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ABSTRACT

Some existing welfare programs ("work-first") require participants to work in exchange for benefits. Others ("job search-first") emphasize private job-search and provide assistance in finding and retaining a durable employment. This paper studies the optimal design of welfare programs when (i) the principal/government is unable to observe the agent's effort, but can assist the agent's job search and can mandate the agent to work, and (ii) agents' skills depreciate during unemployment. In the optimal welfare program, assisted search is implemented between an initial spell of private search (unemployment insurance) and a final spell of pure income support where search effort is not elicited. To be effective, job-search assistance requires large reemployment subsidies. The optimal program features compulsory work activities for low levels of program's generosity (i.e., its promised utility or available budget). The threat of mandatory work acts like a punishment that facilitates the provision of search incentives without compromising consumption smoothing too much.

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1 Introduction

Government policies targeting the poor have the twofold objective of (i) offering income support and (ii) promoting economic self-sufficiency through employment. Achieving both objectives is challenging because the provision of assistance interferes with individual incentives to find and retain a suitable employment. In order to strike the right balance between assistance and incentives, governments use a wide range of policy instruments. These policies typically combine welfare benefits and earnings subsidies with mandatory activities such as job search, work, and training.

In the United States, the Personal Responsibility and Work Opportunity Reconciliation Act (PRWORA) of 1996 deeply reformed the system of cash welfare assistance for poor households –mostly single parents. The reform ended needy families legal entitlement to welfare assistance, and imposed work-related requirements for welfare recipients enforced by sanctions (e.g., benefits suspension in case of noncompliance).[1] The PRWORA legislation also removed much of the federal regulatory authority over the structure of the program, giving states full flexibility in choosing policy instruments and setting benefit levels (Moffitt, 2008). As a result, a variety of programs was implemented across U.S. states. Some programs are focused on assisting and monitoring individual job search, others on education and training, others yet on moving the individual as soon as possible into some form of employment. In this paper, we concentrate on jointly studying job search and work activities.[2]

Public programs centered around job search encompass elements of monitoring, skill enhancement, and help in seeking jobs. Here, we focus on the latter type of interventions where the public employment agency assists the job seeker by selecting suitable vacancies, providing contacts with potential employers, and making job referrals. We label this intervention "Job-Search Assistance".[3] There is also a large

[1]The legislation uses the term "work-related requirement" with a broad meaning. In many cases, programs that enhance job-search skills or assist job-search, as well as education and training programs, satisfy such requirement.

[2]For the time being, we leave training and adult education out of the analysis. Normative analyses of training policies which follow the approach in this paper are contained, for example, in Pavoni and Violante (2005), Spinnewijn (2010), and Pavoni, Setty, Violante, and Wunsch (2012).

[3]To enforce active job search, some programs require the welfare recipient to show evidence of her job-search efforts (applications, contacts, interviews) to the caseworker. The optimal use of monitoring of search activities is analyzed extensively in Pavoni and Violante (2007), and Setty (2012). We return on monitoring below. Other programs contain an element of training, i.e., the development of job-search and interviewing skills. Wunsch (2012) studies the optimal design of this type of

diversity of work-site activities across U.S. states. At one end of the spectrum the work requirement is simply intended as a "social obligation" for the recipient of a welfare check. At the opposite end, the work requirement is meant to function as a transition into self-sufficiency through private employment. For example, while the participant is mandated to work in a public or non-profit agency, the caseworker actively assists her search for private employment in a similar job. Or, the caseworker directly matches the individual to a private employer with the expectation that she might be retained by that same employer. To distinguish the first type of work ("work in exchange for benefits") from the second ("stepping stone to private employment"), we label them, respectively, "Mandatory Work" and "Transitional Work".

Throughout this paper, we use the term "optimal" to denote one among the many welfare programs that are feasible in our stylized model. An "optimal" program is one that maximizes the value of the social planner's objective function, subject to the government budget constraint and a variety of other incentive compatibility and promise keeping constraints.

The central question of the paper is how search-based activities and work-based activities should be optimally combined in a welfare program, and how the associated benefits and wage subsidies should be designed. Our point of departure is the classic setup –originated largely from the seminal article of Shavell and Weiss (1979)– where the optimal unemployment insurance contract is studied in the presence of a repeated moral hazard problem: the risk-neutral principal (planner/government) cannot observe the risk-averse unemployed agent's effort (hidden action). Following the most recent contributions in the literature (Atkeson and Lucas, 1995; Wang and Williamson, 1996; Hopenhayn and Nicolini, 1997; Pavoni, 2007; Shimer and Werning, 2008; Hopenhayn and Nicolini, 2009), we exploit the recursive representation of the planner's problem where the expected discounted utility promised by the contract to the unemployed agent becomes a state variable.

We enrich this repeated moral hazard environment by allowing workers' wages and their job finding probabilities to depend on human capital (skills), and let human capital depreciate along the unemployment spell (as in Pavoni and Violante, 2007, and Pavoni 2009). Human capital is our second key state variable in the recursive representation. Skill depreciation permits a better representation of labor market data

intervention.

along two important dimensions. First, since wages depend on human capital, in our economy workers experience wage losses associated to unemployment, consistently with the findings of a vast set of empirical studies (for a survey, see Fallick, 1996; for recent evidence, see Davis and von Wachter, 2011). Second, since we let the job-finding probability depend on human capital, search effort becomes less effective as the unemployment spell progresses, inducing negative duration dependence in the unemployment hazard–a common feature of the data, as discussed by Machin and Manning (1999) in their survey.[4]

The key innovation that makes this framework amenable to analyze the optimal design of welfare programs is the introduction of additional "technologies" and associated worker "activities" (i.e., use of technologies) besides job search. To model work-based and job-search assistance policies we introduce two technologies. First, a *secondary production* technology that is less productive than the (primary) one used in private employment but that, as the latter, requires effort to yield output. This feature reflects that work-based activities employ the welfare recipients on basic tasks with very low value added, usually in a government agency or a non-profit organization. Second, a costly *assisted search* technology that allows the agent to sample a subset of her available job opportunities without search effort (i.e., a government agency searches on behalf of the unemployed). This technology frees up time from search to either work or rest.

We define a "policy" as a principal's prescription of an activity for the agent with an associated conditional income transfer. We interpret the use of the secondary production technology alone as Mandatory Work, and the joint use of this production technology and assisted search as Transitional Work. Moreover, since the assisted search technology can always be used on its own, the model also includes a Job Search Assistance policy. In addition to these three policy instruments, the framework yields naturally Unemployment Insurance, where the worker exerts search effort on her own, and Social Assistance, corresponding to income support with no effort requirements.

[4] In particular, several studies (e.g., Blank, 1989, for welfare recipients; Bover, Arellano, and Bentolila, 2002, for UI benefits recipients) find a declining hazard even after explicitly controlling for unobserved heterogeneity. Skill depreciation is also a central ingredient in a popular explanation of the comparative unemployment experience of the U.S. and Europe in the 1980s (e.g., Ljungqvist and Sargent, 1998).

To parameterize the model, we use several program evaluation studies. One of our main sources of information is the National Evaluation of Welfare-to-Work Strategies (NEWWS), a large-scale longitudinal study, conducted by the U.S. Department of Health and Human Services between 1991-1999. As part of this survey, 40,000 welfare recipients in seven distinct U.S. locations were randomly assigned to various treatment and control groups. The randomized nature of these studies enables us to identify the key parameters of the job search assistance and production technologies.

We characterize the optimal welfare program along the lines of Pavoni and Violante (2007). Optimality requires maximization of the agent's expected discounted utility subject to the government's budget constraint. A characterization means studying: 1) in which region of the state space (the two dimensional space in promised utility and human capital) each policy dominates the others; 2) the optimal sequence of policies along the program determined by the endogenous dynamics of promised utility and the exogenous human capital depreciation; 3) the optimal level and time-path of benefits and wage subsidies upon employment, associated to each policy.

An important lesson we learn from our exercise is that there are two types of welfare programs that emerge as optimal, depending on the initial level of generosity of the program, a parameter of the economic environment determined by politico-economic or government budget constraints outside our model. After an initial spell of Unemployment Insurance, common to all programs, a generous (or deep pocketed) principal would implement an optimal program based on *search* which follows the sequence Job-Search Assistance $\rightarrow$ Social Assistance. A parsimonious (or more budget constrained) principal would, instead, implement an optimal program based on *work* which follows the sequence Transitional Work $\rightarrow$ Mandatory Work. For low levels of promised utility, the effort compensation cost is smaller and it is efficient for the principal to require the agent to exert work effort and produce in exchange for welfare benefits. For high levels of promised utility, instead, inducing the agent to actively search is too expensive, and the principal searches for jobs on her behalf.

In the baseline model we restrict private job search and work to be mutually exclusive activities. In an extension, we allow individuals to jointly work part-time in the secondary production sector and search for an employment in the primary sector. We show that this joint "Search-and-Work" policy arises in place of Unemployment Insurance for low levels of promised utility. Put differently, as long as the principal is not too generous, the optimal program should start immediately with a spell of part-time work, but the agent should also be incentivized to seek a higher-paying job in the private sector in her residual time.

In a second extension of the baseline model, we introduce a technology that allows the principal to monitor the agent's job search effort at a cost, along the lines of Pavoni and Violante (2007), and Setty (2012). We find that Job Search Monitoring emerges as optimal between spells of private search (i.e., Unemployment Insurance for generous programs, Search-and-Work for parsimonious programs) and spells of assisted search (i.e., Job Search Assistance and Transitory Work, respectively)

We also study the design of welfare benefits and wage subsidies. Here, the main result is that the threat of mandatory work is a very useful policy tool to solve the insurance-incentive trade off. Requiring the agent to work at a future point in the welfare program serves as a punishment for unsuccessful search: it effectively replaces large drops in benefits and, as a result, allows to achieve a higher degree of consumption insurance throughout the program. The counterpart of this result is that, in search-based programs where compulsory work is absent, the principal instead needs to create a large gap in consumption across employment states –i.e., between subsidized wage and welfare benefits– to compensate for the additional work effort required from the agent once she finds employment. This feature of state-contingent payments is especially strong during Job Search Assistance, when effort is zero.

The rest of the paper is organized as follows. Section 2 describes in some detail the different policies that we aim at modeling. Section 3 formalizes the economic environment faced by the agent. Section 4 introduces the principal and describes the set of feasible contracts the principal can offer the agents. Here, we provide a mapping between the activities recommended by the principal to the agent and the actual policy instruments of Section 2. Section 5 parameterizes the model based on program-evaluation studies. Section 6 characterizes the optimal welfare-to-work programs, i.e., where the different policies emerge as optimal in the (U, h) space, the optimal sequences of policies, and optimal consumption (i.e., welfare benefits and wage taxes/subsidies). Section 7 extends the model by incorporating policies that mix job search and work, and monitoring of job-search effort. Section 8 concludes.

2 The US welfare system

For jobless individuals without labor income, but with some significant recent employment history, the main form of government assistance is *Unemployment Insurance*. Workers eligible for Unemployment Insurance receive benefits, linked to their previous earnings, for a given period (ordinarily, 6 months). Upon expiration of unemployment insurance benefits (or immediately, for those without significant employment history), a number of transfer programs are in place. Food stamps and housing subsidies are means-tested, but there is no requirement or obligation attached to them. They configure a form of pure income assistance policy of last resort, which we label *Social Assistance.*

The other major means-tested transfer program is the Temporary Assistance for Needy Families (TANF). Since the PRWORA legislation of 1996, welfare recipients who wish to qualify for TANF benefits are required to participate in work or work-related (e.g., job-search, vocational training, adult education) activities after two years of receiving cash assistance. Failure to participate can result in a reduction or termination of benefits to the family (Moffitt, 2003).

The legislation gives states ample freedom on how to implement these various activities. As a result, even abstracting from training/education and just focusing on search assistance and work, as we do, leaves an enormous variety of policy interventions and summarizing them is an arduous task. At the same time, distilling their key features is necessary for building a formal model and this is the route we take here.

Search-based activities: There are several examples of search-based policy experiments implemented in recent US history.[5] Meyer (1995) surveys six experiments spanning from the late 1970s to the early 1990s.[6] In these experiments, UI recipients were subject to extensive checks of their search activity, or were provided services including job-search workshops, additional information on job openings, and often even direct job placements. Job-search experiments combined elements of monitoring, training, and assistance. States require all UI claimants to submit evidence of

[5]Bergemann and van den Berg (2008) survey job search assistance programs in Europe.

[6]The six job search experiments are the Nevada Claimant Placement Program, Charleston Claimant Placement and Work Test Demonstration, New Jersey UI Reemployment Demonstration, Nevada Claimant Employment Program, Washington Alternative Work Search Experiment, and the Wisconsin Eligibility Review Pilot Project.

their job search efforts (e.g., details of employer contacts), but often actual enforcement is weak. In some of the experiments, enforcement was increased substantially. For example, in the Charleston Claimant Placement and Work Test Demonstration and in the Nevada Claimant Placement Program, UI claimants were actively monitored and required to report every week to employment services who would check on their eligibility.[7] Four experiments, Charleston, New Jersey, Washington, and Wisconsin, required that claimants groups attend a seminar on how to find a job. The intensity of the seminar varied across locations. The Charleston workshop lasted approximately three hours and provided a forum for discussing basic search and interviewing strategies. The Washington workshop lasted two days and included training on skills assessment, interview and application techniques, and preparing resumes. Job-finding services provided also differed substantially. Some experiments offered very little extra services, while others offered substantial assistance to job search. In the Charleston experiment, claimants were placed in the state job-matching system and a job-development attempt or referral was made for each claimant. In New Jersey, a job resource center was set up in each office and listings of job openings and telephones were made available to the unemployed.

A more recent set of experiments, part of the National Evaluation of Welfare-to-Work Strategies (NEWWS) conducted between 1991-1999, mandated some welfare recipients to participate in "job clubs", i.e., job search activities including instructions for resume preparation, job search, and interviewing, as well as offering supervised "phone rooms" where participants could call prospective employers and seek job leads. Some sites employed job developers on staff who searched for job leads in the local community on behalf of the unemployed.

In what follows, we concentrate our attention on the *Job Search Assistance* component of these programs. In an extension, we also analyze *Job Search Monitoring* alongside assistance.[8]

Work-based activities: The most notable movement following the PROWRA legislation has been toward a "work-first" approach in which recipients and new appli-

[7] Ashenfelter, Ashmore, and Dechenes (2005) discuss randomized experiments in Connecticut, Massachusetts, Virginia and Tennessee conducted in the mid 1980s which incorporated only stricter enforcement and verification of job search, and did not contain elements of training or assistance.

[8] We abstract from the analysis of job-search skill augmentation programs. Wunsch (2012) studies the optimal design of such programs in the context of the German labor market.

cants for benefits are moved as quickly as possible into work of any kind (Moffitt, 2003). The types of jobs performed by welfare recipients assigned to work activities involve basic unskilled tasks such as food preparation and delivery, janitorial, maintenance, and custodial tasks in low-income housing blocks or in schools, street and park cleaning, garbage collection, entry-level clerical tasks, housekeeping, caring for the children and the elderly, etc. (Brock et al., 1993). Employers are usually nonprofit organizations, public agencies clustering in social services, and sometimes private for-profit employers.

The intent of the program changes substantially from location to location. According to Fagnoni (2000) –a comprehensive report to Congress on work-site activities in several U.S. locations– there is a "continuum" of work-based policies ranging from those which can be represented as "work in exchange for benefits" to those which are heavily supplemented with job search assistance and/or training and therefore represent a "stepping stone to private employment."

In the former class of pure work-fare programs, the emphasis is on the idea of personal responsibility: work is a pre-condition to receive public assistance. For example, in the West Virginia Community Work Experience, and in New York City Work Experience programs, work was the only activity; there was no training, job-search assistance, or attempt to further job placement. Required work hours were calculated based on TANF plus Food Stamps benefits divided by the minimum wage (Fagnoni, 2000). We label this type of work-based activities *Mandatory Work*.

The latter class of programs is, instead, designed with the aim of guiding the participant towards long-term, private, unsubsidized employment.[9] This objective is pursued in different ways across states.[10] In some programs (e.g., Washington State Community Job Initiative, and Vermont Community Service Employment Program), while employed on community service jobs, clients receive individualized job search assistance from the staff of the program or of collaborating agencies. Activities include job readiness workshops, job clubs, soft skills training, and assistance to job search through the use of computerized job banks (Pavetti and Strong, 2001). In other

[9]For example, a common feature is that participants do not work in exchange for TANF benefits, but they receive a paycheck from their employer subsidized (often entirely) by TANF funds or other funding, pay FICA and payroll taxes. As a result, they qualify for EITC, unemployment insurance, and social security benefits.

[10]Kirby et al. (2002) report that as of May 2001, there were approximately 40 work-based programs of this type around the country.

programs, participants are initially carefully matched with an employer and, while there is no contractual obligation on the part of the employer to hire the participant, there is a mutual expectation of this outcome if the participant performs well. Examples of this design are the Philadelphia TWC program (Pavetti and Strong, 2001), the Massachusetts Supported Work program (Fagnoni, 2000), and the Forest City PREP program (Kirby et al., 2002). We label this type of work-based activities, which combine a work requirement with an active effort to assist job search and job placement, *Transitional Work*.[11]

Finally, for low-income employed households, the key pillar of the US welfare system is the *Earned Income Tax Credit*, an earning subsidy program introduced in 1975, and greatly expanded since then. Our analysis includes the use of history-dependent wage subsidies with the purpose of making work more attractive, relative to non-employment, for unskilled individuals.

3 Economic environment

We now describe an economic environment where the policies of Section 2 arise as activities (i.e., choice of effort and use of technologies) of the individual. Throughout the analysis, we assume that employment in the primary sector is an absorbing state, and focus on the optimal design of a welfare program for jobless individuals.[12]

Demographics and preferences: Individuals are infinitely lived. Preferences are time-separable and the future is discounted at rate $\beta \in (0,1)$. Period utility over consumption c and effort a is given by $u(c) - v(a)$. We impose that $c \geq 0$, and that $u(\cdot)$ is strictly increasing, strictly concave and smooth. The disutility of effort $v(a)$ is normalized to a, without loss of generality.

Activities and effort: An individual can either rest, search for a job, or work. We begin by assuming that search and work are mutually exclusive, and relax this as-

[11]Many transitional work programs also include skill development components (e.g., training related to the target job, workshops on job readiness and adhering to workplace norms). Since we have abstracted from the training component in job search-based programs, we abstract from it also in the context of work-based programs.

[12]The optimal unemployment compensation contract with job separation and multiple unemployment spells is studied by Hopenhayn and Nicolini (2009). Their findings are relevant to our set up only in the sense that, while we assume an exogenous value for initial promised utility of the unemployed, with multiple spells this initial value would be endogenously determined by the employment history.

sumption in Section 7. Rest corresponds to zero effort $(a = 0)$. Work uses the whole effort endowment $(a = \bar{e})$. Search requires effort level $e \in (0, \bar{e})$.

Human capital: At any point in time, agents are endowed with a stock of human capital (skills) $h \geq 0$. During unemployment, human capital depreciates geometrically and deterministically at rate $\delta \in [0, 1]$ and follows the law of motion:

$$h' = (1 - \delta)\, h \tag{1}$$

Note that, given an initial level of human capital h_0 at the start of the unemployment spell, unemployment duration d of a worker with human capital h can be recovered as $d = \log(h/h_0) / \log(1 - \delta)$.

Production technologies: There are two types of production technologies in the economy, which we call primary and secondary. They both require effort $\bar{e}$. We think of the primary technology as the private sector, and of the secondary technology as the government or non-profit sector.

An agent of type h employed on the primary production technology produces output $\omega(h)$. We let $\omega(\cdot)$ be a continuous and increasing function, with $\omega(h) \in [0, \omega_{\max}]$, and $\omega(0) = 0$. Note that, human capital depreciation induces wage depreciation –i.e., a deterioration of the agent's productivity in the primary sector– along the unemployment spell. Access to an employment opportunity (i.e., a job) in the primary sector is frictional, i.e., a primary job is not always available for an individual. Below we describe the friction in detail.

The principal can, instead, always make a secondary job readily available to the individual upon payment of κ^w units of consumption (the government-job administration cost). This secondary technology produces an amount $\underline{\omega} \geq 0$, independently of h.

This dual-sector structure is meant to represent a labor market where finding a job vacancy that matches the agent's occupational skills, and hence paying proportionally to h, takes time, but allocating an agent to perform a simple task (e.g., janitor, fast-food cook, care worker, street sweeper, etc...) in a government agency, or in a non-profit organization, is always feasible, upon payment of an administrative cost.

Private search technology: It is useful to distinguish two distinct stages in the process of searching for a primary sector job: application and interview. In the first stage, an agent of type h locates all her job opportunities, sends out applications and she may be re-contacted by employers with probability $m(h, a)$, a function which is strictly increasing in h for $a = e$, and identically equal to zero if $a = 0$.

If the agent is re-contacted, a meeting (e.g., a job interview or a trial period) between employer and agent takes place. In this second stage, the firm and the agent meet and draw an idiosyncratic outcome: with probability $\theta(r)$ the worker is retained by the firm, where r is the worker's "retention action". We let $r \in \{0, 1\}$ and $\theta(1) \equiv \theta > \theta(0) = 0$. The worker has control of the interview and can always, by choosing $r = 0$, make sure that it fails and that she does not receive a job offer.[13] Putting both stages of the search technology together, the job finding probability is

$$\pi(h, a, r) = \theta(r)m(h, a), \tag{2}$$

where it is useful to note that if $a = 0$ or $r = 0$, then $\pi = 0$. Moreover, since $m \leq 1$, the job finding rate $\pi \in [0, \theta)$. It is important to note that, as the unemployment spell progresses and h declines, so does the hazard rate since the set of job opportunities shrinks. Let y denote the outcome of the search activity during unemployment, with $y \in \{f, s\}$, where f denotes "failure" and s "success".

Assisted search technology: The principal has the opportunity to relieve the unemployed from searching privately and entirely devolve the job-seeking activity to an agency which acts on behalf of the unemployed. Upon payment of a fixed cost κ^s, the agency sends out a fixed maximum number of applications which determine a contact rate $\bar{m}$. We denote by $\bar{\lambda}$ the value $\theta\bar{m}$ which is the highest job finding rate achievable with assisted search.

When h is large, and $m(h, e) > \bar{m}$, then assisted search is less effective than private search and its job finding rate is $\lambda(r) = \theta(r)\bar{m}$, which is independent of h and lower than the private contact rate $\pi(h, e, r)$. When h is low, and $m(h, e) \leq \bar{m}$, then the agency has the ability to apply to all the available job opportunities and the job finding probability of an individual using the assisted search technology is $\lambda(h, r) = \pi(h, e, r)$, exactly as if she exerted search effort privately.

Finally note that the use of assisted search allows to bypass the moral hazard

[13] For example, the worker can appear "sloppy" and "uninterested" about the job at the interview, or pretend she is not competent in the required tasks.

problem due to the unobservability of the search effort required at the application stage, but not the one due to the action r that determines whether the worker is retained by the firm after the initial contact.

4 Contractual relationship

We now introduce a risk-neutral planner/government (principal) who faces an intertemporal budget constraint and a real interest rate equal to $\beta^{-1} - 1$. At time $t = 0$, the planner offers the unemployed worker (agent) an insurance contract that maximizes the expected discounted stream of net revenues (fiscal revenues minus expenditures) and guarantees the agent at least an expected discounted utility level U_0. The value of U_0 should be thought of as an exogenous parameter measuring the "generosity" of the welfare system (e.g., the outcome of voting or a political process). We study the contract when the individual has no access to insurance markets, credit markets, or storage.[14]

Information structure: The use of the private and assisted search technologies and their employment outcome y is observable and contractible. Initial human capital is observable, and since depreciation is deterministic, unemployment duration fully reveals the dynamics of human capital. Output during both primary and secondary work is observable and, since the technology is deterministic, work effort is contractible. However, search effort and the retention action are private information of the agent and under her control: these are the sources of moral hazard.

Contract: At every node, the contract specifies a consumption level for the agent, recommendations on the search or work effort level to exert, on the retention action, and on the use of available technologies: private search, assisted search, or work on

[14]If available, the agent would purchase private insurance against the event she remains jobless, if available. In absence of such markets, she would choose to self-insure by borrowing and saving. In Pavoni and Violante (2005), we show that when agents have *anonymous access* to credit markets, but face a no-borrowing constraint, the optimal contract outlined here can be implemented with a simple additional instrument: a tax on savings. This tax must be large enough to dissuade the agent from jointly saving and not searching. The tax induces the actively searching agent to borrow by reducing the after-tax interest rate. But because of the no-borrowing constraint, the agent optimally chooses to sit at the kink of her budget constraint and remain hand-to-mouth. The presence of a *hidden storage* technology with a negative real return (e.g., because of inflation, the risk of theft, etc.) puts, implicitly, an upper bound on this saving tax.

Table 1: Mapping between effort level and technologies into policies

	Private Search	Assisted Search	Private Search & Assisted Search	Secondary Production	Assisted Search & Secondary Production	None
Effort	UI	$\times$	$\times$	MW	TW	$\times$
No effort	$\times$	JA	$\times$	$\times$	$\times$	SA

the secondary technology. During the unemployment spell, the consumption level corresponds to the unemployment compensation; during (primary) employment, the difference between the consumption level and the wage implies a wage subsidy, if positive, and a tax if negative.

The period t components of the contract are contingent on all publicly observable histories up to t and the search-effort and retention-action recommendations must be incentive compatible. Moreover, at every t, we allow the planner to specify the contract contingent on the publicly observable realization $x_t \in [0,1]$ of a uniform random variable X_t. This "randomization" may be used in the optimal contract to convexify the planner's problem and, thus, enhance utility (Phelan and Townsend, 1991; Phelan and Stacchetti, 2001). A contract is a welfare program.

4.1 Components of the contract as policy instruments of the welfare program

The combination of recommendations on the search effort level $(0, e)$ and the work effort level $(0, \bar{e})$ to expend, on the retention action r, and on the use of technologies (private search, search assistance, and secondary production) configures only five possible options. All other combinations can be easily excluded: 1) prescribing positive search effort with the use of the assisted search technology would be redundant; 2) prescribing the use of private search or secondary production and no effort is not optimal since the technologies require effort as an input to be productive. Similarly, we can exclude: 3) recommending the low retention action $(r = 0)$ and the use of search assistance, as the expenditure κ^s would be wasted; 4) simultaneously prescribing $r = 0$ and use of private search, since the planner could always recommend zero effort and save the agent the disutility of high effort. On this account, the contract always features $r = 1$ and, in what follows, we drop the explicit dependence of the hazard rates $\pi(\cdot)$ and $\lambda(\cdot)$ from r.

We label the residual five options "policies" of the welfare program, and we index them with i. We denote as "Unemployment Insurance" $(i = UI)$ the joint recommendation of private search and positive search effort. The combination of zero effort together with the use of the assisted search technology corresponds to "Job Search Assistance" $(i = JA)$. The zero effort recommendation without the use of any technology denotes "Social Assistance" $(i = SA)$. A positive effort recommendation paired with the use of the secondary production technology denotes "Mandatory Work" $(i = MW)$. Finally, since the costly assisted search technology does not require any effort, it can be used in conjunction with the secondary production function. We call this combination of work and search assistance "Transitional Work" $(i = TW)$. Table 1 summarizes these combinations.

4.2 Recursive formulation

Following Spear and Srivastava (1987) and Abreu, Pearce, and Stacchetti (1990), we formulate and solve this problem recursively. The recursive formulation requires two state variables: human capital h (or equivalently the unemployment duration d) and the continuation utility U promised by the contract. The planner takes the initial conditions of this pair (U_0, h_0) as given.

Exploiting this recursive representation, consider an unemployed agent who enters the period with state (U, h). At the beginning of the period, the planner selects the optimal policy instrument $i(U, h)$ by solving

$$V(U,h) = \max_{i \in \{JA,MW,SA,TW,UI\}} V^i(U,h)$$

where the function V is the upper envelope of the values associated to the different policies which, in turn, we denote by V^i. In choosing a particular policy, implicitly, the planner also chooses an effort recommendation $a(U, h)$, a transfer $c(U, h)$ and the continuation utilities $U^y(U, h)$ conditional on the outcome y of (private or assisted) search, when recommended. We describe these additional choices in the next section.

As anticipated, the planner in general may decide to use randomizations through a random variable X. In this case, the value function for the planner solves

$$\begin{aligned} \mathbf{V}(U,h) &= \int_0^1 \max_{U(x)\in D} V(U(x),h)\,dx \\ s.t. &: \\ U &= \int_0^1 U(x)\,dx \end{aligned} \tag{3}$$

where the constraint says that the planner is committed to keep his promises: it must deliver to the agent continuation utility U in expected value terms (i.e., ex-ante, with respect to the possible shock realizations x).

4.3 Policies

We now describe in detail the planner problem during employment and for each of the five policy instruments available during the welfare program.

Primary employment (wage tax/subsidy): Consider a worker with state (U,h) employed on a primary sector job. Since private employment is an absorbing state without informational asymmetries, the planner simply solves

$$\begin{aligned} W(U,h) &= \max_{c,U^s} \omega(h) - c + \beta W(U^s,h) \\ s.t. &: \\ U &= u(c) - \bar{e} + \beta U^s \end{aligned} \tag{4}$$

where $\bar{e}$ is the work effort level required to produce. The planner will provide full consumption smoothing to the agent, and thus promised utility is constant over time, i.e., $U^s = U$. The promise-keeping constraint implies that in every period the optimal transfer c^E during employment is constant and satisfies $c^E(U) = u^{-1}((1-\beta)U + \bar{e})$. Therefore, the magnitude

$$\tau(U,h) = \omega(h) - c^E(U) \tag{5}$$

is the implicit tax (or subsidy, if negative) the government imposes on employed workers. State-contingent taxes and subsidies are a key component of an optimal welfare plan.

By inspecting problem (4), it is easy to see that the value of employment has the following form:

$$W(U,h)=\frac{\omega\left(h\right)}{1-\beta}-\frac{u^{-1}\left(\left(1-\beta\right)U+\bar{e}\right)}{1-\beta} \tag{6}$$

and therefore W is a continuous function, increasing in h, and decreasing, concave and continuously differentiable in U.

Unemployment Insurance (UI): When the worker is enrolled in the unemployment insurance scheme, the problem of the planner is

$$\begin{aligned} V^{UI}(U,h) &= \max_{c,U^f,U^s} -c+\beta\left[\pi(h)W(U^s,h')+(1-\pi(h))\mathbf{V}(U^f,h')\right] \\ s.t. &: \qquad\qquad (7) \\ U &= u\left(c\right)-e+\beta\left[\pi(h)U^s+\left(1-\pi(h)\right)U^f\right], \\ U &\geq u\left(c\right)+\beta U^f, \qquad\qquad \text{(IC-S)} \\ U^s &\geq U^f \qquad\qquad \text{(IC-R)} \end{aligned}$$

where e is the effort level during search. Next period human capital h' is generated through the law of motion (1). The pair $\left(U^s,U^f\right)$ are the lifetime utilities promised by the planner contingent on the outcomes (s or f) of search. Recall that the outcome of search is verifiable. The first constraint above describes the law of motion of the state variable U (the promise-keeping constraint). The second constraint (IC-S) states that payments have to be incentive compatible to induce search. The third constraint (IC-R) states that payments have to be incentive compatible to induce the worker to act so that, in case a contact is made, the firm will retain her. Therefore, the value of employment for the job seeker must be weakly above the value of unemployment.

By combining the promise keeping constraint and the incentive compatibility constraint on search effort (IC-S), we can rewrite the latter as

$$U^s-U^f\geq\frac{e}{\beta\pi\left(h\right)}. \qquad \text{(IC-S)}$$

Inspecting this new formulation of (IC-S), it is easy to see that the additional incentive compatibility constraint on the retention action (IC-R) will never bind during UI, since the promised utility spread necessary to induce high search effort is also large enough to induce the high retention action $(r=1)$. Finally, the expressions for $\mathbf{V}$

and W are given by equations (3) and (4), respectively.

Job Search Assistance (JA): The problem of the planner that chooses to use the assisted search technology and recommends no effort is:

$$\begin{aligned} V^{JA}(U,h) &= \max_{c,U^f,U^s} -c-\kappa^s+\beta\left[\lambda(h)\,W(U^s,h')+(1-\lambda(h))\mathbf{V}(U^f,h')\right] \\ s.t. &: \qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad (8) \\ U &= u(c)+\beta\left[\lambda(h)\,U^s+(1-\lambda(h))\,U^f\right], \\ U^s &\geq U^f. \qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad (\text{IC-R}) \end{aligned}$$

Notice the similarity between problem (JA) and problem (UI): the two are identical, except for the fact that there is no effort cost in the promise-keeping constraint and no incentive-compatibility constraint (IC-S), in exchange for the additional per period cost κ^s.[15] Another difference with (UI) is that, for high levels of h, $\lambda(\cdot)$ is independent of $h,$ as explained in Section 3, and lower than $\pi(h)$. Clearly, in JA the retention constraint (IC-R) is likely to be binding because, as opposed to JA, private employment requires effort.

Social Assistance (SA): In social assistance, the agent is "released" by the planner for the current period, in the sense that the planner does not demand high effort or the use of technologies, but simply transfers some income to the worker. The problem of the planner is

$$\begin{aligned} V^{SA}(U,h) &= \max_{c,U^f} -c+\beta\mathbf{V}(U^f,h') \\ s.t. &: \qquad\qquad\qquad\qquad\qquad\qquad (9) \\ U &= u(c)+\beta U^f. \end{aligned}$$

The expression for $\mathbf{V}$ is given by equation (3) and the constraint describes how the promised utility U can be delivered by a combination of current and future payments. It is natural to think of SA as a pure income-assistance program.

Mandatory Work (MW): When the planner assigns the worker to the secondary

[15]In this context, the assisted search cost κ^s can be interpreted as the salary of the agency employee ("caseworker") who inspects available vacancies to find a suitable match for the agent, plus the additional administrative expenditures associated to this task.

production technology, at a cost κ^w, its problem becomes

$$\begin{aligned} V^{MW}(U,h) &= \max_{c,U^f} -c - \kappa^w + \underline{\omega} + \beta \mathbf{V}(U^f, h') \\ s.t. &: \\ U &= u(c) - \bar{e} + \beta U^f. \end{aligned} \tag{10}$$

The planner gives up search in the labor market and the worker produces an amount $\underline{\omega}$ by paying a utility cost in terms of work effort $\bar{e}$. Recall that work effort can be observed because output is deterministic. Thus, there is no incentive compatibility constraint during mandatory work. Under this policy, the agent works in exchange for benefits and has no chance of transiting into private employment.

Transitional Work (TW): When the planner uses the assisted search technology and, in addition, assigns the agent to work on the secondary production technology, the planner's problem is

$$\begin{aligned} V^{TW}(U,h) &= \max_{c,U^f,U^s} -c - \kappa^s - \kappa^w + \underline{\omega} + \beta\left[\lambda(h) W(U^s,h) + (1-\lambda(h))\mathbf{V}(U^f,h')\right] \\ s.t. &: \\ U &= u(c) - \bar{e} + \beta\left[\lambda(h) U^s + (1-\lambda(h)) U^f\right], \end{aligned} \tag{11}$$

$$U^s \geq U^f. \tag{IC-R}$$

The way to interpret this policy option, in light of our discussion of Section 2, is that while the agent is required to produce in a secondary sector job, the caseworker actively assists her search for a suitable employment in the primary sector. Note that, because of the use of the assisted search technology, also TW features the incentive constraint (IC-R).

It is convenient to state some basic properties of these value functions. By applying fairly standard results in dynamic programming, the convexified upper envelope $\mathbf{V}$ inherits the same continuity, monotonicity and concavity properties of u, but two caveats are worth mentioning. First, monotonicity in U is guaranteed whenever at (U,h) the consumption level c associated to the optimal program is positive (e.g., whenever $u(0) = -\infty$). Second, the concavity of $\mathbf{V}$ in U is warranted thanks to the randomization in (3). Finally, the properties of $\mathbf{V}$ are inherited by the value functions of each single policy V^i. In particular, all the problems defining policies $i \in \{JM, MW, SA, TW, UI\}$ are also concave, and each V^i is continuously differentiable in U. See Pavoni and Violante (2007) for details.

4.4 Economic forces in the choice of policies

To understand the economic forces at work in the choice of policies, it is useful to compare, for a given pair (U, h) the costs and returns of each policy relative to Social Assistance. SA is a useful benchmark because it has no returns for the planner and, since effort is zero in SA, its cost to the planner is simply that of delivering promised utility U by implementing full insurance, i.e., $c^{SA}(U) = u^{-1}((1-\beta)U)$.

Costs: All the policies that require effort to succeed (MW, TW, UI) entail an *effort compensation cost* for the planner. Since $u(c)$ is concave and disutility from effort is separable, as U increases, the marginal utility of consumption falls whereas the marginal disutility of effort is fixed. The higher U, the higher the transfer the planner has to pay to the agent to deliver the promised utility in order to compensate her for the fixed effort cost. Therefore, the effort compensation cost, a form of wealth effect due to the fact that leisure is a normal good in our model, increases with U. This is a central force in our characterization.

Some of the policies include the incentive compatibility constraint related to private search (IC-S) and the one related to the retention action (IC-R), respectively:

$$U^s - U^f \geq \frac{e}{\beta\pi(h)} \tag{IC-S}$$

$$U^s \geq U^f \tag{IC-R}$$

Recall that (IC-S) is present in UI and (IC-R) is present in JA, TW and UI. However, as explained, (IC-R) is not binding in UI because (IC-S) requires a strictly positive gap between state-contingent promised utilities already. The (IC-R) constraint is not binding in TW either because, as we will see below, once the optimal program has reached TW it will never recommend an effort level lower than $\bar{e}$ thereafter.

Satisfying the incentive compatibility constraints is costly since the agent has concave utility and dislikes consumption (and, hence, promised utility) to be spread out across states. A planner facing an incentive compatibility constraint has to pay the agent a larger transfer, on average, to deliver a given level of promised utility U. These incentive costs for both IC-S and IC-R are increasing in U, since u^{-1} has convex first derivative.[16] Moreover, the cost associated to IC-S is decreasing in h. As the unemployment spell progresses and the job-finding probability decreases, the employment outcome –that can only be achieved if the worker exerts the high job-search effort level– becomes less likely, and the planner needs to differentiate even more the future promised utilities across states to induce the agent to search.

The third, and final, cost component are the fixed costs (κ^s, κ^w) of using the assisted search technology (during JA and TW) and the secondary production technology (during TW and MW).

Returns: The return to the planner of using the secondary production technology (in MW and TW) is output $\underline{\omega}$. The main return of using private or assisted search is that, with positive probability, a match in the primary sector is created. Recall from (6) that the net returns to employment in the primary sector for the planner are increasing in human capital h. There is also an effort compensation cost which makes the return to primary employment decreasing in promised utility U. Therefore, the net returns of private employment are small for low h and high U. Finally, the assisted search technology has an additional return relative to private search: the planner saves on the effort compensation cost and on the costs associated to the incentive compatibility constraint IC-S, since job search can take place without unobservable effort.

5 Parameterization

To parameterize our model, we use a variety of data sources. Our principal source of data is the National Evaluation of Welfare-to-Work Strategies (NEWWS), a longitudinal study that was administered by the US Department of Health and Human Services from 1991 to 1999. Its objective was to estimate the effectiveness of welfare-to-work programs, and specifically "what works best, and for whom?".[17]

[16] The inverse of marginal utility $1/u'$ is the marginal cost to the planner of promising an additional unit of utility U to the agent. By "incentive cost" we mean the extra cost in units of consumption of promising the agent a state-contingent utility lottery delivering U necessary to satisfy incentive compatibility, relative to the cost of promising U with certainty. If $1/u'$ is convex, this incentive cost is increasing in the level of U.

[17] Data files from the NEWWS evaluation are maintained by the National Center for Health Statistics (NCHS) and are publicly accessible. The evaluation was conducted by MDRC under contract to

The study covered eleven mandatory Welfare-to-Work programs in seven distinct locations and included over 40,000 individuals over a five-year follow-up period.[18] It is based on random assignment to treatment groups (subject to program requirements) and to control groups (without any requirement). The vast majority of program members were single mothers. In particular, 94% are women, 95% are singles and all have children. The median number of children is two. Over half of the sample is composed by blacks and hispanics. The average age of participants is 30.5 years old. 42% of the participants are high-school dropouts, 51% have a high-school degree or GED, and only 7% has some years of college education. The average years of education in the sample is 11.2.[19]

The study contains several data sources, three of which are used in our analysis. The "full impact" sample collects five years of administrative records on demographic characteristics, earnings, and benefits for both treatment and control group members from all seven sites. Additional data on outcomes for adults and children were collected by interviewing a random sub-sample of about 5,000 members around two years after their date of random assignment and, in four of the seven sites, around their five-year anniversary. This survey includes data on the assignment of each participant to activities over the period, employment history before assignment, and history of non-cash benefits receipts. The third data source collects data on the costs of each activity drawn from state, county, and local fiscal records, supportive service payment records, administrative records, and case file participation records.

We now turn to the choice of parameters. The unit of time is set to one month. It is useful to divide the parameters of the model into three groups: the preference parameters $\{u(\cdot), \beta, \bar{e}, e\}$; the labor market parameters $\{\omega(h), \delta, \pi(h)\}$; the parameters of the assisted search and secondary production technologies $\left\{\bar{\lambda}, \underline{\omega}, \kappa^w, \kappa^s\right\}$.

We pick a value of of 0.9967 for the monthly discount factor in order to match an interest rate of 4% on an annual basis, and use a logarithmic specification for the period utility over consumption. Based on the evidence surveyed in Pavoni and Violante (2007), we set $\bar{e} = 0.67$. This value represents a cost of working of 49%

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the Federal government from 1989 through 2002.

[18]The seven locations are: Atlanta GA (2 programs), Grand Rapids MI (2 programs), Riverside CA (2 programs), Columbus OH (2 programs), Detroit MI, Portland OR, and Oklahoma City, OK. This last location offered programs which are not of interest for our study.

[19]For more details, see Table 2.3 "Selected Baseline Characteristics of Full Impact Sample Members," pages 43-46 in NEWWS (2001).

in consumption equivalent terms. Within female labor force participation models, Attanasio et al. (2008), Hausman (1980), Cogan (1981), and Eckstein and Wolpin (1989) computed costs of, respectively, 21%, 27%, 41% and 62% in consumption equivalent terms ($\bar{e} = 0.24, \bar{e} = 0.31, \bar{e} = 0.50$, and $\bar{e} = 0.97$).[20] We chose a value on the high end of the range of the existing estimates for women since our sample is composed of low-skilled single mothers who, arguably, have a high cost of working.

There is ample evidence showing that the time unemployed individuals devote to job search is significantly lower than the time the employed ones devote to market work. Krueger and Muller (2010) conclude, from the American Time Use Survey (ATUS), that the average daily duration of job search, for those non-employed individuals who actively seek employment, is 160 minutes. In light of this estimate, we target an effort cost of job search equal to $1/3$ $(160/480)$ of that from work, which yields $e = 0.67/3 = 0.22$.

Without loss of generality, we use a linear monthly earnings function $\omega(h) = \omega h$. We normalize h so that one unit corresponds to monthly earnings of \$100. In the NEWWS data, initial monthly earnings upon entering the program are around \$1,000, and hence $h_0 = 10$. We choose an annual human capital depreciation rate δ of 15 percent (see Pavoni and Violante, 2007, for details).[21]

The unemployment hazard function $\pi(h)$ is estimated from the monthly Current Population Survey (CPS) files over the period May 1995-April 1996, in the middle of the NEWWS sample period.[22] By selecting a sample of single women, 18-45 years of age with at most a high-school degree we stay as close as possible to the NEWWS sample. Overall, we have 5,612 observations. The average age of the sample is 30, and median weekly wage is \$250, consistent with the NEWWS sample (see NEWWS, 2001, Table 2.3). Our estimation strategy follows closely the maximum likelihood estimator outlined by Flinn (1986) and assumes a Weibull distribution

[20] With log utility, the expression for the consumption-equivalent loss is $1 - 1/\exp(e_w)$.

[21] As we explain in Pavoni and Violante (2007), the existing microeconomic estimates of wage depreciation span a wide range. At the high end, Keane and Wolpin (1997) estimate an average annual wage depreciation rate of 23%. At the other end, the estimates of Jacobson, LaLonde and Sullivan (1993, Table 3) imply an annual depreciation of 10%. In the middle of the spectrum, Neal's (1995, Table 3) estimates imply an annual decay rate of 17.5%. Addison and Portugal (1989) implicitly estimate a yearly skill depreciation rate of 16%.

[22] Within the window 1991-1999, the year from May 1995 to April 1996 witnessed a very stable unemployment rate, always between 5.5% and 5.7%. We choose these 12 months for our estimation in order to avoid issues of non-stationarity in the parameters.

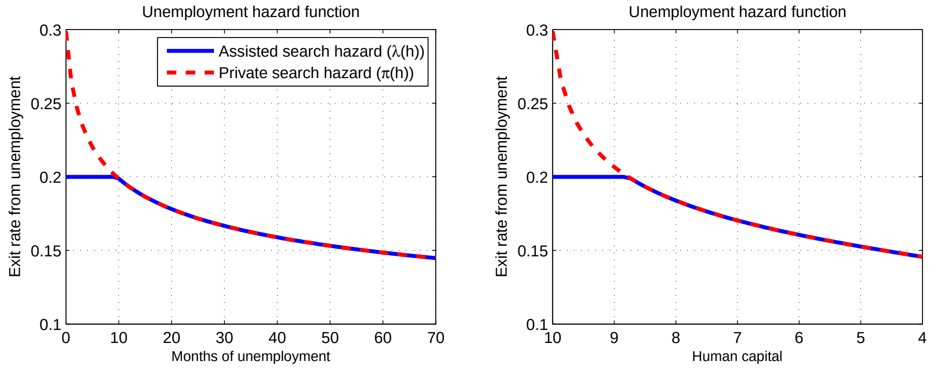

Figure 1: Exit rates from unemployment $\pi(h)$ and $\lambda(h)$. The $\pi(h)$ function is modeled as a Weibull hazard and is estimated on monthly CPS data May 1995-April 1996) for single women aged 18-45 with at most a high-school degree (left panel). The mapping from durations to human capital (right panel) is based on a monthly wage of $\$1,000$ ($h = 10$) at duration zero, and a monthly depreciation rate of 0.0135. The constant portion of the $\lambda(h)$ function is estimated based on the exit rate into private employment out of "Job Clubs" from NEWWS data.

$\alpha\phi d^{\phi-1}$ where d is the duration of the unemployment spell. Our estimation yields parameter estimates of $\alpha = 0.36$, and $\phi = 0.83$. Since $\phi < 1$, the estimated hazard displays negative duration dependence.[23] Figure 1 plots the estimated hazard as a function of duration, and its mapping into levels of h.

To estimate $\bar{\lambda}$, the initial flat region of the hazard rate from JA and TW, we focus on the transition rates into private employment from "Job Clubs", the program in the NEWWS data that most resembles to to job search assistance, at short durations.[24] The average hazard over unemployment durations of at most 6 months, weighted by the number of observations at each duration, yields $\bar{\lambda} = 0.20$.[25] To fix ideas,

[23]We then map this function of duration, into a function of human capital through a depreciation rate of 15% per year and an initial earnings level equal to $1,000 (i.e., $h_0 = 100$).

[24]Here is the description of Job Clubs programs in the NEWWS: *Programs ran assisted job search activities, including classroom instruction on techniques for resume preparation, job search, and interviewing, as well as a supervised "phone room" where participants could call prospective employers and search for job leads. Some sites employed job developers on staff, who searched for job leads in the community. See* NEWWS (2001, p. ES-9 and 15).

[25]This estimate is robust to different assumptions in computing the hazard. For example, including only spells of at most 4, 5, 7, or 8 months gives similar results. The NEWWS survey data contains some monthly records of workers who are simultaneously reported as employed and participants of "Job Clubs". This overlap may reflect either very short job spells (less than one month in duration) or measurement error. To deal with this data anomaly, whenever at month t we have an overlap, and at month $t + 1$ an employment spell, we count it as a successful transition from Job Clubs into

Figure 1 shows that our job search hazard reaches 0.20 for $h = 8.9$, or roughly 10 months into the unemployment spell for a worker who initially has human capital $h_0 = 10$. We note that Cebi and Woodbury (2011), who study the impact of the Washington Alternative Work Search Experiment estimate a *bi-weekly* exit rate from job-search assistance programs between 0.1 and 0.15 (see their Figure 1), supporting our estimate of $\bar{\lambda}$.

The value of the output parameter $\underline{\omega}$ is obtained from Kirby et al. (2002), who analyze in detail six "Transitional Job" programs.[26] Across their six sites, hourly wages for workers on these programs vary between \$5.15 and \$8.5, and hours worked vary between 20 and 40 (Kirby et al., Table 1). Using a baseline of 30 hours per week, monthly output ranges between \$618 and \$1,020. On average, we obtain a value of \$819 for $\underline{\omega}$.[27]

Among the six programs studied by Kirby et al. (2002), PREP Forrest City, AR, and TWC Philadelphia, PA are the only two with a full breakdown of service costs (Kirby et al., 2002, Table V.4). This breakdown can be used to estimate κ^s and κ^w. In our calculation for κ^s we only include the cost component called "unsubsidized-job development and placement" (whose description is the closest to the way we modeled Job-Search Assistance). This component, gross of its share of "general administration" costs, amounts to 14.2% and 13.4% of the total PREP and TWC service costs programs, respectively. Applying the average of these two percentages to the average total service costs across the six sites (\$1,087 from Table V.5 in Kirby et al.), we obtain a value of \$150 of "per-worker per-month" cost κ^s.

In our calculation for κ^w, we only include the cost component called "Transitional Work" (whose description suggests these are costs paid to set-up the job for the welfare recipient). Gross of its share of "general administration", this cost amounts to 25.9% and 30.6% of the total PREP and TWC service costs programs, respectively.[28]

employment only if the worker was unemployed at month $t-1$. Otherwise, we drop the record. Slightly different sample selection criteria do not affect the final estimate.

[26] The six programs studied are: PREP Forrest City, AR; Community Job Tacoma, WA; Community Job Aberdeen, WA; TWC Philadelphia, PA; GoodWorks! Augusta, GA; CJP San Francisco, CA.

[27] See also their Table V.2 for similar calculations.

[28] Of the other components we exclude from κ^w and κ^s, the largest one, accounting for over half of the total cost, is "pre-placement activities". Kirby et al. (2002, page 82) describe them as follows: "The courses included information on work culture, developing resumes, interviewing skills, managing money, and general life skills. Clients were also required to participate in a consumer credit workshop and a substance abuse workshop." Therefore, these activities consist mostly of classes aimed

Table 2: Summary of model's parameterization

Parameter	**Symbol**	**Value**	**Source**
Preferences			
Discount factor	β	0.9967	
Work effort	$\bar{e}$	0.67	Pavoni and Violante (2007)
Search effort	e	0.22	Krueger and Muller (2010)
Labor market			
Initial monthly earnings	h_0	$\$1,000$	NEWWS
Job search hazard	$\pi(h)$	Weibull $\alpha\phi d^{\phi-1}$ with: $\alpha = 0.36, \phi = 0.83$	Monthly CPS (1995-1996)
Monthly depreciation	δ	0.0135	Pavoni and Violante (2007)
Assisted search			
Job search hazard	$\bar{\lambda}$	0.20	NEWWS; Cebi and Woodbury (2011)
Administrative cost	κ^s	$150	Kirby et al. (2002)
Secondary production			
Output	$\underline{\omega}$	$819	Kirby et al. (2002)
Administrative cost	κ^w	$300	NEWWS; Kirby et al. (2002); Brock et al. (1993)
Monitoring			
Administrative cost	κ^m	$5	Ashenfelter et al. (2004)

Once the average of these two percentages is rescaled to all six programs, we obtain a cost of $307. Our second source for κ^w is NEWWS cost data for the activity labeled "Work Experience," the closest activity to our Mandatory Work program.[29] Remarkably, the average estimated cost per worker per month for this activity is $298, very close to what we obtained from our first source (see NEWWS, 2001, Table 13.2, page 304-306). A third source of data is provided by Brock et al. (1993), a survey of eight experimental studies of Mandatory Work programs conducted by the MDRC. Our own calculations based on their cost breakdown for these programs yields a value of

at building job-readiness skills, a dimension we abstract from.

[29] NEWWS (2001) defines Community Work Experience as programs requiring recipients to "work off their grant" in community service jobs.

\$279 for κ^w.[30] Based on these three sources, we set κ^w at \$300.

Table 2 summarizes all parameter values.

6 Optimal welfare programs

We are now ready to characterize the optimal welfare program. We begin by studying in which regions of the state space (U, h) the various policies arise as optimal. The state space can be divided into different connected areas, each corresponding to a specific policy whose value dominates all the others. The state space can also be thought of as a phase diagram, where U moves endogenously and h exogenously, that dictates the optimal sequence of policies along the unemployment spell, for any given initial pair (U_0, h_0). Finally, we turn to the dynamics of unemployment benefits and wage/taxes upon re-employment.

6.1 Optimal policies in the (U, h) space

By projecting the upper envelope $V(U, h) = \max_i V^i(U, h)$ on the (U, h) state space, we obtain a graphical representation of which policy is optimally implemented at every (U, h) pair. Figure 2 depicts this projection at the calibrated values for the model's parameter.

We start by interpreting Figure 2 as we move "horizontally" in the (U, h) space, i.e., we let h change for a given level of utility entitlement U. Next, we study the optimal policies as we move "vertically" through the diagram, i.e., we change U for a given level of human capital h.

Moving horizontally (along h): For high levels of U and high levels of h (top left region of Figure 2), the planner assigns the worker to UI because the job finding probability $\pi(h)$ and the wage $\omega(h)$ are both large. As human capital decreases (still for this high level of promised utility) the job finding rate decreases and, in order to save on the incentive cost associated to constraint IC-S, the planner shifts from UI to JA. Finally, as human capital further depreciates, the return to assisted search decreases because output in primary employment, a function of h, falls. The

[30] Our calculation is based on their Tables 10 and 11. Table 10 reports a cost breakdown per participant. We used the two components called "worksite activities" and "participant monitoring" which includes worksite development, assignment of participants to positions, monitoring and sanctioning functions. Table 11 reports the average duration of the program per participant.

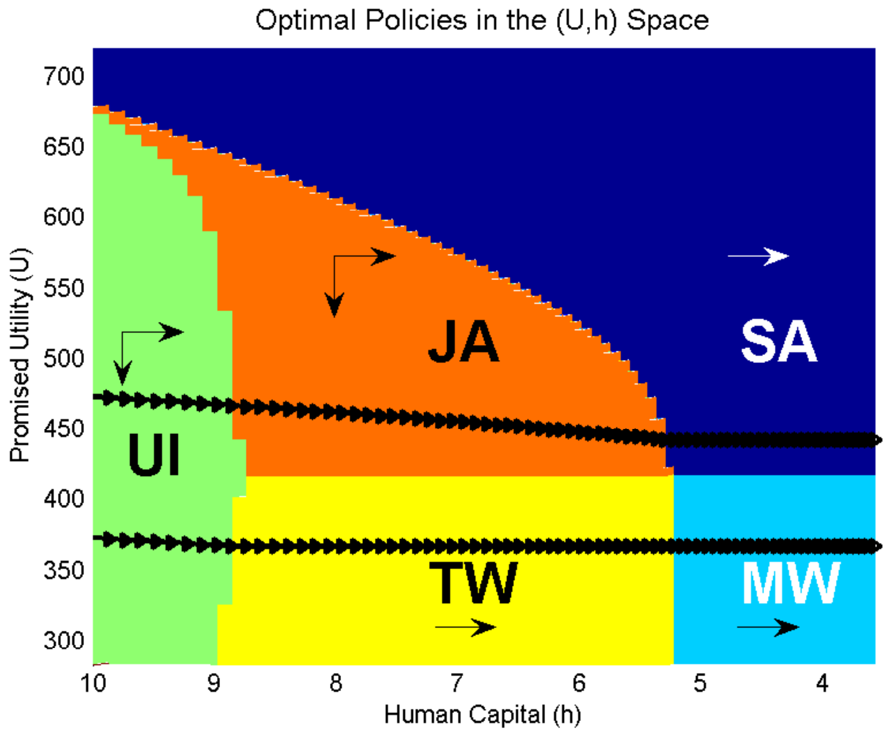

Figure 2: Policies of the optimal welfare program in the (U, h) space. The small arrows indicate the direction of the evolution of U and h under each policy. The two sample paths plotted in the figure correspond to a search-based program $(U_0 = 475)$ and a work-based program $(U_0 = 375)$.

planner finds it optimal to save on the search assistance cost and simply provides the agent with a constant transfer in SA. Social Assistance tends therefore to emerge for low h and high U, once the return to employment are too low and/or the effort compensation cost is too high (top right region of Figure 2).

Consider now moving horizontally across the state space for lower levels of U. For low enough levels of U, TW appears in the state space in place of JA. The effort compensation cost is low enough that, while the planner uses the assisted search technology, it simultaneously finds it optimal to require the agent to work as well. Similarly, moving to the right, MW appears instead of SA. The planner gives up the search technology because its return is too small, since $\pi(h)$ and $\omega(h)$ are too small, and requires the agent to work in the secondary sector in exchange for her benefits.

Moving vertically (along U): As U decreases, the effort compensation cost declines and the planner shifts from policies without effort (JA, SA) to policies requiring effort (UI, TW, MW). The shift from SA to JA (neither one requiring effort) in the upper part of Figure 2 is explained by two forces. First, as U falls, so does the cost of satisfying the retention constraint (IC-R). Second, the effort compensation cost during primary employment (a possible outcome of JA only) falls as U is reduced.[31]

6.2 Two types of optimal welfare programs

The optimal sequence of policies is dictated by the evolution of the state vector (U, h). Conditional on unemployment, h declines monotonically. The evolution of U depends on the specific policy. U is declining during UI and JA because of the binding incentive constraints, but it remains constant during SA, MW and TW. During TW, the IC-R constraint is not binding because from then onward the program always specifies the highest level of (work) effort.

The main insight about optimal policy transitions is that there are two types of welfare programs that are most likely to emerge as optimal, depending on the initial level of generosity U_0. The directional arrows in Figure 2 illustrate the policy sequence in these two programs. After an initial, common spell, of UI a generous (or deep-pocketed) principal would implement an optimal program based on *search* which follows the sequence $JA \to SA$. A more parsimonious (or more budget constrained) principal would, instead, implement an optimal program based on *work* which follows the sequence $TW \to MW$.

For $h_0 = 10$, our initial condition for human capital, the relative duration of each policy depends on initial promised utility. We restrict attention to a high and a low level, $U_0^{high} = 475$ and $U_0^{low} = 375$, which induce a search-based program and a work-based program, respectively. In the search-based program, the planner uses UI until month 9, then it switches into JA until month 47, and then starts implementing SA, an absorbing state. In the work-based program, UI is used for the first 9 months as well, TW for the subsequent 39 months, and then the planner switches into MW. Overall, the switching times from UI to assisted search and from assisted search into the absorbing program are quite similar across the two welfare programs.

[31] The higher is h, the higher the level of promised utility U at which this switch takes place. The reason is that the return to primary employment, present in JA but not in SA, is increasing in h.

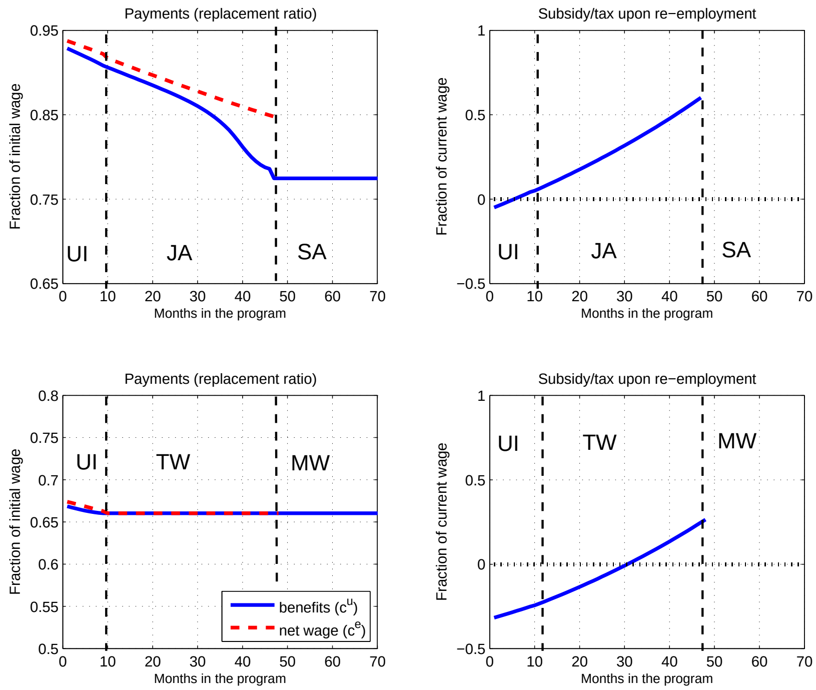

Figure 3: Sequence of payments in two optimal welfare programs. The top two panels plot benefits and re-employment tax/subsidy in the search-based program starting at $(U_0 = 475)$. The bottom two panels correspond to the work-based program with $(U_0 = 375)$.

6.3 Optimal sequence of payments and taxes/subsidies

Figure 3 plots the optimal path of welfare benefits and wage tax/subsidy upon re-employment corresponding to the search-based program initialized at U_0^{high} and to the work-based program initialized at U_0^{low}. In both cases the unemployed worker starts at $h_0 = 10$, and her job search is never successful, and hence after roughly 4 years she reaches an absorbing policy.

Consider the search-based program first (top two panels). Unemployment benefits fall during UI because of the binding IC-S constraint. Optimal replacement ratios for UI benefits are high in search-based programs because of the high initial promised utility. The top-left panel shows that satisfying the retention constraint during JA requires both declining benefits and a positive wedge between promised consumption upon employment $c^e\left(U, h\right)$ and benefits $c^u\left(U, h\right)$ during unemployment. The reason is that the agent exerts no effort in JA whereas employment requires high effort $\bar{e}$, and hence she will choose $r = 1$ only if the principal promises a level of consumption during employment high enough to compensate for the disutility of work effort. This consumption wedge grows quickly as JA approaches SA and it entails both a fast drop in unemployment benefits (left panel) and a fast rise in wage subsidy upon reemployment (right panel).

Moving to the work-based program, the bottom-left panel shows that the consumption wedge is negligible in UI and is not present at all in TW. Recall that the incentive constraint on the retention action IC-R is not binding during TW, since the program always features an effort level $\bar{e}$ from that point onward. As a result, the principal can fully insure the agent upon her switch from UI into TW, as demonstrated by the constant consumption path. This result illustrates clearly the effectiveness of the work-based policies as a way of providing incentives (to search and to be retained) to the worker without creating too much consumption dispersion. The punishment for unsuccessful search is administered by enforcing work effort instead of cutting welfare benefits.

Finally, because of the higher average level of promised utility and the necessity of creating a positive consumption wedge, wage subsidies are more generous and appear at earlier durations in search-based program, compared to work-based welfare programs. For example, 30 months into the program, TW is still associated with a small tax upon reemployment, whereas JA requires a subsidy around 25 percent. Therefore, in order to be effective, Job Search Assistance must be combined with generous re-employment subsidies.[32]

7 Extensions

7.1 Joint search-and-work

So far, we have assumed that (i) work takes up the whole effort endowment, and therefore (ii) search and work are mutually exclusive activities. We now relax these assumptions and allow part-time work on the secondary technology at effort level

[32] This normative conclusion receives some support in the empirical literature. Meyer (1995) surveys four re-employment bonus experiments based on random assignment. Bonuses were determined as a fraction of UI benefits, in turn proportional to previous earnings. Estimated effects are often imprecise and their range wide, but in general larger bonuses led to significantly shorter unemployment spells (Meyer, 1995, Table 2).

$\bar{e}-e$, which allows an individual to jointly search and work part-time. The cost and output of the part-time secondary technology are proportional to hours worked, i.e., a fraction $(\bar{e}-e)/\bar{e}$ of κ^w and $\underline{\omega}$, respectively. We retain the assumption that effort when employed in the primary sector equals $\bar{e}$, i.e., private employment is full time.

Our first result, which simplifies the analysis significantly, is that part-time work on the secondary technology alone is never used in the contract. The reason is that the principal can always randomize across policies to effectively achieve part-time work. To see this, consider a randomization between SA and MW. Simple inspection of problems (9) and (10) demonstrates that randomizing across the two policies with probabilities $e/\bar{e}$ and $(\bar{e}-e)/\bar{e}$, respectively, is equivalent to part-time MW. Moreover, the planner can always freely choose a different set of probabilities to achieve an even higher value. Overall, randomizations always dominate part-time work alone.

In light of these observations, the only additional policy that arises in the optimal program is the joint use of private search and part-time work on the secondary technology, which we call "Search and Work."

Search and Work (SW): The problem of the planner is:

$$\begin{aligned} V^{SW}(U,h) &= \max_{c,U^f,U^s} -c+(\underline{\omega}-\kappa^w)\left(\frac{\bar{e}-e}{\bar{e}}\right)+\beta\left[\pi(h)W(U^s,h')+(1-\pi(h))\mathbf{V}(U^f,h')\right] \\ s.t. &: \qquad\qquad (12) \\ U &= u(c)-\bar{e}+\beta\left[\pi(h)U^s+(1-\pi(h))U^f\right], \\ U &\geq u(c)-(\bar{e}-e)+\beta U^f, \qquad \text{(IC-S)} \\ U^s &\geq U^f \qquad \text{(IC-R)} \end{aligned}$$

As for UI, the (IC-R) constraint is not binding and the (IC-S) constraint reduces to $\beta\left(U^s-U^f\right)\geq e/\pi(s)$. Therefore UI and SW are easily comparable: SW is a version of UI augmented with part-time work effort, and hence should be used in, roughly, the same human capital range as UI, but for lower levels of promised utility U corresponding to a lower effort compensation cost. Figure 4 illustrates that this is precisely the area in the state space where SW emerges as optimal.

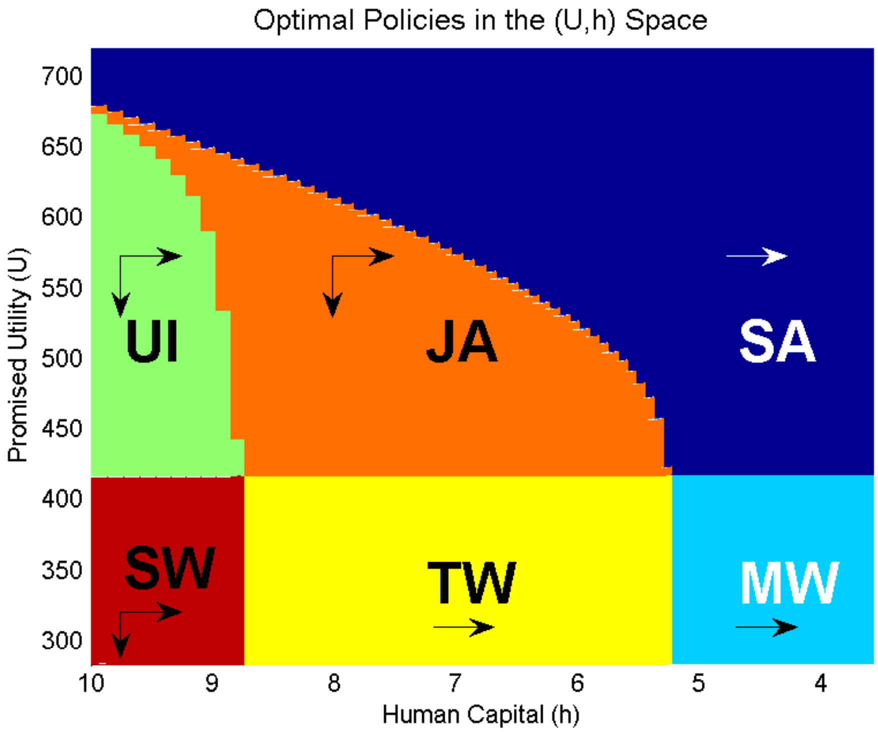

Figure 4: Policies of the optimal welfare program in the (U, h) space in the presence of Search and Work (SW). The small arrows indicate the direction of the evolution of U and h under each policy.

7.2 Monitoring of agent's search effort

As discussed in Section 2, there is a variety of job-search based programs. In some of these programs, the emphasis is on monitoring and enforcing the individual private search effort. Here, we introduce a monitoring technology, as in Pavoni and Violante (2007), i.e., upon payment of a cost $\kappa^m > 0$, the job-search effort of the agent can be perfectly observed and enforced by the planner.[33] This cost should be interpreted as the additional costs for the caseworker to monitor and enforce the search activity of the unemployed agent. We maintain the assumption that the retention action r is unmonitorable.

Note that monitoring (i) would never be accompanied by a no-effort recommendation, because the cost would be wasted; and (ii) would not be paired with the use of assisted search for the same reason why private search is not used alongside with

[33] Setty (2012) generalizes this analysis to the case where monitoring allows the principal to acquire a costly imperfect signal of the agent's effort that can be used in the contract.

assisted search. As a result, the only new policy that arises in our environment is one where the planner prescribes search effort and the use of monitoring, which we call *Job Search Monitoring*.

Job Search Monitoring (JM): The problem of the planner that chooses to monitor the search effort of the agent is:

$$\begin{aligned} V^{JM}(U,h) &= \max_{c,U^f,U^s} -c-\kappa^m+\beta\left[\pi(h)W(U^s,h^f)+(1-\pi(h))\mathbf{V}(U^f,h^f)\right] \\ s.t. &: \qquad (13) \\ U &= u(c)-e+\beta\left[\pi(h)U^s+(1-\pi(h))\,U^f\right], \\ U^s &\geq U^f. \qquad \text{(IC-R)} \end{aligned}$$

Notice the similarity between problem (JM) and problem (UI): the former is identical to (UI) except for the fact that there is no incentive-compatibility constraint (IC-S) for effort in exchange for the additional per period cost κ^m.

Monitoring could also be used when private search effort e is recommended jointly with work effort $\bar{e}-e$ on the secondary production technology. The only change in problem (13) is that the planner's value includes the terms $(\underline{\omega}-\kappa^w)\left(\frac{\bar{e}-e}{\bar{e}}\right)$. Instead of defining an extra policy, we use the term Job Search Monitoring in a broad sense that also encompasses this latter case.

7.2.1 Results

We first discuss the parameterization of the monitoring cost κ^m. Ashenfelter et al. (2004) report that, in the experiments they evaluate (discussed in Section 2), the additional weekly processing costs per claim associated with the treatments varied from $1 to $15. These costs were mainly due to the added staff-time required to go through the supplemental eligibility checks and to monitor search effort.

Corson and Nicholson (1985) and Meyer (1995) evaluate the Charleston Experiment which had the objective of strengthening the monitoring of UI work test, offering job-search workshops to job seekers, and enhancing their placement through additional services. UI claimants were divided into three groups differing in the intensity of the treatment. Group 3 was only subject to additional eligibility checks. Corson and Nicholson (1985) estimate that the program cost per claimant in treat-

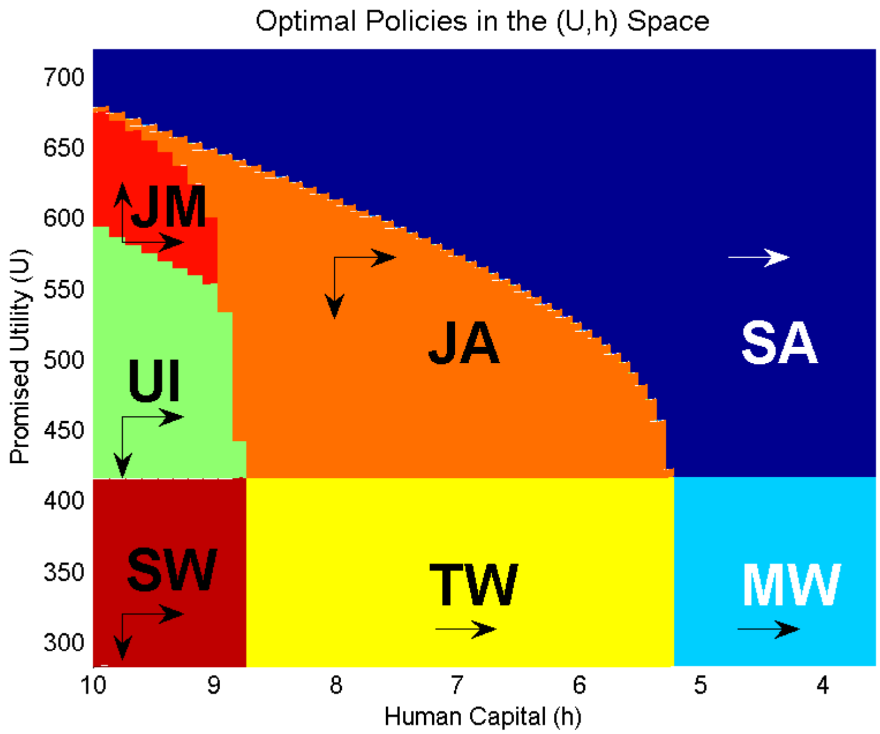

Figure 5: Policies of the optimal welfare program in the (U, h) space in the presence of Search and Work (SW) and Job Search Monitoring (JM) with cost $\kappa^m = \$5$ per worker per month. The small arrows indicate the direction of the evolution of U and h under each policy.

ment in this group was roughly \$9. Meyer (1995) reports, for this same experiment, smaller weekly costs, around \$6, because he measures costs for the treatment group net of those for the control group which should be interpreted as the costs of administering UI and, as such, should be excluded from our calculation.

Setty (2012) uses data from the Minnesota Family Investment Program, where each caseworker was responsible for 100 clients and, among other tasks, was assigned to apply sanctions, assist with housing, and document client activities. He obtains a weekly cost of \$7.5 per unemployed worker monitored. This value is an upper bound, since the caseworker is involved in more activities than monitoring alone.

In sum, there is a wide range of estimates for κ^m varying between \$4 and \$60 per worker per month. Given our parameterization of Section 5, JM never appears as optimal for monitoring costs beyond \$50. Below, we analyze how the optimal welfare program would be modified by the presence of JM when monitoring costs are on the low-end of available estimates.

Figure 5 uses $\kappa^m = \$5$. Job search monitoring emerges as optimal in the upper region of the state space between UI and JA. To understand why, move vertically in the state space from top to bottom in the area where JM penetrates between UI and JA. For high levels of U, the effort compensation cost is high, and no-effort search assistance policies are implemented. As we lower U, it becomes efficient to induce search effort, and the planner switches to JM to avoid the high incentive costs (increasing in U) associated to the unobservable search effort. As U falls and incentive costs are reduced, UI becomes optimal.

8 Conclusions

Since Shavell and Weiss (1979), the literature on the efficient provision of consumption insurance and search incentives to the unemployed in presence of private information has largely focused on the optimal path of benefits during the unemployment spell. Unemployment compensation during job search is a key pillar of the welfare state, but it is by no means the only instrument used by policy makers. Many welfare programs directed to the low-income unemployed actively assist them in locating suitable employment, or do not elicit search effort at all from them and, instead, require them to work in exchange for benefits.

In this paper, we have proposed extending the tools of recursive contract theory to study the optimal design of a welfare program that combines private job search, assisted search, job search monitoring, and work activities. Our novel approach consists in augmenting the standard "optimal UI" environment with additional technologies, and showing how the use of these technologies, and the associated payments to the agent, can be mapped directly into a variety of observed policy instruments. Once these policy instruments arise naturally as components of the optimal contract between the government-principal and the unemployed-agent, one can study when and how they should be used along the unemployment spell. The paper contains such characterization.

Our investigation can be extended to quantify the potential welfare gains/budget saving in switching from actual to optimally designed programs. A reduced-form test of whether US states, roughly, get their programs right could be performed. There is significant variance in the generosity of welfare programs across states (measured for example by the level of TANF benefits), and our framework suggests that the most (least) generous states should implement search-based (work-based) programs. State-level data about expenditures on different types of programs from the U.S. Department of Health and Human Services could, possibly, allow to address this question.

A more structural approach would entail computing the expected promised utility (U_0 in our model) implicit in existing programs (from the observed sequence of policies, their duration, their benefits and wage subsidies), and calculating the optimal program corresponding to the same level of U_0. A comparison would then determine budget savings from switching to the optimal program and would identify the major discrepancies between actual and optimally designed programs.

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