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Monitoring Job Search as an Instrument for Targeting Transfers

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ABSTRACT

Redistribution programs are constrained because those not working may be either unable to work, voluntarily unemployed or involuntarily unemployed. The inability to distinguish among these three cases inhibits the targeting of transfers to those most in need. Enabling the government to monitor whether unemployed individuals are searching for work and accepting any offered jobs increases its ability to redistribute income. We show that these monitoring activities are complementary, and consider how a minimum wage might be a useful adjunct to monitoring contingent tax-transfer policies.

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I. INTRODUCTION

Employment status is an important consideration in targeting transfers to the poor. Transfer systems typically attempt to distinguish both between employables and unemployables (disabled), and between the voluntary and involuntary unemployed. But these distinctions are not readily observable to the policy-makers, and will not be voluntarily revealed by transfer recipients. For this reason, transfer programs directed to the poorest members of society are typically not delivered solely through the income tax system, which relies on self-assessment and self-reporting, but are implemented by welfare or unemployment agencies. A major role of these agencies is to engage in monitoring activities to separate transfer applicants into categories.

Various types of monitoring can be, and are, undertaken. Applicants can be screened, or *tagged* to use the common term, for disability or for other dimensions of need. This type of targeting to sort out the disabled from those able to work has begun to be recognized in the literature.[1] Our concern is more with monitoring job search activities to separate persons according to employment status. Two main types of activities each involving a separate decision on the part of the individual can be distinguished. The first is the decision to search for a job itself — seeking out employment opportunities and applying for them. The second is the decision to accept any job offers which come one's way. Both of these decisions are private information to the job applicants, but welfare or unemployment insurance administrators can monitor individuals to obtain some information about their job search activities and use this information to determine eligibility for transfers.

The purpose of this paper is to investigate the role of monitoring job application and job acceptance in the design of a tax-transfer system. We do so in setting which is an extension of the standard optimal non-linear income tax model to allow for voluntary and

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[1] See Parsons (1996) and the World Bank volume edited by van Walle and Nead (1995).

involuntary unemployment, where the latter arises as an equilibrium outcome in a simple matching model of job search. Our economy consists of three types of persons — the disabled, who cannot work; low-ability workers, who may be involuntarily unemployed; and the high-ability, who we assume are always fully employed. This setting is simple but rich enough to allow us to make the distinctions between the disabled and the employable low-ability persons, and between the low-ability persons who are and are not involuntarily unemployed. As in the optimal income tax literature, income can be observed, and transfers can be made contingent on observed incomes. Employment status can also be observed, and optimal transfers can also be made contingent on it. We investigate in this setting the extent to which monitoring of application for jobs and of acceptance of job offers can improve the targeting of transfers.

Monitoring is modeled as a costly activity in which a random proportion of the relevant population can be accurately observed, in much the same as the way auditing for tax evasion is modeled. Recent literature on income tax evasion has emphasized how the requirement of relying on self-reporting of incomes can restrict the ability of the government to achieve its redistributive objectives. As Cremer and Gahvari (1996), Marhuenda and Ortuño-Ortin (1997) and Chandar and Wilde (1998) show, this problem can be mitigated by monitoring or auditing activities by the tax administration. But as long as penalties for misreporting are restricted, the need to use costly enforcement procedures to induce truthful revelation compromises optimal policies relative to the case where the authorities can observe incomes.[2] As in this literature, we also impose restrictions on the penalties so that the Becker (1968) solution, in which truthful behaviour is induced with minimal auditing and maximal sanctions, cannot be achieved.

Even in this simple setting, the fact that there are two different margins of unemployment makes the analysis complicated. We therefore proceed by studying two cases separately. In the first case, which we call the *perfect tagging case*, we assume that transfer administrators know perfectly the ability-type of each person, but they cannot observe job search activities. Since the disabled can be distinguished from the employables, the only issue is separating the voluntary from the involuntary unemployed. Transfers to the

[2] Indeed, Chandar and Wilde show that the optimal income tax can be regressive because of tax evasion even if there is no labour-leisure distortion.

involuntary unemployed can be viewed as unemployment insurance. The second case, the *no-tagging case*, is one in which abilities cannot be observed, while there is no involuntary unemployment. In this case, part of the purpose of the transfer and monitoring system is to separate without the aid of tagging the disabled, all of whom are unemployed, from the employables, who may choose to be voluntarily unemployed and obtain the transfer meant for the disabled.

We model the policy problem of government as choosing the most efficient way to achieve a given amount of redistribution from the employables to the disabled, and from the high-ability to the low-ability employables. Our analysis confirms that the inability to observe job market activities by transfer recipients significantly restricts the ability of the government to make transfers both to the least well-off members of society, that is, those who are disabled, and to those who are involuntarily unemployed. Monitoring to verify that transfer recipients are both applying for jobs and accepting job offers will enhance the amount of transfers that can be made to the disabled and to the involuntarily unemployed. But, significantly, monitoring for job application and for job acceptance turn out to be complementary activities: increases in one type of monitoring must be accompanied by increases in the other to be effective.

II. PERFECT TAGGING: THE UNEMPLOYMENT INSURANCE CASE

The economy consists of taxpayers and four classes of potential transfer recipients — the working poor, the unemployed who cannot find work (involuntarily unemployed), the unemployed who are not looking for work (voluntarily unemployed), and those unable to work. To distinguish among them and to concentrate our attention on those receiving transfers, it suffices to restrict attention to three ability-types of individuals — Type 0 (disabled) persons who are unable to work, Type 1 (low-ability) persons, and Type 2 (high-ability) persons. Their proportions in the population are given by N_i, for $i = 0, 1, 2$. The disabled obtain utility from consumption alone according to the increasing and strictly concave utility function $v(c)$. The other two types of individuals are employable and have the common utility function $u(c) - d$, where $u(\cdot)$ is also increasing and strictly concave and d is the disutility from working. In this section, the government can identify all persons by their ability type, so can target transfers perfectly to the disabled. But among the unemployed Type 1's, it cannot distinguish those searching for work from those not looking for work. It simplifies matters considerably (and does not affect the qualitative results) to assume in this section that working individuals supply a fixed amount of labour, which is normalized to one. In the next section where ability types are private information, we are in the standard optimal tax setting where the variability of labour supply serves a useful role in terms of allowing the tax-transfer system to separate households by ability type. Given that firms can observe worker abilities, high-ability individuals earn a higher income than low-ability individuals, $y_2 > y_1$.

There exist two labour markets. Individuals in the high-ability labour market (Type 2's) are fully employed, but there is equilibrium unemployment in the low-ability labour market.[3] The friction in the low-ability labour market is modeled below using a matching technology which results in there being Type 1 individuals who are willing to work at the prevailing wage (or, in this fixed labour supply setting, income), but are unable to find work. Restricting involuntary unemployment to the Type 1's allows us to focus on the interdependencies between unemployment insurance and transfers to the working poor, and conforms with the fact that unemployment rates of the professional, managerial, entrepreneurial and skilled labour classes are lower than those of the working poor. The government is concerned with redistributing income to both the disabled and the low-ability individuals, and doing so efficiently. Given that Type 1's are risk averse, this entails insuring them against unemployment. But, Type 1 individuals may choose to be unemployed simply by not conducting a job search or accepting jobs that are offered. If the government is unable to observe job search activities, it cannot distinguish voluntary (not searching for work, or rejecting job offers) from involuntary (unable to find work) unemployment among the Type 1's. As a result, the level of unemployment insurance offered is severely constrained. The model developed in this section shows how the efficiency of transfers to the unemployed and the disabled can be enhanced by the government monitoring unemployed individuals for job search activities, as well as by intervening directly in the labour market and setting minimum wages. Both these policies are observed in the real world.

[3] This is in contrast to the standard optimal income tax model which assumes the demand for labour is infinitely elastic in all labour markets: anyone seeking a job can find one and is paid a wage equal to their marginal productivity. We adopt this assumption in the next section.

Before turning to these issues, we present a simple search model that yields unemployment as an equilibrium. This model applies only to the Type 1's: the demand for Type 2's is perfectly elastic and independent of the number of Type 1's employed.

A Search Model of Equilibrium Unemployment

As will become obvious in our analysis below, the model of equilibrium unemployment must be compatible with unemployment insurance which may leave employed workers no better off than unemployed individuals. Models in which equilibrium unemployment reflects efficiency wages (Shapiro and Stiglitz, 1984) would clearly not be suitable since they restrict employment precisely by making unemployment undesirable.[4] Nor are the standard search models found in Diamond (1982) or Pissarides (1985) suitable. In these models, once a match is formed, wages are determined by a bargaining process between the employer and the employee. The value of a job must exceed the value of being unemployed, which is incompatible with optimal unemployment insurance. In order to obtain equilibrium unemployment in a setting in which there is no gain to unemployed workers from searching for work, we adopt a simplified version of the static matching model of unemployment found in Johnson and Layard (1986) which takes the individual's decision to search as given.[5] Therefore, assuming all individuals look for work, we can determine the equilibrium wage and employment. In the next section, we show how the government can design a tax-transfer system to induce all individuals to search for work and, thereby, give rise to the equilibrium level of unemployment we derive below.

As is standard in search theory, we assume that there are a large number of identical firms. These firms compete for Type 1 workers by offering a wage and by creating a number

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[4] It is well-known that attempts to redistribute to the unemployed will be frustrated in efficiency wage models by their requirement of an income differential between the employed and the unemployed. Some consequences of this have been recently analyzed in Sørenson (1998) and Stiglitz (1998).

[5] The main simplification we adopt is to make separations from the firm exogenous rather than allowing workers to quit voluntarily. Incorporating this into the model would necessitate the addition of monitoring for voluntary quits versus involuntary lay-offs. Although this type of monitoring is practiced in most unemployment insurance systems, we ignore it for simplicity. It can be assumed that the government perfectly observes whether or not an individual quits their job. If they do, then the individuals face the maximum penalty. Inducing individuals to accept any job offer with imperfect monitoring ensures individuals will never quit.

of job vacancies. The proportion of vacancies that are filled by a given firm depends upon a matching function. This function is concave and is increasing in both the relative wage r, which is the wage offered by the firm relative to the wage rate w offered elsewhere, and the ratio of unemployment U to the total number of vacancies offered by all n firms V, or nv, where v is vacancies per firm. In our setting, the size of the Type 1 labour force is given by N_1. Let $u = U/V = (N_1 - E)/V$, where E is total employment of Type 1's. For simplicity, we assume that the matching function takes the form $rm(u)$, with $m(u)$ increasing and strictly concave in u, and $m(u) \to 1$ as $u \to \infty$.

The firm takes as given both u and w and chooses r and v to maximize its profits. The need for the firm to create vacancies arises because a given proportion of its workforce b separates from the firm in each period. Let e be the number of workers employed by a firm. The firm has an increasing and strictly concave production function $f(e)$, and incurs both a fixed cost ϕ of maintaining each filled position and each vacancy, and a fixed cost k of running the firm. The firms profits are then $f(e) - rwe - \phi[e + v] - k$. For each firm, separations must equal new hires in equilibrium, so $be = rm(u)v$. Using this to eliminate e from the firm's profits, the first-order conditions for the firm's choice of vacancies v and its choice of relative wage rate r, evaluated at the equilibrium when all firms set the same wage, so $r = 1$, may be written as:

$$f'(m(u)v/b) - w + \phi - \phi b/m(u) = 0 \qquad (v)$$

$$f'(m(u)v/b) - 2w - \phi = 0 \qquad (r)$$

These yield $w(u)$ and $v(u)$ as well as the profit function $\pi(u)$ for all firms in the industry. Using the equality of separations and hires, we can then solve for $e(u)$. It is straightforward to show that w will be decreasing and both e and π will be increasing in u.

It remains to determine $u = (N_1 - E)/V$. Economy-wide equilibrium requires that $E = ne(u)$, that is, total employment equals the number of firms times employment per firm. Given that total separations equals total new hires $bE = m(u)V = m(u)(N_1 - E)/u$, we can determine $E(n)$ and $u(n)$, where $E'(n) > 0$ and $u'(n) < 0$. This, in turn determines $V(n) = (N_1 - E(n))/u(n)$. The profit function of each firm then becomes $\pi(u(n))$. If there is free entry of firms, the number of firms will be determined by $\pi(u(n)) = 0$.[6]

[6] The equilibrium will be a stable one — an increase in the number of firms will reduce per firm profits — since $\pi(u)$ is an increasing function and $u(n)$ is decreasing.

Equilibrium in this search model has a number of features which are important for our subsequent analysis. First and foremost, there will be frictional unemployment of the Type 1's in equilibrium. The unemployment rate will be simply U/N_1. This determines the probability of having a job E/N_1, denoted by p in what follows. Second, since with free entry there are no profits in equilibrium, only labour income need be considered in our analysis of government policy. Third, in this model neither the unemployment rate nor the equilibrium wage rate depend upon the amount of transfers given to the unemployed: the labour supply is fixed and the wage rate is determined by the demand side of the labour market given all individuals search for work. Thus, the analysis of government transfer policies can take as given the wage rate, or income per worker, as well as the probability of finding a job provided all individuals are induced to search for work. Fourth, the equilibrium can be affected by the government imposing a minimum wage above the equilibrium wage. When wages are above the equilibrium level, firms would have an incentive to bid them down (set $r < 1$), but the minimum wage precludes that. In these circumstances, equilibrium unemployment will rise thereby reducing the probability of finding a job. We show at the end of this section how that might be a welfare improving policy.

The Optimal Tax-Transfer System

In the absence of government intervention, working individuals consume what they earn. Both disabled individuals and unemployed Type 1 individuals will have zero consumption, with utility levels $v(0)$ and $u(0)$. Given that there are no costs associated with searching for work, we assume both Type 1 and Type 2 individuals will do so; that is, $u(c_i)-d > u(0)$ for $c_i = y_i$ sufficiently close to zero. Since all Type 1 individuals are looking for work, both the proportion of them who find work, p, and the income they earn, y_1, are determined by the matching model just outlined. The expected utility of low-ability individuals will then be $p[u(c_1) - d] + (1 - p)u(0) < u(c_2) - d$, given that $y_2 > y_1$: Type 2 individuals will be strictly better off than Type 1 individuals.

Consider now the policy of a government which has a welfaristic objective function (i.e., one that depends on the utility levels of the three types of persons) and which favours transferring income from higher to lower ability persons.[7] To avoid being precise about exactly how much redistribution the government seeks to achieve, we frame the policy problem as a Pareto-optimizing one. The government maximizes the welfare of the disabled individuals, given minimum levels of utility of the other two types of individuals. Initially, the policy instruments are transfers or taxes to the two types of employed persons, to the disabled, and to the unemployed.[8] The former are conditioned on the individual's type (which, recall, is observable in this section), while the latter depends upon whether monitoring establishes if the unemployed person has applied for employment and has been offered a job.

Following the optimal income tax literature, we can use the revelation principle and let the government directly choose consumption bundles for the various individuals to maximize the consumption transfer to the disabled individuals. The government is able to condition transfers on the individual's type and their employment status. As well, if monitoring establishes that an unemployed person has either not applied for a job or has refused a job that has been offered, the transfer can reflect that. For simplicity, we assume that among persons monitored there is no reward for honest behaviour. That is, unemployed persons who have been monitored and found to have either searched for a job or not to have rejected any offers, or both, all obtain the same transfer as an unemployed Type 1 person who has not been monitored. This can be justified on various grounds: it accords with actual practice, it satisfies horizontal equity norms, and it turns out not to affect the main qualitative results.

Costless Monitoring

In analyzing job market behaviour by the unemployed, we distinguish two stages: the

[7] In the literature on poverty alleviation, non-welfaristic objective functions are sometimes assumed, such as reducing some index of poverty (Kanbur, Keen and Tuomala, 1995), achieving a target level of consumption for the poor (Besley and Coate, 1992), or improving the capability of the poor to function in the economy (Sen, 1995). Since our focus is on labour market responses and imperfections, it is natural to give welfare weight to changes in leisure when employment is taken.

[8] In the real world, such transfers may be delivered by different institutions — unemployment insurance agencies, welfare agencies, and the tax system itself. Since we do not model the details of institutional decision-making, we ignore these differences. We do, however, suppose that the unemployed must apply for transfers, and that triggers the monitoring process.

job application stage and the job offer acceptance stage. Initially we assume that for the unemployed to obtain a job offer, they must engage in a search for jobs to apply for.[9] Then, if they receive an offer they may choose whether to accept it. As a benchmark case, we assume first that the government knows not only each individual's ability-type but also whether an unemployed individual has applied for a job and been offered one. We can think of this as the costless monitoring case — all Type 1's are monitored for job application, and all unemployed Type 1's are monitored for job acceptance, both without cost. The government can ensure that all unemployed persons apply for jobs and accept any offers by penalizing them enough if they do not (e.g., give them a zero transfer, the maximum penalty the transfer system can impose).

Let $\bar{c}_0$ be the consumption of a disabled persons, while (c_1, y_1) and (c_2, y_2) are the consumption-income bundles of persons of Types 1 and 2 who are employed. Those low-ability types who apply for a job, but are not offered one obtain consumption of $\bar{c}_1$. Since all unemployed persons will apply for a job and accept any jobs that are offered, the expected utility of Type 1's is $EV^1 = p[u(c_1) - d] + (1-p)u(\bar{c}_1)$. The government's problem is to choose $(\bar{c}_0, \bar{c}_1, c_1, c_2)$ to maximize $v(\bar{c}_0)$ subject to $EV^1 \geq \overline{V}^1$, $u(c_2) - d \geq \overline{V}^2$, and its revenue constraint, $N_2(y_2 - c_2) + N_1 p(y_1 - c_1) - N_1(1-p)\bar{c}_1 - N_0\bar{c}_0 \geq \overline{R}$, where $\overline{R}$ is the government's required revenue, and $\overline{V}^1$, $\overline{V}^2$ are the minimum (expected) utility levels required for low-and high-ability persons. We presume that both minimum utility levels exceed $u(0)$ so persons are not better off idle. (This also ensures that they will in fact apply for jobs and accept any that are offered.)

The solution to this problem is straightforward. The first-order conditions on $\bar{c}_1$ and c_1 entail that $\bar{c}_1 = c_1$: Type 1's are fully insured against unemployment. This implies that they are better off unemployed than working, an outcome which could not be achieved if job application and job offer acceptance were not observable; otherwise, Type 1's would choose not to apply for a job or take one if offered. The relative sizes of $\bar{c}_0$, c_1 and c_2 are determined by the exogenously given levels of $\overline{V}^1$ and $\overline{V}^2$: a higher value of $\overline{V}^1$ induces a higher value of c_1, and therefore reduces the consumption transfer to the disabled, and similarly for $\overline{V}^2$. Different values of $\overline{V}^1$ and $\overline{V}^2$ trace out points on the first-best utility possibilities frontier. If abilities could not be observed, some of these first-best allocations

[9] We relax this assumption later in this section and allow for unsolicited job offers.

would not be implementable. We shall be concerned in Section III with the consequences of this.

Costly Monitoring

Suppose now that the government cannot perfectly observe whether Type 1's have applied for a job or been offered one. In the extreme case of no monitoring, the government is completely uninformed about the job search activities of the unemployed and thus cannot penalize those who do not engage in job search activities: it must rely entirely on c_1 and $\bar{c}_1$ to achieve its redistributive objectives. To induce households to look for work and accept job offers, the government must ensure working Type 1 individuals are as well off as unemployed Type 1 persons, $u(c_1) - d \geq u(\bar{c}_1)$. Therefore, c_1 must exceed $\bar{c}_1$ by enough to compensate the Type 1's for working, so insurance is incomplete. Compared with the full-information allocation where $u(c_1) = u(\bar{c}_1)$, more total consumption must be provided to them to compensate them for incomplete unemployment insurance, leaving less resources available for the consumption of the disabled. The complete reliance on the tax-transfer system to induce households to engage in search activities severely constrains the transfers that could be targeted to the unemployed. This motivates us to examine the use of monitoring to improve the information available to the government and thereby relax the constraint that imperfect information imposes on its ability to make transfers.

Suppose that the government can monitor unemployed individuals randomly to determine whether they have applied for a job; and subsequently, those who remain unemployed can be monitored to see if they have been offered a job and turned it down. Only Type 1's need to be monitored: all Type 2's apply (given that $\overline{V}^2 > u(0)$) and are offered a job, while no Type 0's will obtain a job offer so they need not apply. The government monitors a proportion q^a of all Type 1's at the time of application. For those monitored, the government learns with certainty whether or not they have applied for a job. For the rest of the Type 1's, it remains private information. Similarly, the government monitors a proportion q^o of Type 1's who are unemployed to determine if they have been offered a job. Again, for those monitored, the government obtains perfect information. The costs of monitoring for job applications and job offers are given by $M_a(q^a)$ and $M_o(q^o)$, respectively.[10] It is

[10] Independent costs is the simplest case to consider. Monitoring costs could also be comple-

assumed that both cost functions are increasing and strictly convex, with $M_j(0) = 0$ for $j = a, o$.

Type 1 persons make two decisions: whether or not to apply for a job, and whether or not to accept a job if one is offered. In an optimum, all Type 1's will be induced both to apply for a job and to accept a job if offered one. Given the probability of finding a job p, and the payoffs from different outcomes, the *ex ante* expected utility of each Type 1 household in an optimum is $EV^1 = p[u(c_1) - d] + (1-p)u(\bar{c}_1)$. The decision of whether to accept a job offer depends upon the probability of being monitored for job acceptance. Job offers will be accepted if the following job offer constraint is satisfied:

$$u(c_1) - d \geq q^o u(0) + (1 - q^o)u(\bar{c}_1) \qquad (\phi^o)$$

where the maximum penalty of zero transfer is imposed if a person is found to have declined a job offer. The job application incentive constraint, assuming that the job offer constraint (ϕ^o) is satisfied, is given by:

$$p[u(c_1) - d] + (1-p)u(\bar{c}_1)] \geq q^a u(0) + (1 - q^a)u(\bar{c}_1) \qquad (\phi^a)$$

Again, detection of failure to apply for a job leads to zero consumption.

The government's problem is to choose $(\bar{c}_0, \bar{c}_1, c_1, c_2, q^a, q^o)$ to maximize $v(\bar{c}_0)$ subject to incentive constraints (ϕ^a) and (ϕ^o) as well as the minimum utility constraints and the budget constraint which now includes the cost of monitoring,

$$p[u(c_1) - d] + (1-p)u(\bar{c}_1)] \geq \overline{V}^1 \qquad (\mu_1)$$

$$u(c_2) - d \geq \overline{V}^2 \qquad (\mu_2)$$

$$N_2[y_2 - c_2] + N_1 p[y_1 - c_1] - N_1[1-p]\bar{c}_1 - N_0\bar{c}_0 - M_a(q^a) - M_o(q^o) \geq \overline{R} \qquad (\lambda)$$

We follow the convention of labeling constraints according to the Lagrange multiplier used in the constrained maximization problem. The first-order conditions are listed in the Appendix.

From the first-order conditions on c_1 and $\bar{c}_1$, it is apparent that in an interior optimum when all the constraints bind, $c_1 > \bar{c}_1$. That is, there is less than complete unemployment

mentary, but this will not change the qualitative results.

insurance: Type 1's receive more consumption than those unemployed (to compensate them enough for working so that the incentives to apply for and accept a job are satisfied). Given that Type 1's are risk averse, this implies that additional resources from the costless monitoring case will be required to ensure they achieve the given utility level $\overline{V}^1$, so there are less resources available to redistribute to the Type 0 individuals.

The key results on monitoring can be determined from the government's constraints. The objective of the government is to redistribute as much as possible to the disabled individuals, given $\overline{V}^1$ and $\overline{V}^2$. Both minimum utility constraints will bind in the optimum. If either of the constraints were slack, the government could extract additional revenue from the Type 1's or the Type 2's and improve the welfare of the disabled. Therefore, c_2 is determined from the Type 2's minimum utility constraint and depends only on $\overline{V}^2$. The optimal combination of c_1 and $\bar{c}_1$ is the one that minimizes the resource cost of giving Type 1's an expected utility of $\overline{V}^1$ while satisfying the two incentive constraints (ϕ^a) and (ϕ^o). These constraints will also both bind in the optimum. If either of them were slack, then since monitoring is costly, the government could reduce the amount of monitoring and transfer the saved resources to the disabled. The three binding constraints (μ_1), (ϕ^o), and (ϕ^a) constitute three equations in four unknowns c_1, $\bar{c}_1$, q^a, and q^o. Using them, we can assess the benefits and costs of both types of monitoring as well as their complementarity.

Benefits of Monitoring

Monitoring enhances the amount of unemployment insurance the Type 1's receive and thereby reduces the amount of total resources needed to obtain $\overline{V}^1$. To see this, we let the three constraints (μ_1), (ϕ^o), and (ϕ^a) determine, say, c_1, $\bar{c}_1$, and q^o, treating q^a as exogenous. (Alternatively, we could have treated q^o as exogenous and let q^a be determined by the constraints. The same qualitative results will apply.) Differentiating the constraints and solving for the effect of q^a on c_1, $\bar{c}_1$, and q^o, we obtain:

$$\frac{\partial c_1}{\partial q^a} = -\frac{(1-p)[u(\bar{c}_1) - u(0)]}{p(1-q^a)u'(c_1)} < 0; \quad \frac{\partial \bar{c}_1}{\partial q^a} = \frac{u(\bar{c}_1) - u(0)}{(1-q^a)u'(\bar{c}_1)} > 0; \quad \frac{\partial q^o}{\partial q^a} = \frac{1-pq^o}{p(1-q^a)} > 0$$

Thus, an increase in q^a reduces the consumption differential $c_1 - \bar{c}_1$ and thereby increases the degree of unemployment insurance to the Type 1's. To ensure that the job offer constraint continues to bind, q^o must also increase: q^o and q^a cannot be chosen independently. The effect on the resource cost of transfers to the Type 1's of an exogenous increase in q^a

is

$$N_1 p \frac{\partial c_1}{\partial q^a} + N_1(1-p)\frac{\partial \bar{c}_1}{\partial q^a} = N_1 \frac{1-p}{1-q^a}(u(\bar{c}_1) - u(0)) \left[\frac{1}{u'(\bar{c}_1)} - \frac{1}{u'(c_1)} \right] < 0$$

Thus, not surprisingly, the increase in insurance provided to the Type 1's by an increase in monitoring reduces the amount of resources that have to be transferred to them. This constitutes the benefits of monitoring.

Costs of Monitoring

Not all the savings in transfers to the Type 1's are available for increased transfers to the disabled. At least some of them are used up in increased monitoring costs. As we have seen, the two types of monitoring will always move in tandem: an increase in monitoring will involve both q^a and q^o increasing, thereby increasing both total $(M_j(q^j))$ and marginal costs of monitoring $(M_j'(q^j))$.

The optimal amount of monitoring should be such that the savings in resources from reducing total transfers to the Type 1's just offsets the marginal monitoring costs. At these monitoring levels, no further increases in $\bar{c}_0$ are possible. This can be clearly seen from the first-order conditions on q^a and q^o which in an interior optimum are given by:

$$\phi^j[u(\bar{c}_1) - u(0)] - \lambda {M_j}'(q^j) = 0 \qquad j = a, o \qquad (q^j)$$

The two conditions are satisfied only at the levels of monitoring such that the marginal social value of the resources released from monitoring (the first positive terms) is equal the marginal cost of monitoring (the second terms). Clearly, if monitoring was costless, so $M_a(q^a) = M_o(q^o) = 0$ for all q^a and q^o, the government would want to increase both q^a and q^o until the full insurance outcome is achieved $(c_1 = \bar{c}_1)$.[11]

We can summarize the above in the following result.

Result 1 *Increased monitoring enhances the degree of unemployment insurance and reduces the total transfers required to attain a given level of expected utility for Type 1's. The*

[11] From the assumption that $\overline{V}^1 > u(0)$ (given c_1 and $\bar{c}_1$), the incentive constraint (ϕ^a) will not bind for all $q^a \in (\frac{d}{\overline{V}^1 + pd - u(0)}, 1]$ and the incentive constraint (ϕ^o) will not bind for all $q^o \in (\frac{pd}{\overline{V}^1 + pd - u(0)}, 1]$. The full insurance outcome is achieved when both these constraints are non-binding and therefore, when q^a and q^o are less than one.

disabled will be made better off as long as the saving in transfers to the Type 1's exceeds the additional costs of monitoring.

Complementarity of the Two Types of Monitoring

It is apparent from the above analysis that a change in $M_a(q^a)$ or $M_o(q^o)$ will cause both q^a and q^o to change in the opposite direction. Suppose it became more costly to monitor for job applications. This implies an increase in the marginal cost of q^a and, optimally, the government reduces q^a. In order to ensure that the job application constraint is not violated, the government must either decrease $\bar{c}_1$ or increase c_1. Any optimal adjustment in the Type 1's consumption levels must ensure that the expected utility constraint continues to bind. Thus, both c_1 increases and $\bar{c}_1$ decreases. Given q^o, the job offer constraint is now slack. The government will then optimally reduce q^o. An analogous argument can be made for an increase in the cost of q^o and the decrease in either of the monitoring costs. Therefore, even though the costs of monitoring are independent, increases in either of them reduces both monitoring intensities.

Suppose now that the government is unable to monitor job offers. In this case, the job offer constraint becomes $u(c_1) - d \geq u(\bar{c}_1)$. If this constraint is satisfied, then the job application constraint is slack and $\phi^a = 0$. From the first-order condition on q^a, it is clear that the optimal level of q^a is zero. Consider instead the case when the government is unable to monitor job applications. In this case, the job application constraint becomes $u(c_1) - d \geq u(\bar{c}_1)$. If this constraint is satisfied, then the job offer constraint is necessarily slack and $\phi^o = 0$. From the first-order condition on q^o, it is clear that the optimal amount of monitoring for job offer when there is no monitoring for job applications is zero. These results are summarized below.

Result 2 *Monitoring for job applications and job offer acceptance are complementary in the sense that:*

(i) Changes in one will be accompanied by changes in the other in the same direction

(ii) If $q^a = 0$, then increases in q^o above zero will be welfare-reducing, and vice versa

(iii) If either $M_a(q^a)$ or $M_o(q^o)$ falls (rises), both q^a and q^o should be increased (reduced).

Unsolicited Job Offers

Suppose now that there is some positive probability that a Type 1 individual receives a job offer without having applied for a job. Denote this probability by $\hat{p} \in (0, p)$. A Type 1 individual accepts this unsolicited job offer if

$$u(c_1) - d \geq q^a u(0) + [1 - q^a][q^o u(0) + [1 - q^o]u(\bar{c}_1)] \qquad (\widehat{\phi}^o)$$

This constraint is always satisfied and non-binding given the job acceptance constraint when individuals applied for work (ϕ^o) is satisfied. Therefore, it can be excluded from the government's problem. Given these unsolicited offers, the job application constraint becomes:

$$p[u(c_1) - d] + [1 - p]u(\bar{c}_1) \geq \hat{p}[u(c_1) - d] + [1 - \hat{p}][q^a u(0) + [1 - q^a]u(\bar{c}_1)] \qquad (\widehat{\phi}^a)$$

In equilibrium, all Type 1 individuals apply for work and accept any job offer, so the revenue constraint is unchanged. As explained above, the government optimally ensures that all the constraints bind. If one was slack, then the government could either reduce the amount of consumption to the Type 1's or Type 2's, or reduce the amount of monitoring, and redistribute the resource savings to the disabled.

As in the previous case, there is incomplete unemployment insurance, $c_1 > \bar{c}_1$, in an interior optimum. The first-order conditions on q^a and q^o are:

$$\phi^a[1 - \hat{p}][u(\bar{c}_1) - u(0)] - \lambda {M_a}'(q^a) = 0 \qquad (q^a)$$

$$\phi^o[u(\bar{c}_1) - u(0)] - \lambda {M_o}'(q^o) = 0 \qquad (q^o)$$

Unsolicited job offers reduce the marginal benefit of monitoring for job applications. Previously, monitored individuals who did not apply for work faced the zero transfer penalty with a probability of one, whereas in this case they face it with a probability of less than one. Suppose the government is unable to monitor job offers, $q^o = 0$, so the job offer constraint becomes, $u(c_1) - d \geq u(\bar{c}_1)$. If this constraint is binding, the job application constraint is slack, $\widehat{\phi}^a = 0$, and the optimal level of q^a is zero. Suppose instead the government is unable to monitor job applications, so $q^a = 0$. Then the job application constraint can only bind if $u(c_1) - d = \bar{c}_1$ since $\hat{p} < p$. Therefore, given $\widehat{\phi}^a > 0$, the job offer constraint is slack, $\phi^o = 0$, and the optimal level of q^o is zero. These results are summarized below.

Result 3 *Unsolicited job offers do not affect the benefits of monitoring as stated in Result 1 or the complementarity of monitoring as stated in Result 2.*

Minimum Wages

So far we have restricted ourselves to the use of taxes and transfers supplemented by monitoring to achieve the government's goals of Pareto efficient redistribution. In the simple search model that we adopted to generate equilibrium unemployment, both the amount of unemployment and the income earned by the employed Type 1's was independent of the tax-transfer system. But, as mentioned, the government can influence both of these things by intervening in the setting of wages through a minimum wage which determines the minimum income Type 1's can earn.

Return to the basic search model. Suppose the government sets the minimum wage $\bar{w}$ above the equilibrium wage. Since firms cannot bid the wage down, they effectively now become wage-takers in the labour market.[12] We can suppress r as a choice variable (setting it to unity), and treat the wage $\bar{w}$ as exogenous to the economy. The firm now simply chooses v to maximize profits $f(e)-\bar{w}e-\phi[e+v]-k$, where $e=m(u)v/b$ as before. The first-order condition is $[f'(m(u)v/b)-(\bar{w}+\phi)]m(u)/b-\phi=0$. This yields $v(\bar{w},u)$ as well as the profit function $\pi(\bar{w},u)$ for all firms in the industry. From the equality of separations and hires, we obtain $e(\bar{w},u)$. It is easily shown that $e_{\bar{w}}<0$ and $e_u>0$, as expected, and $\pi_{\bar{w}}<0$ and $\pi_u>0$. The details of the analysis are given in the Appendix.

Proceeding as before to determine the economy-wide equilibrium, total employment is $E=ne(\bar{w},u)$. Since $bE=m(u)V=m(u)(N_1-E)/u$, we can determine $E(\bar{w},n)$ and $u(\bar{w},n)$, where $E_{\bar{w}}<0$, $E_n>0$, $u_{\bar{w}}>0$ and $u_n<0$. This, in turn, determines $V(\bar{w},n)=(N_1-E(\bar{w},n))/u(\bar{w},n)$. The profit function of each firm then becomes $\pi(\bar{w},u(\bar{w},n))$. If there is free entry of firms, the number of firms will be determined by $\pi(\bar{w},u(\bar{w},n))=0$.[13] This yields $n(\bar{w})$, which can be shown to be a decreasing function. Finally, since total

[12] It is assumed that the minimum wage legislation is completely enforceable and no side contracts are possible between the firms and Type 1 individuals.

[13] The equilibrium will again be a stable one: an increase in the number of firms will reduce per firm profits since $\pi_u>0$ and $u_n>0$.

employment can now be written as $E(\bar{w}, n(\bar{w}))$, differentiating it yields,

$$\frac{dE}{d\bar{w}} = E_w + E_n \frac{dn}{d\bar{w}} < 0$$

Therefore, an increase in $\bar{w}$ will increase unemployment, implying that it will reduce p, the probability of finding a job. In what follows, we therefore treat $p(\bar{w})$ as the probability of finding a job, with $p'(\bar{w}) < 0$. As well, since workers supply one unit of labour if employed, an increase in their wage by one unit will increase their income by one unit as well, or $dy_1/d\bar{w} = 1$.

Consider the welfare effect of imposing a minimum wage in the imperfect information setting considered earlier. Given $\bar{w}$, the Lagrangian expression for the government's optimal tax-transfer problem is the same as that shown in the Appendix but with p and y_1, both treated as functions of $\bar{w}$. Using the Envelope Theorem, the welfare effect of increasing the minimum wage can be obtained by differentiating this Lagrangian expression with respect to $\bar{w}$:

$$\frac{\partial \mathcal{L}}{\partial \bar{w}} = (\mu_1 + \phi^a)p'(\bar{w})[u(c_1) - d - u(\bar{c}_1)] + \lambda N_1 p'(\bar{w})[y_1 - (c_1 - \bar{c}_1)] + \lambda N_1 p(\bar{w})$$

In the case where there is an interior monitoring solution, $0 < q^a, q^o < 1$, the first term on the right-hand side is positive. This follows from the binding job offer constraint, $u(c_1) - d < u(\bar{c}_1)$, given $p'(\bar{w}) < 0$. The sign of the second term depends on the relative magnitude of $c_1 - \bar{c}_1$ and y_1. This term is positive if working Type 1 individuals receive a transfer greater than $\bar{c}_1$. The last term on the right-hand side represents the increase in output per Type 1 worker as a result of the higher minimum wage: firms will employ fewer workers, and their productivity will be driven up. This term is an artifact of our assumption that free entry of firms dissipates all profits of firms (by increasing fixed costs per firm k along with costs of employment and vacancies ϕ). In the absence of this profit dissipation, the increase in wages paid to workers will be largely offset by reductions in firm profits. Nonetheless, it is clearly possible that the sum of the first two terms can be positive, especially if $\overline{V}^1$ is relatively large so that a large transfer is made to working Type 1's.

The influences at work can be brought out most clearly by considering the two extreme informational cases — no monitoring and costless monitoring. If monitoring costs are high enough to preclude any monitoring ($q^a = q^o = 0$), the government's inability to observe either job search activity implies that it must ensure working individuals are at least as well off as non-working individuals, $u(c_1)-d \geq u(\bar{c}_1)$. In the optimum, this will be binding, so the first two terms of the above expression reduce to $\lambda N_1 p'(\bar{w})[y_1-(c_1-\bar{c}_1)]$. This term arises from the change in proportion of workers employed. Workers are now indifferent between working and not working, but one less worker reduces income by y_1, while at the same time reducing transfers by $(c_1-\bar{c}_1)$. In this case, the larger is $\overline{V}^1$, the larger is this consumption differential, and the more likely the above term will be positive.[14]

At the other extreme, when the government can costlessly observe job search activities, neither job incentive constraint binds and Type 1 individuals are perfectly insured against unemployment. The first two terms of the above expression reduce to $\mu_1 p'(\bar{w})[u'(c_1)y_1-d]$. This expression represents the difference between the value of the lost output in utility terms from having fewer Type 1's employed at the pre-existing wage rate and the utility gain given that fewer Type 1's incur the disutility of supplying labour.[15] This term could be positive or negative, it being more positive (less negative) the greater is $\overline{V}^1$.[16]

Result 4 *A minimum wage will be welfare-improving if the transfer to employed Type 1's is large enough relative to the unemployment insurance payment. In the extreme cases, where there is no monitoring and where monitoring is costless, there will be a value of* $\overline{V}^1$*, above which a minimum wage will be welfare-improving.*

III. NO TAGGING: THE SOCIAL ASSISTANCE CASE

In the previous section, we assumed that the government could observe abilities perfectly, and we concentrated on the usefulness of monitoring job search activities to separate the involuntary from the voluntary unemployed. In this section, we adopt the standard non-linear income taxation framework and assume abilities are private information and labour

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[14] Totally differentiating the binding incentive constraint, we obtain $dc_1/d\bar{c}_1 = u'(\bar{c}_1)/u'(c_1) > 0$. From the binding expected utility constraint, $d\bar{c}_1/d\overline{V}^1 = 1/u'(\bar{c}_1) > 0$. Together, these imply that $d(c_1-\bar{c}_1)/d\overline{V}^1 > 0$.

[15] Type 1's are fully insured for unemployment, $c_1 = \bar{c}_1$, so the expected utility constraint becomes $u(c_1) - pd = \overline{V}^1$. Differentiating this expression, we obtain $dc_1/dp = d/u'(c_1)$.

[16] Given p, differentiating the binding $\overline{V}^1$ constraint, gives $dc_1/d\overline{V}^1 = 1/u'(c_1) > 0$.

supply is variable. The government can only observe individuals' earned income and thus, their employment status. Therefore, the government is unable to distinguish between a Type 0 (disabled) individual and an unemployed Type 1 individual. The issues that arise in this section closely parallel those in social assistance or welfare programs.

As is standard in the non-linear income taxation model, we assume that there is full employment in all labour markets. Firms can perfectly observe abilities and thus, individuals earn a wage equal to their marginal productivity. Type 1 and Type 2 preferences are now given by $u(c)-\ell$ where ℓ is the amount of labour they choose to supply given their wage rates, $w_2 > w_1$. Using the definition of labour income $y_i = w_i\ell$, we can restate the individuals' utility function, $V^i(c_i, y_i) \equiv u(c_i) - y_i/w_i$. Given the quasi-linear form of the utility function, the marginal rate of substitution between consumption and income for a given ability-type depends only on the level of consumption: $MRS^i(c) \equiv -V^i_y/V^i_c = 1/(w_i u'(c))$. This implies that the single-crossing property is satisfied, $MRS^1(c) > MRS^2(c)$.

As before, Type 1 individuals must decide whether to apply for a job, and if they are offered one, whether to accept it. In this case they are always offered a job if they apply for one. Since abilities are unobservable, the government must ensure that Type 2 individuals self-select into the income tax system, i.e. apply for work and accept any job offer. In the optimum, all Type 1's and Type 2's are induced to be employed and their utility levels are given by $V^1(c_1, y_1)$ and $V^2(c_2, y_2)$, respectively. It is apparent that for monitoring to be helpful, Type 0's must also apply for work.[17] They will do so if $v(\bar{c}_0) \geq q^a v(0) + (1-q^a)v(\bar{c}_0)$. This constraint never binds given $\bar{c}_0$ is positive, so it can be ignored in the government's problem.

The government chooses income-contingent transfers and monitoring intensities to maximize the utility of the disabled, $v(\bar{c}_0)$, given the minimum levels of utility, $V^1(c_1, y_1) \geq \overline{V}^1$ and $V^2(c_2, y_2) \geq \overline{V}^2$, and subject to its incentive and resource constraints. The latter is $N_2[y_2 - c_2] + N_1[y_1 - c_1] - N_0\bar{c}_0 - M_a(q^a) - M_o(q^o) \geq \bar{R}$. The incentive constraints now include the standard self-selection constraint of the optimal income tax literature on Type 2's since ability-types are not observable:

$$V^2(c_2, y_2) \geq V^2(c_1, y_1) \qquad (\sigma)$$

[17] We maintain the assumption that there are no costs associated with job search.

where σ also serves as the Lagrange multiplier on this constraint. And, as before Type 1's are constrained to apply for a job and accept any job offer:[18]

$$V^1(c_1, y_1) \geq q^j V^1(0,0) + (1-q^j)V^1(\bar{c}_0, 0) \qquad j = a, o \qquad (\phi^j)$$

where unemployed Type 1's now obtain consumption bundles meant for the disabled.[19] Both of these constraints will bind. Suppose one of the constraints was non-binding ($\phi^j > 0$). By reducing the monitoring of this activity (q^j), the government could save resources and increase the transfer to the disabled. In an interior optimum, since the constraints are identical the government will set $q^a = q^o = q \in (0,1)$. This allows us to replace both constraints with a single job search constraint as a function of q. The actual level of q will depend on the available resources and the costs of monitoring. If the government was unable to monitor one of the job search activities, then optimally it would not monitor for the other. The above can be summarized in the following result.

Result 5 *If abilities are private information and there is full employment, monitoring for job applications and job offer acceptance are perfect complements.*

If ability-types were known and the government could perfectly (and costlessly) observe whether an unemployed individual had applied for a job and been offered one, then neither the self-selection constraint nor the two incentive constraints would bind. Both Type 1 and Type 2 individuals would work, consume a level of consumption such that $MRS^i(c_i) = 1$, and earn a level of income such that they each receive their minimum utility levels, $\overline{V}^1$ and $\overline{V}^2$. The consumption transfer to the disabled would be determined from the binding revenue constraint.

At the other extreme, when abilities are unobservable and the government is unable to monitor for job search activities, redistribution options would be severely restricted. The level of transfers offered to the disabled cannot be so generous as to induce the Type 1's to choose to be unemployed, that is, $V^1(c_1, y_1) \geq V(\bar{c}_0, 0)$. Obviously, given the government's

[18] Unemployed individuals must apply for the unemployment transfer which triggers the monitoring process.

[19] Provided the self-selection constraint and the Type 1's incentive constraints are satisfied, Type 2's will strictly prefer working to mimicking the disabled individuals and applying for social assistance.

objective it will ensure that this constraint and the Type 1's minimum utility constraint are just binding. Monitoring job search should allow the government to make a larger transfer to the disabled since a zero-transfer penalty will be imposed on individuals found not to have sought a job or accepted any job offers that have been received.

Suppose then that abilities are unobservable, but the government is able to monitor for both job offers and job applications at some cost. The government's policy instruments are $(\bar{c}_0, c_1, y_1, c_2, y_2, q)$. The Lagrangian expression and first-order conditions for this problem are listed in the Appendix. For the Type 2's, we obtain from the first-order conditions on c_2 and y_2 the standard result that $MRS^2(c_2) = 1$: high-ability individuals have a zero marginal tax rate, and receive the same amount of consumption and income as in the full-information case. From the conditions on c_1 and y_1 we obtain that in an interior optimum

$$MRS^1(c_1) = 1 + \frac{\sigma\left(\widehat{MRS}^2(c_1) - 1\right)}{\mu_1 + \phi}$$

where $\widehat{MRS}^2(c_1)$ denotes the marginal rate of substitution between consumption and income of a Type 2 individual who is mimicking a Type 1 individual, i.e., $\widehat{MRS}^2(c_1) = 1/(w_2 u'(c_1))$. Since $\widehat{MRS}^2(c_1) < 1$ by the single crossing property, $MRS^1(c_1) < 1$ (assuming the self-selection constraint binds, $\sigma > 0$). Thus, Type 1's will have their consumption distorted downwards from the full information case. They now have a positive marginal tax rate to reduce the incentive of the Type 2 individuals to mimic them. This result is standard in the optimal income tax literature.[20]

As before, the key results on monitoring can be determined from the government's constraints. The objective of the government is to redistribute as much as possible to the disabled individuals, given $\overline{V}^1$ and $\overline{V}^2$. Both minimum utility constraints bind in the optimum. If either of them were slack, the government could extract additional revenue

[20] This result assumes that y_1 can take any non-positive value. In practice, there may be a lower bound on income $(\bar{y})$ reflecting indivisibilities in the number of hours worked. If we impose the constraint that $y_1 \geq \bar{y}_1$ and it is binding, then the sign of Type 1's marginal tax rate becomes ambiguous. As stated above, Type 1's consumption is distorted downwards to reduce Type 2's incentive to mimic. To ensure Type 1's meet their minimum income requirement, the government distorts upwards their consumption. It is uncertain which distortion dominates. In the full information case, only the latter distortion exists and Type 1's face a negative marginal tax rate.

from the Type 1's or the Type 2's and improve the welfare of the disabled. From the discussion above, it is clear that the consumption-income bundles for the Type 1's and the Type 2's are uniquely determined from these two constraints, the self-selection constraint, and the first-order conditions.[21] That leaves only $\bar{c}_0$ and q to be determined.

Since c_1 and y_1 are determined, the job search constraint can be rewritten as $\overline{V}^1 = qV^1(0,0) + (1-q)V^1(\bar{c}_0, 0)$. Thus, an increase in monitoring allows more resources to be transferred to the disabled without violating the constraint. However, both monitoring and transferring to the disabled are costly. For a given $\overline{V}^1$ and $\overline{V}^2$, the resources available to transfer to the disabled and to monitor individuals are fixed. Thus, the optimal amount of monitoring (q) and the optimal transfer to the disabled ($\bar{c}_0$) will be uniquely determined from the binding job search and revenue constraint, given $\overline{V}^1$ and $\overline{V}^2$. Any increase in the resources available to the government will increase the amount of monitoring and the transfer to the disabled, given $\overline{V}^1$ and $\overline{V}^2$.[22]

If we move along the utility possibility frontier, q will also change. Suppose, for example, we decrease $\overline{V}^1$ holding $\overline{V}^2$ fixed.[23] Although this increases both the income earned by Type 1's and their consumption, c_1 rises by less than y_1, so the government extracts more net revenue from the Type 1's.[24] This decrease in $\overline{V}^1$ necessarily increases

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[21] The constraints are $\overline{V}^2 = V^2(c_2, y_2) = V^2(c_1, y_1)$ and $\overline{V}^1 = V^1(c_1, y_1)$, and the first-order conditions are represented by the expressions for the marginal rate of substitution. If the self-selection constraint is not binding ($\sigma = 0$), then the Type 1's consumption-income face a zero marginal tax rate and receive their full information (c, y)–bundle, that is, $MRS^1(c_1) = 1$.

[22] Rewriting the revenue constraint as $M_a(q) + M_o(q) + N_0\bar{c}_o = K$, where K represents the total resources available to the government to monitor and transfer to the disabled, and totally differentiating this constraint and the job search constraint, we obtain, $\partial\bar{c}_0/\partial K = [u(\bar{c}_0) - u(0)]/H > 0$ and $\partial q/\partial K = (1-q)/H > 0$, where $H = [M_a'(q) + M_o'(q)](1-q) + N_0[u(\bar{c}_0) - u(0)] > 0$.

[23] Any change in $\overline{V}^1$ holding $\overline{V}^2$ fixed, necessarily changes the resources available to the government in the opposite direction. If instead we changed $\overline{V}^2$ holding $\overline{V}^1$ fixed, the effect on the government's resources is ambiguous and therefore, we can not determine what direction q changes in. The larger N_2, the smaller N_1, and the larger the wage differential, the more likely a decrease in $\overline{V}^2$ will increase the resources available to the government and subsequently increase both q and $\bar{c}_0$.

[24] Totally differentiating the two minimum utility constraints and the self-selection constraint, treating $\overline{V}^2$ as fixed, we obtain, $\partial c_1/\partial\overline{V}^1 = D^{-1}/w_2 < 0$ and $\partial y_1/\partial\overline{V}^1 = D^{-1}u'(c_1) < 0$,

the amount of monitoring q to ensure the job search constraint is not violated, but may or may not increase $\bar{c}_0$.[25] If monitoring is very costly, then it is possible that all the additional resources are depleted before q is increased enough to ensure the constraint is satisfied. In this case, the transfer to the disabled must also decrease. The marginal reduction in $\overline{V}^1$ will increase $\bar{c}_0$ if the sum of the marginal costs of monitoring is less than the increase in revenue raised from the Type 1's.[26] If monitoring was costless, then a reduction in $\overline{V}^1$ would always increase the transfer to the disabled. We can summarize the above in the following.

Result 6 *For a given $\overline{V}^1$ and $\overline{V}^2$, the binding job search and revenue constraints uniquely determine the intensity of monitoring and the transfer to the disabled. Redistributing more to the disabled from the low-ability individuals requires greater monitoring.*

V. CONCLUDING REMARKS

Economists have long tended to focus on extending the income tax system to transfer recipients as a way of implementing redistributive objectives. But, transfer programs are typically not delivered through the income tax system with its reliance on self-assessment and self-reporting. Instead, they are usually administered by unemployment insurance or social assistance agencies whose administrators are involved in *ex ante* monitoring of applicants.

The reason for this is that income is of limited use for targeting transfers to those most in need. Many of the most needy earn no income either because they are unable to work or because they are unemployed. In this paper, we have focused on monitoring the labour market activities of low-income persons. Transfer recipients are commonly monitored to verify whether they are searching for work and accepting jobs that are offered. We have

where $D = u'(c_1)[1/w_2 - 1/w_1] < 0$ and $u'(c_1) > 1/w_2$ by the single crossing property.

[25] Totally differentiating the incentive constraint, $V^1(c_1, y_1) = qV^1(0,0) + (1-q)V^1(\bar{c}_0)$, and the revenue constraint, treating c_2 and y_2 as fixed, and using the results and the expression for D from the previous footnote, we obtain, $\partial q/\partial\overline{V}^1 = G^{-1}[(1-q)u'(\bar{c}_0)X + N_0 Y] < 0$ and $\partial\bar{c}_0/\partial\overline{V}^1 = G^{-1}[(u(\bar{c}_0) - u(0))X - Y(M_a'(q) + M_o'(q))]$, where $G = -(M_a'(q) + M_o'(q))u'(\bar{c}_0) - N_0(u(\bar{c}_0) - u(0)) < 0$, $X = D^{-1}N_1[1/w_2 - u'(c_1)] > 0$, and $Y = D^{-1}u'(c_1)[1/w_2 - 1/w_1] > 0$.

[26] By footnote 25, $\partial\bar{c}_0/\partial\overline{V}^1 > 0$ if $M_a'(q) + M_o'(q) < N_1 w_1 w_2(\widehat{MRS}^2 - 1)[u(\bar{c}_0) - u(0)][w_1 - w_2]^{-1}$.

investigated how these two types of monitoring can help differentiate those searching for work from those not searching for work, and the disabled from the voluntarily unemployed, and thereby improve the efficiency of the transfer system. We have also highlighted the complementarity of the two forms of monitoring.

Our analysis could be extended in a number of directions to make it more realistic. We have assumed that there are no costs of applying for a job. Typical job search costs include both time and money. This could be particularly interesting especially where the costs varied systematically among individuals, i.e. varying preferences for leisure. We have also studied only two form of labour market monitoring, job applications and job offers. There are others that are relevant for transfer programs. One is whether or not unemployed persons have been laid off or have quit their jobs, something which is of special relevance for unemployment insurance systems. Others might include job training activities, and participation in the underground economy. Information obtained from monitoring may be imperfect. There may be both type I and type II errors, which will complicate the design of programs considerably. By the same token, there may be imperfect tagging, rather than the two extreme cases of no tagging and perfect tagging we considered. Moreover, individuals may differ along dimensions other than ability, such as tastes. Finally, since the information obtained by those administering transfer programs is private to them, there will be agency problems associated with operating welfare and unemployment insurance programs.[27] This will increase the programs' cost and be a source of yet another trade-off to be considered.

[27] The problem of agency costs in welfare programs has been addressed by Boadway, Marceau, and Sato (1999). Information obtained by social workers in the process of tagging welfare applicants becomes private to them. They must be induced to exert the optimal effort and to use this information efficiently.

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APPENDIX

The Perfect Tagging Case

The Lagrangian expression for the problem in Section II is:

$$\begin{aligned}\mathcal{L} =& v(\bar{c}_0) + \mu_1 \left(p[u(c_1) - d] + [1-p]u(\bar{c}_1) - \overline{V}^1\right) + \mu_2 \left(u(c_2) - d - \overline{V}^2\right) \\ &+ \phi^o \left(u(c_1) - d - q^o u(0) - [1-q^o]u(\bar{c}_1)\right) \\ &+ \phi^a \left(p[u(c_1) - d] + [1-p]u(\bar{c}_1) - q^a u(0) - [1-q^a]u(\bar{c}_1)\right) \\ &+ \lambda \left(N_2[y_2 - c_2] + pN_1[y_1 - c_1] - [1-p]N_1\bar{c}_1 - n_0\bar{c}_0 - M_a(q^a) - M_o(q^o) - \bar{R}\right)\end{aligned}$$

The first-order conditions of the problem are:

$$v'(\bar{c}_0) - \lambda N_0 = 0 \qquad (\bar{c}_0)$$

$$[\mu_1[1-p] - \phi^o[1-q^o] + \phi^a[q^a - p]]u'(\bar{c}_1) - \lambda N_1[1-p] = 0 \qquad (\bar{c}_1)$$

$$[\mu_1 p + \phi^o + \phi^a p]u'(c_1) - \lambda N_1 p = 0 \qquad (c_1)$$

$$\mu_2 u'(c_2) - \lambda N_2 = 0 \qquad (c_2)$$

$$\phi^j[u(\bar{c}_1) - u(0)] - \lambda {M_j}'(q^j) = 0 \qquad j = a, o \qquad (q^j)$$

Effect of a Minimum Wage in the Matching Model

Given $r = 1$, firm profits are $f(e) - \bar{w}e - \phi[e + be/m(u)]$. The firm can be viewed as choosing e, which is equivalent to choosing v given the equilibrium condition $m(u)v = be$. The first-order condition is $f'(e) - \bar{w} - \phi[1 + b/m(u)] = 0$. This yields $e(\bar{w}, u)$, where

$$e_{\bar{w}} = 1/f''(e) < 0; \quad \text{and} \quad e_u = -\phi bem'(u)/m^2(u) > 0 \qquad (a.1)$$

The profit function is $\pi(\bar{w}, u)$, and by the envelope theorem

$$\pi_{\bar{w}} = -e < 0 \quad \text{and} \quad \pi_u = ef''(e)e_u \qquad (a.2)$$

Given n, industry equilibrium requires that total separations equals total matches, and total employment equals the sum of firms' employment, $bE = m(u)(N_1 - E)/u$ and $E = ne(\bar{w}, u)$. These give $E(\bar{w}, n)$ and $u(\bar{w}, n)$. Differentiating the first condition yields

$$\frac{du}{dE} = \frac{b + m(u)/u}{(m'(u) - m(u)/u)V} \qquad (a.3)$$

where $dU/dE < 0$ since $m'(u) - m(u)/u < 0$ by the strict concavity of $m(u)$. Differentiating the second condition yields

$$dE = \frac{e(\bar{w}, u)dn + ne_{\bar{w}}d\bar{w}}{1 - ne_u dU/dE} \tag{a.4}$$

which implies

$$E_n(\bar{w}, n) > 0; \quad E_{\bar{w}}(\bar{w}, n) < 0; \quad u_n(\bar{w}, n) < 0; \quad u_{\bar{w}}(\bar{w}, n) > 0 \tag{a.5}$$

Given $u(\bar{w}, n)$, the profit function from the firm's equilibrium becomes $\pi(\bar{w}, u(\bar{w}, n))$. Free entry will drive profits to zero, $\pi(\bar{w}, u(\bar{w}, n)) = 0$. This determines $n(\bar{w})$. Differentiating the zero profit condition yields, $(\pi_{\bar{w}} + \pi_u u_{\bar{w}})d\bar{w} + \pi_u u_n dn = 0$. Using $(a.1)$, $(a.2)$, $(a.4)$ and $(a.5)$, this yields:

$$\frac{dn}{d\bar{w}} = \left[\left(1 - ne_u \frac{du}{dE}\right) f''(e)e_u\right]^{-1} < 0$$

Then, from $E(\bar{w}, n(\bar{w}))$,

$$\frac{dE}{d\bar{w}} = E_w + E_n \frac{dn}{d\bar{w}} < 0$$

The No Tagging Case

The Lagrangian expression for the problem in Section III is:

$$\begin{aligned}\mathcal{L} =& v(\bar{c}_0) + \mu_1 \left(u(c_1) - y_1/w_1 - \overline{V}^1\right) + \mu_2 \left(u(c_2) - y_2/w_2 - \overline{V}^2\right) \\ &+ \sigma\left(u(c_2) - y_2/w_2 - u(c_1) + y_1/w_2\right) + \phi\left(u(c_1) - y_1/w_1 - qu(0) - (1-q)u(\bar{c}_0)\right) \\ &+ \lambda\left(N_2[y_2 - c_2] + N_1[y_1 - c_1] - N_0\bar{c}_0 - M_a(q) - M_o(q) - \bar{R}\right)\end{aligned}$$

The first-order conditions of the problem are:

$$v'(\bar{c}_0) - [\phi^o(1 - q^o) + \phi^a(1 - q^a)]u'(\bar{c}_0) - \lambda N_0 = 0 \tag{$\bar{c}_0$}$$

$$[\mu_1 - \sigma + \phi^o + \phi^a]u'(c_1) - \lambda N_1 = 0 \tag{c_1}$$

$$[\mu_2 + \sigma]u'(c_2) - \lambda N_2 = 0 \tag{c_2}$$

$$-\mu_1/w_1 + \sigma/w_2 - \phi^o/w_1 - \phi^a/w_1 + \lambda N_1 = 0 \tag{y_1}$$

$$-\mu_2/w_2 - \sigma/w_2 + \lambda N_2 = 0 \tag{y_2}$$

$$\phi[u(\bar{c}_0) - u(0)] - \lambda[{M_a}'(q) + {M_o}'(q)] \tag{q}$$