w}$, only those with a motivation higher than $\bar{\alpha}$ will prefer public employment.

It turns out, however, that for any distribution of α_i satisfying our assumptions, setting $w = \bar{w}$ will lead to a suboptimally low production of the public good: To avoid attracting at least some shirkers, the size of the public sector has to be kept too low compared to the first-best.

First, define social welfare as¹⁹

$$W = \sum_{j=1}^N [u(b_j) - c(e_j) + \theta G] \quad (17)$$

Further, define the the first-best social optimum as the hypothetical situation in which W is maximized with respect to e_i and τ_i , disregarding any incentive problems.²⁰ Then, we have the following result:

Proposition 5 *If α_i is approximately continuously distributed, then for $w = \bar{w}$ the public sector is smaller than the first-best optimum.*

Proof. See the Appendix. ■

6.1 Changing the wage

For $w > \bar{w}$, the public sector will hire both the least and the most motivated. There are two marginal individuals, one with low and one with high work motivation. For the least motivated marginal individual, $\Delta W_{-i} < 0$. Thus, others' welfare declines as this individual moves into the public sector.

¹⁹Alternatively we could define total welfare to include self image:

$$W = \sum_{j=1}^N [u(b_j) - c(e_j) + \theta G + S_j]$$

Including self-image in the social welfare function would have negligible effects on the ranking of social states as long as the policy to be evaluated does not change the benchmark state. However, many policies will affect the benchmark, and in such cases the choice of social welfare function matters for normative conclusions.

²⁰Note that we have not claimed that \bar{w} is a second-best optimal wage level. This requires further analysis since w affects not only efficiency, but also the income distribution.

As the wage level increases, and more people are attracted to the public sector, taxes will increase. Eventually, $y_j - t$ will become very low. Hence, if the wage is too high, it could happen that *only* the least motivated prefer to work in the public sector, while highly motivated individuals feel more useful in the private sector. Let w^* denote the *highest* wage level where the most motivated still prefer the public sector, and where at least one individual prefer the private sector. The next Proposition is illustrated by Figure 2.

Proposition 6 *For any wage level $w^* > w > \bar{w}$, at least one individual i exists who will be attracted into the public sector by a wage increase, such that*

$$\Delta W_{-i}^0(\alpha_i) < 0,$$

while at the same time there exists at least one worker j , not attracted by a wage increase and thus left in the private sector, such that

$$\Delta W_{-j}(\alpha_j) > 0.$$

Thus, because work motivation α_i is unobservable, the allocation of workers between the public and private sector will never be first-best optimal.

Proof. See the Appendix. ■

The above proposition established that when $w > \bar{w}$, the public sector always attracts some shirkers, while some relatively highly motivated workers are left in the private sector. In fact, Lemma 10, given in the appendix, demonstrates that increasing nurses' wage has a stronger recruitment effect for potential shirkers than for highly motivated workers.

Lemma 7 *Assume that $w^* > w > \bar{w}$. Then, a marginal increase in w increases $\Delta U(\alpha_j)$ more than $\Delta U(\alpha_i)$ if $\alpha_i > \alpha_j$.*

Proof. See the Appendix. ■

6.2 Improving nurses' working conditions

If the regulator cannot hire a sufficiently large number of devoted nurses by increasing their wage, without at the same time attracting even higher numbers of shirkers, one may want to look for alternative policy tools. Are there available instruments which would make working as a nurse more attractive to the highly motivated, but not to the shirkers?

Intuition suggests that this might be the case. Consider, for example, a devoted nurse who tries to prevent the spread of an infectious disease, and who wants to provide important information to

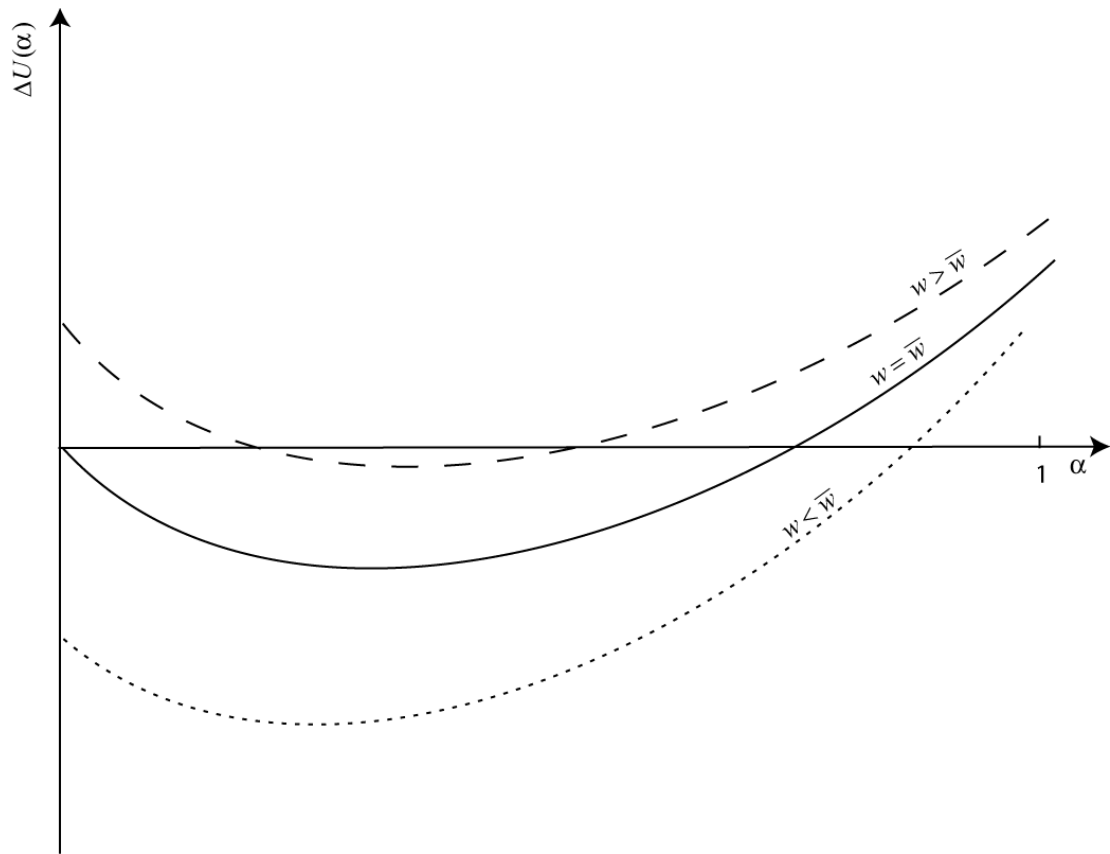


Figure 2: $\Delta U(\alpha)$ for different wage levels

high-risk groups who do not visit her office on their own initiative. However, the government has provided her with very poor working conditions: she has neither a car nor internet access from her office. Such working conditions must obviously be unattractive for a worker who cares about being important. For a worker who doesn't care, and who simply wants to shirk and collect her wage, the opportunity to do a good job will not matter much.

Let κ be an investment which has a "public good" property in the sense that once the investment has been made, it increases the productivity of all nurses (think of, for example, roentgen equipment; to make the example clear-cut, the capital input should improve nurses' productivity while not affecting their material utility directly). Thus, in the production function for the public good (3), replace $g(e_i)$ by a function $\hat{g}(e_i, \kappa)$, such that each nurse's production is given by $g_i = \hat{g}(e_i, \kappa)$ where $\hat{g}'_e > 0$, $\hat{g}'_\kappa \geq 0$, $\hat{g}''_{ee} < 0$, and $\hat{g}''_{\kappa\kappa} < 0$. Moreover, assume that $\hat{g}(0, \kappa) = 0$, i.e. capital investment is of no use unless nurses exert at least some effort. (This implies that $\hat{g}'_\kappa(0, \kappa) = 0$; but we will assume that $\hat{g}'_\kappa > 0$ for every $e_i > 0$.) To balance public budgets, the tax equation (4) must now be replaced by

$$t = \frac{Mw + \kappa}{N} \quad (18)$$

Intuitively, if the common equipment κ increases nurses' marginal productivity, motivated nurses will work harder the better equipped the public sector is. Moreover, the better opportunities to be important as a nurse, the more attractive it will be to become a nurse for those with high motivation. Proposition 8 establishes that this is indeed the case here.

Proposition 8 *a) For a nurse who initially provides a strictly positive effort, an increase in the capital input κ increases effort if $\hat{g}''_{e\kappa} > 0$; it leaves effort unchanged if $\hat{g}''_{e\kappa} = 0$, and decreases effort if $\hat{g}''_{e\kappa} < 0$. b) For a worker with $\alpha_i = 0$, an increase in the capital input κ does not affect the attractiveness of public employment. For a worker with $\alpha_i > 0$, who would exert a strictly positive effort level if employed as a nurse, public employment becomes strictly more attractive when the capital input κ increases, provided that $\hat{g}''_{e\kappa} \geq 0$. If $\hat{g}''_{e\kappa} < 0$, being a nurse could become either more or less attractive when κ increases.*

Proof. See the Appendix. ■

For a given wage, more devoted workers can be recruited by increasing nurses' opportunities to do a good job: The higher the investment κ , the more attractive it is for motivated workers to be a nurse; and the higher one's work motivation α_i , the stronger is the motivational effect of increasing investments. The exception is if $\hat{g}''_{e\kappa} < 0$, which means that the capital input makes the nurse's work, on the margin, *less* useful. This should be no surprise. Of course, the reverse also holds: If the government reduces capital input, making devoted nurses' working conditions harder (assuming that

$\hat{g}_{e\kappa}'' \geq 0$), being a nurse will become less attractive; the more so for the highly motivated workers. Consequently, there are two good reasons for the government to provide capital: First, it is productive *per se*; but secondly, it improves recruitment of motivated workers to the public sector. The latter provides, in fact, a reason for the government to "overinvest" in the nursing sector.

If the investment were, instead, worker specific (i.e. a fixed capital input per worker), i 's choice to become a nurse would imply a marginally higher tax payment for every individual. In this case, the motivational effect of increased capital input works only up to the point where it would anyway be socially efficient to increase capital input; thus, with fixed per worker capital input there is no argument for overinvestment. For a formal analysis of this case, see the Appendix.

7 Conclusions

Above, we have formalized the idea that work is not only motivated by its monetary compensation, but also by a desire to be important to other people. We have shown that with lump-sum taxation, the desire to be important does not change the behavior of individuals receiving performance pay (bakers); it does, however, change the behavior of those whose performance cannot be efficiently monitored and who thus are not paid according to their marginal productivity (nurses).

With this preference structure, public sector jobs may be attractive for two very different reasons: they provide the opportunity to shirk, but also the opportunity to be important. This implies that unless the public sector wage is kept strictly lower than income in the private sector, shirkers will be attracted to the public sector. On the other hand, if the wage is kept low enough to keep the shirkers out, the public sector will be suboptimally small.

If nurses' productivity can be increased through fixed capital investments, however, higher investments will make nursing more attractive to motivated workers; more so the higher the worker's motivation. For a regulator trying to attract more devoted nurses while keeping shirkers out, investing in nurses' opportunity to do a good job can be a better policy instrument than increasing nurses' wages. This argument provides a rationale for overinvestment in certain types of public sector production capital.

Furthermore, our model provides one possible explanation why unemployment seems to be associated with a loss of utility. Within the present framework, both private and public sector workers experience a loss of self-image when losing their job, and the higher a worker's motivation, the larger is her self-image loss. The only group who would not experience a loss of self-image when losing their jobs are the shirking nurses. Workers' self-image loss is not necessarily compensated by the decreased cost of effort. In fact, in the case of full income compensation through unemployment benefits, every

nurse who provides a strictly positive effort would become worse off if losing her job. The same would hold for bakers whose work motivation is relatively high. For poorly motivated bakers, however, the loss of self-image would be more than compensated by the reduced effort costs, and utility as unemployed would thus be higher than when working as a baker. A similar argument holds for other types of welfare payments. Our model would thus predict that although some individuals will exploit a generous welfare state, choosing, if they get the option, to live off welfare rather than working, many groups of workers would rather prefer to work, keeping up a good self-image as someone who is important to others.

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A Proofs

Lemma 9 *For public sector employees, the optimal effort $e^*(P, \alpha_i)$, and hence also provision $g(e^*(P, \alpha_i))$, are non-decreasing and increasing in α_i for $e^*(P, \alpha_i) > 0$.*

Proof. Optimal effort $e^*(P, \alpha_i) > 0$ is the solution to the equation

$$(1 + \alpha_i(N - 1))\theta g'(e_i) = c'(e_i)$$

where $c'(e_i)$ is increasing in e_i , while $g'(e_i)$ is decreasing. A positive shift in the left hand side will then yield equality at a higher value of e_i . Note that since $\theta g'(0) < c'(0)$,

$$(1 + \alpha_i(N - 1))\theta g'(0) < c'(0)$$

for

$$\alpha_i < \frac{c'(0) - \theta g'(0)}{(N - 1)\theta g'(0)}$$

and in this area $g(e^*(P, \alpha_i)) = e^*(P, \alpha_i) = 0$. ■

Lemma 10 *The change in others' welfare if i moves from the private to the public sector, $\Delta W_{-i}^0(\alpha_i)$, is non-decreasing in the strength of i 's motivation α_i , and increasing for $e^*(P, \alpha_i) > 0$.*

Proof. We know from (13) that $\Delta W_{-i}^0(\alpha_i) = \sum_{j \neq i} [u\{y(e_j^0, \tau_j^0) - t - \Delta t\} - u\{y(e_j^0, \tau_j^0) - t\} + \theta g(e^*(P, \alpha_i))]$. Differentiation gives

$$\frac{\partial \Delta W_{-i}^0(\alpha_i)}{\partial \alpha_i} = \sum_{j \neq i} \theta g' \frac{\partial e^*(P, \alpha_i)}{\partial \alpha_i} = (N - 1)\theta g' \frac{\partial e^*(P, \alpha_i)}{\partial \alpha_i}$$

Since $\partial e^*(P, \alpha_i)/\partial \alpha_i > 0$, for $e^*(P, \alpha_i) > 0$ as shown in Lemma 9, it follows that $\partial \Delta W_{-i}^0(\alpha_i)/\partial \alpha_i > 0$. For small values of α_i we know as shown in Lemma 9, that $\partial e^*(P, \alpha_i)/\partial \alpha_i = 0$ and hence $\partial \Delta W_{-i}^0(\alpha_i)/\partial \alpha_i = 0$ ■

Lemma 11

$$\frac{\partial}{\partial \alpha_i} [\Delta U(\alpha_i)] = \Delta W_{-i}^0(\alpha_i).$$

Proof. By definition

$$\Delta U(\alpha_i) = \max_{e_i} U(e_i, P; \alpha_i) - \max_{e_i} U(e_i, B; \alpha_i)$$

and since e_B^* is independent of α_i , we can write, using (14)

$$\begin{aligned} \Delta U(\alpha_i) &= \max_{e_i} [U(e_i, P; \alpha_i) - U(e_B^*, B; \alpha_i)] \\ &= \max_{e_i} [u(w - t - \Delta t) - u(f(e^{*B}) - t) - c(e^*(P, \alpha_i)) + c(e^{*B}) + \theta g(e^*(P, \alpha_i)) + \alpha \Delta W_{-i}^0(\alpha_i)] \end{aligned}$$

Hence, by the envelope theorem,

$$\frac{\partial}{\partial \alpha_i} [\Delta U(\alpha_i)] = \Delta W_{-i}^0(\alpha_i).$$

■

Proposition 2

Proof. a) By lemma 11

$$\frac{\partial}{\partial \alpha_i} [\Delta U(\alpha_i)] = \Delta W_{-i}^0(\alpha_i).$$

Since $\Delta W_{-i}^0(\alpha_i)$ is nondecreasing, and increasing for $e^*(P, \alpha_i) > 0$, as in stated in Lemma 10, it follows that $\Delta U(\alpha_i)$ is weakly convex, and strictly convex for $e^*(P, \alpha_i) > 0$. Similarly it follows that $\Delta U(\alpha_i)$ is decreasing for $\alpha_i < \hat{\alpha}$ and increasing for $\alpha_i > \hat{\alpha}$.

b) From a) and Lemma 10, we know that $\Delta U(\alpha_i)$ is linear and declining for small α_i until $e^*(P, \alpha_i) > 0$ and then strictly convex. It follows that $\Delta U(\alpha_i) = 0$ for at most two different values of α_i . Define a threshold value $\underline{\alpha}$ such $\underline{\alpha} = 0$ if $\Delta U(0) < 0$ and otherwise $\Delta U(\underline{\alpha}) = 0$. Similarly, $\bar{\alpha} = 1$ if $\Delta U(1) < 0$ and otherwise $\Delta U(\bar{\alpha}) = 0$. Then, also by the concavity of $\Delta U(\alpha_i)$, it follows that $\Delta U(\alpha_i) < 0$ for $\alpha_i \in (\underline{\alpha}, \bar{\alpha})$, while $\Delta U(\alpha_i) > 0$ for $\alpha_i \in [0, \underline{\alpha}] \cup (\bar{\alpha}, 1]$. ■

Proposition 3

Proof. a) Let Δ_{BZ} denote changes when an individual moves from the private sector to unemployment. The change in others' welfare is

$$\begin{aligned} \Delta_{BZ} W_{-i}^0(\alpha_i) &= \sum_{j \neq i} [u\{y(e_j^0, \tau_j^0) - t - \Delta_{BU} t\} - u\{y(e_j^0, \tau_j^0) - t\}] \\ &\approx -\Delta_{BU} t \sum_{j \neq i} u' \end{aligned} \tag{19}$$

where $\Delta_{BU} t$ is the change in tax required to maintain budget balance. Now, since the person now

receives unemployment benefits λ , to maintain budget balance the tax changes for others are $\Delta_{BU}t = \lambda/(N-1)$. Thus

$$dS^B = \alpha_i \Delta_{BZ} W_{-i}^0(\alpha_i) \approx -\alpha_i \Delta_{BU} t \sum_{j \neq i} u' = -\alpha_i \frac{\lambda}{(N-1)} \sum_{j \neq i} u' = -\alpha_i \lambda \bar{u}.$$

b) Similarly, the change in others' welfare when the individual moves from the public sector to unemployment is

$$\begin{aligned} \Delta_{PZ} W_{-i}^0(\alpha_i) &= \sum_{j \neq i} [u\{y(e_j^0, \tau_j^0) - t - \Delta_{PZ} t\} - u\{y(e_j^0, \tau_j^0) - t\} + \theta g(e^*(P, \alpha_i))] \quad (20) \\ &\approx (N-1) \theta g(e^*(P, \alpha_i)) - \Delta_{PZ} t \sum_{j \neq i} u' \end{aligned}$$

As a nurse, the net transfer from others to the individual is $w - t$, while when unemployed, the net transfer is $\lambda - t$. Thus $\Delta_{PZ} t = (\lambda - w)/(N-1)$, and we get

$$dS^P = \alpha_i [(N-1) \theta g(e^*(P, \alpha_i)) - (\lambda - w) \bar{u}]$$

■

Proposition 4

Proof. a) Note first that a nurse who provides no effort will have the exact same utility as an unemployed who receives the same public income and also makes no contribution to society. A nurse who chooses $e^*(P, \alpha_i) > 0$ does so because this yields a higher utility than $e_i = 0$. Hence her utility must be higher as a nurse than it would have been as unemployed, since in the latter case her effort is unproductive. b) For a baker with $\alpha_i = 0$ the only utility change caused by unemployment is due to a reduction in the effort cost, $c(e_B^*)$. Hence he is strictly better off as unemployed. But the cost of effort is independent of α_i , while the change in self-image is $dS_i^B \approx -\alpha_i \lambda \bar{u} < 0$, which depends on α_i . It follows that the baker will lose utility if

$$\alpha_i > \frac{c(e_B^*)}{\lambda \bar{u}}.$$

■

Proposition 5

Proof. Note that with a continuous distribution and $\bar{\alpha} < 1$, there will be an individual such that $\alpha_i = \bar{\alpha}$. This i will be indifferent between public or private sector employment ($\Delta U(\bar{\alpha}) = 0$). For the individual with $\alpha_i = 0$ we know that he is indifferent when $w = \bar{w}$, thus

$$u(\bar{w} - t - \Delta t) = u(f(e_B^*) - t) - c(e_B^*)$$

Now, e_B^* is independent of α_i , so this equality holds for all α_i . Inserting in (14), using $\Delta U(\bar{\alpha}) = 0$, we get

$$-c(e^*(P, \bar{\alpha})) + \theta g(e^*(P, \bar{\alpha})) + \bar{\alpha} \Delta W_{-i}^0(\bar{\alpha}) = 0$$

When $\bar{\alpha} < 1$, this implies that the welfare effect for others is strictly larger than the private net cost for the marginal public sector worker: The "first" worker in the private sector, i.e. the private sector worker with the highest α_i , agrees that the increased welfare for others, had he chosen to move to the public sector, would have exceeded the private net costs for himself. However, since his $\alpha_i < 1$, he places less emphasis on others' welfare than on his own; consequently, he is not willing to move. From a social point of view, thus, the size of the public sector is too small.²¹ ■

Lemma 6

Proof. By Proposition 2, ΔU is U-shaped, and as $w^* > w > \bar{w}$ it follows from the definition of w^* and \bar{w} , that $\Delta U(0) > 0$ and $\Delta U(1) > 0$, and $\Delta U(\alpha_i) < 0$ for some α_i . As seen in figure 2, this implies that $\Delta U(\alpha_i) = 0$ for two values of α_i , one (α_i) where ΔU is downward sloping, and one (α_j) where it is upwardsloping. Next, by lemma 11 in the appendix, $\frac{\partial}{\partial \alpha} [\Delta U(\alpha_i)] = \Delta W_{-i}^0(\alpha_i)$. The claim follows. ■

Lemma 12 . Denote by \bar{w} a wage such that $\Delta U(0) = 0$, then if $c(e^{*B}) > u(\bar{w} - t) - (\bar{w} - t - \Delta t)$

$$\bar{w} < f(e_B^*). \quad (21)$$

Proof. This implies that

$$\begin{aligned} u(\bar{w} - t - \Delta t) &= u(f(e^{*B}) - t) + c(e^*(P, 0)) - c(e^{*B}) - \theta g(e^*(P, 0)) - \alpha_i \Delta W_{-i}^0(0) \\ \implies u(\bar{w} - t - \Delta t) &= u(f(e^{*B}) - t) - c(e^{*B}) \\ \implies u(\bar{w} - t) - u(f(e^{*B}) - t) &= -c(e^{*B}) + u(\bar{w} - t) - (\bar{w} - t - \Delta t) \end{aligned}$$

Since, by assumption, $c(e^{*B}) > u(\bar{w} - t) - (\bar{w} - t - \Delta t)$, it follows that $u(\bar{w} - t) < u(f(e^{*B}) - t)$, and hence

$$\bar{w} < f(e_B^*). \quad (22)$$

■

Lemma 7

Proof. of Differentiation of $\Delta U(\alpha_i)$ (eq. (14)) with respect to w , using (13) and (4), yields

$$\begin{aligned} \frac{d\Delta U(\alpha_i)}{dw} &= \frac{du(w - \frac{(M+1)w}{N})}{dw} - \frac{du(f(e^{*B}) - \frac{Mw}{N})}{dw} + \frac{d\alpha_i[(N-1)\theta g(e^*(P, \alpha_i)) - \frac{w}{N} \sum_{j \neq i} u']}{dw} \\ &= (1 - \frac{(M+1)}{N} + \frac{M}{N})u' - \alpha_i \frac{1}{N} \sum_{j \neq i} u' \\ &= (1 - \frac{1}{N})u' - \alpha_i \bar{u} \end{aligned}$$

²¹Note that even if we have, for simplicity, assumed a linear utility of the public good, the socially optimal size of the public sector is limited by the concave and increasing utility of income.

assuming that u' is unaffected by the required marginal increase in taxes. The first part of this, $(1 - \frac{1}{N})u'$, is unaffected by α_i , while the latter part, $-\alpha_i\bar{u}$, is decreasing in α_i . Hence $\frac{d\Delta U(\alpha_i)}{d\alpha_i}$ is decreasing in α_i . ■

Proposition 8

Proof. a) Nurses' first order condition for utility maximization with respect to effort is now

$$\theta\hat{g}'_e(1 + \alpha_i(N - 1)) = c' \quad (23)$$

To find the effect on effort of increased investment, we differentiate (23) with respect to κ . This yields

$$\frac{de_i}{d\kappa} = \frac{\theta(1 + \alpha_i(N - 1))\hat{g}''_{e\kappa}}{(c'' - \theta(1 + \alpha_i(N - 1))\hat{g}''_{ee})} \quad (24)$$

Since $c'' > 0$, and $\hat{g}''_{ee} < 0$, the denominator is strictly positive. The numerator has the same sign as $\hat{g}''_{e\kappa}$. Hence, for interior solutions, the change in individually optimal effort when κ increases has the same sign as $\hat{g}''_{e\kappa}$.

b) If i decides to become a nurse, the required change in taxes per person equals $\frac{w}{N} = \Delta t$. i will prefer public employment if the following expression is positive:

$$\Delta U(\alpha_i) = u(w - t - \Delta t) - u(f(e^{*B}) - t) - c(\hat{e}^*(P, \alpha_i, \kappa)) + c(e^{*B}) + \theta\hat{g}(\hat{e}^*(P, \alpha_i, \kappa), \kappa) + \alpha_i\Delta W_{-i}^0(\alpha_i) \quad (25)$$

where $e_i = \hat{e}^*(P, \alpha_i, \kappa)$ is the utility maximizing effort for a nurse with motivation α_i when the capital input equals κ , implicitly given by (23). Differentiation of $\Delta U(\alpha_i)$ with respect to κ , using (13) and where $\frac{de_i}{d\kappa}$ is given by (24), gives

$$\frac{d\Delta U(\alpha_i)}{d\kappa} = -c' \frac{de_i}{d\kappa} + \theta(\hat{g}'_e \frac{de_i}{d\kappa} + \hat{g}'_\kappa) + \alpha_i[(N - 1)\theta(\hat{g}'_e \frac{de_i}{d\kappa} + \hat{g}'_\kappa) \quad (26)$$

$$= \frac{de_i}{d\kappa}([1 + \alpha_i(N - 1)]\theta\hat{g}'_e - c') + \theta\hat{g}'_\kappa[1 + \alpha_i(N - 1)] \quad (27)$$

$$= \alpha_i[\frac{de_i}{d\kappa}\theta\hat{g}'_e(N - 1) + \theta\hat{g}'_\kappa(N - 1)] + \theta\hat{g}'_\kappa \quad (28)$$

By assumption, $\hat{g}(0, \kappa) = 0$. Hence, if $e_i = 0$, $\theta\hat{g}'_\kappa$ must equal zero. Recall that workers with $\alpha_i = 0$ provide no effort. Eq. (26) then shows that if $\alpha_i = 0$, $\frac{d\Delta U(0)}{d\kappa} = 0$. For those with $\alpha_i > 0$ and an interior utility maximum in effort ($e_i > 0$), $\frac{d\Delta U(\alpha_i)}{d\kappa}$ is always strictly positive if $\frac{de_i}{d\kappa} \geq 0$, i.e. when $\hat{g}''_{e\kappa} \geq 0$, and the value of $\frac{d\Delta U(\alpha_i)}{d\kappa}$ is then increasing in α_i . If $\hat{g}''_{e\kappa} < 0$, however, $\frac{d\Delta U(\alpha_i)}{d\kappa}$ may be either positive or negative. ■

B Fixed capital investment per nurse

Assume that there is a fixed capital input K per nurse, so that (3) is replaced by

$$\gamma(e_i, \tau_i) = \begin{cases} 0 & \text{if } \tau_i = B \\ g_i = \tilde{g}(e_i, K) & \text{if } \tau_i = P \end{cases} \quad (29)$$

where $\tilde{g}'_e > 0$, $\tilde{g}'_K > 0$, $\tilde{g}''_{ee} < 0$, and $\tilde{g}''_{KK} < 0$. For simplicity, assume that $\tilde{g}''_{eK} = 0$. Further, let (4) be replaced by

$$\tilde{t} = \frac{M(w + K)}{N} \quad (30)$$

Then, the first order condition for utility maximization with respect to effort is

$$[(1 + \alpha_i(N - 1))\theta\tilde{g}'_e(e_i, K) = c'(e_i)] \quad (31)$$

and nurses' effort is unaffected by changes in K , due to the assumption $\tilde{g}''_{eK} = 0$ and similar arguments as above.

Assume that i works in the private sector. If she moves to the public sector, the number of nurses M will increase by one, and taxes increase by $\Delta\tilde{t} = \frac{w+K}{N}$. Let $\Delta\tilde{t}$ be marginal in the sense that for every j , we can neglect its impact on the marginal utility of income. i will prefer public employment if the following expression is positive:

$$\Delta U(\alpha_i) = u(w - \tilde{t} - \Delta\tilde{t}) - u(f(e^{*B}) - \tilde{t}) - c(\tilde{e}^*(P, \alpha_i, K)) + c(e^{*B}) + \theta\tilde{g}(\tilde{e}^*(P, \alpha_i, K), K) + \alpha_i\Delta W_{-i}^0(\alpha_i) \quad (32)$$

where $\tilde{e}^*(P, \alpha_i, K)$ is implicitly determined by (31). To see how the choice of occupation varies with K , we differentiate this expression:

$$\frac{d\Delta U(\alpha_i)}{dK} = \theta\tilde{g}'_K - \frac{1}{N}u' + \alpha_i[(N - 1)\theta\tilde{g}'_K - \bar{u}] \quad (33)$$

If the public good benefits for others exceed the value of others' increased tax costs, then $\alpha_i[(N - 1)\theta\tilde{g}'_K - \bar{u}] > 0$ for every $\alpha_i > 0$. $\theta\tilde{g}'_K$ is the increase in the individual's own public good benefit; and $\frac{1}{N}u'$ is the consumption loss in terms of her own extra tax payment to finance the increase in K . The two latter are independent of α_i , but are presumably both small, possibly negligible. Thus, when K increases, it becomes relatively more attractive to be a nurse, provided that $[1 + \alpha_i(N - 1)]\theta\tilde{g}'_K > \alpha_i\bar{u} + \frac{1}{N}u'$ (that is, the individual thinks the extra tax payments are worth it); and the increase is larger the higher α_i . Note, however, that if $[(N - 1)\theta\tilde{g}'_K - \bar{u}] > 0$, the capital investment would be socially efficient even in the absence of self-selection problems. With a fixed per nurse investment, thus, overinvestment in capital is never a good idea.

Assuming a fixed capital per nurse, let us see how $\Delta U(\alpha_i)$ varies with w :

$$\frac{d\Delta U(\alpha_i)}{dw} = (1 - \frac{1}{N})u' - \alpha_i\bar{u}$$

assuming that u' is unaffected by the required marginal increase in taxes. If the regulator decreases w marginally, while increasing K marginally, exactly balancing the budget, the resulting change in $\Delta U(\alpha_i)$ is thus

$$\frac{d\Delta U(\alpha_i)}{dK} - \frac{d\Delta U(\alpha_i)}{dw} = \alpha_i(N - 1)\theta\tilde{g}'_K + \theta\tilde{g}'_K - u'$$

For an individual with $\alpha_i = 0$, $\frac{d\Delta U(\alpha_i)}{dK} - \frac{d\Delta U(\alpha_i)}{dw} = \theta\tilde{g}'_K - u'$. It seems reasonable to assume that $\theta\tilde{g}'_K < u'$. Then $\frac{d\Delta U(\alpha_i)}{dK} - \frac{d\Delta U(\alpha_i)}{dw}$ will always be negative for a person with $\alpha_i = 0$. However, there will be a threshold value

$$\alpha^* = \frac{u' - \theta\tilde{g}'_K}{(N-1)\theta\tilde{g}'_K}$$

such that for every $\alpha_i > \alpha^*$, a decrease in the wage by one dollar, along with an increase in the capital input per worker by one dollar, would make being a nurse more attractive, while for $\alpha_i < \alpha^*$, being a nurse would become less attractive. For this to be relevant, we must have $\alpha^* < 1$. This implies that $N\theta\tilde{g}'_K > u'$, which seems reasonable.