Optimal Unemployment Insurance when Search Takes Effort and Money

Prepared for XV Applied Economics Meetings

Draft: Please do not quote or reference without permission

Jeremy Schwartz*

February 29, 2012

Abstract

Searching for work is costly. It involves finding available openings, completing applications, and attending interviews, to name but a few of the activities involved in the process. The optimal unemployment insurance (UI) literature models the cost of these activities as either a reduction in leisure or an unpleasant bad that directly reduces utility, but largely ignores their associated monetary costs. If search requires out of pocket expenses, a large reduction in UI benefits for the long-term unemployed, which is the standard recommendation from the literature, may make further job search unaffordable. This paper investigates the welfare maximizing optimal structure of UI in an economy where job search is not only unpleasant, but requires a monetary investment. The model suggests that in this context the optimal unemployment insurance system includes a period of almost ten months during the unemployment spell where benefits are almost constant. This is because the benefits of a sharp reduction in UI benefits in incentivizing greater search effort is mitigated by decreasing the worker's ability to purchase the goods and services needed for a successful search. Further, when one allows for capital markets and the monetary costs of search, the optimal UI system is significantly more generous than in an economy without these monetary costs of search.

Keywords: unemployment insurance, moral hazard, hidden information, unemployment, search
JEL Classification Numbers: J64, J66, D82

*Contact Information: Loyola University Maryland, Department of Economics, 4501 North Charles Street, Sellinger 315, Baltimore, MD 21210, phone: (410) 617 - 2919, email: jsschwartz1@loyola.edu

1 Introduction

Searching for work is a costly endeavor. The process involves a set of fairly unpleasant activities, such as searching through help wanted advertisements, preparing resumes and applications, and attending interviews. Modelers interested in the search process, and in particular the optimal design of unemployment insurance (UI), incorporate these costs as either a loss of leisure time or an intangible bad that reduces utility. To date the literature largely ignores out of pocket expenses that are required to perform a search. Search not only requires some intangible effort, but a variety goods and services ranging from transportation and professional attire for interviews to computing resources and paid recruiters. The standard result from the optimal UI literature is that to provide incentives for workers to adequately search for work UI benefits must fall during the course of an unemployment spell. However if out of pocket expenses are important to the job hunt, such a policy would leave the long-term unemployed financially unable to continue their search. To determine how monetary costs affects the optimal UI system I investigate an economy where search reduces utility, both because it is an unpleasant activity and because it requires diverting financial resources from consumption to the monetary costs of search.

To explore the optimal design of UI this paper develops a search model, where the worker's actions are hidden from the government along three dimensions: (1) the intangible search effort they exert, (2) the financial resources the worker devotes to the search, and (3) the degree workers use precautionary savings to self-insure against an unemployment shock. The first hidden action, the non-monetary, intangible effort exerted by the unemployed to find work, I refer to simply as search effort. Shavell and Weiss (1979) and Hopenhayn and Nicolini's (1997) seminal works on optimal unemployment insurance focus solely on the moral hazard problem that arises from not being able to observe search effort. Shavell and Weiss (1979) maximize the welfare of an unemployed worker subject to a fixed budget. When workers cannot save, it is optimal for benefits to fall throughout the unemployment spell. Forward looking workers realize their consumption will fall if they remain unemployed, and consequently a declining sequence of benefits provides strong incentives for exerting search effort. Hopenhayn and Nicolini (1997) use a recursive contract approach where the government determines the cost minimizing UI benefit and employment tax that are contingent on the entire employment history of the worker. Similar to Shavell and Weiss (1979) the optimal sequence of benefits falls throughout the unemployment spell.

The work of Shavell and Weiss (1979) and Hopenhayn and Nicolini (1997) have been extended in a variety of ways with similar conclusions. For instance, Pavoni (2007) allows for a lower bound on the promised level of utility in a Hopenhayn and Nicolini (1997) framework. The author finds that benefits fall faster to a subsistance level of consumption. Cahuc and Lehmann (2000) and Fredriksson and Holmlund (2001) use a Pissarides (1991) type general equilibrium search model. In these models, providing the newly unemployed with more generous insurance increases the bargaining power of workers, which leads to higher wages, greater labor costs and lower job creation. As a result, benefits early in the unemployment spell may be undesirable, which calls into question the benefits of a falling sequence of benefits. Despite this ambiguity, numerical exercise in both papers suggest that even under these circumstances benefits should fall with the length of an unemployment spell. Hansen and Imrohoroglu (1992) frame the moral hazard question slightly differently. Rather than unobservable search effort, The authors assume that the government can not monitor whether job offers are accepted or rejected. They find that the standard U.S. system actually lowers welfare by discouraging workers from accepting jobs. While, these important papers establish the optimal form of UI when workers must expend effort, they ignore the monetary costs of the search process.

In this paper I argue that search effort alone is not a complete picture of the job search process. Finding a job also requires additional goods and services that make search effort more productive, but do not increase the utility of the unemployed. For instance, locating job opportunities is not just unpleasant, but may involve transportation costs to inquire if positions are available. Filling out applications cannot be done with effort alone, but one needs computing resources to complete on-line applications. While, being successful on an interview requires the ability to demonstrate one's knowledge and qualifications, professional attire can substantially increase the chances of converting an interview into a job offer. Further one may not be able to attend interviews without paying for childcare services. Other goods and services include, professional resume writing services, paid recruiting services, or plane or train tickets to extend the search geographically. These costs can be a substantial portion of the rather small average weekly UI benefit in the United States of just $291.[1]

For long unemployment spells, where individuals have exhausted unemployment insurance and their savings, even basic services may become unaffordable and may impede the job search. For instance, struggling to pay the phone bill makes it difficult to be contacted for interviews and cutting back on Internet service at home makes it difficult to apply for jobs and check emails related to the search. A final set of goods and services that may assist in the job search are certifications, such as a GED. However I take the view that such certifications only serve as a signal of a worker's acceptability and not additional human capital which may lead to a higher wage. Considering the monetary costs of search suggests that the standard result in the literature, that benefits should fall with duration of unemployment, may leave some without the financial resources to effectively search for work.

I include these monetary expenses as a second hidden action which makes search effort more productive. I refer to the stock of goods and services that assist in the job search as search capital and additions to search capital as search investment. The idea of search capital has thus far been largely ignored by the literature. One exception is Hassler and Mora (2002). In the authors' model search costs money and some worker's have the opportunity to make costly investment to either move to locations where jobs are more plentiful or go through training. The authors however do not allow for standard search effort. Hassler and Mora (2002) finds that in these conditions UI benefits should stay constant or even rise during the spell to ensure future search is funded.

The last hidden action I model in this paper is private savings. The inclusion of savings has long been shown to significantly affect the optimal UI policy. Flemming (1977) allows for capital markets and determines an optimal level of benefits that is provided for an infinite duration. Flemming (1977) shows that the optimal replacement rate goes from just 20%, with perfect capi-

[1]The average week benefit amount reported by the Department of Labor for the first quarter of 2011.

tal markets, to 70% when capital markets are nonexistent. Wang and Williamson (2002) uses an approach similar to Hopenhayn and Nicolini (1997), but allow for multiple unemployment spells. The authors also allow effort to increase the probability of finding work and, when employed, decrease the probability of losing ones job. The authors find that with savings the welfare gains of UI are low and the optimal benefit schedule is non-montonic. Benefits begin low in the first quarter of unemployment when workers' assets are high. Then benefits increase to provide insurance as assets are exhausted and finally, if unemployment continues, a fall in benefits provides incentives to search. Abdulkadiroglu et al. (2002) extends Hansen and Imrohoroglu's (1992) model to allow for hidden savings. Like Hansen and Imrohoroglu (1992) they find welfare gains from UI to be quite low. Interestingly, similar to Wang and Williamson (2002), their optimal benefit scheme is non-montonic, however the timing of the benefits is quite different. In Abdulkadiroglu et al. (2002) it is optimal to pay large benefits upfront, which can be saved and used througout the spell. After this initial payment, UI benefits are quite low as workers exhaust their savings and then rise somewhat to provide some level of consumption for the long-term unemployed. Lentz (2009) estimates an empirical model of job search to determine the optimal UI replacement rate for Denmark. The duration of UI is unlimited, consistent with the long duration provided by the Denmark system. The author estimates that the optimal replacement rate is between 43% and 80%. These studies suggest that the determination of the optimal UI benefits schedule is more complex when allowing for capital markets.

In this paper a benevolent government maximizes a utilitarian welfare function within a search model framework. Since, search effort, search capital and private savings are all unobservable, the government must use the UI system to provide incentives for workers to exert effort and use financial resources to search for work. The government has the flexibility to vary the benefit structure with worker's current unemployment history and is limited by a balanced budget constraint and the behavior of workers.

To explore the role of the monetary costs of search I use the model to numerically simulate three scenarios: Scenario 1 allows for both search capital, search effort and hidden savings, Scenario 2 allows for hidden savings, search effort, but does not allow for search capital, and Scenario 3 allows for search capital and search effort, but no savings. The results indicate that the inclusion of search capital into the model substantially changes the UI system. While a declining sequence of benefits is still optimal, there is a large portion of the unemployment spell where benefits are almost constant. This is because allowing workers to utilize precautionary savings to self-insure against a job loss shows that the inclusion of search capital justifies a more generous UI system.

The remainder of this paper is organized as follows. In the next section I describe an economy where the job search involves both effort and money and embodies all three Scenarios. In Section 3 I discuss the calibration and computation strategy. Section 4 presents the results for the economy under the current UI system as well as the optimal UI benefit schedule. Finally, Section 5 concludes.

2 The Economy

To understand how search capital influences the optimal UI program, I develop a dynamic discrete time model of the savings behavior of all workers, and the search behavior of the unemployed. The model this section describes nests each of the three scenarios that the introduction describes. Also, note that I do not explicitly model firms, but instead assume a constant, exogenous wage.

The economy consists of a continuum of utility maximizing workers and for simplicity I normalize their measure to one. Workers are infinitely lived and ex-ante identical, but due to random employment shocks ex-post differ by their current employment status. Workers' maximize the expected value of time separable discounted utility:

$$E\sum_{t=0}^{\infty}\beta^t u(c_t) - \theta_t e_t \tag{1}$$

where β is a common subjective discount factor and c_t is consumption in time period t. The employment status of the worker is given by θ_t which is 0 when employed and 1 when unemployed. The intensity of search effort, e_t, enters the instantaneously utility function linearly. Note that others have chosen to model search effort as a time cost which reduces leisure when unemployed. However, using the American Time Use Survey Aguiar et al. (2011) show that the actual time spent on the job search is quite small, just 1.4 hours a week. As a result, I view these search activities, as simply unpleasant, and a direct reduction of utility.

I categorize each worker into $D+1$ states. The first, $d=0$, indicates the worker is employed. States $d = 1$ to $D-1$ indicate workers unemployed for d periods and workers in state D are unemployed D or more periods. The grouping of all workers unemployed D or more periods together is done for tractability, but is of little consequence to the results as long as the measure of workers in state $d = D$ is small.[2]

Production is storable and can be seamless transformed into consumption or search investment. Denoting the amount of savings as a, the law of motion for savings is as follows:

$$a' = Ra + y^d - i - c \tag{2}$$

where R is the return on savings, y^d is disposable income and i is search investment. Note that for convenience I have dropped the t subscripts in favor of denoting a variable x's value next period as x'.

Disposable income is given by:

$$y^d = \begin{cases} w - \tau \text{ if } d = 0 \\ b(d) \text{ if } d = 1, ..., D \end{cases} \tag{3}$$

While employed workers receive a fixed amount of production, w, of a good, of which portion, τ, is paid to the government to fund the UI program. While unemployed, in $d = 1, .., D$ states workers receive a benefit, $b(d)$, that is conditional on the current state. It is important to note a key difference between this benefit system and those that use the recursive contract approach, where the benefit is based on the individual's entire employment history. Here the contract is more restrictive. It is only based upon the current length of the unemployment spell, which is done to

[2]In the numerical simulations for the calibration in Section 4.1 there is just 0.6% of the unemployed in state $d = D$.

make the model more tractable.

A stochastic process governs the transitions into and out of employment. The unemployed can influence their probability of finding work, $p(k', e)$ through the accumulation of search capital, k, and by exerting search effort. The job finding rate $p(k', e)$ conforms to $p_{k'}(k', e) > 0$, $p_e(k', e) > 0$, $p_{k'k'}(k', e) < 0$, $p_{ee}(k', e) < 0$ and $p_{k'e}(k', e) > 0$. Search capital follows the following law of motion:

$$k' = k(1 - \delta) + i \tag{4}$$

where δ is the depreciation rate for search capital.

Denoting V^u and V^e as the discounted utility for the unemployed and employed the maximization problem facing the unemployed can be represented with the following bellman equation:

$$V^u(d, a, k) = \max_{a', k', e} u(c) - e + \beta(p(k', e)V^e(0, a', k') + (1 - p(k', e))V^u(d', a', k')) \tag{5}$$

subject to (2) and (4) and non-negative constraints, $e \geq 0$, $k' \geq 0$ and $c \geq 0$ as well as a maximum storage capacity $a' \leq \bar{a}$. The assumption that capital markets are incomplete, $a' \leq \bar{a}$, signifies that workers cannot perfectly self-insure, justifying the need for government provided insurance.

Equation (5) also illustrates the timing of the model. Workers enter each period with a stock of search capital and savings. During the period they decide how much search effort to exert and how much new search capital to purchase. This in turn determines the probability of finding work. Simultaneously workers choose the level of savings next period, a', which together with the choice of k' and y^d, determines consumption. At the end of the period the uncertainty in the labor market resolves itself and the unemployed either transition to employment, with $d' = 0$, or advance to the next unemployment state, with $d' = \min(d + 1, D)$.

While employed workers must decide whether or not to save to partially insure against the possibility of losing one's job. The employed's problem can be represented as:

$$V^e(0, a, k) = \max_{a'} u(c) + \beta(sV^u(1, a', 0) + (1 - s)V^e(0, a', k'))) \tag{6}$$

subject to (2) and $a' > 0$ and $a' \leq \bar{a}$. While employed workers determine the level of savings next period. I assume that search capital does not transition to a new spell of unemployment and consequently all newly unemployed begin their spell with no search capital. Consequently, while unemployed $i = 0$. With an exogenous probability s, workers separate from productive employment and enter the first state of unemployment, $d = 1$, and with probability $(1 - s)$ workers continue employment with the new stock of savings.

Definition: Collecting state variables, (d, a, k) into a vector ω a stable equilibrium is given by a set of policy functions $c(\omega)$, $a'(\omega)$, $k'(\omega)$, and $e(\omega)$ as well as a time invariant distribution of workers across states, $\lambda(\omega)$ and a fixed tax rate, τ that satisfy the following conditions:

1. a balanced budget constraint $\sum_{a,k} \lambda(0, a, k)\tau = \sum_{d\geq 1,a,k} \lambda(d, a, k)b(d)$
2. the goods market clears such that $w \sum_{a,k} \lambda(0, a, k) = \sum_{\omega} \lambda(\omega)c(\omega) + i(\omega) + a'(\omega) - a(\omega)]$
3. A stable distribution across states that solves:

$$\lambda(d', a', k') = \begin{cases} (1 - s) \sum_{(a,k)\in\Omega} \lambda(0, a, k) + \sum_{d\geq 1} \sum_{(a,k)\in\Omega} p(d, a, k)\lambda(d, a, k) \text{ if } d' = 0 \\ s \sum_{(a,k)\in\Omega} \lambda(0, a, k) \text{ if } d' = 1 \\ \sum_{(a,k)\in\Omega}(1 - p(d - 1, a, k))\lambda(d - 1, a, k) \text{ if } d = 2, ..., D - 1 \\ \sum_{(a,k)\in\Omega}(1 - p(D - 1, a, k))\lambda(D - 1, a, k) \\ + \sum_{(a,k)\in\Omega}(1 - p(D, a, k))\lambda(D, a, k) \text{ if } d = D \end{cases} \tag{7}$$

where $\Omega(a', k') = \{(a, x) : a' = a'(d, a, k) \text{ and } k' = k'(d, a, k)\}$ defines the transition rule from (a, k) to (a', k') and $p(d, a, k) = p(e(d, a, k), k'(d, a, k))$.

The first line of equation (7) states that $1 - s$ of the employed last period will continue to be employed and $p(d, a, k')$ from each unemployment state transition to employment. The second line indicates that a proportion s of the employed will become newly unemployed. For states $d = 2, ..., D - 1$ a proportion $(1 - p(d, a, k))$ will continue the next state of unemployment. Finally

Table 1: Parameter values

Parameter	Value	Source
β (discount rate)	0.9915	Literature standard (Cahuc and Lehmann, 2000)
w (production while employed)	1.0000	Normalization
σ (Coefficient of risk aversion)	2.0000	Consistent with Fredriksson and Holmlund (2001)
s (Separation rate)	0.0321	Aggregated from Fujita and Ramey (2009)
δ (Depreciation rate of search capital)	0.5000	Baseline assumption
$\bar{a}$ (Maximum savings)	1.9100	Almost four months wages
UI Replacement rate	0.4620	Department of Labor
SA Replacement rate	0.1700	Wang and Williamson (1996)
Calibrated parameter		
r (Scenario 1)	0.7056	Calibration
r (Scenario 2)	0.2762	Calibration
r (Scenario 3)	1.1511	Calibration

the measure in state $d = D$, which covers those unemployed D periods or greater, is determined by those that were in state D and $D-1$ last period, but did not find a job.

A benevolent government maximizes a utilitarian social welfare function of the form:

$$SW = \max_{b(d)} \sum_a \sum_k \lambda(0,a,k)W(a,k) + \sum_{d>0} \sum_a \sum_k \lambda(d,a,k)U(d,a,k) \tag{8}$$

subject to the definition of a stable equilibrium. The next section discusses the computation algorithm used to compute (8).

3 Methedology

3.1 Calibration

I calibrate the model using data from the literature. First, the period length is two months and consequently I set $\beta = 0.95^{1/6}$, a fairly standard value in the literature (see Cahuc and Lehmann, 2000). Next, similar to Hopenhayn and Nicolini (1997), I use the following functional form for the job finding rate:

$$p = (1 - exp(-\upsilon(k', e))) \tag{9}$$

$$\upsilon(k', e) = rk'^{\gamma} e^{1-\gamma} \tag{10}$$

This form is consistent with an urn-ball type matching function as described in Petrongolo and Pissarides (2001) where υ serves as the number of applications (or tosses of the ball) and (10) describes a Cobb-Douglas application production function with inputs of search capital and search effort.

I use a constant relative risk aversion utility function over consumption with a linear cost to search effort:

$$u(c, e) = \frac{c^{(1-\sigma)}}{1-\sigma} - \theta e \text{ if } \sigma \neq 1 \tag{11}$$

$$u(c, e) = log(c) - \theta e \text{ if } \sigma = 1 \tag{12}$$

Given these functional forms parameterizing the model involves choosing values for r, σ, γ, s,w, R, and δ. I start by normalizing the value of production, w, to one. Next, I set $\sigma = 2$, which is consistent with Fredriksson and Holmlund (2001). Fujita and Ramey (2009) estimates a mean monthly separation rate of 0.0196 for the period 1976 - 2005. Aggregating to a bi-monthly separation rate I set s to 0.0321.[3] Next, to capture the notion that some goods that may assist with the job search may be durable and others non-durable, I set the the depreciation of search capital to 0.5 each period. Finally, I assume that the maximum amount of savings is approximately two times bi-monthly wages.

I set R and γ to different values depending on the scenario. For Scenario 1 the good is storable and search capital assists in making the search more effective, so I set $\gamma = 0.5$ and $R = 1$. In

[3] I Aggregate by determining the probability individual who is observed employed today will be unemployed two months later. The bi-monthly separation rate is then $s = s^r(1 - f^r) + (1 - s^r)s^r$ where s^r and f^r are the Fujita and Ramey (2009) estimates of the job finding and separation rates of 0.3405 and 0.0196.

Scenario 2 the good is storable, but search capital is not important to the job search, so I set $\gamma = 0$ and $R = 1$. Finally, in Scenario 3 the good is not storable and both search effort and search capital increase the probability of finding work, so I set $\gamma = 0.5$ and $R = 0$.

The final parameter r is calibrated to match a target unemployment rate of 6.17%, which is the average rate in the U.S. since 1948. I accomplish this by first setting the replacement rate to 0.462 for the first six months (3 periods) which is consistent U.S. unemployment insurance in 2010. After, the first six months of unemployment, UI is exhausted and I assume a social assistance benefit is available with a replacement rate of 0.17, as Wang and Williamson (1996) reports. I then adjust r until the model reaches the target unemployment rate. Note, that this is done for each of the three scenarios the introduction discucess, so that each set of assumptions replicates a 6.17% unemployment rate given the U.S. unemployment insurance system. Table 1 presents the alternative r's under each scenario.

3.2 Computational Strategy

To compute the optimal UI benefit system I utilize the simultaneous perturbation stochastic approximation (SPSA) approach that Spall's (2003) outlines, for the government's problem along with discrete space approach for the workers' problem. In the algorithm I approximate the benefit schedule, $b(d)$, with a third order chebyshev polynomial of the form:

$$b(d) = \sum_{n=0}^{3} \alpha_n T_n(d) \tag{13}$$

where n indicates the order of the polynomial and α_n is the associated coefficient. This allows me to conduct the maximization over the shape of the benefit schedule rather than the individual benefit amount in each period of unemployment.

To determine the welfare maximizing UI system I then use the following steps:

1. Choose an initial vector of coefficients for the chebyshev polynomial, α_k.

2. Randomly perturb the coefficients by Δ to form $\alpha_k^+ = \alpha_k + c_k\Delta$ and $\alpha_k^- = \alpha_k - c_k\Delta$, where

c_k is a decreasing gain sequence and Δ is drawn from a symmetric Bernoulli distribution.

3. For α_0^- and α_0^+ evaluate SW_k to determine SW_k^+ and SW_k^- using the following steps:

   (a) Discretize the state space using approximately 700 grid points across the savings and search capital state space.

   (b) with an initial guess at $W(a')$ and $U(d', a', k')$ calculate $W(a)$ and $U(d, a, k)$ by value function iteration and determine policy functions $k'(d, a, k)$, $a'(d, a, k)$ and $e(d, a, k)$.

   (c) With an initial guess at $\lambda(d, a, k)$ and policy functions calculate $\lambda(d', a', k')$.

   (d) Using $\lambda(d', a', k')$ and the UI policy calculate government savings.

   (e) Calculate the value of SW

   (f) Update $\lambda(d', a', k')$ with $\lambda(d', a', k')$ and increase (decrease) τ if government savings is negative (positive).

   (g) Repeat these steps until SW converges (which requires the $\lambda(d', a', k')$ to converge to $\lambda(d, a, k)$ and government savings to converge to zero).

4. Calculate an estimate of the gradients as $\hat{g}_k = \frac{-SW_k^+ + SW_k^+}{2c_k\Delta}$ and update the chebyshev polynomials coefficients using $\alpha_{k+1} = \alpha_k - a_k\hat{g}_k$ where a_k is another decreasing gain sequence.[4]

5. Repeat these steps until $(\alpha_{k+1} - \alpha_k)^2$ is sufficiently small.

The results in the next section use this algorithm to determine the optimal benefits system in each of the three Scenarios.

4 Results

4.1 Current UI policy

[4]The negatives of SW are used since the algorithm seeks the function's minimum.

Table 2: Current unemployment insurance policy results

State (d)	Income (All Scenarios)	Scenario (1) Search Capital: Yes Storage: Yes			Scenario (2) Search Capital: No Storage: Yes			Scenario (3) Search Capital: Yes Storage: No		
		Search Capital	Savings	Consump.	Search Capital	Savings	Consump.	Search Capital	Savings	Consump.
$d = 1$ (1 -2 months)	0.462	0.611	1.071	0.550	-	1.180	0.766	0.150	-	0.312
$d = 2$ (3 - 4 months)	0.462	0.813	0.529	0.499	-	0.734	0.918	0.240	-	0.297
$d = 3$ (5 - 6 months)	0.462	0.751	0.260	0.383	-	0.389	0.643	0.330	-	0.252
$d = 4$ (7 - 8 months)	0.170	0.562	0.000	0.266	-	0.177	0.542	0.180	-	0.155
$d = 5$ (9 - 10 months)	0.170	0.256	0.000	0.168	-	0.081	0.429	0.120	-	0.140
$d = 6$ (11 - 12 months)	0.170	0.146	0.000	0.151	-	0.000	0.256	0.090	-	0.140
$d = 7$ (13 - 14 months)	0.170	0.115	0.000	0.127	-	0.000	0.170	0.090	-	0.125
$d = 8$ (15 - 16 months)	0.170	0.090	0.000	0.138	-	0.000	0.170	0.090	-	0.125
$d = 9$ (17+ months)	0.170	0.090	0.000	0.125	-	0.000	0.170	0.090	-	0.125

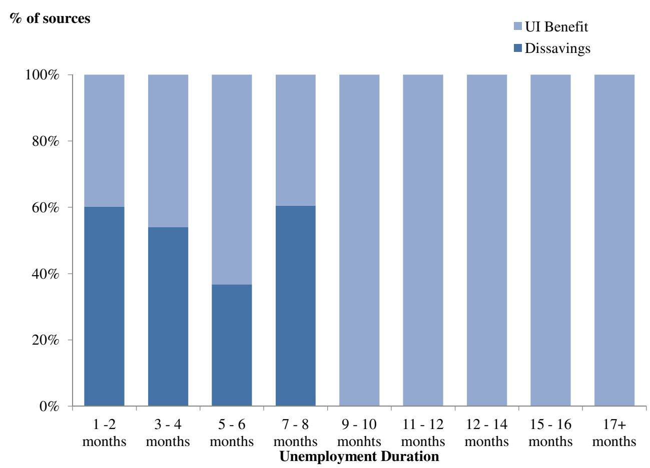
In this section I examine the economy under current policy, where UI is provided for the first six months of unemployment at a replacement rate of 0.462, and a social assistance benefit thereafter with a replacement rate of 0.17. Table 2 presents the average level of savings, search capital and consumption at each unemployment state, $d = 1, ..., D$ for each of the three sets of assumptions. In Scenario 1 workers use their savings slowly during the first eight months of their unemployment spell to help fund search capital and consumption. As pictured in panel (a) of Figure 1 in the first two months of unemployment ($d = 1$) dissavings accounts for 60% of financial resources with UI accounting for the other 40%. In the two months prior to exhausting unemployment benefits (months 5 - 6, $d = 3$) only 40% of financial resources comes from savings. When savings are exhausted (months 7 - 8, $d = 5$) workers rely soley on UI income to maintain search capital.

Panel (b) of Figure 1 presents workers use of these financial resources. In the first period of unemployment they are evenly split between consumption and search investment. Devoting a large percentage of resources to search capital builds up a search capital stock that peaks at 0.813 in months 3 - 4. As savings falls and UI nears exhaustion more financial resources are used for consumption. In order to maintain an even lower level of search capital, which falls to just 0.09 in the final two periods an increasing amount of the social assistance benefits is used for search investment.

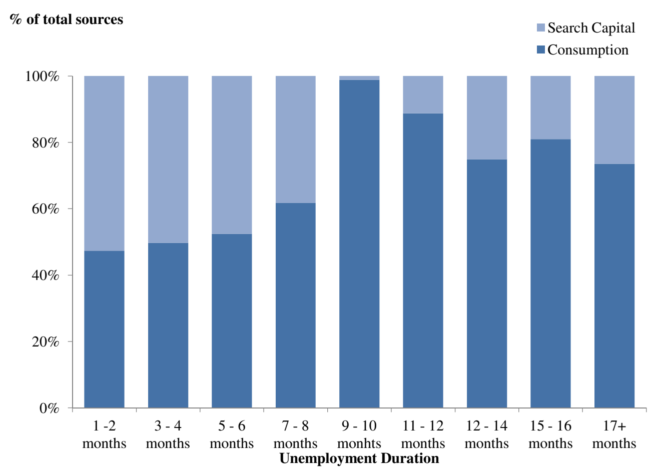
The final important measure to examine is the job finding rate as a function of the duration of unemployment which can be found in Figure 2. Under the assumptions of Scenario 1 the job finding rate starts around 40% and increase in the first three periods up to 61% as search capital increases. Once both savings and UI are exhausted the lower social assistance benefit, and the fact that savings has been exhuasted, leads workers unable to maintain the same level of search capital. Consequently, the job finding rate is significantly lower than in the intial periods where consumption and income are higher. This contrasts with models that do not allow for search capital and where a declining sequence of benefits lead to an increasing job finding rate.

In comparison to Scenario 1, under the assumptions of Scenario 2, where there is no search capital, workers exhaust their savings at a much much slower rate. The absence of search capital

Figure 1: Sources and uses of financial resources



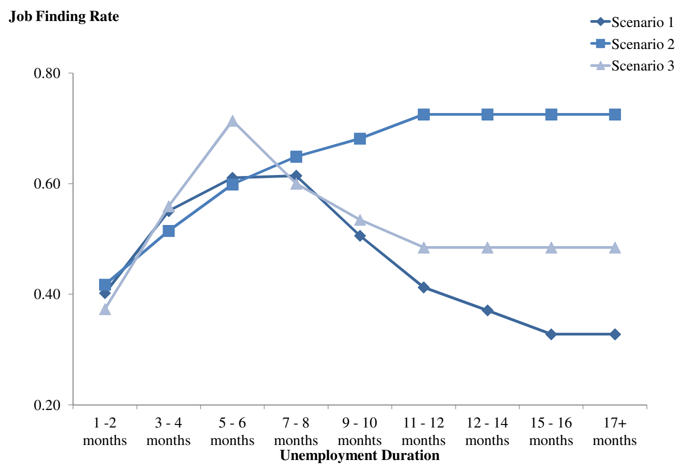
(a) Sources of financial resources



(b) Uses of financial resources

eliminates an expense workers take on in Scenario 1. As a result, the level of savings is much higher than in Scenario 1 and savings is exhausted four months later. The exclusion of the search capital shows a time path for the job finding rate that is also very familiar in the literature. As consumption falls due to exhaustion of savings and UI benefits, intangible search effort increases. This pushes the job finding rate from 42% in the first period to 73% in the final three months. After,

Figure 2: Job finding rate

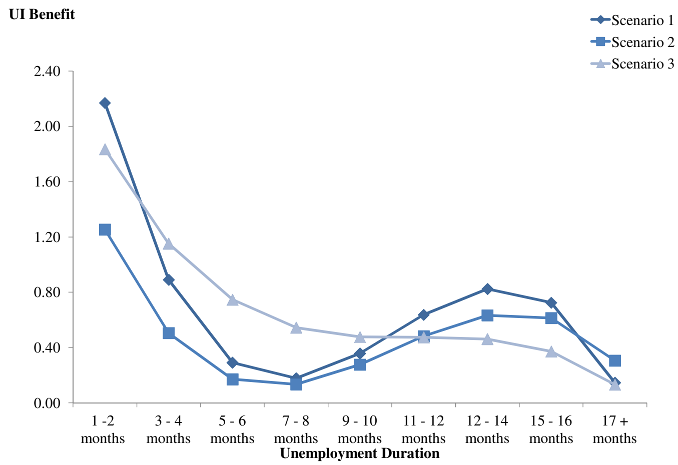


UI and savings have been completely exhausted, consumption, search effort and the job finding rate are all constant. Under the assumptions of this scenario a declining sequence of benefits leads to an increase in the job finding rate, unlike Scenario 1.

The third scenario, which Table 2 presents in the last set of columns, allows for search capital, but not savings. Since, the unemployed must only rely on UI, search capital accumulates at a slower rate than in Scenario 1. In addition, once UI is exhausted search capital falls at faster rate. Looking at how this affects the job finding rate Figure 2 shows the job finding rate rises faster as search capital is being accumulated. This is because without savings consumption is lower which incentivizes greater search effort than in the first scenario. However, this also makes search capital harder to maintain so that the job finding rate peaks earlier than Scenario 1. Also, similar to Scenario 1 a cut in benefits does not ensure a rising exit rate from unemployment.

Each of these scenarios suggest very different environments. In the traditional, framework without search capital and with savings, a downward profile of benefits increases the probability of exiting unemployment monotonically over the unemployment spell. The third scenario suggests that this is not the case when there are monetary costs to search. While the threat of exhausting benefits does increase search effort and increases the job finding rate when workers are eligible for

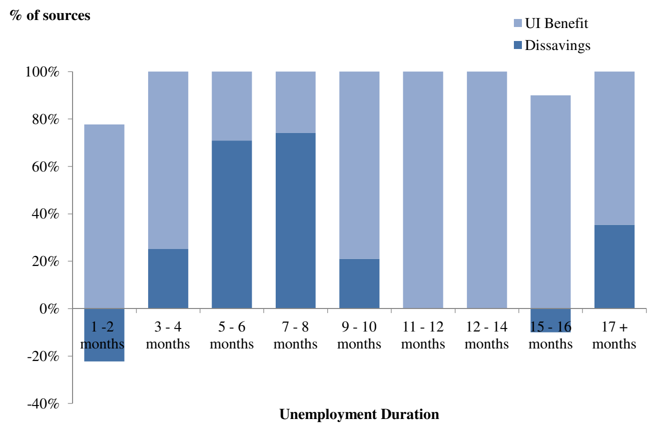
Figure 3: Optimal UI Systems: Benefit Schedule



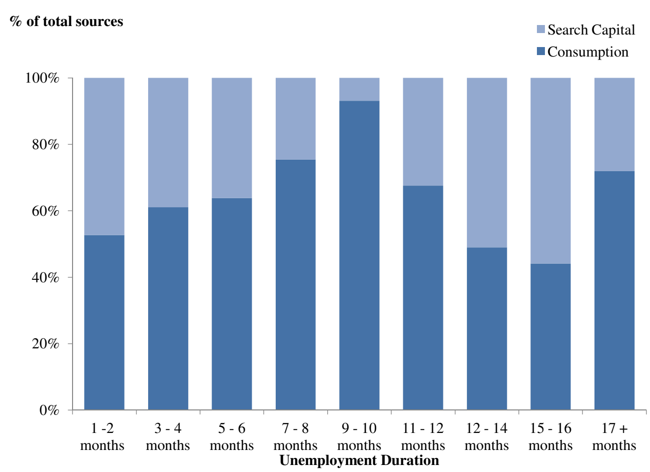
UI, once UI is exhausted the job finding rate falls as it becomes hard to maintain search capital. Finally, Scenario 1 shows that this can be somewhat mitigated by precautionary savings, which allows workers to maintain a higher level of search capital for a longer period of time. The next section explores the optimal benefit schedule under these three different environments.

4.2 Optimal UI Systems

Figure 4: Optimal UI: Sources and uses of financial resources



(a) Sources of financial resources



(b) Uses of financial resources

Table 3: Optimal UI policy results

	Scenario (1) Search Capital: Yes Storage: Yes				Scenario (2) Search Capital: No Storage: Yes				Scenario (3) Search Capital: Yes Storage: No			
State (d)	UI Benefit	Search Capital	Savings	Consump	UI Benefit	Search Capital	Savings	Consump.	UI Benefit	Search Capital	Savings	Consump.
$d = 1$ (1 -2 months)	2.17	0.73	1.62	0.82	1.25	-	1.37	0.84	1.83	0.80	-	1.03
$d = 2$ (3 - 4 months)	0.89	0.83	1.32	0.73	0.50	-	1.10	0.77	1.15	0.76	-	0.79
$d = 3$ (5 - 6 months)	0.29	0.78	0.61	0.64	0.17	-	0.60	0.68	0.75	0.54	-	0.59
$d = 4$ (7 - 8 months)	0.18	0.56	0.09	0.52	0.13	-	0.18	0.56	0.54	0.36	-	0.45
$d = 5$ (9 - 10 months)	0.36	0.31	0.00	0.42	0.28	-	0.00	0.45	0.48	0.28	-	0.38
$d = 6$ (11 - 12 months)	0.64	0.36	0.00	0.43	0.48	-	0.00	0.48	0.47	0.28	-	0.33
$d = 7$ (12 - 14 months)	0.82	0.60	0.00	0.40	0.63	-	0.00	0.63	0.46	0.30	-	0.30
$d = 8$ (15 - 16 months)	0.72	0.66	0.08	0.28	0.61	-	0.08	0.54	0.37	0.28	-	0.24
$d = 9$ (17 + months)	0.15	0.27	0.00	0.16	0.31	-	0.00	0.35	0.13	0.11	-	0.12
Tax Rate	0.09				0.05				0.09			

Figure 5: Optimal UI Systems: Job finding rate

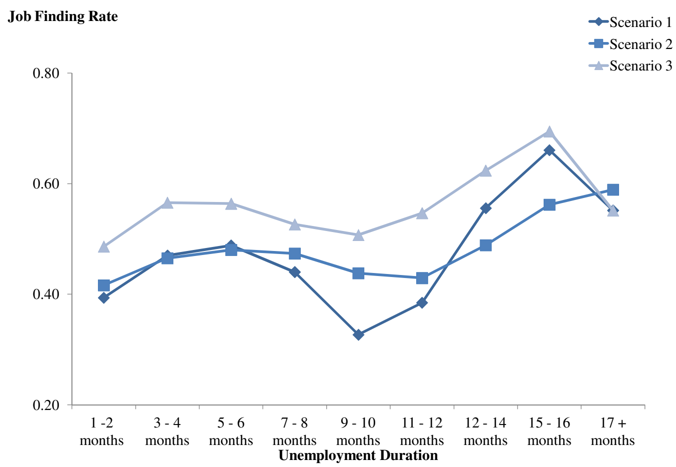


Table 3 presents the optimal UI systems under each scenario along with average search capital, savings and consumption for each period of unemployment and Figure 3 presents the results of the optimal UI systems graphically. For Scenario 1 the replacement rate starts very high, more than twice bi-monthly wages. The average worker uses almost a third of this benefit to purchase an initial stock of search capital and saves almost another third. The optimal benefit schedule falls quickly to just 0.18 in the months 7-8, almost the same as the social assistance benefit in the U.S. system. A declining sequence of benefits through the first six months provides incentives for search effort and to use savings rather than rely on UI benefits. Figure 4 indicates that during this period savings goes from being a use of financial resources to a source, as more than 60% of a workers budget comes from savings in the 7 - 8 month. However, as savings dwindles workers use a greater proportion of resources for consumption. During the beginning of an unemployment spell workers use just about 50% of their financial services for search capital, but by months 9-10 the use less than 10% for search capital.

When workers exhaust savings in months 9 - 10, UI benefits increase to provide greater insurance against lost consumption, as well as to provide resources for search capital. The percentage of the UI benefit that workers use for search capital rises from around 10% in months 9 - 10, to more than 50% in months 15 - 16. Finally, benefits in the final periods fall substantially. This serves a threat of lost consumption for workers, which they will try to avoid by exerting more search effort.

In Scenario 1 increasing the generosity of the UI system in any period has two effects. First, it allows the worker to maintain a higher level of search capital. The second effect is that a higher level of benefits, particularly early in the unemployment spell, disincentivizes precautionary savings. The average worker saves just one periods worth of wages while unemployed in Scenario 1. The low amount of savings reflects a difficult choice for the government. On one hand greater benefits early in the unemployment spell allows workers to build search capital. On the other hand the higher benefits disincentives savings, meaning that the government must take on more of the burden of supplying the financial resources for the job search.

Figure 5 shows the job finding rate for each period of unemployment. The figure shows a very different pattern than what exists under the current U.S. system in Figure 2. Under the optimal UI system the job finding rate shows a general upward trending, despite a small dip after the average worker exhausts their savings. In the standard UI system which pays benefits for six month and then a steep drop to social assistance the exit rates rise fall for the long-term unemployed. However, the optimal benefit schedule does induce a *general* increase in exit rates from unemployment.

When monetary search is not assumed the optimal UI system is a less volatile version of Scenario 1. The optimal UI benefit at the start of an unemployment spell is far lower than in Scenario 1, although still high (1.25). The high level of benefits can be saved for use during the unemployment spell. In the subsequent periods UI benefits falls to 0.13 in months 7 - 8. In the following period all savings is exhausted and it is optimal for benefits to increase to mitigate the exhaustion of savings on consumption. Similar to Scenario 1 benefits again fall to provide incentives to search. The path of the job finding rates in Figure 5 are also similar to Scenario 1, but less volatile.

The last scenario in Table 3 presents the results with search capital, but without savings. In this case the UI benefit starts close to same level as Scenario 1 with an initial replacement rate of 1.83. This funds an initial search capital of 0.80. The replacement rate falls to 1.15 in the next period and a further 0.50 reduction in the following period, reducing benefits by more than half in the first six months. These sharp reductions in benefits, incentivizes greater search effort. From months 7 to 16 however the UI benefit schedule is relatively flat. This allows workers to maintain a level of search capital in between a narrow range (0.28 to 0.36). Average consumption falls throughout, but in comparison to the Scenario 1, it falls faster, since precautionary savings cannot mitigate the fall in consumption.

5 Conclusion

A long list of studies have examined the optimal design of unemployment insurance. For the most part these studies focus on the need to exert search effort to find work, where the costs of this effort is either a direct reduction in utility or a loss of leisure. In this paper I argue that in addition to this intangible search effort, workers can purchase goods and services that may assist in the job search. To capture the affect of these purchases I develop a simple partial equilibrium search model where three actions of workers are hidden from the government: savings, search capital and search effort.

Many studies in the UI literature show that the optimal UI system includes a decline in benefits over the course of the unemployment spell. Such a decreasing schedule of benefits can provide incentives for workers to exert intangible search effort. However, if there are goods and services that are critical to the search process the long-term unemployed may not be able to afford to continue their search if UI benefits are exhausted. This may result in workers being caught up in long-term unemployment.

The results of this paper suggest that the optimal UI system is more complex than a declining sequence of benefits. When monetary benefits are considered and capital markets are non existent, UI benefits are almost constant for 10 months of the unemployment spell, so that workers can maintain their search capital. When, hidden savings is also allowed, but not monetary costs of search, UI benefits decline sharply until savings is exhausted. Benefits then increase to preserve consumption, but then decline again to give incentives to search effort. Finally, when search capital and savings is assumed, the volatility of the benefits schedule is increased. This is because greater benefits are needed in order to assist the worker in purchasing search capital.

The results suggest that the current UI system in the U.S., and in many other countries is inappropriate. Most developed countries pay a given amount of benefits for a certain period of time after which there may be a social assistance system to provide a subsistence of level of consumption. The model this paper explores suggest that after a period of time where workers can be expected to supplement UI benefits with savings, benefits should rise. Both the initial UI benefit and the subsequent increase in benefits should be sufficient to allow workers to purchase the goods and services that are needed to mount an effective job search.

References

Abdulkadiroglu, A., Kuruscu, B., and Sahin, A. (2002). Unemployment Insurance and the Role of Self-Insurance. *Review of Economic Dynamics*, 5(3):681–703.

Aguiar, M., Hurst, E., and Karabarbounis, L. (2011). Time Use During Recessions.

Cahuc, P. and Lehmann, E. (2000). Should unemployment benefits decrease with the unemployment spell. *Journal of Public Economics*, 77(1):135–153.

Flemming, J. (1977). Aspects of Optimal Unemployment Insurance: Search, Leisure and Capital Market Imperfections.

Fredriksson, P. and Holmlund, B. (2001). Optimal Unemployment Insurance in Search Equilibrium. *Journal of Labor Economics*, 19(2):370–399.

Fujita, S. and Ramey, G. (2009). THE CYCLICALITY OF SEPARATION AND JOB FINDING RATES. *International Economic Review*, 50(2):415–430.

Hansen, G. and Imrohoroglu, A. (1992). The Role of Unemployment Insurance in an Economy with Liquidity Constraints and Moral Hazard. *Journal of Political Economy*, 100(1):118–142.

Hassler, J. and Mora, J. (2002). Should UI benefits really fall over time?

Hopenhayn, H. and Nicolini, J. (1997). Optimal unemployment insurance. *Journal of political economy*, 105(2):412–438.

Lentz, R. (2009). Optimal unemployment insurance in an estimated job search model with savings. *Review of Economic Dynamics*, 12(1):37–57.

Pavoni, N. (2007). On optimal unemployment compensation. *Journal of Monetary Economics*, 54(6):1612–1630.

Petrongolo, B. and Pissarides, C. A. (2001). Looking into the black box: A survey of the matching function. *Journal of Economic Literature*, 39(2):390–431.

Pissarides, C. A. (1991). *Equilibrium Unemployment Theory*. Basil-Blackwell.

Shavell, S. and Weiss, L. (1979). The Optimal Payment of Unemployment Insurance Benefits over Time. *Journal of Political Economy*, 87(6):1347–1362.

Spall, J. C. (2003). Introduction to stochastic search and optimization: estimation, simulation, and control.

Wang, C. and Williamson, S. D. (1996). Unemployment insurance with moral hazard in a dynamic economy. *Carnegie-Rochester Conference Series On Public Policy*, 44:1–41.

Wang, C. and Williamson, S. D. (2002). Moral hazard, optimal unemployment insurance, and experience rating. *Journal of Monetary Economics*, 49:1337–1371.