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Optimal Unemployment Insurance: A Guide to the Literature

Edi Karni

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Social Protection Unit
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Edi Karni
Johns Hopkins University

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Abstract

Unemployment insurance has been the subject of numerous theoretical and empirical studies. These studies elucidate the benefits and the cost of unemployment insurance, namely, the improved the allocation of risk bearing and the reduced incentives for work.

In the past two decades a branch of the literature has emerged that deals with the optimal design of unemployment insurance. This literature has been influenced by ideas and methods from the field of information economics and theories from the field of labor economics. The result is a collection of models designed to highlight a variety of issues pertaining to the provision of optimal unemployment insurance.

This paper reviews these issues, summarizes the relevant literature, assesses its accomplishments, and points out problems that require further study.

OPTIMAL UNEMPLOYMENT INSURANCE:
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Introduction

Unemployment insurance (UI) programs vary across countries and over time in terms of eligibility for benefits, their size and duration, and methods of financing.[1] .Eligibility for UI benefits may depend on employment history, the immediate reason for becoming unemployed, efforts made to secure new employment, and record of refusal to accept suitable job offers. The size of the benefits may depend on the unemployed past earnings and the duration of the current spell of unemployment. The duration of UI benefits may be limited or not. The program may be financed by one or more of the following methods: contributions of employers, contributions of employees, or from general tax revenue.

Presumably these variations reflect attempts to balance the benefit of more efficient allocation of the unemployment risk and the cost of reduced work incentives and other distortions associated with UI insurance. It is, therefore, not surprising that much of the theoretical and empirical research on UI aimed at identifying and assessing the magnitude of its various incentive effects and its impact on unemployment and wages. The knowledge thus obtained should prove useful for the purpose of designing optimal UI programs. These in turn should provide useful guidelines for policy makers and practitioners interested in instituting such programs in countries in which they do not exist and to reform programs in countries in which UI program exist. The purpose of the present paper, however, is to review the existing literature on optimal UI insurance, to assess its accomplishments, and to point out relevant issues that require further study.

1.1 Unemployment Risk

The demarcation line between UI and other social insurance programs is not always clear. In this paper, UI is taken literally to include only programs designed to indemnify the unemployed for loss of income resulting from the loss of employment. It is important to recognize that not every kind of loss of employment constitutes an insurable risk. The principle used to guide the definition of unemployment risk is the extent to which the loss of employment - and, consequently, of income - is due to circumstances that are, by and large, beyond the control of the employee.

An employee may become unemployed by quitting his job voluntarily, by being fired for industrial misconduct or unsatisfactory job performance, or as a result of adjustments in employment required by business considerations of the firm in which he is employed. Quitting voluntarily or being fired for industrial misconduct are within the control of the

[1] See, for example, the survey by Atkinson and Micklewright (1991) of the variation in unemployment insurance among OECD countries.

employee and, consequently, do not qualify as unemployment risk. Unsatisfactory job performance is a source of unemployment risk, although in practice it is difficult to distinguish from shirking; job performance may be subject to manipulation by employees. Variations in employment that are due to business considerations may be a response to the introduction of labor-saving technologies, to reorganization of the firm's operations, or to reduced demand for the firm's output. Note, however, that predictable demand variations, such as seasonal variations in employment of agricultural workers, do not require UI. Only unanticipated variations in employment - whether temporary or permanent, due to demand shifts or any other reason - justify institution of UI.

1.2 Preliminary Observations

The literature on optimal UI is relatively new. Its development during the past two decades have been influenced by ideas and methods from two main fields of research, labor economics and economics of information.

From labor economics it borrowed models describing the search behavior of the unemployed as well as job-matching models of the labor market. The job-search models depict the behavior of the unemployed in terms of an optimal stopping rule in environments in which information concerning job offers appears sequentially and the decision at each stage is whether to accept a current job offer or to reject the offer and continue the search.[2] The job-matching models introduces general equilibrium considerations according to which the success of the search effort depends on the relative number of vacancies and job seekers.

Developments in the economics of information, especially advances in the theory of incentive contracts, had a decisive influence on the analysis of optimal UI schemes.[3] Somewhat less pronounced was the influence of ideas about incentive compatibility constraints and equilibrium concepts introduced to model markets plagued by adverse selection problems.

Some studies of UI were conducted within the framework of partial equilibrium analysis, while others adopted a general equilibrium approach. Typically, studies of the former type take the wage rate (wage distribution) as given, thereby disregarding the effects of UI on the equilibrium. In general equilibrium models the equilibrium wage rate is determined jointly with the parameters of the optimal UI program.

The notion of optimality itself is not uniform across studies. In some studies, typically those that take the partial equilibrium point of view, the criterion for evaluating alternative UI schemes is minimizing the cost of UI subject to the condition that it attains a minimum level of expected utility of the participating individuals. Other studies, notably those that take the general equilibrium viewpoint, use the criterion of Pareto

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[2] For surveys of this literature see Lippman and McCall (1976a, 1976b) and Mortensen (1986).

[3] Today analysis of the economic consequences of asymmetric information is a standard topic covered in graduate textbooks on microeconomics theory. A more detailed exposition is given in Salanie (1994) and Mach-Stadler and Perez-Castrillo (1997)

optimality, appropriately defined for environments characterized by asymmetric information. For some purposes the former approach entails no essential loss of generality, especially if the economy is assumed to be populated by individuals who, for the purpose of UI, are identical. In general, however, the second approach is preferable since it implies minimizing the cost of UI and is capable of dealing with the choice of the level of expected utility of diverse groups.

1.3 Asymmetric Information

Moral hazard and adverse selection problems impede the effectiveness of social insurance programs in general and of UI in particular.[4] Hence any attempt to tackle the problem of the design of optimal UI must begin by identifying and characterizing potential sources of private information pertaining to hidden actions and hidden characteristics that give rise to problems of moral hazard, adverse selection, and fraud.

Two kinds of hidden actions may give rise to moral hazard problems in UI: the effort, time and money, the unemployed person expands to secure new employment and his implicit willingness to accept specific job offers, and the effort employees exert performing their jobs. Together these influence the duration of the unemployment spell and the UI compensation. Second the effort employees exerted performing their jobs. Specifically, shirking affects the probability of transition into the state of unemployment. From the viewpoint of UI shirking may be classified as industrial misconduct. Consequently, if the unemployment is a direct result of shirking the dismissed employee is not entitled to UI. It seems, therefore, that shirking is not a problem. In practice, however, it may be difficult to distinguish shirking from incompetence and to attribute low level of performance to voluntary behavior on the part of the employee. Thus, the probability of transition to a state of covered unemployment is to some degree subject to manipulation by the employee and cannot be dismissed, *a priori*, as a source of moral hazard. The literature on incentive contracts suggests that this issue of motivation is dealt with by the wage contract. Consequently, in so far as the design of optimal UI is concerned, the main question is the analysis of the effect of alternative UI designs on resource allocation in the presence of incentive wage contracts. Note that the issue of incentive contracts also arises insofar as the behavior of the unemployed is concerned. There, however, the UI itself is the incentive contract. Not surprisingly, therefore, most of the literature on optimal UI has focused on this issue.

Two kinds of hidden characteristics may give rise to adverse selection problems in UI. First, employees differ in terms of their preferences for leisure (or, more generally, nonmarket employment of their time). These differences may reflect the personalities of the workers as well as the nonmarket opportunities they face, which may be difficult if not impossible to monitor. At one extreme are individuals who would rather work even if the replacement ratio offered as UI benefit is 100 percent because they derive psychic pleasure (fulfillment) from their work, at the other extreme are individuals who would

[4] See the discussion of this point in Diamond (1993

rather be unemployed even without UI benefits. After having a baby, for example, a new parent may decide to stay home regardless of whether he or she is covered by UI.

A second source of private information that may give rise to adverse selection is due to firm-specific risk. Each firm or industry is subject to demand variations or technological changes that bear upon future employment prospects. These changes become apparent to insiders including management and employees, long before they are perceived by outsiders, including the provider of UI. For instance, insiders may observe well in advance of outsiders that insufficient orders or plans to install new equipment are likely to result in work force redundancy and eventual unemployment. Employees who find themselves in this kind of situation are more inclined to take out UI.

In the context of UI, the different characteristics of either firms or individuals interact with their actions, producing an effect that tends to exacerbate the problem of adverse selection. This effect, termed endogenous adverse selection by Chiu and Karni (1998), is the result of imperfect experience rating. To grasp this notion, suppose that UI is financed by contributions by employees and consider the optimal job search policies of individuals characterized by a distinct preference for leisure. Specifically, (ceteris paribus) unemployed individuals with stronger preference for leisure are characterized by a higher reservation wage and are less likely to accept a job offer than individuals characterized by a weak preference for leisure. Hence, individuals of the first type tend to remain unemployed longer and, consequently, represent more risky prospects to the UI provider than individuals of the second type. In principle this difference in risk should be reflected in the UI premium paid by the different types so that each type would bear the full social cost of its policy. In practice, however, the reservation wages are private information and, consequently, experience rating is, at best, imperfect. Under imperfect experience rating neither type internalizes the entire social cost of its job search strategy. Consequently, both types tend to adopt more selective job search policies, which increases the overall unemployment rate and the total cost of UI. Moreover, the job search behavior of the high-risk type is subsidized by the low-risk type.

Similar distortions arise with regard to the layoff policies of firms characterized by distinct firm-specific risks. Consider an economy in which, as in the U.S., the UI program is financed through contributions by employers. *Ceteris paribus*, employees of firms characterized by high firm-specific risk are more likely to be laid off than employees of low-risk firms. They, therefore represent more risky prospects from the viewpoint of UI. In principle, these variation in riskiness should be reflected in the UI contribution of the respective employers. In practice, however, experience rating of employers is imperfect and employment in high-risk firms is implicitly subsidized by the employees in the low-risk firms. Imperfect experience rating means that firms of all types adopt more aggressive layoff policies, which tends to increase the overall rate of unemployment.[5] Furthermore, this cross subsidization by artificially lowering the cost of employment in

[5] This issue was first raised by Feldstein (1976, 1978) who claimed that a significant part of the unemployment in the U.S., where firms pay the UI premium in the form of payroll tax, is due to layoff policies that are made affordable by imperfect experience rating. See also Ehrenberg and Oxana (1976), Topel and Welch (1980), and Topel (1983, 1984).

high-risk sectors of the economy and increasing it in the low-risk sectors tends to distort the allocation of employment.
Finally, difficulties monitoring the activities of the unemployed give rise to UI fraud. The provider of UI may find it costly and perhaps practically impossible to ascertain that individuals receiving UI benefits are, in fact, unemployed. In such circumstances the unemployed are tempted to conceal the fact that they have found employment so that they can continue to collect their benefits. This behavior increases the cost of UI and defeats the purpose of the program.

In the next section we review the literature on optimal UI that has addressed these issues and identify the main insights it provides. This limited objective means that the vast literature on the positive economics of UI is ignored. Section 3 contains a discussion of the accomplishments of this literature and points out questions and areas that require further study.

2. Literature Review

2.1 Analytical Ideas and Empirical Findings

Much of the literature on UI has been devoted to the study of the effect of UI benefits on the duration of unemployment spells. This literature emphasizes the moral hazard problem created by insufficient monitoring of job search efforts. Strongly influenced by the work of Mortensen (1977), this literature addresses two aspects of the problem: the intensity of efforts made to secure new employment and the willingness of the unemployed to accept a job offer. To model the situation, Mortensen regards job search as a process of sequential sampling from a distribution of wage offers.

In many situations involving sampling from a known distribution, the optimal search strategy is characterized by a reservation wage property. This means that, prior to obtaining a new observation, there is a wage rate such that if the new observation exceeds that level then the offer is accepted and search terminates, otherwise the offer is rejected and search continues. Hence, *ceteris paribus*, the higher the reservation wage the less likely the unemployed is to accept an offer at any given stage of the process and, consequently, the longer is the duration of the unemployment spell.

In Moretensen's model, job search takes the form of a sequential sampling from a known distribution of wage offers, F with no recall.[6] Sampling takes place over time, and the probability of generating a job offer during a given time interval, h, is assumed to be proportional to the fraction of the period devoted to search. The cost of search is taken to be the value of forgone leisure, which depends on the person's income, including UI benefits. The probability of being laid-off during any given interval is assumed to be constant and *independent of the worker's actions.*

[6] No recall means that a job that is not accepted when offered is not be available at a later date.

Individuals in this model are assumed to pursue search strategies so as to maximize the expected sum of discounted utility of the future stream of income-leisure combination, taking into account the ever-present unemployment risk and UI benefits. Individuals are assumed to consume their income in each period, so there is no self-insurance against unemployment risks. To qualify for unemployment compensation, an individual must have held a job prior to entering the state of unemployment and he or she must have been laid-off (as opposed to voluntarily quitting). Qualified unemployed individuals are entitled to unemployment compensation for a limited time. Hence, their job search efforts in each period are affect by the benefit rate, which is *assumed constant,* as well as the time remaining before their entitlement period is exhausted.

The probability that an unemployed worker will make the transition from the state of unemployment to employment during a time interval, the *escape rate*, equals the product of the probability of generating a job offer, which is a function of the intensity of the search effort, and the probability of accepting the offer, which depends on the individual's reservation wage. The escape rate, q, is given by:

$$q = \alpha\,(1 - F(\omega)),$$

where α is the probability of generating a job offer and ω is the reservation wage. Notice that the escape rate is inversely related to the average duration of the unemployment spell. For a fixed escape rate, $\bar{q}$, the expected unemployment spell is given by:

$$D(\bar{q}) = \int_0^\infty v\bar{q}e^{-\bar{q}v}\,dv = \frac{1}{\bar{q}}.$$

Mortensen's analysis shows that:

(1) *The escape rate of a qualified worker who has not exhausted his unemployment benefits increases with the duration of the unemployment spell*. This result is due to the fact that the reservation wage is set at the point at which the worker is indifferent between remaining unemployed and taking a job at the reservation wage. The optimal level of search intensity is set at the point at which the marginal (indirect) utility of time allocated to search equals the marginal utility of leisure. As the unemployed approaches the limit on the duration of UI benefits, the utility associated with remaining unemployed declines. This induces the unemployed to lower his reservation wage and at the same time to increase the intensity of his search, both of which have the effect of increasing the escape rate. By the same logic, unemployed individuals who are either unqualified for UI or have exhausted their benefits will select a constant search effort and reservation wage and, consequently, will have a constant escape rate.

(2) *The escape rate of newly unemployed individuals decreases with the duration of the benefit period. If consumption and leisure are complementary goods, then the escape rate decreases when the benefit rate increases.* These comparative statics results reflect the

fact that an increase in either the size or the duration of unemployment benefits tend to increase the reservation wage. This is the traditional incentive effect. Moreover, an increase in unemployment benefits reduces the expected return to search. In addition, if consumption and leisure are complements then an increase in the benefit rate increases the value of leisure. Both these factors tend to reduce the search intensity and, consequently, the escape rate.

(3) *The escape rate of unemployed individuals who are not receiving unemployment benefits increases with both the benefit rate and the duration of the benefit period.* The rationale underlying this conclusion is that improved UI terms increase the expected utility in future unemployment states. However, to qualify for unemployment benefits in the future, an individual must first find employment.

Mortensen's work was not intended to study the welfare implications of UI or the design of such program. Yet several aspects of this work are relevant for our purpose. First, the model provides a framework for the analysis of the incentive effects of UI on job search. Second, the analysis underscores the differential effects of UI on search depending on the state of the searcher. Third, by emphasizing the difference in the incentive effects of UI on unemployed receiving benefits and unemployed not qualified for such benefits, the analysis highlights the role of employment as mean of creating UI-capital (i.e., by building eligibility for future UI benefits).

An empirical study of the validity of the predictions of Mortensen's model and estimation of the effects of the UI variables on the duration of the unemployment spells is provided by Meyer (1990).[7] More specifically, Meyer postulated an instantaneous escape (hazard) rate function, $\lambda_i(.)$, of the following form:

$$\lambda_{i,}(t) = \lambda_0(t) \exp(z_i(t)'\beta),$$

where $\lambda_0(t)$ is the base line hazard at time t, which is unknown; $z_i(t)$ is a vector of explanatory variables for individual i at time t; and β is a vector of unknown parameters. The explanatory variables include the number of dependents, marital status, race, age, state unemployment rate, UI benefit level, pre-UI after tax wage, and variables representing the duration of the period until the benefits lapse. The probability that an unemployment spell lasts until time t+1 conditional on its lasting up to period t is given by:

$$\Pr\left[T_i \geq t+1 \;\middle|\; T_i \geq t\right] = \exp\left[-\int_t^{t+1} \lambda_i(s)ds\right],$$

where T_i is the duration of individual i unemployment spell. If $z_i(t)$ is assumed constant between t and t +1, then substituting for λ_i from the previous equation we get:

[7] Meyer uses data from Continuous Wage and Benefit History which includes males from twelve state in the U.S. during the period 1978-1983.

$$\Pr\left[T_i \geq t+1 \;\middle|\; T_i \geq t\right] + \exp\left[\left(z_i(t)'\beta\right) + Int\int_t^{t+1} \lambda_o(s)ds\right].$$

The escape rates were estimated using several specifications. Insofar as our main interest is concerned, the following conclusions are worth noting:

(1) *High UI benefits reduce the escape rate.* In particular, a 10percent increase in the UI benefits is associated with 8.8 percent decrease in the escape rate, suggesting that UI benefits have strong disincentive effect. Put differently, the estimated effect of a 10 percentage point increase in the replacement ratio is to increase the duration of unemployment spells by about one and a half weeks. (These estimates are somewhat higher than those obtained in other studies and they apply to the period before UI benefits are exhausted.)

(2) *The main effect of the duration of the period until benefits are exhausted is at the outset of the unemployment spell and just before benefits lapse.* More specifically, ”the point estimates imply that moving from 54 to 41 weeks until exhaustion raise the hazard by 46 percent. The hazard is essentially flat between 46 and 6 weeks, but the point estimate imply small decrease in the hazard. Between 6 and 2 weeks before benefit exhaustion the hazard rises 109 percent. One week away the hazard rises additional 95 percent” [Meyer (1990), p. 780].

While these findings do not constitute a test of Mortensen's theory, they suggest substantial disincentive effects of UI benefits. The large increase in the escape rate toward the exhaustion of the benefit period suggests that the anticipated decline (elimination) of these benefits also has a strong effect. The fact that the escape rate also increases at the outset of the unemployment spell may be explained by the prevalence of temporary layoffs. The relation between UI and temporary layoff is a subject that received much attention and will be discussed in the sequel.

2.2 Optimal UI and the Role of Saving

Both the theoretical and empirical analyses of the effects of UI on the duration of unemployment spells are exercises in positive economics and, as such, take the parameters of the UI program as given. These studies underscore the incentive implications of UI and, consequently, raise the issue of the design of UI program that strikes the best balance between the benefits associated with consumption smoothing and the adverse impact on the incentives to work. This issue was first address in Baily (1977a, 1977b) in the framework of a two-period consumption-saving model with a second period income risk. The income risk is interpreted as loss of income due to unemployment. The risk of losing one's job is exogenous. However, the income loss depends on the duration of the unemployment spell and is affected by the job search effort and the reservation wage.

In the absence of UI, saving is a form of self-insurance intended to smooth consumption over time. Since saving entails sacrificing current consumption in exchange for future consumption, he optimal level of saving occurs when the marginal utility of a dollar saved equals the expected discounted marginal utility of future consumption. In the event that the individual is employed in the second period, he consumes too much; in the event that he is unemployed, he consumes too little. The shortcoming of saving as a mean of self-insurance is that, unlike UI, it is not a contingent claim against future consumption. Under symmetric information, actuarially fair UI will replace that part of household saving intended as a precaution against unemployment risk. Moreover, fair UI induces individuals to take out full insurance which renders consumption independent of the state of employment. However, if the job search effort of the unemployed person is private information, then full UI insurance reduces the motivation to work, thereby distorting the job search process and increasing the duration of the unemployment spell.

Baily (1977a) addresses the issue of optimal UI in a model with homogenous work force and private information regarding job search efforts. The assumption of a homogenous population simplifies the analysis, since the social welfare function coincides with the expected utility of the representative worker. Assuming UI that is financed by proportional income tax and operating under balanced budget, Baily examines the necessary conditions under which of the UI benefits are optimal. He finds that, at the optimal level, the marginal benefits of consumption smoothing equal the welfare loss associated with the marginal increase in the average unemployment spell. He then considers the possible effect of redundancy payment (i.e., a lump-sum payment upon becoming unemployed) on the adverse effect of UI. Unlike the regular UI benefits, which are paid periodically, a redundancy payment does not have the adverse incentive effects. Thus, it is welfare enhancing in the restricted setup of Baily's model . This conclusion does not take into account the consumption smoothing advantage of UI if the unemployment spell is prolonged, however. Moreover, if the probability of becoming unemployed is affected by the employee's performance and if this performance is subject to manipulation, redundancy payment may create a moral hazard problem of a different type. A worker who is likely to find new employment quickly will intentionally perform poorly in order to be dismissed and collect the redundancy payment. Furthermore, if the experience rating is not accurate, firms will exploit the situation by adopting a policy of short-term layoffs that would permit the workers to collect the redundancy payment.

The work of Baily is important in that it addressed for the first time the issue of the design of optimal UI program. Moreover, it underscores some possible implications of UI. It does so, however, in the context of a model that is too simple in some important respects. First, the assumption that dismissal from a job is exogenous and, in particular, unaffected by job performance, leaves out potentially important sources of moral hazard. Second, the model does not consider the effects of UI on firm behavior. Third, the use of a representative agent, in addition to begging important issues concerning the welfare criterion, deprives the model of the ability to deal with hidden characteristics of workers that may give rise to significant adverse selection problems.[8]

[8] Baily (1977b) mentions the potential adverse selection problem and recognizes that in reality not all workers are alike and may differ in their lay-off probability. However, he regards this as a potential problem for the provision of private

An alternative analysis of optimal UI emphasizing the role of saving and capital markets imperfections is provided by Flemming (1977) who proposes several variations of a model of an economy in which homogeneous individuals work, consume, and save. Each individual in the economy is subject to idiosyncratic exogenous unemployment risk. If unemployed, the individual receives UI benefits and engages in a search for new employment. The probability of finding a new job in any time interval is an increasing function of the amount of money (in one version, the amount of time) invested in search. The assumption that both individuals and jobs are homogeneous means that the wage rate is the same for every worker and every job. Thus the search problem facing the unemployed is how much money (or time) to spend looking for new job. It does not include a decision about the reservation wage; in other words, every job that is found is accepted. The only source of heterogeneity in these models is employment history, which is captured by the individuals' wealth positions.

UI is financed by taxes, and the benefits are proportional to the duration of the unemployment spell. The budget of the UI program is supposed to be balanced on average, but it need not be balanced every year. The objective function of the program is the maximization of the sum of individuals' indirect utilities of wealth which turns out to be the weighted average of the expected indirect utilities of employed and unemployed individuals, with weights given by the employment and unemployment rates, respectively, and expectations taken with respect to the distribution of wealth in the two groups. However, the wealth distribution may change over time, which means the objective function is a moving target. In other words, the optimal design of the UI program is sensitive to the particular period for which the objective is defined. Moreover, as pointed out by Flemming, UI affects the level of precautionary saving and, consequently, the rate of capital accumulation. Hence its welfare effect evolves through time according to the path of capital accumulation induced by the choice of UI.

Flemming solves the problem of optimal UI numerically for specific utility functions under two alternative assumptions regarding the capital markets: perfect capital markets and no capital markets. Since perfect capital markets afford better opportunities for consumption smoothing, it is not surprising that, for the specific parameter values chosen to solve the model, the optimal replacement ratio is lower (approximately 50 percent) under perfect capital markets than in the absence of capital markets.

Building upon the work of Baily and Flemming, Davidson and Woodbury (1997) investigate the optimal UI program, focusing on the relation between the optimal replacement ratio and the duration of the UI benefits. For an analytical framework they use an equilibrium search model in which workers are either employed at an equilibrium wage rate, ω; unemployed receiving UI benefits, x; or unemployed and after T periods, having exhausted their benefits, receiving no income. Employees lose their jobs as a result of exogenous random shocks; upon becoming unemployed they engage in job search. This search is costly and the probability of success depends on the vacancy rate as well as the number of total job applications submitted. The unemployed choose their

UI. The compulsory nature of government UI programs overcomes the problem adverse selection presents for the private provision of UI, but it does not address the issue of gains and losses from the program.

search effort optimally, given the equilibrium wage and the parameters of the UI program. UI is financed by a proportional wage tax.

The complexity of the model defies closed form solution, and Davidson and Woodbury resort to calibration methods to obtain the optimal structure of the UI program. However, two general qualitative results are obtained that do not depend on the specific calibration: First, as in Mortensen's analysis, when the duration of the UI benefits is finite, the optimal search effort increases throughout the unemployment spell and individuals that exhaust their benefits or are ineligible for UI search more intensively than others. Thus although the effort spent looking for a job is private information, the limited duration of the benefit period provides the incentive necessary to induce worker to engage in job search. Second, (for every given actuarial value of benefits the optimal UI requires unlimited duration of the benefit period). To grasp this conclusion fix the actuarial value of the benefits and compare the welfare of a person upon becoming unemployed under two alternative UI programs. The first alternative provides him the full actuarial value of the benefits during the first unemployment period; the second alternative spreads the benefits over two consecutive periods contingent on his remaining unemployed. Under the first alternative the individual may save some of his benefits to finance his second-period consumption. However, as we already observed, since savings is not a contingent asset, it is not as efficient mean of dealing with unemployment risk as UI. Hence the individual is better off under the second alternative. The same reasoning applies to any number of periods. Thus under optimal UI, the duration of the benefit period is indefinite. Moreover, lowering the UI benefits and extending the period tends to reduce search efforts, which further increases individual welfare.

The reasoning so far is based on the assumption that the actuarial present value of the benefits remain intact. However, the lower search effort tends to increase the unemployment spell and reduce the tax revenues that finance the UI program. Hence general equilibrium considerations gives rise to the possibility that the indirect adverse effects of extending the benefit period outweigh the beneficial direct effects. This, Davidson and Woodbury claim, is unlikely in the context of their model.

Employing the calibration method and using estimates form the literature and from the Illinois Reemployment Bonus Experiment, Davidson and Woodbury figure that the optimal UI program calls for an infinite duration of benefits with a replacement ratio of about 0.5. However, if the duration of coverage is restricted, the replacement ration increases, with full replacement attained when the duration of coverage is 32 weeks. Finally, Davidson and Woodbury discuss the effects on their results of variations in the specification of the model, including the introduction on unemployed individuals ineligible for UI, saving, risk aversion, and endogenizing the random process that cause individuals lose their jobs.

2.3 Benefits Schedule

The literature on incentive contracts in the presence of moral hazard emphasizes the tension between the desire to allocate risk bearing efficiently and the need to induce the agent (the informed party) to choose the action that is optimal from the point of view of the principal (the uninformed party.) In general, optimal incentive contracts attain second-best allocations by exposing the (risk-averse) agents to more risk than would be efficient if the actions taken by the agents could be freely monitored. The risk borne by the agents stems from the need to relate the payoff to the outcome so as to induce the choice of appropriate action (or to exert the appropriate level of effort.) Unemployment insurance contracts whose primary purpose is to attain an improved allocation of the unemployment risk are no exception. Shavell and Weiss (1977) exploit this analogy to address the issue of the optimal schedule of UI benefits.

If the actions taken by the unemployed to find new employment were public information, then UI contracts would need to address solely the issue of the optimal allocation of risk bearing. In this hypothetical case, if the objective of the UI program is to enable the unemployed to attain a prespecified level of discounted expected utility at minimum discounted expected cost and the subjective rate of discount is equal to the market rate of discount, then UI benefits should be scheduled so as to equate over time the marginal utility of the unemployed consumption. This, in turn, means that UI benefits may be either constant (if the initial wealth of the unemployed is zero) or zero at the outset of the unemployment spell and then increase for a while as the unemployed depletes his initial wealth; once the wealth is depleted, benefits attain a permanent level for the remainder of the unemployment spell. The lack of monitoring makes it possible for the unemployed to take a leisurely attitude toward finding a new job or be more selective in accepting job offers without suffering the full consequences. To formalize this idea, Shavell and Weiss model the job search process as sequential draws from wage distributions and assume that the optimal search strategy is characterized by a reservation wage property. However, rather than taking the wage distribution as given they assume that the pertinent wage distribution depends on the unemployed's job search efforts. Formally, the probability of obtaining a job in period t as a function of the effort, e_t, and reservation wage, ω_t*, is given by

$$p\left(\omega_t^*, e_t\right) = \int_{w_t^*}^{\infty} f\left(\omega_t \mid e_t\right) d\omega_t$$

where $f(.| \ e_t,)$ denotes the density function of ω_t conditional on the search effort level, e_t. The unemployed is assumed to plan ahead and choose a sequence of effort levels and reservation wages, $p\{e_t, \omega_t^*\}_{t=1}^{\infty}$, so as to maximize his discounted expected utility. This choice determines the probability of employment and, consequently, the cost of the UI program. Moreover, the optimal choice of effort and reservation wage depends on the UI benefits.

The policymaker (that is, the principal) is supposed to choose an unemployment benefits schedule, $\{b_t\}_{t=1}^{\infty}$, with the objective of minimizing the expected discounted sum of UI benefits subject to the constraint that the unemployed attain a given level of expected discounted utility, while taking into account their optimal choice of effort and reservation wages. The main insight provided by the analysis of this problem is that *if the* *unemployed agent has no wealth to begin with and has no access to borrowing, then the optimal UI benefits should decline over time, approaching zero in the limit.*

The intuitive explanation of this conclusion relies on the fact that, since the unemployed chooses the level of effort and the reservation wage in each period optimally, actuarially fair variations in the stream of benefits have no first-order effect on his expected utility. A lowering of the future benefits, however, does affect the probability of finding and accepting a new job, thus lowering the cost of the UI program. More precisely, since the subjective rate of discount of the unemployed is the same as that of the provider of UI, if it was not for the incentive effects the UI benefits should be uniformly spread over the duration of the unemployment spell. Following Shavell and Weiss, let $b_t = b_{t+1}$ and consider an actuarially fair variation in these benefits increasing b_t (that is, $db_t + [(1 - P(\omega_t^*, e_t,))/(1+r)]db_{t+1} = 0$, $db_t > 0$.) Since $b_t = b_{t+1}$ to begin with, the marginal utilities of the benefits are the same. Hence this variation of benefits has no direct effect on the unemployed's expected utility. Moreover, by the envelope theorem, the indirect effect on the unemployed's expected utility resulting from the changes in the endogenous variables - namely, the reservation wage and the level of effort - are negligible. However, the decline in future benefits makes the prospect of remaining unemployed less attractive, thereby inducing the unemployed to search more vigorously and to lower his reservation wage. The result is an increase in the probability of finding new employment and a reduction in the expected cost of the UI program. (For a simple model of UI with moral-hazard and an analysis of the optimal benefit schedule see Appendix part A.)

No clear-cut conclusions emerge when the unemployed has some wealth to start with or when he can borrow. On the one hand, UI benefits must be kept low and rising at the outset of the unemployment spell to deplete the initial wealth; on the other hand, benefits must decline in order to induce the necessary level of job search effort and willingness to accept job offers. It can be shown that within the framework of Shavell and Weiss, the optimal UI benefits schedule implies that the level of effort increases and the reservation wage declines over the unemployment spell. Together these imply that the escape rate increases the longer the unemployed is out of work. The rationale for this result is that the declining unemployment benefits mean that, given a level of effort and a reservation wage, the expected utility associated with these conditional on the person being unemployed at time t is larger then the expected utility conditional on being unemployed at time $t+1$. Thus the optimal response is to increase the level of effort and to reduce the reservation wage rate.

The analysis of Shavell and Weiss focuses exclusively on the moral hazard problem associated with the inability of the UI provider to monitor the job search efforts and reservation wage of the unemployed. The main insight of this analysis is that the problem is best dealt with if the UI benefits decline monotonically with the duration of the unemployment spell. This conclusion seems robust, although some issues concerning the design of the UI benefits remain unsettled. To begin with, the criterion for optimality used by Shavell and Weiss is the minimization of the cost of UI program subject to the constraint that the unemployed are ensured a given level of expected utility. This criterion disregards other welfare aspects of UI program, such as the efficiency implications of job search. A prolonged job search, while obviously costly in terms of output forgone, increases the chance of placing the unemployed where his marginal productivity is higher. Some of this efficiency is lost when the incentives lead to a reduction in the reservation wage. By the same token, the increase in job search effort tends to improve this aspect of efficiency.

A different issue concerns the modeling of job search effort. In contrast to Mortensen (1977) who defines job search effort in terms of the time spent looking for a job, Shavell and Weiss model job search effort more abstractly as a source of disutility that produces a stochastically dominating shift in the distribution of wage offers. The advantage of the Mortensen formulation is that effort is empirically observable, its disadvantage is that the analysis is complicated since effort interacts with income (or consumption). Shavell and Weiss avoid this complication by treating effort as additively separable source of disutility. They do not explain, however, what will be an empirical counterpart of this concept. Moreover, the separability of the (dis)utility of effort and consumption is necessary for their conclusions. Since effort seems to be an elusive concept, this raises concern regarding the robustness of the conclusions.

Finally, it is not clear how the optimal UI benefits schedule is to be implemented, since the parameters include the unobservable utility of the unemployed. Specifically, the assumption that all unemployed are identical seems unacceptable. However, without this assumption it is far from obvious that it is possible to individualize the benefits so as to provide the recipients the predetermined levels of expected utility.

The analysis of Shavell and Weiss is predicated on the implicit assumption that the only means by which the provider of UI may reward or punish the unemployed - and, thereby, induce the appropriate job search effort – are unemployment benefits. Building upon this work, Hopenhayn and Nicolini (1997) discuss the design of an optimal UI program in which the insurer's power to reward or punish includes the ability to tax or supplement the insuree's income after he is reemployed. While taxes or income subsidies that depend on the unemployment history are not a feature of existing UI programs, if used correctly, the increased flexibility afforded by the extended set of punishments and rewards have positive welfare implications. More specifically, under the improved design the same level of utility for each individual is attainable at lower cost.

Hopenhayn and Nicolini model the relationship between the unemployment insurer and insurees as a repeated principal-agent relationships with moral hazard. The key feature of their model is that the likelihood of finding new employment in any given period depends on the search effort of the unemployed, which is private information. Unlike the model of Shavell and Weiss in which neither the effort nor the job offers received by the unemployed are observed, Hopenhayn and Nicolini assume that only the job search efforts are not observed. In other words, the provider of UI is able to monitor at no cost the job offers received by the unemployed. Obviously unrealistic, this assumption is analytically convenient, since it implies that the unemployed cannot decide his reservation wage.

The unemployment insurer in this model is a risk-neutral agent whose objective is to minimize the expected present value of the cost of UI benefits. Individuals are risk averse and behave as if they maximize the expected discounted sum of their utility of consumption and disutility of job search effort. The rate of discount is the same for the unemployment insurer and the insurees. Unemployment insurance is a contract between the UI provider and the individual specifying a transfer payment from the insurer to the individual and a level of job search effort in each period as a function of the unemployment history of the individual. Formally, a contract is a function $\tau : H_t \rightarrow \mathbf{R}_+ \times \mathbf{R}$ where H_t is the set of employment histories. An employment history is represented by a sequence of zeros and ones denoting, respectively, periods in which the individual was employed and periods in which he was unemployed; $(e_t, b_t) \in \mathbf{R}_+ \times \mathbf{R}$ represent the levels of job search effort and UI benefits in period *t*.

To simplify their analysis, Hopenhayn and Nicolini assume that all jobs are identical and pay the same wage, ω, and that once employed the individual remains employed forever. This assumption restricts the set of possible employment histories to sequences that start with zeros; once a one appears the rest of the sequence is ones. This assumption implies that UI insurance is *sold only to unemployed individuals*. Moreover, by ruling out future unemployment, this assumption also nullifies Mortensen's (1977) "entitlement effect" of unemployment insurance. The probability of finding employment in period *t* is an increasing, concave function, $p(e_t)$, of the level of effort, e_t, satisfying the Inada conditions.

A crucial assumption in the formulation of the UI program as a repeated principal-agent problem is that the UI provider can control the consumption level of the agent in every period. A possible rationale for this assumption is that insured individuals cannot save and have no access to credit. We defer further discussion of this assumption until after we gain better understanding of the model and its implication. At this point it suffices to note that the insuree's consumption level is chosen directly by the UI provider, since it is equal to the UI benefits when the insuree is unemployed and it is equal to the insuree's disposable income in the employment state. (The disposable income equals the wage rate net of taxes imposed by the UI program.)

The objective function of the UI program is to minimize the cost of providing UI insurance subject to the participation constraint which requires that, *at the outset*, the expected utility of the individuals do not fall short of an exogenously given reservation level, and the incentive compatibility constraints on the level of effort. Note that after having enrolled in the UI program, the expected utility corresponding to the state of unemployment is determined endogenously. Indeed, under the optimal UI scheme the level of expected utility will decline as a function of the duration of the unemployment spell.

The analysis of the optimal UI scheme is based on the *assumption* that the cost of providing UI is a convex function of the reservation utility level of the unemployed. This analysis leads to two main conclusions:

(a) *UI benefits must decline with the duration of the unemployment spell*. This conclusion is similar to that of Shavell and Weiss and is based on the same logic. To motivate the unemployed to exert some effort looking for employment, the expected utility associated with remaining unemployed must decline over time. Since the unemployed chooses his level of effort optimally, the effect of decreasing the reservation utility level is captured by the increasing marginal utility of consumption. But the consumption level is equal to the UI benefits. Hence these benefit must decline as the duration of the unemployment spell increases.

(b) *The tax imposed on the insurees after they find employment depends on the duration of the unemployment spell prior to finding a job. Moreover, under some technical conditions on p* (e)*, the tax is increasing as a function of the duration of the unemployment spell*. Notice that this conclusion is not merely that a tax needs to be imposed on the income of the employed. Rather it requires that this tax depend on the duration of the preceding unemployment spell. This idea carries the logic of the previous argument a step forward by observing that the consumption smoothing and incentive roles of UI insurance does not have to stop on the threshold of employment. In fact, if the optimal consumption stream could be chosen for the entire lifetime of the insured rather than just for the unemployment spell, the same level of incentive could be attained with lower cost in terms of efficiency. Put differently, if the UI provider can control only consumption spending during the unemployment spell then it is possible that the consumption level increases once employment starts. The optimal allocation of consumption over time would require that some of this consumption is shifted to the unemployment periods, thereby increasing the overall level of utility of the insuree without a corresponding increase in the cost of insurance. This is the consumption smoothing aspect of UI. If the tax were to be independent of the duration of the unemployment spell, then the need to lower the UI benefits during the period of unemployment would mean that the consumption level associated with long unemployment spells would be too low relative to the consumption level associated with employment. If the tax increases with the duration of the unemployment spell, the same level of incentives can be attained with smaller distortion of the consumption stream. Hence the expected utility level of the insuree can be attained at lower cost to the insurer.

To get an idea of the potential social gains from the proposed unemployment tax, Hopenhayen and Nicolini use empirical results based on U.S. data to calibrate their model and calculate the gain from implementing their scheme over the optimal UI scheme that does not involve a tax on the employed. Postulating a constant relative risk aversion utility function and assuming that $p(e) = 1 - \exp(-re)$, they show that with the tax the decrease in benefits over the unemployment spell is considerably more moderate and the gain may be anywhere from15 to 35 percent, depending on the reservation utility level of the individual.

An immediate practical difficulty with this result arises from the fact that the model does not recognize individuals who do not participate in the labor force. This omission permits the selling of UI to unemployed individuals, since they all would rather work. However, if there were individuals that would rather not work, the aforementioned scheme would involve a transfer of wealth from labor force participants to nonparticipants that may well exceed the possible gain from the optimal scheme. This last observation is more of a criticism of the particular model than of the main insight, namely, that individuals buying insurance should be taxed according to their unemployment history.

2.4 General Equilibrium Analysis of UI with Moral Hazard

Thus far the analysis of the economic effects of UI was carried out in the framework of partial equilibrium analysis. As we have emphasized, this begs potentially important welfare implications of UI, such as the distortions introduced by the additional taxes needed to finance the UI program or the effect on the wage rate itself.

Employing a quantitative dynamic general equilibrium approach, Hansen and Imrohoroglu (1992) estimate the potential of the welfare effects of alternative UI schemes. They introduce a rather simple model to described the employment dynamics. To begin with, all individuals are assumed to be identical in terms of both their preferences and their productivity. Preferences are characterized by a Cobb-Douglas utility function on consumption and leisure displaying constant relative risk aversion. Individuals face idiosyncratic unemployment risks. The idiosyncratic unemployment risk is described by a matrix of transition probabilities $[p_{ij}]$, where $\Pr\{s_{t+1} = i \mid s_t = j\}$, $i, j \in \{e, u\}$, where e is the a state of employment, u is the state of unemployment, and s_t is the employment state in period t. Individuals may accumulate assets, but they are not allowed to borrow. In each period every individual either receives a job offer or does not. If he does not receive an offer he remains unemployed for the duration of the period. If he receives a job offer he must decide to accept it or reject it. If he reject the offer he stays unemployed for at least one period.

All unemployment insurance programs have the following features: (a) Individuals that qualify for UI receive payment equal to θ percent of their wages (recall that all workers are equally productive, hence the equilibrium wage is the same for all.) (b) Monitoring is imperfect so that an individual who is offered a job in period t and declines to take it will not be detected and will collect UI benefits with probability $\pi(s_{t-1})$, where s_{t-1} is the employment status of the individual in the preceding period. (c) UI is financed by a proportional tax on all incomes and is actuarially fair.

Clearly, UI in this economy helps smooth individual consumption spending over time, thereby reducing the need for self-insurance through saving. However, if the benefits of the program are generous and the level of monitoring low, a moral hazard problem arises as individuals are more inclined to take their chances and reject employment opportunities.

A stationary general equilibrium in this economy is a set of consumption, employment, and asset-holding functions of the state variables (wealth, last period employment status, last period employment decision, and the UI benefits policy) a time-invariant distribution of individuals over the set of states, and a tax rate satisfying the following conditions: (a)

For each individual consumption, asset-holding and employment decisions are made so as to maximize the expected discounted sum of that individual's utility. (b) Aggregate consumption equals aggregate output. (c) The UI program is actuarially sound (that is, self-financing).

The benchmark for the evaluation of alternative UI programs is the allocation (of consumption over time of each individual and employment) attainable by a fully informed social planner. In other words, it is the first-best allocation that maximizes the expected discounted utility of an individual subject to the constraint that his expected consumption in the employment and unemployment state does not exceeds the output in each period. The social planner is free to choose the employment probability provided it does not exceeds an exogenous value determined by the transition probability matrix.

Using the calibration methods, the authors proceed to solve the model numerically under alternative assumptions regarding the replacement rate, θ , and the monitoring of the UI program. They show that if each individual's job market behavior is perfectly monitored and if UI insurance benefits are denied to individuals who are offered employment and decline to take it, then, with the appropriate choice of replacement ratio, the first-best welfare level is attainable as an equilibrium outcome. However, if monitoring is imperfect, the moral hazard problem that arises implies a welfare loss. Furthermore, many configurations of replacement ratios and monitoring levels result in welfare loss that exceeds the loss of welfare that would occur if no UI were offered at all.

The work of Hansen and Imrohoroglu underscores the need to consider the general equilibrium implications of UI program, in particular, the need to take account of the distorting effects of taxes required to sustain such a program and the need to base its evaluation on the broader criterion of welfare maximization rather than the criterion of minimizing its cost.

A different approach to the welfare analysis of UI in the context of general equilibrium model is taken by Fredriksson and Holmlund (1998), who look at the incentive effects of UI on job search. The analytical framework is a job matching model and the social welfare function used to evaluated alternative UI programs is the weighted sum of individual utilities.

Fredriksson and Holmlund distinguish among three labor market states: employment, insured unemployment, and uninsured unemployment, where transition among the three states is random. More specifically, workers lose their jobs and enter the insured unemployment state according to exogenously given rate ϕ. Insured employees are entitled to UI benefits at a constant replacement rate, b, per period; uninsured employees are entitle to social assistance, z, per period. Let u^I and u^N denote the number of the insured unemployed and uninsured unemployed, respectively.

Unemployed individuals search for new employment. The arrival rate of employment opportunities depends on the job search effort, $e^j, j = \{I,N\}$, which is measured by proportion of the time they allocate to job search and by a measure of the tightness of the labor market, expressed as the ratio, φ,of job vacancies to the effective number of employment seekers. Specifically, the net hiring, *H*, in a given period is characterized by a job matching, constant return to scale, function

$$H = H(S,v)$$

where *S* denotes the *effective employment seekers,* defined as $S = e^I u^I + e^N u^N$, and *v* denotes job vacancies. Thus, the escape rate from the insured unemployment to the employment state is $a^j = e^j H(1, \varphi)$, $J = \{I, N\}$. Finally, the transition from the insured unemployment state to the uninsured unemployment state takes place at a constant, exogenously given, average rate, λ. Notice, however, that for each individual the transition is random.

Workers and firms engage in wage bargaining the outcome of which is the Nash bargaining solution. Since the fall-back position of employees is the state of insured unemployment, the threat point of each worker is assumed to be the utility of the insured unemployed. This assumption implies that an increase in the UI benefits improves the bargaining position of the workers and, as a result, exerts pressure on the equilibrium wage rate.

Fredriksson and Holmlund assume that employees do not save and the unemployed cannot borrow to smooth their consumption. The unemployed choose the intensity of their search efforts so as to maximize the discounted sum of their expected utilities. UI benefits and social assistance are financed by a tax on wages.

Given an UI program that specifies a replacement rate, a social assistance program, and a tax rate τ an equilibrium in this model is search intensities, e^I and e^N and a wage rate, ω such that e^I and e^N and maximize the individual utilities, the wage rate is determined by the Nash bargaining solution, the labor-market clearing conditions:

$$\phi\left(1 - \mu^I - \mu^N\right) = \alpha^I \alpha^I + \alpha^N u^N$$

and

$$a^N u^N = \lambda u^I$$

hold, and the balanced budget constraint

$$\tau\left(1 - u^I - u^N\right) = bu^I = zu^N$$

is satisfied.

The first labor market clearing condition requires that the flow from the employment state to the insured unemployment state (the expression on the left-hand side) is equal to the flow from the two unemployment states to the employment state (the expression on the right-hand side.) The second labor market clearing condition requires that the flow from the uninsured unemployment state is equal to the flow into the uninsured unemployment state.

The social welfare function is taken to be the weighted sum of individual utilities in the different labor market states, the weights being the proportion of the population in each state.

The first question concerns the optimality of the equilibrium in this economy. The answer is obvious once we realize that individual search efforts have positive externalities. In particular, an increase in the job search effort tends to reduce the equilibrium rate of unemployment and, consequently, the unemployment expenditure, or taxes. Since individuals not are compensated fully for their search effort, *the equilibrium search intensity is suboptimal.*

The second result is that *optimal UI benefits must exceed the level of social assistance*. If one regards social assistance as a continuation of UI benefits, the latter result seems analogous to the conclusion of Shavell and Weiss (1979) that optimal UI benefits decline over time. However, the driving forces behind these conclusions are different. This difference underscores the role of distinct incentives. Whereas the conclusion of Shavell and Weiss is driven by the fact that, when the benefits are uniform, a variation in the benefit rates will have a net incentive effect, the present result derives from the combined influences of the ``entitlement effect'' first noted by Mortensen (1977) and the fact that the search effort in equilibrium is suboptimal. More specifically, the assumption that individuals enter the insured unemployment state only from the employed state means that, starting from *optimal uniform* benefits (i.e., $b^*=z^*$,) an increase in the benefits associated with the insured unemployment state will have the effect of increasing the search effort of the uninsured unemployed. Together with the fact that search effort in equilibrium is suboptimal this implies an increased social welfare.

The analysis of Fredriksson and Holmlund (1998) highlights the implications of the externalities of job search effort and the role of the entitlement effect for the unemployment insurance program. Their main conclusion is that unemployment benefits should decline over time. Certain features of their model, however, raise some concern regarding the robustness of the main result. First, as the authors recognize, the assumption that employees do not save is unrealistic. Yet, as the analysis of Shavell and Weiss (1979) indicates, this assumption is critical. It may well be the case that, if wealth accumulation by employees is permitted, then the optimal UI insurance may require that the benefits decline at the outset of the unemployment spell. This consideration tends to mitigate and may even dominate the entitlement effect. Second, the assumed exogeneity of the rate of transition from the employment state to the insured unemployment state begs the potentially important issue of the effect of the UI program on this rate. Specifically, better UI benefits encourage shirking. Thus in equilibrium the level of effort exerted by the employee performing his job is suboptimal for the same reason that the search effort is suboptimal. Consequently, if the probability of transition from the employment state to the state of insured unemployment is affected by the employees' job performance then, other things equal, a higher level of benefits in the insured state tend to reduce social welfare. Finally, the assumption that the transition from the insured to the uninsured state is a random process at the individual level introduces another unrealistic feature; it seems obvious that, in a society of risk averse individuals, this artificially imposed idiosyncratic risk entails unnecessary loss of welfare.

2.5 Shirking

A different aspect of moral hazard associated with UI has to do with imperfect monitoring of the level of effort exerted by employees in discharging their duties. There are many instances in which the effort of individual workers is not observable directly and may not be accurately inferred from observing the level of output. The latter problem arises when output is the result of team effort rather than the effort of particular employees, or when output is random. In these circumstances the employer-employee relationship is subject to the usual agency problem. To induce employees to exert the desired levels of effort, wage contracts include the threat of dismissal if the performance of an individual worker or a team is judged inadequate. The incentive to perform is motivated in part by fear of losing one's job. Shapiro and Stiglitz (1984) present a model in which voluntary unemployment is an equilibrium phenomenon whose purpose is to deter shirking. To the extent that UI mitigates the economic hardship associated with unemployment, it reduces the deterrence effect and, by consequence, workers may be more inclined to shirk. The probability of transition from the employment state to the unemployment state thus becomes endogenous, presumably increasing with improvements in the terms of UI.

Wang and Williamson (1996) study a dynamic model of an economy with UI and two sources of moral hazard: moral hazard associated with private information regarding the unemployed's job search effort and moral hazard associated with private information concerning job performance effort. They do not distinguish between the two types of effort and do not attempt to specify their empirical counterparts. As in the model of Shavell and Weiss (1979), effort is an abstract source of disutility to the agent that increases the probability of being retained if the worker is currently employed and the probability of generating a job offer if unemployed.

In other respects the model of Wang and Williamson is not essentially different from earlier models. Individuals in this model maximize the discounted sum of expected utility, which is additively separable in consumption and effort; they are risk averse; and their lifetime is random. Moreover, individuals do not save and may not borrow to smooth their consumption spending. Optimal unemployment insurance is modeled as a steady-state solution to a dynamic principal-agent problem. The provider of UI seeks to minimize the program's cost (defined as the steady-state aggregate consumption minus the steady-state aggregate output) subject to the constraint that every new entrant of the labor force be ensured a given level of expected utility. In addition, in each period participation constraints require that the steady-state expected utility corresponding to the states of employment and unemployment do not fall short of the expected utility that individuals can attain without UI, and incentive compatibility constraints that ensure that agents will select the prescribed levels of efforts corresponding to the state of employment and unemployment.

The stochastic process underlying the individual risks has three components: the probability of death, which is exogenous and fixed in every period and is the same regardless of the employment state of the individual; the risk of losing one's job, the probability of which is monotonic decreasing function of the level of work effort; and the risk of continued unemployment, the probability of which is a decreasing function of the level of job search effort.

To analyze the implications of their model, Wang and Williamson calibrate it using U.S. data and compute the optimal UI program. They then estimate its effects under the assumption that the guaranteed expected lifetime utility of new labor force entrants is such that the budget of the UI program is balanced. Their main findings are as follows:

(a) *The optimal UI benefits of the unemployed decrease initially and then increase and fall gradually after that*. This conclusion seems to contradict the findings of Shavell and Weiss (1979) and of Hopenhayen and Nicolini (1997) that benefits are monotonically decreasing. It suggests that the need to deter shirking calls for severe punishment in the initial period of unemployment.

(b) *Compared with current unemployment insurance in the U.S., implementing optimal UI would result in a welfare gain and a decline in the rate of unemployment*. This conclusion is somewhat surprising. It suggests that the incentives built into the optimal UI program outweigh the negative incentives associated with consumption smoothing.

(c) *The consumption level (benefits) of the employed increase in the initial period following reemployment and then fall*. This conclusion contradicts the findings of Hopenhayen and Nicolini (1997) that the tax on wages following an unemployment spell should decrease monotonically over time. I see no obvious explanation for this finding.

These findings suggest that the effects of UI on shirking may be an important factor shaping the design of the optimal UI program. Unfortunately, direct empirical evidence on this point is lacking. Thus, pending further study, we must resort to speculation.

In his discussion of the work of Wang and Williamson, Hopenhayen (1996) claims, correctly, that the presence of private information about the work effort is presumably dealt with by wage contracts themselves. If UI increase the tendency to shirk, wage contracts will be adjusted to counteract this effect. Therefore the net result is that shirking is not an important consideration in the design of UI.

A different conclusion is implied by the analysis of Chiu and Karni (1998). They note that unemployment insurance is unique in that it has never been provided by the private sector. Supposing that this extreme form of market failure is due to asymmetric information, they develop a model of UI that they use to study conditions for the existence of equilibrium with no UI. It turns out that the two key elements whose interaction accounts for the nonexistence of private UI in competitive equilibrium are: the presence of individuals in the populations that, in some periods, prefer not working and the ability of the employee to affect the probability of being dismissed through shirking.

It is interesting to note that asymmetric information regarding job search effort is a contributing factor in the sense of making the conditions for no unemployment insurance equilibrium more likely to be met. However, it is neither a necessary nor a sufficient condition for this result. This argument, in conjunction with the fact that no UI was ever provided by the private sector, suggests that shirking may actually be more important than is generally perceived.

Poor performance may be due to factors outside the worker's control, the result of shirking, or the consequence of incompetence. If the employee wants to keep his job, incentive contracts can be designed to make him exert the level of effort desired by the employer. However, if a worker is not interested in keeping his job, he is unlikely to respond to the incentives built into the contract. Yet the employer may be hard pressed to attribute poor performance to shirking or, more generally, misconduct (in which case the worker may not be entitled to unemployment benefits) as opposed to incompetence.

This discussion suggests that *asymmetric information about effort exerted by employees in performing their jobs cannot be dismissed, on a priori grounds as being unimportant for the design of UI programs*. The lack of empirical evidence on the effect of UI benefits on this type of effort leaves an important gap in our knowledge.

2.6 Experience Rating

To attain an efficient allocation of the unemployment risk, the UI premia should reflect variations in the risk of unemployment among employees due to personal characteristics and actions as well as variations due to the employment policies of the firms in which they are employed. In other words, employees seeking UI should, in principle, be experience rated by their personal employment risk and the risk associated with the their employers. In practice, however, such experience rating is not perfect; as a result, UI entails a certain amount of cross-subsidization among individuals and firms. The fact that high-risk employees or firms do not internalize the full cost of their employment policies creates a moral hazard problem that tends to increase the frequency and duration of unemployment spells.

Insofar as optimal UI is concerned, imperfect experience rating may reflect the fact that firms' employment records are imperfect indicators of their lay-off policies and individuals' employment records are imperfect indicators of their work ethics and search behavior. Since the unemployment record is, to a significant extent, the result of hidden actions or hidden characteristics, the problems posed by imperfect experience rating are the usual problem of moral hazard and adverse selection.

Mortensen (1983) studies the welfare implications of imperfect experience rating of UI. He compares the first-best UI design under perfect experience rating to second-best designs without experience rating. For this study he postulates an economy in which the worker's value of marginal product is random. Workers are laid off or remain unemployed whenever the value of their marginal product falls short of a reservation level, z. This assumption is open to alternative interpretations. One interpretation is in terms of search unemployment. According to this interpretation z represents the reservation wage characterizing the job search policy of the unemployed. In competitive equilibrium the wage offer reflects the value of marginal product. Hence if the value of marginal product falls short of the unemployed reservation wage, the offer is rejected and the unemployment is prolonged. According to the second interpretation employment is governed by an implicit contract according to which employees are laid off whenever the value of their marginal product falls below z[9]. Employment contracts are pairs (y,z) in which y represents the instantaneous income contingent on being employed.

Let $\phi(z)$ denote the stationary equilibrium probability of the unemployment state. $\phi(z)$ also represents the equilibrium rate of unemployment.) Mortensen assumes that all employees are identical and that the representative employees' instantaneous expected stationary utility under the contract (y,z) is given by

$$\phi(z)u(x+b-c)+(1-\phi(z))u(y)$$

where x denotes income generated by household production, b denotes UI benefits, and c is the cost associated with searching for employment. Employees are risk averse, thus u is monotonic increasing and concave.

Firms are risk neutral, and their expected profit from employing a worker under the contract (y,z) is given by

$$\pi(y,z,t)=(1-\phi(z))(\varpi(z)-y-t)$$

where t is the UI premium (or UI tax) and $\varpi(z)$ is the expected value of marginal product conditional on it being no less that the reservation level z.

The UI program is said to be self-financed if

$$t(1-\phi(z))=b\phi(z).$$

Given an UI program (b,t) a competitive equilibrium in this economy is a set of contracts such that: all contracts offer the same expected utility to the employees, each contract maximizes the expected profit of the firm offering it, and the least-profitable employer earns zero expected profit.

The competitive equilibrium is obtained as a solution to the program: Maximize the employees' stationary expected utility with respect to z and y subject to the constraint $\pi(y,z,t)\geq 0$.

[9] For a survey of the literature on implicit contracts in its relation to labor markets see Rosen (1985).

If UI is based on perfect experience rating, then each firm is required to pay a premium corresponding to the risk it represents, which in this model is a function of is reservation level, \$z.\$ Thus under experience rating the premium is given by

$$t(z) = \frac{\phi(z)}{(1-\phi(z))} b.$$

If the firms are charged UI premium according to the above formula, their choice of employment contract fully internalizes the cost of unemployment. Under this condition (which also implies that the UI is actuarially fair,) competitive equilibrium corresponds to efficient allocation of the unemployment risk. Note, however, that since the firms are risk neutral and the employees are risk averse efficient allocation of risk bearing requires that the employment contracts guarantee the employees the same income across the states of employment and unemployment. Indeed, in the implicit contract interpretation of the model the optimal UI benefit is the difference between the equilibrium income in the employment state, y^* and the exogenously given alternative value of time in the unemployment state. In the search unemployment interpretation, the cost of job search reduces the alternative value of time in the unemployment state. Thus the optimal UI benefit equals the difference between the equilibrium income in the employment state and the alternative value of time in the unemployment state net of the associated search cost. In both cases the optimal UI benefits increase in response to either an increase in the productivity of labor or a mean-preserving spread of the distribution of the value of marginal product, both of which increase the equilibrium value of the income in the employment state. Furthermore, if the UI benefits are not set at the optimal level, then an increase in benefits induces an increase in the reservation value, z, and consequently in the unemployment rate if and only if the benefit is below its optimal level.

In practice, the employment policies of firms or individuals (i.e., their choice of reservation levels) are costly to monitor. Hence even under an optimal UI program the experience rating is bound to be imperfect. This gives rise to a moral hazard problem, since firms and individuals do not internalize the full social cost of their choice of reservation level. Mortensen (1983) examines the polar case in which there is no experience rating at all. In this case each firm in the implicit contract interpretation and each individual in the search unemployment interpretation is a ``UI-premium taker." In other words, the firm in the former case and the individual in the latter case consider the UI tax and benefit to be independent of their employment policies. This means that the UI tax is regarded (mistakenly from a social viewpoint) as an additional cost of employment and the corresponding UI benefit is not considered a cost of not employing a worker. Similarly, the unemployed searching for employment does not consider the benefit as an extra cost of not accepting a job offer. Thus the cost-benefit analysis of employment policies is biased against employment. Consequently, *given a tax-benefit pair (t,b), the choice of the reservation level tends to be too high, and the unemployment rate increases accordingly.*

Furthermore, even though the UI program is self-financing and hence fair in a global sense, by only considering the UI tax as cost, individual employers and workers behave as if the UI is actuarially unfair and thus seek less than full insurance. Put differently, given the tax-benefit pair, the equilibrium wage contracts are such that the income in the employment state exceeds the income in the unemployment state.

The institution of UI program, even if optimally designed is bound to raise the reservation level and cause an increase in unemployment. (In fact, increases in both the UI tax and benefit tend to increase the reservation level.) Even so, *optimally designed UI program can be shown to be welfare enhancing. The benefit of reduced variability of income associated with the unemployment risk due to UI exceeds the cost of rising unemployment due to the UI program*.

2.7 Adverse Selection

Unlike moral hazard problems, which have been studied extensively, problems of adverse selection have received only scant attention in discussions of optimal UI. This is not because the problems associated with the presence of private information regarding hidden characteristics are less important. In fact, hidden characteristics can be an important factor curtailing the benefits of UI as suggested by the following example of firm-specific adverse selection.

During the 1982-83 recession a voluntary Canadian unemployment insurance plan, Career Guard, was introduced to provide unemployment insurance for executives. To mitigate the obvious problem of individuals taking out insurance policies upon learning that they are about to lose their jobs, the insurance policy did not cover executives fired within 6 months of purchasing insurance. The exclusionary period failed to protect the program, however, since a very high proportion of those who purchased insurance were dismissed by their employers following the 6-month qualifying period. "It appeared that Career Guard failed primarily because of adverse selection - those executives who knew they were likely to be dismissed were the main purchasers of insurance, and the insurer could not distinguish high-risk from low-risk customers." (Green and Ridell [1993]).

Insurance market failure due to adverse selection is often cited to justify the public provision of UI. The explanation of Chiu and Karni (1998) of the absence of private provision of UI relies in an essential way on adverse selection associated with private information concerning individuals' preferences for leisure. According to this explanation, the presence of employees who, at some period of their life, would rather not work combined with their ability to manipulate the probability of losing their job by shirking may make it impossible for UI to be privately provided in competitive equilibrium. Yet with few exceptions the literature on optimal UI has failed to address this issue.

One exception is Mortensen (1983), who examines the welfare implication of UI with no experience rating in the presence of two types of workers, differentiated solely by their opportunity cost of time. The difference in the opportunity cost of time induces a difference in the corresponding reservation wage rates. Specifically, individuals with a higher alternative value of time find unemployment less costly and will implement more selective employment policy based on higher reservation wage. This entails that individuals with higher opportunity time cost are unemployment-prone and represent higher risk. It is worth noting in this context that, unlike in the usual analysis of adverse selection (see, for example, Rothschild and Stiglitz [1976]), in which the risk type is exogenous, in the present analysis the risk is the result of behavior induced by other personal characteristics, namely, the opportunity cost of time. Since the reservation wage is not readily observable, this phenomenon gives rise to an adverse selection problem. Thus UI contracts that are actuarially sound if taken out by the low-risk type will attract the high-risk types and thereby become insolvent.

Mortensen examines the menus of UI contracts (that is, UI tax-benefit pairs) that are incentive compatible (that is, each type prefers its contract over the contract of the other type.) He shows that different possible solutions may arise depending on the level of risk aversion. One solution implies a first-best allocation in which each type is offered an actuarially fair contract designed to reflects its own characteristics. In this case the presence of high-risk type do not prevent the offering of optimal contracts to the low-risk type. Another solution is likely to arise when risk aversion is relatively low. In this case separating contracts, each of which is actuarially sound and satisfies the incentive compatibility constraints, exist. However, since one of the incentive compatibility constraint is binding, there exists an actuarially fair pooling contract that Pareto dominates the separating contracts. This analysis compares only two extreme solutions: pooling contracts versus separate, actuarially fair contracts that satisfy the incentive compatibility constraints. It disregards the possibility of equilibrium with partial experience rating in which separate contracts that pool subgroups of individuals with cross-subsidization may actually Pareto dominate mandatory global pooling under a government sponsored UI program. (A simple model of optimal UI in the presence of endogenous adverse selection is described and analyzed in the Appendix, part B.)

3. Summary and Conclusions

The fact that no private provision of UI has ever been observed suggests an extreme form of market failure. Presumably the same factors that hinder the provision of UI by the private sector are likely to impede the effectiveness of public UI insurance. In this paper we identified sources of private information that are likely to impinge upon UI and surveyed the way they were dealt with in the literature on optimal UI. Our review underscores the alternative approaches to modeling the labor market in the presence of asymmetric information and highlights their implications for the design of optimal UI.

The variety of approaches to modeling the labor market makes some of the results model specific and thus difficult to compare. Nevertheless, a consensus about some aspects of the formulation of the problem of optimal UI exists and some conclusions emerge that seem robust with respect to model specification.

1. *The main objective of UI is to enable households to smooth their consumption spending in the face of unemployment risk.* The risk involved is the loss of earnings in the event of unanticipated unemployment. Unemployment insurance, being a contingent claim, dominates saving as a mean of consumption smoothing.

2. *The durations of unemployment spells depend on the intensity of the job search activities of the unemployed and their search strategies.* While the search intensity, or effort, is a generic aspect of modeling labor market, the exact interpretation of what this intensity means in practice is not always spelled out. Implicitly search effort means spending time and money acquiring information about job vacancies, filling out job applications, and showing up for interviews. Thus a formal treatment of search effort requires explicit attention to the interaction of consumption and leisure. Unfortunately, this is not easy to do; as a result, the issue has not been addressed by the literature.

Optimal search strategy is assumed to be characterized by reservation wage. This approach is convenient and appropriate when sampling is from known distributions; it is less appropriate when sampling is also associated with learning about the wage distribution.

3. *Under the optimal UI scheme benefits decline with the duration of the unemployment spell.* The intensity of search and the reservation wage are private information giving rise to a moral hazard problem. This problem requires forgoing some of the benefits from consumption smoothing in order to induce the appropriate level of search effort and to lower the reservation wage. The work so far suggests the if the only source of moral hazard is search behavior and the unemployed wealth is relatively small, then to produce the right incentives, UI benefits must decrease as a function of the duration of the unemployment spell.

Two related results are also noted: First, the duration of the benefits period should be unlimited even though this entails reduced replacement ratio. Second, the UI premium paid by employees following an unemployment spell should increase as a function of the duration of the spell. The latter result should be interpreted with some caution since it was established in a context in which the only source of moral hazard is the search behavior. If job performance itself is subject to manipulation by employees, then high UI premium may have adverse effects on the motivation to work and increase unemployment.

4. *Under an optimal UI scheme, premiums should be based on extensive experience rating*. Firms and individuals have hidden characteristics that, in the absence of perfect experience rating, interact with their actions to produce a phenomenon called endogenous adverse selection. The presence of endogenous adverse selection makes first-best allocation of unemployment risk bearing unattainable. Experience rating is costly and perfect experience rating is likely to be infeasible and nonoptimal. However, to minimize the impact of endogenous adverse selection experience rating should be incorporated in optimal UI schemes.

Rich and diverse as is the literature on optimal UI has failed to address several issues that, a priori, seem no less important than some of the issues that have been discussed at length. To conclude our discussion, we comment briefly on these omissions:

(a) *Unemployment insurance fraud*. If the UI agency lacks the means of monitoring the employment of unemployed individuals receiving benefits, these individuals will be tempted to conceal the fact that they have found new employment in order to collect the benefits. Deterrence of UI fraud requires an enforcement mechanism that will detect fraud and a legal framework that will penalize fraudulent behavior. Information collected by tax agencies that track the employment status of labor force participants should prove useful for enforcement purposes.

(b) *Aggregate risk*. Unemployment is strongly correlated with business cycle thus representing significant aggregate risk. To spread over time the budget of the UI program must be flexible, allowing to run into deficits during recessions and accumulate surpluses in periods of high employment.

(c) *Administrative costs*. Operating an UI program is costly, yet the various models of optimal UI are based on the assumption that programs are actuarially fair. If an UI program is to be self-financing, the premium should be loaded to cover the costs of its administration. In such a case, it is well known that full insurance is not optimal even when there are no problems of moral hazard or adverse selection. This suggests that a minimum deductible should be part of the structure of the benefits, possibly excluding an initial period of unemployment from the coverage.

(d) *Labor force participation*. The discussion of optimal UI takes place in the context of models in which there are states of employment and various states of unemployment. There is hardly a mention of the presence of individuals who are out of the labor force, either temporarily or permanently. Yet the presence of such individuals, who constitute a significant part of the population in every country, may impinge on the provision of UI. To begin with, individuals not in the labor force are difficult to distinguish from the unemployed. Yet in an obvious sense they do not face unemployment risk and are irrelevant for the purpose of UI. It is thus necessary to devise criteria for eligibility that would deny UI to individuals who are not in the labor force but not to individuals who are unemployed. Since willingness to work is private information, this raises an adverse selection problem.

(e) *Pooling and separating UI contracts*. Most of the work on optimal UI is based on the implicit assumption that the programs entail pooling all employees under a uniform contract. This assumption is natural when all individuals are identical and may be justified when individuals have distinct hidden characteristics.[10] In reality individuals

[10] The latter assumption is not separated from the specification of the objective function of the program. On this point, see the discussion in Crocker and Snow (1985)

have observable characteristics, such as profession, occupation, education, age, family situation, as well as employment history, that may allow their classification into distinct risk categories. It makes sense for optimal UI program to include separate contracts designed to fit the risk characteristics of the different groups.

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APPENDIX

A. Unemployment Insurance and Moral Hazard: The following is a simple example illustrating the nature of the optimal UI benefits in the presence of moral hazard problem.

Consider an UI program with the following features: If an insured person is laid-off he is entitled to UI benefits up to two consecutive periods provided he remains unemployed during these two periods. More specifically, upon losing his job the unemployed person receives the first period's UI benefit, b_1. During that period he engages in job search.. If he is successful he is reemployed at the outset of the second period at the competitive wage rate, w. If he is unsuccessful he receives, at the outset of the second period the second (final) installment of his UI benefits, b_2.

Assume that the probability, $p(e)$, of finding a new job depends on the search effort, e, of the unemployed person, where is a monotonic increasing and concave function. In other words, increased job-search effort increase the likelihood of success but is subject to the law of diminishing marginal returns. Assume, moreover, that the level of job search effort is private information (that is, it may not be observe by the provider of UI).

Unemployed individuals are assumed to choose a level of effort so as to maximize the expected discounted sum of their utilities. Formally, an unemployed person chooses the level of e so as to maximize:

$$v(b_1) + \delta[p(e)v(w) + (1 - p(e))v(b_2)] - e,$$

where δ is the discount factor and $v(.)$ is monotonic increasing concave utility function.

The objective of the UI program is to ensure the unemployed a minimum level of discounted expected utility, v_0, at minimum cost. The cost of UI insurance is given by:

$$C(b_1, b_2) = b_1 + \frac{1}{1+r}(1 - p(e))b_2,$$

where r is the market interest rate. Suppose that

$$\delta = \frac{1}{1+r}.$$

Claim: The optimal UI benefit schedule satisfies $b_1 > b_2$.

The claim is that, in view of the moral hazard problem, the optimal UI benefit schedule requires that the benefit decrease with the duration of the duration of the unemployment spell. To prove this claim we formulate the problem of the design of the benefits schedule as a principal-agent problem.

Choose b_1, b_2, and e so as to maximize

$$-\left[b_1 + \frac{1}{1+r}(1-p(e))b_2\right]$$

subject to:
a. incentive compatibility constraints:

$$p(e)v(w)+(1-p(e))v(b_2)-e \geq p(e')v(w)+(1-p(e'))v(b_2)-e', \text{ for all } e'$$

b. participation constraint:

$$v(b_1)+\delta[p(e)v(w)+(1-p(e))v(b_2)]-e \geq v_0.$$

Observation: *Since $p(.)$ is concave the "first order approach" is valid for this problem.. Hence, the incentive compatibility constraints may be replaced by the following first order condition:*

$$-1+p'(e)[v(w)-v(b_2)]=0.$$

The Lagrangian expression for the "first order approach" is as follows:

$$L(b_1,b_2,e,\lambda,\mu)=-\left[b_1+\frac{1}{1+r}(1-p(e))b_2\right]+$$
$$\lambda\{v(b_1)+\delta[p(e)v(w)+(1-p(e))v(b_2)]-e-v_0\}+\mu\delta\{-1+p'(e)[v(w)-v(b_2)]\},$$

where $\lambda \geq 0$ and μ are the Lagrange multipliers. Differentiating L with respect to b_1, b_2, and e and denoting by asterisks the optimal values of the variables we obtain the (necessary) conditions:

$$\frac{\partial L}{\partial b_1}=-1+\lambda v'(b_1^*)=0.$$

$$\frac{\partial L}{\partial b_2}=-\frac{1}{1+r}(1-p(e^*))+\delta[\lambda(1-p(e^*))v'(b_2^*)-\mu p'(e^*)v'(b_2^*)]=0.$$

and

$$\frac{\partial L}{\partial e}=\frac{1}{1+r}p'(e^*)b_2+\delta u p''(e)[v(w)-v(b_2^*)]=0.$$

The first condition implies:

$$\frac{1}{v'(b_1^*)} = \lambda.$$

Since $\delta = 1/(1+r)$ the second condition implies:

$$\frac{1}{v'(b_2^*)} = \lambda. - \mu \frac{p'(e)}{1 - p'(e)}.$$

The third condition implies:

$$\mu = \frac{p'(e^*)b_2^*}{p''(e^*)[v(w) - v(b_2^*)]}.$$

But, our assumptions about $p(.)$ imply that $p'(e^*) > 0$ and $p''(e^*) < 0$. Hence, if the replacement rate of UI is smaller than 100 percent, that is, $w > b_2^*$ then $\mu > 0$. Hence, the first two necessary conditions imply: $v'(b_2^*) > v'(b_1^*)$. But v is concave, thus $b_1^* > b_2^*$. This completes the proof of the claim.

B. Unemployment Insurance and Adverse Selection: The following is a simple example illustrating the nature of the optimal UI benefits in the presence of adverse selection.

Consider a simple UI market with the following features: Individuals live for one period during which they may or may not be employed. Individuals are risk averse and before they know their employment situation each individual is offered an UI policy, (α, β), where α denotes the UI premium and β denotes the UI net benefits. Each individual enters the market looking for employment. He is allowed one draw from a known distribution of wages on the unit interval, [0,1]. Each insured individual chooses a reservation wage, z, so that if the observation that he draws exceeds his reservation wage (i. e., if $w > z$) he accepts the job. Otherwise he declines the job offer and remains unemployed and collects the UI benefit, β.

Suppose that individuals in this economy are identical in every respect except of their preference for leisure. More specifically, let there be two types of individuals, 1 and 2. For individuals of type1 the utility associated with being unemployed is $t_1 v(\beta)$ and for individuals of type 2 the utility of being unemployment is $t_2 v(\beta)$ where $1 > t_2 > t_1 > 0$.

Individuals of both types are assumed to choose their reservation wages so as to maximize their expected utilities. Formally, given the UI policy (α, β) individual of type $j \in \{1,2\}$ chooses a reservation wage z^j so as to maximize

$$U^i(\alpha,\beta) = \int_{z^j}^1 v(w-\alpha)dF(w) + F(z^j)t_j v(\beta)$$

where $v(.)$ is monotonic increasing and concave function and $F(.)$ is the cumulative distribution function of wages.

Question: What is the Optimal UI program for this Economy?

Assume that individuals choose their reservation wages optimally. Given our assumption, the necessary and sufficient condition for optimality is:

$$v\left(z_j^*(\alpha,\beta)-\alpha\right) = t_j v(\beta) \text{ for } j = 1,2.$$

Since v is monotonic increasing $t_2 > t_1$ implies

$$z_2^*(\alpha,\beta) > z_1^*(\alpha,\beta).$$

In other words, *individuals with higher preference for leisure choose a higher reservation wage. This makes them less likely to find an acceptable job offer and more likely to remain unemployed*. The interaction of the hidden characteristic "preference for leisure" with the hidden action of choosing a reservation wage gives rise to a problem that is referred to as *endogenous adverse selection*.

Next observe that the "single crossing property" holds. In other words, the indifference curves in the $\alpha - \beta$ plane of the two types cross only once. To see this note that

$$\left.\frac{d\alpha}{d\beta}\right|_{U^j(\alpha,\beta)=cont.} = \frac{t_j v'(\beta)F\left(z_j^*(\alpha,\beta)\right)}{\int_{z^j}^1 v'(w-\alpha)dF(w)}.$$

Thus, $t_2 > t_1$ and $z_2^* > z_1^*$ imply

$$\left.\frac{d\alpha}{d\beta}\right|_{U^2(\alpha,\beta)=cont.} > \left.\frac{d\alpha}{d\beta}\right|_{U^1(\alpha,\beta)=cont.}.$$

Fair UI for type j is given by:

$$\left[1-F\left(z_j^*(\alpha,\beta)\right)\alpha\right] = F\left(z_j^*(\alpha,\beta)\right)\beta \text{ for } j = 1,2.$$

Thus, the slope of the fair-insurance locus of type j is given by:

$$\left.\frac{d\alpha}{d\beta}\right|_{fairinsurance} = \frac{F\left(z_j^*\right) + (\alpha+\beta)F'\left(z_j^*\right)\frac{\partial z_j^*}{\partial \beta}}{1 - F\left(z_j^*\right) - (\alpha+\beta)F'\left(z_j^*\right)\frac{\partial z_j^*}{\partial \alpha}} > \frac{F\left(z_j^*\right)}{1-F\left(z_j^*\right)} > 0.$$

Thus, the fair insurance premiums are monotonic increasing convex functions of the levels of benefits. Moreover, $z_2^* > z_1^*$ implies that for each level of benefits, β, the fair insurance premium of individual of type 2 exceeds that of type 1 individual, (see Figure 1 below.)

If the type was readily observable then the optimal self-financed U policies are depicted in Figure 1 and are given by $\left(\alpha_1^*, \beta_1^*\right)$ and $\left(\alpha_2^*, \beta_2^*\right)$. These policies would attain a first-best allocation of the UI risk. Under asymmetric information, however, only second-best allocations are attainable.

A *separating equilibrium* allocation is depicted in Figure 2, where the low-risk (type 1) individuals take out the UI policy $\left(\hat{\alpha}_1, \hat{\beta}_1\right)$ satisfying the incentive compatibility constraints:

$$U^2\left(\alpha_2^*, \beta_2^*\right) \geq U^2\left(\hat{\alpha}_1, \hat{\beta}_1\right).$$

and

$$U^1\left(\hat{\alpha}_{1,} \hat{\beta}_1\right) \geq U^1\left(\alpha_2^*, \beta_2^*\right).$$

Note that the population-wide fair insurance locus, FI, is everywhere above the indifference curve of the low-risk individual corresponding to their equilibrium contract. If the FI, locus intersect the indifference curve of the low-risk individuals then a pooling UI policy such as the policy $\left(\overline{\alpha}, \overline{\beta}\right)$ in Figure 2 Pareto dominates the separating equilibrium. Thus, the nature of the optimal UI program in the presence of endogenous adverse selection depends on the specific characteristics of the relevant population.

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