Int Tax Public Finan (2006) 13:565–585
DOI 10.1007/s10797-006-6249-3

Optimal unemployment insurance design: Time limits, monitoring, or workfare?

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Abstract This paper analyses crucial design features of unemployment insurance (UI) policies. We examine three different means of improving the efficiency of UI: the duration of benefit payments, monitoring in conjunction with sanctions, and workfare. To that end we develop a quantitative model of equilibrium unemployment. The model features worker heterogeneity in preferences for leisure. The analysis suggests that a system with monitoring and sanctions restores search incentives most effectively, since it brings additional incentives to search actively so as to avoid the sanction. Therefore, the UI provider can offer a more generous UI replacement rate in a system with monitoring and sanctions than in the other two systems. Workfare appears to be inferior to the other two systems.

Keywords Unemployment insurance · Search · Monitoring · Sanctions · Workfare

JEL Code J64 · J65 · J68

1 Introduction

Theoretical modeling of unemployment insurance (UI) has typically focused on the benefit level or the replacement rate, i.e., the fraction of earnings replaced by unemployment benefits. Of course, the design of an optimal UI system raises many other issues. For example, should there be a time limit on benefit receipt? To what extent should benefit recipients be induced to follow prescribed search requirements? Is there a case for a work requirement in exchange for benefits?

The present paper contributes to the welfare analysis of UI by analyzing three different means of improving the efficiency of UI. The first instrument is the duration of benefit

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payments, or more generally the time sequencing of benefits; the second is monitoring in conjunction with sanctions; and the third is workfare. The purpose is to offer a framework that allows a comparison of the three instruments in a coherent fashion. Needless to say, an exhaustive discussion of UI design should also consider other issues, such as modes of financing and entitlement rules, issues that are ignored in the present paper.

The question of time sequencing of benefits is about whether benefits should be paid at a fixed rate over the spell of unemployment or decline (or increase) over the spell. This issue appeared in the literature on optimal UI in the late 1970s and has attracted new attention in recent research.[1] Issues regarding monitoring and sanctions concern how much resources should be spent on checking search behavior and how sanctions, such as benefit cuts, should be implemented if prescribed search requirements are not met. These questions have been discussed in policy circles but only rarely been the subject of research.[2]

Workfare—the requirement that a benefit recipient participate in some work activity in exchange for benefits—has been on the policy agenda for a very long time; indeed, examples of workfare in France and Britain can be traced centuries back (Besley and Coate, 1992). Workfare has been scrutinized in the public finance literature on poverty alleviation (Besley and Coate 1992, 1995). In the context of UI, workfare has sometimes been discussed in conjunction with active labor market policies (Jackman, 1994). One idea in this discussion is that labor market programs can be useful to implement the work test of UI. Although the idea has been around for some time, it has not been subject to much rigorous formal analysis.[3]

In this paper we formulate a quantitative model of equilibrium unemployment within which each of the three policy instruments can be examined. The model extends the analyses of Fredriksson and Holmlund (2001), Boone and van Ours (2000), and Boone et al. (2002) by incorporating worker heterogeneity and by enlarging the set of policy instruments. Worker heterogeneity appears as differences in preferences for leisure. The motivation for this approach is the desire to shed light on the role of workfare as a screening device. When workers differ in their preferences for leisure, they will also differ with respect to their search effort. However, search effort is unobserved by the insurer—or at least observed imperfectly—and UI benefits can therefore not be directly conditioned on search. If search indeed were observed one would expect that an optimal UI policy would reward active and penalize less active search. Workfare schemes may conceivably be useful as a means to encourage UI beneficiaries to engage in active job search. To our knowledge, no earlier study has systematically explored the performance of workfare in comparison to other conceivable policy instruments.

The next section presents the basic theoretical framework. Throughout we rule out the possibility of self-insurance via privates savings during employment. This omission partly

[1] Shavell and Weiss (1979) is the seminal paper in this area. More recent studies include Wang and Wiliamson (1996), Davidson and Woodbury (1997), Hopenhayn and Nicolini (1997), Cahuc and Lehmann (2000) and Fredriksson and Holmlund (2001).

[2] Recent theoretical papers include Boone and van Ours (2000) and Boone et al. (2002). A growing number of empirical studies suggest that monitoring in conjunction with sanctions can have substantial behavioral effects. See Abbring, van den Berg, and van der Ours (1998), van den Berg, van der Klaauw, and van Ours (2004) and Lalive, van Ours, and Zweimüller (2002) for evidence on the effects of sanctions. Several randomized experiments from the United States indicate that more stringent search requirements reduce the duration of benefit receipt (Johnson and Kleppinger, 1994; Benus and Johnson, 1997).

[3] The recent paper by Thustrup Kreiner and Tranæs (2005) is an exception. Several empirical studies have found support for the idea that workfare works as a screening device. The study by Black et al. (2003) indicates that the mere threat of being placed in a labor market program can reduce time spent on UI and boost job findings. The results reported by Benus and Johnson (1997) point in the same direction. Fredriksson and Holmlund (2003) offer a survey of recent literature on how to improve incentives in UI.

reflects the strive for a tractable model. The possibility of savings may affect the desirability of reducing benefit generosity over the course of the unemployment spell (e.g. Hassler and Rodriguez Mora, 2002). But in the present paper we are interested in comparing instruments that all have the flavour of reducing the generosity of UI compensation over the unemployment spell. Therefore, we do not think that the omission of savings will bias this comparison in a substantive way.

Section 3 turns to the welfare analysis. This analysis suggests that a system with monitoring and sanctions restores search incentives most effectively, since it brings additional incentives to search actively so as to avoid the sanction. Therefore, the UI provider can offer a more generous UI replacement rate in a system with monitoring and sanctions than in the other two systems. Workfare appears to be inferior to the other two systems.

2 The model

The model extends the analysis in Fredriksson and Holmlund (2001) by incorporating individual heterogeneity. We consider heterogeneity in preferences for leisure, i.e. the same form of heterogeneity as Beaudry and Blackorby (1998) and Thustrup Kreiner and Tranæs (2005).

2.1 Utility functions and labor market transitions

We follow Thustrup Kreiner and Tranæs (2005) in assuming that there are only two types of individuals: workers (w) and non-workers (n). For an individual of type $i = w, n$, instantaneous utility is given by

$$v_i^j = \ln c_i^j + \delta_i \ln \ell_i^j \tag{1}$$

where c denotes consumption and ℓ leisure. The marginal rate of substitution between consumption and leisure differs between workers and non-workers. In particular we assume that $\delta_w < \delta_n$. This difference in turn implies different levels of consumption and leisure for workers and non-workers. We will make the extreme assumption that non-workers do not search for a job unless the monetary compensation outside employment becomes unreasonably low. This, in turn, implies that a non-worker will never be employed.

There are four potential states (j): employment (e), unemployment insurance (UI) receipt (u), participation in workfare (p), or unemployment assistance (UA) receipt (a).[4] Associated with each state is a present discounted value, V_i^j, $j = e, u, p, a$.

To preserve tractability we assume that consumption equals income in each instant, i.e., individuals cannot save nor borrow. Consumption and leisure depend on the state; in particular we assume that

$$\begin{array}{ll} c_i^e = w & \ell_i^e = \overline{\ell} \\ c_i^u = bw & \ell_i^u = 1 - s_i^u \\ c_i^p = bw' & \ell_i^p = 1 - p - s_i^p \\ c_i^a = zw & \ell_i^a = 1 - s_i^a \end{array}$$

[4] We refer to this state as unemployment assistance. But one could equally well think of it as social assistance (welfare) or any other income of last resort.

where w denotes the aggregate wage and s_i^k, $k = u, p, a$, search intensity. b and z are the replacement rates provided by the unemployment benefit system and p is the time requirement on workfare.[5] We take work-hours to be fixed and independent of the wage, so $\ell_i^e = \overline{\ell}$, and compensation on UI and workfare to be greater than unemployment assistance i.e., $b \geq z$.[6]

2.1.1 Workers

An employed worker is separated from his job at an exogenous Poisson rate, ϕ. A spell of employment immediately qualifies for UI benefits. The job offer arrival rate for individuals outside employment depends on search intensity and the aggregate state of the market. For individuals in state k, job offers arrive at the rate $s_i^k \alpha$. The offer arrival rate conditional on search, α, is a market variable that we endogenize later on. Finally, UI recipients are transferred to UA or workfare at the rate $\mu\pi(s_i^u)$. We interpret this transition rate below.

Having defined the relevant transition rates and the compensation in each state we can write the value functions for workers as follows

$$rV_w^e = \upsilon_w^e + \phi\left(V_w^u - V_w^e\right) \tag{2}$$

$$rV_w^u = \upsilon_w^u + s_w^u \alpha\left(V_w^e - V_w^u\right) + \mu\pi\left(s_w^u\right)\left[\max\left(V_w^p, V_w^a\right) - V_w^u\right] \tag{3}$$

$$rV_w^p = \upsilon_w^p + s_w^p \alpha\left(V_w^e - V_w^p\right) \tag{4}$$

$$rV_w^a = \upsilon_w^a + s_w^a \alpha\left(V_w^e - V_w^a\right) \tag{5}$$

where r is the subjective rate of time preference. Equations (2)–(5) embody the assumptions that time is continuous and individuals have infinite horizons.

2.1.2 Non-workers

Since non-workers do not search (by assumption) we have $s_n^k = 0$ and the employment state is not relevant for non-workers. The asset values for non-workers are thus given by

$$rV_n^u = \upsilon_n^u + \mu\pi\left(s_n^u\right)\left[\max\left(V_n^p, V_n^a\right) - V_n^u\right] \tag{6}$$

$$rV_n^p = \upsilon_n^p + \varphi\left(V_n^u - V_n^p\right) \tag{7}$$

$$rV_n^a = \upsilon_n^a + \varphi\left(V_n^u - V_n^a\right) \tag{8}$$

The interpretation (6) is analogous to (3) (apart from the fact that a non-worker does not search). While receiving UI, non-workers enjoy the direct utility of υ_n^u. UI expires at the rate $\mu\pi(s_n^u)$ and the non-workers are then transferred to UA or workfare.

Now, consider the interpretation of (7) and (8). Non-workers receive the direct utility of υ_n^p while being on workfare and υ_n^a when receiving UA. At the rate φ they escape workfare for UI, thereby enjoying a gain of $V_n^u - V_n^p$; analogously they escape UA for UI at the same rate and enjoy a gain of $V_n^u - V_n^a$. Thus, there is some "churning" of non-workers among the three unemployment states. In this way we ensure that UA (or workfare) does not become an

[5] We refer to w as the wage although it is in fact wage income, i.e., the wage rate times hours of work.

[6] If workers choose their working time, taking the hourly wage as given, work-hours – and thus leisure – will be independent of the wage. In particular, leisure will be given by $\ell_w^e = \delta_w/(1+\delta_w)$.

absorbing state for non-workers in situations where the UI expiration rate ($\mu\pi(s_n^u)$) is strictly positive. The assumption $\varphi > 0$ is a shortcut that incorporates the idea that non-workers may claim entitlement to UI by faked employment records. Non-workers may get some job offers even if they don't search. Since they (by assumption) are not willing to supply effort on the job, they will lose their jobs at rates that are very high, possibly infinitely high. There is a positive probability that a non-worker gets UI if the UI case-worker cannot determine whether such transitions represent genuine job destructions or quits.

2.1.3 Time limits, monitoring and sanctions, and workfare

The three institutions that we consider come out as specific ways of modeling the asset value of being on UI. Consider first the system with time limits. A convenient way of parameterizing such a system is as follows: Write the stochastic termination rate as being independent of s_i^u, i.e., $\pi(s_i^u) = 1$ and restrict p such that $\max(V_w^p, V_w^a) = V_w^a$, i.e., workers (and hence non-workers) prefer UA over workfare. In this incarnation, the model features stochastic duration of benefit receipt; the expected potential duration of unemployment insurance receipt is $(1/\mu)$. Using this modeling strategy we avoid the non-stationarities associated with fixed duration that complicates the model without adding much insight; see Fredriksson and Holmlund (2001).

Consider next the system with monitoring and sanctions. Recipients of UI benefits are monitored with respect to their search behavior at the Poisson rate μ. Monitoring is a random inspection of an individual's search activity. Given monitoring, there is some probability that the observed search effort does not meet the search requirement, in which case the worker is sanctioned and transferred to state a. Thus, $\mu\pi(s_i^u)$ is the probability of being sanctioned per unit time given that the individual is monitored and supplies s_i^u units of search. In sum, the system with monitoring and sanctions is parameterized as follows: the termination rate of UI benefit receipt is a decreasing function of search, $\partial\pi(s_i^u)/\partial s_i^u \leq 0$, and p is set such that $\max(V_w^p, V_w^a) = V_w^a$.

For practical purposes, we choose $\pi(s_i^u) = 1 - \sigma s_i^u$ as our parameterization of the sanctioning probability. To ensure that π is a proper probability, we take σ to be bounded by the unit interval, that is, $\sigma \in [0, 1]$. This restriction implies that there is a positive probability of being sanctioned for all values of s_i^u. In other words the monitoring technology is plagued by Type II errors – some complying individuals are sanctioned. The parameter σ measures to which extent the sanction probability depends on an agent's own search effort. One way to interpret σ is that it indexes the precision of the inspection technology. A simple example may illustrate why it is useful to think of σ as an indicator of the precision of the inspection technology. Consider the extreme case when $\sigma = 0$. This case mirrors the situation where benefit administrators roll a dice to determine whether the monitored individual has searched to rule or not. The inspection technology is thus completely random from the job searcher's perspective. In this case, the monitoring and sanctions system is equivalent to our incarnation of a system with finite duration of UI benefit receipt. We can therefore meaningfully compare the two systems by changing one parameter.

Consider finally a system with workfare. Individuals are randomly subjected to a work test at rate μ. Given an offer to participate in workfare, they choose $\max(V_i^p, V_i^a)$. For a workfare system to be operative it must be true that $\max(V_w^p, V_w^a) = V_w^p$ and $\max(V_n^p, V_n^a) = V_n^a$. That is, the time requirement should be set such that workers opt for workfare while non-workers prefer unemployment assistance. Thus a workfare system is defined by $\pi(s_i^u) = 1$ and the self-selection constraints $V_w^p \geq V_w^a$ and $V_n^a \geq V_n^p$.

2.1.4 Worker search behavior

Workers determine search in an atomistic fashion, i.e., by taking all wages and the offer arrival rate conditional on search, α, as given. In general, optimal search for individuals on UI satisfies

$$\frac{\delta_w}{\ell_w^u} = \alpha\left(V_w^e - V_w^u\right) + \mu\sigma\left(V_w^u - V_w^a\right) \tag{9}$$

The left-hand-side of (9) represents the marginal cost of search, that is, the marginal utility of leisure, while the right-hand-side constitutes the marginal return to search. The marginal return has two components: the first term refers to an increase in the job offer arrival rate and the second term to a reduction in the transition rate to UA. The systems with a time limit and workfare have $\sigma = 0$, so the second component never appears in the marginal return to search. Optimal search for individuals in the remaining two states is given by

$$\frac{\delta_w}{\ell_w^m} = \alpha\left(V_w^e - V_w^m\right), \quad m = p, a \tag{10}$$

Non-workers do not search at all so for them it must be true that δ_n is strictly greater than the marginal return to search in each state.

2.1.5 Flow equilibrium

We restrict attention to a steady state environment. There are flow equilibrium constraints that define the rates of employment and unemployment in the working population. For instance, the employment rate among workers is given by

$$e_w = \frac{\alpha\left[\lambda_w^u s_w^u + I\left(V_w^p > V_w^a\right)\lambda_w^p s_w^p + I\left(V_w^p \le V_w^a\right)\lambda_w^a s_w^a\right]}{\phi + \alpha\left[\lambda_w^u s_w^u + I\left(V_w^p > V_w^a\right)\lambda_w^p s_w^p + I\left(V_w^p \le V_w^a\right)\lambda_w^a s_w^a\right]} \tag{11}$$

where $I(\cdot)$ is the indicator function ($I(\cdot) = 1$ if the expression within parenthesis is true) and $\lambda_w^j = u_w^j/(1 - e_w)$ is the number of workers in state j relative to non-employment.

Non-workers are never employed. Independently of which of the three systems that we are considering, the share of non-workers on UI is given by

$$u_n^u = \frac{\varphi}{\mu + \varphi} \tag{12}$$

where μ is a policy parameter that will be determined optimally. We assume that φ is exogenously given for the UI provider.[7]

2.2 Matching and wage determination

The equilibrium in the model has an endogenous wage (w) and an endogenous offer arrival rate conditional on search (α). We endogenize w and α by specifying a matching technology

[7] In the monitoring and sanctions system the hazard rate out of UI for non-workers is $\mu\pi(s_n^u) = \mu$ since non-workers do not search.

and a wage bargaining model. With respect to the matching technology we make the standard assumptions that the matching function, $h = h(\bar{s}_w, v)$, is of the constant returns to scale variety and increasing in both arguments. The "inputs" to the production of matches are the effective numbers of searchers, $\bar{s}_w = s_w^u u_w^u + I(V_w^p > V_w^a)s_w^p u_w^p + I(V_w^p \leq V_w^a)s_w^a u_w^a$, and the number of vacancies (v). The probability of finding a job conditional on search is then $\alpha(\theta) = h(\bar{s}_w, v)/\bar{s}_w$, where $\theta \equiv (v/\bar{s}_w)$ is a measure of labor market tightness. Firms fill vacancies at the rate $q(\theta) = h(\bar{s}_w, v)/v = h(1/\theta, v)$. It is straightforward to verify that $\alpha'(\theta) > 0$ and $q'(\theta) < 0$, i.e. the tighter the market the easier it is for workers to find jobs and the more difficult it is for firms to find workers.

Wages are determined in individual bargaining between the worker and the firm. To determine the outcome of the wage bargain we must also specify firm values. The government finances unemployment expenditure by a proportional payroll tax (τ) levied on firms. Labor productivity is constant and given by y. The cost of holding a vacancy open is κy, with $\kappa > 0$. The value functions take the usual form

$$rJ^v = -\kappa y + q(\theta)(J^e - J^v) \tag{13}$$

$$rJ^e = y - w(1+\tau) + \phi(J^v - J^e) \tag{14}$$

where J^v is the asset value of a vacant job and J^e the asset value of an occupied job. Since there is no cost of entering and exiting the vacancy market, a free entry condition, $J^v = 0$, determines the number of vacancies in the market. From the free entry condition we obtain the wage cost, $w_c \equiv w(1+\tau)$, as proportional to the marginal product of labor:

$$w_c = [1 - (r+\phi)(\kappa/q(\theta))]y \equiv d(\theta)y$$

We refer to $w_c = d(\theta)y$ as the zero-profit condition. It specifies a negative relationship between w_c and θ, $d'(\theta) < 0$, since wage costs have to be lower in a tighter market in order to be consistent with zero profits.

Now consider wage determination. Given that bargaining is conducted at the individual level, the wage is given by

$$w = \arg\max \left[V_w^e(w) - V_w^u\right]^\beta [J^e(w) - J^v]^{1-\beta}$$

where $\beta \in (0, 1)$ is a measure of worker bargaining power. Imposing symmetry and the equilibrium condition, $J^v = 0$, we write the outcome of the wage bargain as

$$V_w^e - V_w^u = \frac{\beta}{1-\beta}\frac{J^e}{w_c} \tag{15}$$

The model has a convenient recursive structure where the zero-profit condition and Equation (15) determine θ and w_c. To see this, note that free entry of vacancies implies $J^e = \kappa y/q(\theta)$. The right-hand side of (15) is thus increasing in θ but independent of s_w^j. The left-hand side of (15) is a function of θ. But it is independent of w, given our chosen utility function and constant replacement rates. Moreover, it can be shown that it is independent of s_w^j when the first-order conditions for optimal search are invoked. With tightness determined, we get s_w^j from (9) and (10), recognizing that the wage does not affect the differences in present values. With θ and s_w^j determined, we get the unemployment and employment rates from the flow equilibrium conditions. As we have set up the model, taxes do not affect search and unemployment.

2.3 Welfare

We are interested in Pareto optimal UI policies. The objective of the UI provider is to maximize the expected utility of workers subject to non-workers receiving at least a minimum amount of utility. Thus, the welfare objective is

$$W_w = e_w \upsilon_w^e + u_w^u \upsilon_w^u + I\left(V_w^p > V_w^a\right) u_w^p \upsilon_w^p + I\left(V_w^p \leq V_w^a\right) u_w^a \upsilon_w^a \tag{16}$$

This is the relevant objective if there is no discounting because then firm values are irrelevant. We ignore discounting in order to validly compare alternative steady states without considering the adjustment process.

The final piece of the model is the government budget constraint. In general, it takes the form

$$\begin{aligned}\gamma \tau e_w w = {} & \gamma\left[u_w^u bw + I\left(V_w^p > V_w^a\right) u_w^p bw + I\left(V_w^p \leq V_w^a\right) u_w^a zw\right] \\ & + (1-\gamma)\left[u_n^u bw + u_n^a zw\right] + C(\cdot)\end{aligned} \tag{17}$$

where γ is the worker share of the population. The left-hand-side of (17) represents the revenues from the payroll tax. The right-hand-side constitutes unemployment expenditure. The first component, in square brackets, refers to unemployment expenditure in relation to the worker population and the second component is compensation paid to non-workers. Notice that in specifying the compensation to non-workers we have directly imposed that a viable workfare policy must screen out non-workers, implying that workfare is never an option for them. $C(\cdot)$, the real resource cost of running the monitoring and sanctions system, is assumed to be given by

$$C = c(\sigma)\mu\left(\gamma u_w^u + (1-\gamma) u_n^u\right) w \tag{18}$$

where $c(\sigma) \geq 0$ ($c'(\sigma) > 0$ and $c(0) = 0$) is the marginal cost of monitoring. Costs are increasing in the number of monitored individuals ($\mu(\gamma u_w^u + (1-\gamma)u_n^u)$); the sanction itself commands no resources. As argued above, σ can be interpreted as indexing the precision of the inspection technology. We take the marginal cost of monitoring to be increasing in σ; thus a more precise technology requires greater effort on the part of those who monitor search behavior. Finally, the indexation of the monitoring cost to the aggregate wage level reflects the fact that we think of monitoring as a labor intensive activity.

2.4 Optimal search incentives and screening

Before proceeding to the numerical results let us ask the question: Is worker search behavior optimal from society's point of view? The answer is that, as long as it is optimal to provide some insurance to the unemployed, search intensity will be too low in equilibrium. The reason is that there is a "taxation externality" associated with increasing search. If all individuals supplied additional search, employment would increase and, consequently, the tax that finances a given unemployment insurance system would be lower. Everyone would gain from a lower tax rate since the consumption wage would be higher. This effect is not taken into account in the private determination of search; see Fredriksson and Holmlund (2001) for details.

If there would have been no argument for improving search incentives, then we would only have to worry about the screening properties of the three systems. Workfare is a perfect screen in the sense that it induces all workers to opt for workfare rather than UA. However, some screening is also implied by a system with monitoring and sanctions. It is more likely that UI benefits expire for a non-worker who doesn't search than for a searching worker, for a given μ. But we should also care about what the three systems do to search effort. It is here useful to distinguish between ex ante effects and ex post effects; the ex ante effect refers to the threat of UI expiration while the ex post effect refers to the effect on search when UI has expired. It is also useful to hold the benefit parameters (b, z, and μ) fixed across systems.

Consider, first, the ex ante effect. Although, there are empirical results suggesting that workfare is indeed a threat (e.g. Black et al., 2003), the threat of workfare must be lower than the threat of unemployment assistance. The reason is, of course, that workers would rather be on workfare than on unemployment assistance. A system with monitoring and sanctions has the greatest ex ante effect because such a system has the greatest effect on search incentives for those on UI. Now, consider the ex post effect. The ex post effect is lowest for workfare. The reasons are twofold. First, workers are, again, better off on workfare than on unemployment assistance; second, the time requirement in workfare reduces the time available for search. The ex post effect is presumably somewhat higher in a system featuring monitoring and sanctions than in the time-limited UI system.[8]

2.5 Calibration of the model

We take a quarter as the basic time unit and calibrate the model for a uniform benefit system, i.e., one that has $b = z$. We set the uniform wage replacement rate to 30 percent, which approximately corresponds to uniform characterization of the US unemployment benefit system; see Fredriksson and Holmlund (2001). The marginal product of labor is normalized to unity. The matching function is of the Cobb-Douglas variety: $h = a(\bar{s}_w)^\eta v^{1-\eta}$. We set $a = 1.28$ and $\eta = 0.5$; the latter is at the upper end of the estimates in Blanchard and Diamond (1989). We set the bargaining parameter to $\beta = \eta$, which is the optimal value if there would be no policy interventions; see Hosios (1990).

The remaining parameters, κ, ϕ, and δ_w, are calibrated with respect to the worker population. The calibration is such that the unemployment rate is 6.5 percent, unemployment duration is one quarter, and the partial equilibrium elasticity of the hazard to employment with respect to benefits equals 0.5. These calibration points are broadly in line with the recent US experience.

We also need to assign some values for the number of workers (γ), the escape rate (φ) and δ_n. We think of the potential labor force as consisting of two groups of individuals. A fraction has a relatively low preference for leisure and therefore finds it worthwhile to search when out of work. Workers in this category constitute the "effective" labor force. The remaining fraction has a high preference for leisure and does not search. Somewhat arbitrarily, we

[8] This statement reflects the fact that $\sigma > 0$ (for given b, z, and μ) implies that UI is more generous since the risk of benefit expiration is lower. Since search intensity on UA is increasing in the generosity of UI, this will increase the magnitude of the ex post effect (for given labor market tightness).

Table 1 Baseline parameters

Description	Parameter
Matching technology: $h = a(\bar{s}_w)^\eta v^{1-\eta}$	$a = 1.282335$
	$\eta = 0.5$
Distribution of individuals and leisure values	$\gamma = 0.95$
	$\delta_w = 0.776489$
	$\delta_n = 2.646591$
Inflow to UI for non-workers	$\varphi = 0.223327$
Marginal product of labor	$y = 1$
Separation rate	$\phi = 0.069519$
Share parameter in the wage bargain	$\beta = 0.5$
Marginal cost of monitoring: $c(\sigma) = \psi\sigma$	$\psi = 0.02$

assume that the ratio between the effective and the potential labor force is 0.95.[9] The value for the escape rate out of unemployment assistance for non-workers (φ) was calculated in the following way. Swedish data on search activity according to the Labor Force Surveys suggest that 20 percent of workers on UI did not search at all during the week of measurement. This number thus suggests that $\frac{(1-\gamma)u_n^u}{(1-\gamma)u_n^u+\gamma u_w^u} = 0.2$. Given $\gamma = 0.95$, $u_w^u = 0.065$, and $\mu = 0.5$, we can use Equation (12) to back out a value for φ. To assign a value for δ_n we assumed that non-workers would be willing to search only if $b = z \leq 0.1$. The exact value of δ_n is only relevant when designing a system with workfare.

To calculate the numbers for the monitoring and sanctions system we need an estimate of $c(\sigma)$ in (18). We used Swedish data and performed the following calculation to get a reasonable number for this parameter. In Sweden, the employment offices monitor job search. Job counselors devote around 30 percent of their time to meetings with job searchers; see Lundin (2000). The number of employees at the employment offices is approximately equal to 0.25 percent of the labor force. Therefore, we took $0.3 \times 0.0025 = 0.00075$ as an estimate of the real resource cost of the monitoring and sanctions system relative to GDP. Thus $c(\sigma)\mu(\gamma u_w^u + (1-\gamma)u_n^u)$ should equal 0.00075. According to Lundin (2000), public employment service officers on average have close to two meetings with an unemployed per quarter. If we set $\mu = 2$ and $\gamma u_w^u + (1-\gamma)u_n^u$ to 0.1, this implies $c(\sigma) = 0.00375$. To proceed we must specify the marginal cost function. We take a simple linear cost function $c(\sigma) = \psi\sigma$ and use $\psi = 0.02$ when we calculate the numbers for the monitoring and sanctions system. It seems to us that this is a fairly large value for the marginal cost of monitoring. Still we prefer a "conservative" number since there is genuine uncertainty about the value of this parameter. Table 1 summarizes the baseline parameters and Table 2 shows some key outcomes in the baseline calibration with a uniform benefit system.

[9] Existing labor force surveys include various measures of "disguised" unemployment. One category, referred to as "latent job seekers" in Sweden, consists of non-participants reporting to be willing and able to work although they do not fulfill the search criteria for being classified as unemployed. Over the period 1995–2002, the ratio between the official and the potential labor force (the latter including latent job seekers) was 0.96 in Sweden.

Table 2 Baseline calibration and a benefit system with time limits

	Baseline (1)	Optimal system with time limits (2)
Policy variables		
b (UI replacement rate)	0.3	0.4958
z (UA replacement rate)	–	0.2623
μ	–	0.81
τ (tax rate)	0.0377	0.0487
Economic outcomes		
Worker search		
s_w^u	0.6081	0.5280
s_w^a	–	0.6482
Worker unemployment		
u_w^u	0.0650	0.0402
u_w^a	–	0.0334
Non-worker unemployment		
u_n^u	1	0.2161
u_n^a	–	0.7839
# individuals on UI		
$\gamma u_w^u + (1-\gamma)u_n^u$	0.1118	0.0490
Wage		
w	0.8891	0.8862
Welfare gain		
ε	–	0.43%

Notes: Superindex u and a refer to UI and respectively. Remaining symbols in the table are explained in the main text. The change in welfare (ε) is measured relative to the base run.

3 A comparison of the policy instruments

3.1 A uniform benefit system

The baseline calibration features an unemployment rate among workers (u_w^u) of 6.5 percent and unemployed individuals spend 61 percent of their time searching for a job; see s_w^u. Wages (net of taxes) are lower than the marginal product of labor because of search frictions. In the baseline calibration, the wage (w) amounts to 89 percent of the marginal product of labor.

How does search respond to changes in the UI replacement rate? Since an increase in the replacement rate decreases the gain of finding employment, individuals respond by searching less when UI becomes more generous. As we shall see later, however, this is not necessarily true when we consider more general UI systems than the one paying a constant wage replacement rate indefinitely.

We consider Pareto optimal benefit policies and assume that the UI provider maximizes the expected utility of workers subject to the constraint that non-workers receive at least a minimum amount of utility. The UI provider knows the distribution of workers and non-workers in the population but it cannot tell if an individual is a worker or a non-worker. In addition to providing insurance, an optimally designed UI system should ideally screen out non-workers and increase the search intensity among workers.

Suppose that the base run defines the minimum utility of non-workers, i.e., $v_n^u = \ln bw = 0.3 \times 0.8891$; see column (1) in Table 2. Can we design an optimal uniform benefit system that is different from the base run? The answer to this question is no. The reason is that with only the wage replacement rate as an instrument it is impossible to separate the two types. The wage replacement rate is tied down to 30 percent because of the minimum utility constraint.

3.2 Time limits in benefit receipt

Consider now the case with time limits on UI benefit receipt. The search intensity among workers depends on whether she is insured or non-insured (i.e. on UA). If $b \geq z$, it is straightforward to verify that $s_w^u \leq s_w^a$, that is, a worker searches less intensively when receiving UI (indexed by u) compared to UA (indexed by a). The intuition is simply that search intensity while receiving UI is lower because there is a smaller gain associated with finding employment.

What happens to search in each state when we change the replacement rates? With respect to z the model works much the same as before: search intensity is falling in the generosity of unemployment assistance. However, there is a differential effect of the UI replacement rate. An increase in b reduces the search intensity of the insured, but increases the search intensity of the non-insured. The latter effect is the entitlement effect, first highlighted by Mortensen (1977). Those on UA search harder when UI becomes more generous since employment is a prerequisite for receiving UI. Since there is a taxation externality associated with search, an optimal benefit system exploits the entitlement effect by introducing finite duration of UI receipt (see Fredriksson and Holmlund, 2001).

Now, consider solving for an optimal time-limited UI system. This involves choosing b, z, and μ such that the expected utility among workers is maximized subject to the minimum utility constraint for non-workers, the budget constraint, and the market equilibrium constraints.

Figure 1 plots the expected utility of workers for each value of the benefit expiration rate (μ); remaining policy parameters (b and z) are set at their optimal values conditional on μ. Figure 1 clearly shows that there exists a Pareto-optimal policy involving an interior value of μ. An optimal policy implies that the expected potential duration of UI benefits ($1/\mu$) should equal 1.2 quarters (1/0.81).

In column (2) of Table 2 we present the implications of the optimal system with time limits. The optimal system with time limits gives workers substantially more insurance than the base run. The UI replacement rate amounts to almost 50 percent of the wage. Since compensation is more generous, search intensity decreases while receiving UI. The total unemployment rate among workers and taxes increase. Notice, also, that the number of individuals receiving UI decreases from 11 to 5 percent.

As a measure of the change in welfare implied by a move to the optimal system we consider the consumption tax (ε) that would make workers indifferent between living in the optimal system and the base run.[10] As shown by the last row in Table 2, they would be willing to pay 0.43 percent of consumption to live in the optimal system with time limits.

[10] The consumption tax is equivalent to the change in welfare. To illustrate this, consider two candidate policies 0 and 1. Let $\widehat{W}_1(\varepsilon)$ denote welfare after the imposition of the consumption tax and W_0 denote welfare without the tax. The consumption tax that makes workers indifferent between the two systems is defined by

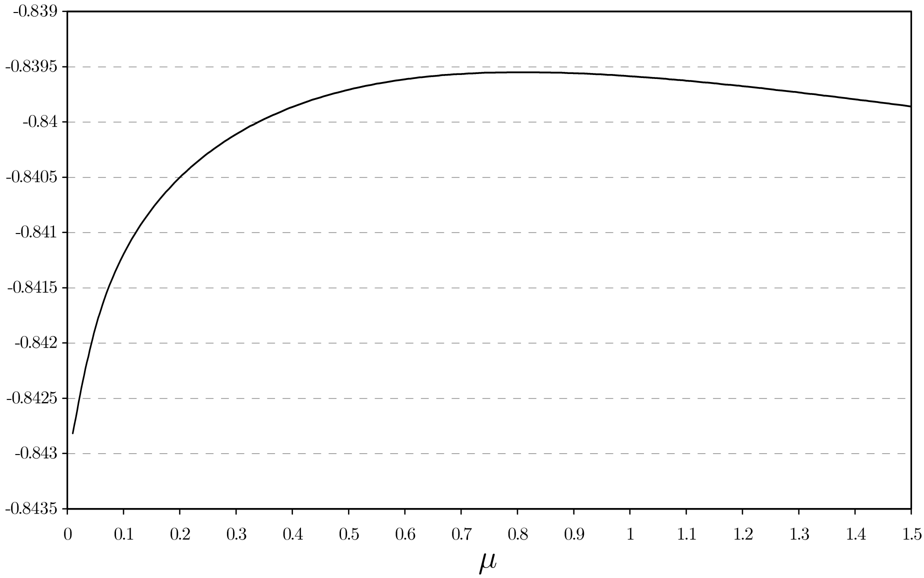

Fig. 1 Worker expected utility as a function of the UI expiration rate (μ)

3.3 Monitoring and sanctions

Now let us consider monitoring and sanctions. Our incarnation of a monitoring and sanctions system involves one additional parameter—the precision of the inspection technology, σ.

There are two behavioral implications of introducing a system with monitoring and sanctions. First of all, for given wage replacement rates, UI recipients will search harder since an increase in search reduces the risk of being sanctioned and transferred to UA receipt. Second, workers will bargain more aggressively. This is because there will be a reduction in the transition rate to UA receipt given search intensity. In the system with time limits, the transition rate is μ; in the monitoring and sanctions system it is $\mu(1 - \sigma s_w^u)$. The reduction of the transition rate to the least favored state yields an improvement of workers' outside opportunities. Therefore, workers bargain more aggressively—wage costs increase and fewer jobs are created. All in all, the policy experiment thus has two opposing effects on employment—search increases but at the same time wage pressure rises—and the employment effect of the policy is a priori ambiguous.

Figure 2 shows worker expected utility as a function of the monitoring rate (μ). It is constructed in the same way as Figure 1; that is, for a given value of μ we choose the remaining policy parameters optimally. In turns out that all optimal policy combinations involve $\sigma = 1$. Thus the UI provider should always opt for a precise technology. Presumably, this result is driven by the assumed cost structure and, therefore, we are reluctant to place a lot of emphasis on the exact value for σ. Nevertheless, in Boone et al. (2002) we conclude that the introduction of a system with monitoring and sanction is a welfare improvement relative to a system with time limits for reasonable values of monitoring costs. These costs would have to be implausibly high in order for this conclusion not to hold. Therefore, we are

the solution to $\widehat{W}_1(\varepsilon) = W_0$. Because of our utility function, ε solves $W_1 + \ln(1 - \varepsilon) = W_0$. If ε is small, we have $\ln(1 - \varepsilon) \approx -\varepsilon$ and therefore $\varepsilon = W_1 - W_0$, i.e. the change in welfare associated with the two policies.

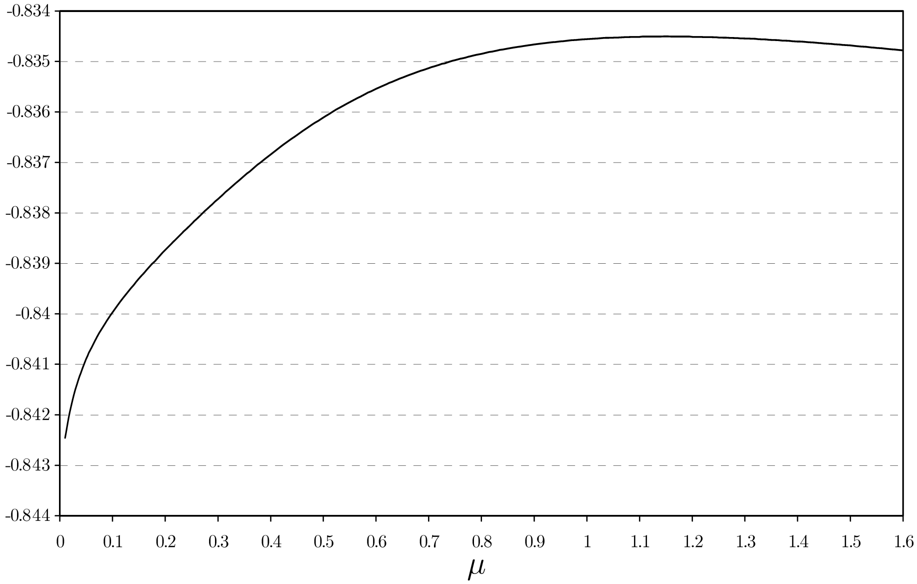

Fig. 2 Worker expected utility as a function of the monitoring rate (μ)

reasonably comfortable with the conclusion suggested by a comparison of the welfare scales in Figures 1 and 2, i.e., that workers are better off in a system with monitoring and sanctions than in a system with time limits.

In column (2) of Table 3 we report a set of outcomes pertaining to the system with monitoring and sanctions. For ease of comparison, we give the outcomes with time limits in column 1.

With monitoring and sanctions, the UI provider can afford to be more generous to UI recipients. The UI replacement rate equals 63 percent in a system with monitoring and sanctions; the corresponding number with time limits is 50 percent. Despite the fact that search intensity increases, total unemployment among workers increases slightly with monitoring and sanctions. This has to do with the adverse effect on wage setting induced by an improvement in workers' outside option. Workers' outside options increase both because the UI replacement rate is higher but also because the introduction of monitoring and sanctions improves workers bargaining position. Since wage costs increase firms respond by creating fewer vacancies.

3.4 Workfare

Consider, finally, how the system works with workfare. We think of a world where employment officers administer a "work test" randomly at rate μ. If the unemployed worker enters workfare she is required to perform some duties (p) that reduce the time available for other activities; hence, leisure while participating in workfare is given by $\ell_w^p = 1 - p - s_w^p$. In exchange for these duties she gets to keep the UI benefit.

As noted by Thustrup Kreiner and Tranæs (2005), workfare is potentially a welfare improving screening device. Consider a benefit system that is uniform initially, i.e., $b = z$. Since preferences for leisure are private information to the individuals, both workers and

Table 3 A benefit system with monitoring and sanctions

	Time Limits (1)	Monitoring and sanctions (2)
Policy variables		
b (UI replacement rate)	0.4958	0.6284
z (UA replacement rate)	0.2623	0.2621
μ	0.81	1.15
σ	0	1
τ (tax rate)	0.0487	0.0612
Economic outcomes		
Worker search		
s_w^u	0.5280	0.6285
s_w^a	0.6482	0.6506
Worker unemployment		
u_w^u	0.0402	0.0506
u_w^a	0.0334	0.0248
Non-worker unemployment		
u_n^u	0.2161	0.1626
u_n^a	0.7839	0.8374
# individuals on UI		
$\gamma u_w^u + (1-\gamma)u_n^u$	0.0490	0.0562
Wage		
w	0.8862	0.8829
Welfare gain		
ε	0.43%	0.94%

Notes: Superscripts u and a refer to UI and UA respectively. Remaining symbols in the table are explained in the main text. The change in welfare (ε) is measured relative to the base run.

non-workers will claim and receive benefits. Imagine now that workfare is introduced as a requirement for benefit receipt along with a slight increase in UI while keeping UA fixed. The welfare of non-workers is not affected as long as they avoid workfare and prefer not to search. The welfare of workers may well increase since they care less about the reduction in leisure associated with workfare.

Appropriately designed (non-productive) workfare must satisfy two self-selection constraints. If workfare acts as a screen, it should not be optimal for workers and non-workers to mimic each other. Thus UI-cum-workfare must be at least as good as UA for workers, i.e. $V_w^p \geq V_w^a$. Analogously, UA must be at least as good as UI-cum-workfare for non-workers, i.e., $V_n^a \geq V_n^p$. If it is optimal for workers to opt for UA rather than workfare, then the model is formally equivalent to the system with time limits. So the defining constraint on a system with workfare is that it must not be optimal for non-workers to mimic workers.

If non-workers mimic workers, then it will never be optimal to require (non-productive) workfare. The reason is that in this case workfare fulfils no screening function, it only imposes costs on workers and non-workers. Since the time requirement in workfare (p) imposes costs

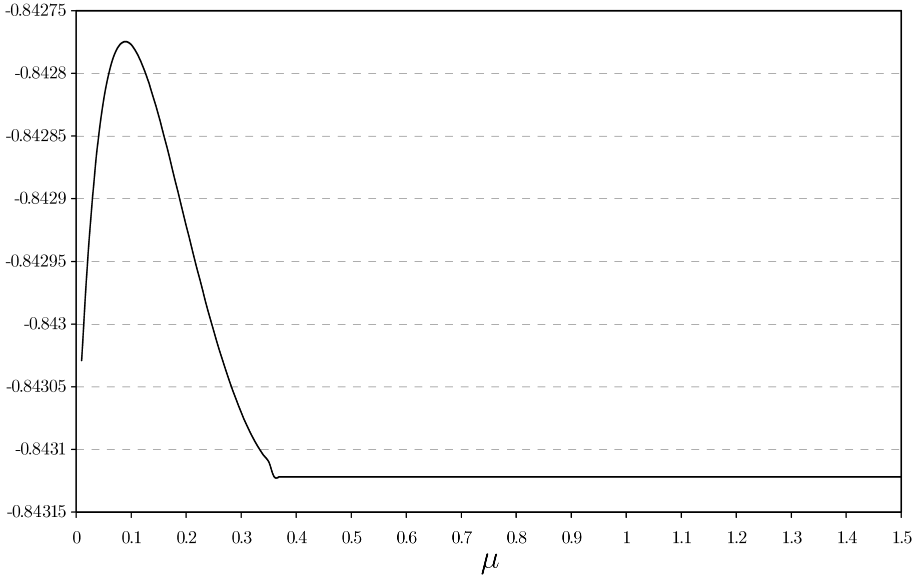

Fig. 3 Worker expected utility as a function of the workfare offer rate (μ)

on workers, the Pareto optimal policy featuring workfare will be such that the incentive compatibility constraint is binding, $V_n^a = V_n^p$.

If there is an equilibrium with workfare, then no worker will ever be transferred to unemployment assistance. Only non-workers will end up on UA. In this sense workfare is the perfect screening device. However, workfare is not conducive to search since there is a reduction in the available leisure time. Hence, it is not obvious that workfare will raise the expected utility of workers relative to the case with time limits. Moreover, the existence of a system with workfare depends crucially on whether the difference in terms of preferences for leisure is sufficiently large between workers and non-workers; see Thustrup Kreiner and Tranæs (2005). Thus it not clear that a system with workfare dominates a uniform benefit system, either.

The policy experiment with workfare amounts to choosing μ, b, z, and p optimally in the same fashion as above. The leisure value for non-workers is calibrated so that they would not search for a job if in the uniform system. The ratio between the two leisure values is $(\delta_n/\delta_w) \approx 3.4$. Figure 3 graphs the expected utility of workers as a function of rate that the work test is administered (μ). The figure shows that there is an interior solution with workfare but also that the work test should be used infrequently.

Column 2 of Table 4 reports a set of outcomes implied by an optimal system with workfare. Again, we give the corresponding outcomes with time limits in column 1 for ease of comparison. As shown in the table, the UI replacement rate is much lower with workfare than with time limits. This implies that search intensity on UI is higher than with time limits. The table also shows that the employment rate among workers turns out to be equal in the two systems, despite the fact that workfare reduces the available time for other activities. The fact that the optimal monitoring rate is very low, $\mu = 0.09$, implies most non-workers will receive UI rather than UA. Notice finally that workers would rather live in an optimal

Table 4 A benefit system with workfare

	Time Limits (1)	Workfare (2)
Policy variables		
b (UI replacement rate)	0.4958	0.3449
z (UA replacement rate)	0.2623	0.2425
μ	0.81	0.09
p	0	0.1246
τ (tax rate)	0.0487	0.0451
Economic outcomes		
Worker search		
s_w^u	0.5280	0.5667
s_w^a	0.6482	–
s_w^p	–	0.5230
Worker unemployment		
u_w^u	0.0397	0.0659
u_w^a	0.0334	–
u_w^p	–	0.0072
Non-worker unemployment		
u_n^u	0.2161	0.7128
u_n^a	0.7839	0.2872
# individuals on UI		
$\gamma u_w^u + (1-\gamma)u_n^u$	0.0484	0.0982
Wage		
w	0.8862	0.8864
Welfare gain		
ε	0.43%	0.11%

Notes: Superindex u (a) refers to UI (UA) and p refers to workfare. Remaining symbols in the table are explained in the main text. The change in welfare (ε) is measured relative to the base run.

system with time limits. The prime reason for this result is that there is too little insurance with workfare.

3.5 Sensitivity analysis

The numerical analysis suggests a case for monitoring and sanctions. Workfare, on the other hand, seems to be the least preferred option. The question is how robust these conclusions are with respect to reasonable changes in the parameters—such as the marginal cost of monitoring—and the structure of the model.

We argued earlier that the marginal cost of monitoring is probably on the high side in the baseline case. Obviously, lowering this value would only strengthen our conclusions. Also, we think that the qualitative results are insensitive to varying individual risk aversion. In

Fredriksson and Holmlund (2001) we show that increasing risk aversion does not affect the case for a time-limited UI system (in comparison to a uniform one).[11]

The most novel of our results is probably that the case for workfare is weak, at least when comparing to the other two policy instruments. Can we overturn this qualitative conclusion in some way? Two aspects of the model strike us as particularly relevant in this respect. The first, and most obvious one, is the fact that we have modelled workfare as a completely unproductive activity. The second, more subtle point, is that we have modelled search intensity as a relatively elastic margin.

Let us begin with the first point. Consider the following question: How much more productive would workfare have to be in order to deliver the same expected utility for workers as in the time-limited case? To address this question we add the production in workfare to the revenue side of the government budget constraint and calculate the marginal product of labor in workfare that makes the two systems equivalent.[12] It turns out that workfare is equivalent to time limits if the marginal product in workfare amounts to 68 percent of the marginal product in regular jobs. This strikes us as a high number, in particular since we are assuming that there are no direct crowding out effects associated with public employment and we are ignoring any direct costs of running the workfare system.

Now, consider the second point. The case for a time-limited system or a system with monitoring and sanctions hinges on the hazard to employment being responsive to incentives; in other words, search intensity must respond to incentives. Absent such responsiveness, we should only care about the screening properties of each system and workfare would clearly be superior to the other two systems. However, search being completely unresponsive to incentives is a highly implausible case that has been safely rejected by the empirical literature. Let us instead calibrate the model so as to get a substantially lower elasticity of the job hazard with respect to benefits. In particular, choose parameters such that this elasticity equals 0.1, which is the lower bound of the available empirical estimates. Let us further assume that non-workers are extremely unwilling to search and work. In particular, assume that they would be willing to search for a job only if $b = z \leq 0.01$ (implying that it is easy to screen out non-workers when subjecting them to a work-test). This strategy yields two new values for δ_w and δ_n; relative to our baseline case there is a more than ten-fold increase in the ratio of the two.[13]

Figure 4 graphs the result of this exercise. As the figure shows, workfare is inferior to the other two systems for all values of μ.We think that the message delivered by Figure 4 applies fairly generally. The case considered is close to the most potent case for workfare. In the case depicted in the figure, it is very easy to deter non-workers from claiming UI cum workfare. Consequently, the time requirement that screens out non-workers from the system is very small. Then workers are not penalized by being subjected to a work test. In this extreme case, workfare enables the UI provider to design what is effectively a uniform benefit system that is optimal for workers. In Fredriksson and Holmlund (2001) we showed that a system with time limits always dominates the optimal uniform system. Therefore, we are reasonably confident in saying that workfare can never outperform time limits, given that the duties performed on workfare are unproductive. Of course, as suggested by the analysis above, matters may be different if there was some valuable production going on while participating in workfare.

[11] We have also conducted some sensitivty analysis with respect to the other parameters. The results appear to rather insensitive to moderate variations in φ, for instance.

[12] All policy parameters are recalculated such that they are the optimal ones.

[13] The ratio of the two leisure value increases from 3.4 to 38.

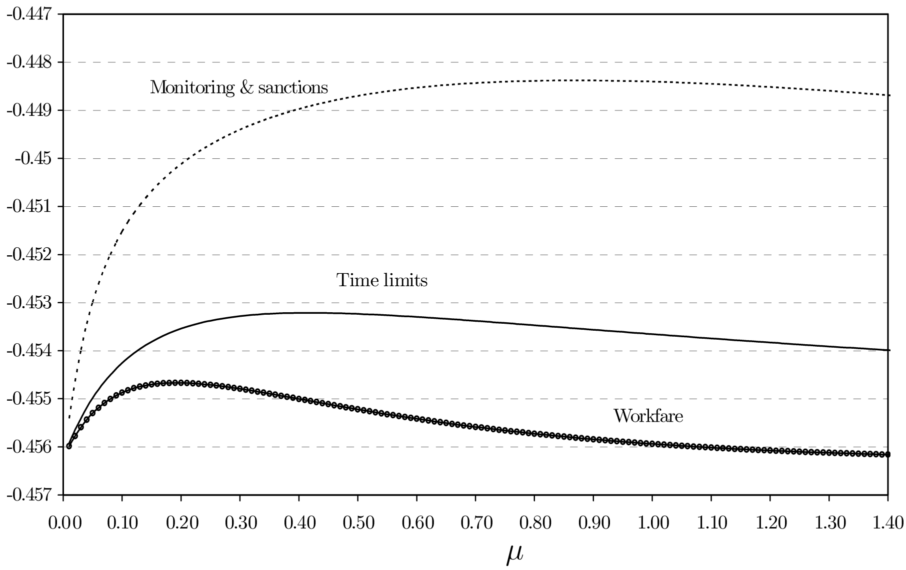

Fig. 4 A comparison of the policy instruments when search elasticity is low and it is easy to screen out non-workers (worker expected utility as a function of μ)

4 Discussion

The three measures that we have considered are alternative ways of encouraging search activity while at the same time discouraging non-workers from claiming UI benefits. A common feature of the systems is that they make it possible for the UI provider to offer more generous compensation to workers than would be feasible with a uniform benefit system. Workers will, therefore, prefer a UI system featuring time limits, monitoring and sanctions, or workfare to a system paying a constant wage replacement rate indefinitely.

The numerical analysis suggests a case for a monitoring and sanctions system. Since the system with monitoring and sanctions gives additional incentives to search, so as to avoid being transferred to UA, the UI provider can offer more insurance to the unemployed workers. One caveat to this conclusion may be that monitoring and sanctions raise the incentive to substitute formal search for informal search, as argued by van den Berg and van der Klaauw (2001). This is a complication that we have not considered in our numerical exercise. If informal and formal search are perfect substitutes then monitoring and sanctions will just be costly and bring no benefits in terms of restoring search incentives. Still it is difficult to believe that they are perfect substitutes; presumably there are some economies of scale of having search organized via the employment offices.

Another caveat in the case for monitoring and sanctions is that the costs of the system are difficult to estimate. Nevertheless, in Boone et al. (2002) we showed that the costs of introducing monitoring and sanctions would have to be implausibly large in order to overturn the conclusion that monitoring and sanctions is a welfare improvement relative to time limits.

The numerical results are less favorable to the case for workfare. Workfare is a perfect screening device—in the sense that workers are never subjected to unemployment assistance—but it is not conducive to search. Therefore, the UI provider sets a lower UI replacement rate than in the systems with time limits and monitoring and sanctions. With preference heterogeneity as the only source of heterogeneity and unproductive workfare, we think that this conclusion applies fairly generally.

Acknowledgements We thank three anonymous referees as well as Per-Anders Edin, David Grubb, and Oskar Nordström Skans for helpful comments. We also acknowledge the comments from seminar participants at the Ministry of Finance, Stockholm, the Institute for Labour Market Policy Evaluation (IFAU), Uppsala, and the University of Aarhus. This research has been supported by the Swedish Council for Working Life and Social Research (FAS) and in part by OECD's Directorate for Education, Employment, Labour and Social Affairs.

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