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A WELFARE ANALYSIS OF UNEMPLOYMENT INSURANCE: VARIATIONS ON SECOND BEST THEMES

by

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Research identifying and estimating the effects of unemployment insurance (UI) on behavior in the labor market has been and continues to be a growth industry.[1] The empirical results reported suggest that more liberal benefits prolong the length of the average unemployment spell, make unemployment spells more frequent and encourage labor force participation.[2] What are we to make of these empirical facts? These effects are generally attributed to the moral hazard problems attributable to the fact that the tax used to finance UI benefits is typically not fully experience rated and the fact that UI benefits are not always subject to income tax. Because without a fully experience rated UI tax or fully a taxed UI benefit the system subsidizes unemployment, unemployed workers search longer on average and employers layoff more frequently than is socially optimal according to search and layoff theories of unemployment. Hence, the principal policy recommendations arising from this research have been calls for a more fully experience rated UI tax and for treatment of UI benefits as ordinary income for income tax purposes.

The principal purpose of this paper is to ask a different set of questions. What should the UI benefit level be? Should the level be higher or lower than that which prevails? Does the empirical literature on the effects of UI have any implication for the answers to these questions? In the paper, answers are attempted within the framework of both a search unemployment model and an implicit contract model of layoffs, the two models typically used to interpret the existing empirical results. Within the context of either model, the questions are interesting only if the system provides an insurance benefit to workers. Specifically, workers must be risk averse or, more accurately, income constrained when unemployed. In the paper, two polar cases are considered: a fully experience rated UI tax and non-experience rated tax. In the latter case, the optimal UI benefit problem involves a tradeoff between the insurance benefit and efficiency distortions associated with moral hazard.

In the absence of a fully experience rated tax, problems of cross subsidization also arise when sectors differ with respect to unemployment risk. Distortions in the allocation of labor across sectors characterized by differential unemployment risk can result as a consequence. In principle, cross subsidization can be eliminated by setting the tax and benefit rates in each sector to equate expected receipts and payments. However, recent results in the theory of insurance suggest that adverse selection may complicate separate provision.[3] A second but equally important purpose of the paper is to consider the implications of these arguments for eliminating inter-sector subsidies.

An analytic framework is developed in the first section of the paper which incorporates both the temporary layoff and the search unemployment models as special cases. An important contribution of the paper is the demonstration that the two models have similar implications as a consequence of their common structure. The socially optimal UI benefit level for each model is derived in the second section in the case of the first best world of a fully experience rated UI tax. In this case, the level can be explicitly characterized in terms of taste and technology parameters. The fact that the level of unemployment is sensitive to the UI benefit level even when the tax is fully experience rated is also documented in the section. Specifically, unemployment and the UI benefit are positively associated if, and only if, the benefit level is below its optimal value when workers are averse to income risk.

In the third section of the paper, the case of a non-experience rated UI tax is considered. In this case, unemployment always rises in response to an increase in either the UI benefit or the UI tax rate whether the workers are risk averse or not as a consequence of moral hazard. Consequently, the empirical evidence has nothing to say about the optimality of prevailing UI benefit levels. Although the optimal benefit level in this second best world is shown to be strictly positive in spite of moral hazard, characterizing the optimal benefit level further appears to be quite complicated.

The problem of cross subsidization, which arises when the UI tax is not experience rated and unemployment risk differs across firms or sectors, is analysed in the fourth section of the paper. For this purpose an example is considered. In the example, unemployment risk differs across firms because workers are assumed to have different opportunity costs of working. Under these conditions, those with the higher alternative value of time work for firms that offer a higher wage and a higher unemployment probability. Since this form of worker heterogeneity is not observable _ex ante_, pooled provision can Pareto dominate separate provision as a consequence of adverse selection.

Models of Unemployment Insurance Effects

The best known analyses of the effects of unemployment insurance (UI) on unemployment are set within the context of temporary layoff and search unemployment models. Typically these are peopled by workers who are indifferent to risk in income across employment and unemployment states of the world. Although the assumption of risk neutrality is a convenient simplificatiion for the purpose of identifying and studying the incentive effects of the UI system, models embodying the restriction shed no light on the relevant policy question--the trade off between returns to risk sharing and efficiency losses attributable to moral hazard and cross subsidization. The principal purpose of this section is to propose a theoretical model of equilibrium unemployment designed for this purpose. In doing so, the common structure of layoff and search models of unemployment is exploited.

Although search and layoff unemployment appear to be quite different conceptually, in fact the existing models can be placed within a common framework. For example, the worker's value of marginal product (VMP) is a random variable, denote it as p, in both types of models. The worker is employed at a given moment if, and only if, the current realized VMP available is at least as large as some reservation value, call that z, in either model. The only apparent difference is that the worker is viewed as choosing this "reservation wage" and, therefore, unemployment is regarded as "voluntary" in the case of search models, while the employer is viewed as choosing it and unemployment is sometimes regarded as "involuntary" in the case of layoff models. This distinction is absolutely irrelevant, at least under conditions of symmetric information.[4]

In the Azariadis-Baily model of temporary layoff, each worker is viewed as "attached" to a particular employer. The worker's VMP to his employer is assumed to change from time to time according to the laws of some stochastic process. One way to formalize this idea is to assume that the arrival of a new value is a Poisson process characterized by an arrival rate η and that the new value is a random sample drawn from a distribution characterized by the c.d.f. $F(p)$. Employers offer workers a contract specifying the wage to be paid when the worker is employed and the probability of temporary layoff. Although mobility may be restricted <u>ex post</u>, <u>ex ante</u> mobility is costless. Therefore, equilibrium in a market composed of identical workers and risk neutral employers obtains when all employers offer contracts of equal value to the workers, the contract offered by each employer maximizes expected profit subject to this restriction, and the expected profit of the least profitable employer is zero. Given a contract characterized by a wage paid when employed y and a reservation VMP z, an employed worker is laid off at the next arrival date with probability $F(z)$ while a laid off worker is recalled with probability $1-F(z)$. Since this specification defines a continuous time Markov chain defined on two states--employment and unemployment--with an instantaneous transition rate from unemployment to employment equal to $\eta[1-F(z)]$ and from employment to unemployment equal to $\eta F(z)$, the stationary equilibrium probability of unemployment is

$$\phi(z) = \frac{\eta F(z)}{\eta F(z) + \eta(1-F(z))} = F(z), \tag{1}$$

the probability that a VMP drawn randomly from $F(p)$ is less than the reservation value.

In the typical search model, an unemployed worker is not "attached" to an employer. Instead, offers randomly arrives via a Poisson process with arrival rate α . The offer is a random wage drawn from a distribution characterized by F(p). The offer is acceptable and employment commences if the offered wage exceeds the worker's reservation wage z. The duration of the job is exponentially distributed with expectation equal to the exogeneously determined parameter $1/\delta$. Alternatively, employers might be viewed as offering contracts as in the temporary layoff model reviewed above. This time the contract is visualized as composed of a wage y and an a probability of acceptance equal to F(z), where z is the minimum productivity acceptable and F(p) is a distribution of prospective marginal productivities assumed to be specific to the employer and the same for all workers. In this case, workers choose the preferred contract type and seek employment among the employers offering that type. Again, the equlibrium contacts have equal expected utility when workers are identical, each maximizes the expected profit of the risk neutral employer offering it subject to this constraint, and the least profitable employer earns an expected profit equal to zero. Since the instantaneous transition rate from unemployment to employment is $\alpha[1-F(z)]$ and from employment to permanent layoff is δ, the stationary probability of unemployment associated with this continuous time Markov chain is

$$\phi(z) = \frac{\delta}{\delta + \alpha(1-F(z))}. \tag{2}$$

Because the worker is willing to accept employment at any firm offering an equilibrium contract, denial of employment to any worker by a particular employer produces what appears to be "involuntary" unemployment. The same worker offered the realized VMP would "voluntarily" refuse it in the standard search theoretic formulation of the problem. In other words, contract theory under symmetric information implies that the choice of the reservation VMP will not depend on who makes it. Behavior and welfare are invariant to the interpretation.

Given any candidate (y,z) for equilibrium in either model, the average stationary utility per period per worker associated with it is

$$V(y_0,y_1,z) = \phi(z)u(y_0) + (1-\phi(z))u(y_1) \tag{3}$$

where u(y) is the common instantaneous utility of income per time period and y_0 and y_1 are respectively income when unemployed and employed. Since $\phi(z)$ can also be interpreted as the fraction of each worker's life time spent unemployed V(.) also represents average life time utility per period for each individual. In this paper, this function is assumed to represent each individual worker's preferences over future income streams that are uncertain because of unemployment risk.[5]

To complete the specification of the framework, we only need to define state contingent incomes. Thoughout the paper, income transfers between states of the world in which a worker is employed and unemployed are possible only through the mechanisms of the UI system. However, actuarily fair income insurance across states in which a worker is employed is assumed to exist. Although these assumptions are not realistic, they do capture the principal justification for publicly provided unemployment insurance. Variations in income while employed are insured either by the employer or through the capital market but private insurance and capital markets fail to provide the means of spreading income variations attributable to unemployment risk, possibly as a consequence of problems of monitoring and adverse selection.

Under the assumptions $y_0 = x+b-c$, where x is the alternative value of time spent in non-labor market activities, c is the cost of search, and b is the UI benefit paid to an unemployed worker per period. Hence, the expected utility associated with the contract composed of a wage payment equal to $y_1 = y$ and a reservation wage equal to z is

$$V(y,z,x+b-c) = \phi(z)u(x+b-c) + (1-\phi(z))u(y). \tag{4}$$

The expected profit of the same contract to an employer characterized by the c.d.f. of VMP, F(p), is

$$\Pi(y,z,t) = (1-\phi(z))[w(z) - y - t], \tag{5}$$

where

$$w(z) = E\{p \,\|\, p \geq z\} = \frac{\int_z^\infty p dF(p)}{1 - F(z)} \tag{6}$$

is the expected acceptable VMP and t is the UI tax paid per employed worker per period.

The UI tax is said to be fully experience rated if, and only if, the expected tax paid on behalf of a worker while employed is equal to the expected benefit drawn when the worker is unemployed. Since the expected duration of employment and unemployment are $1/\eta F(z)$ and $1/\eta(1-F(z))$ respectively in the case of the temporary layoff model, the condition is

$$\frac{t}{\eta F(z)} = \frac{b}{\eta(1-F(z))} . \tag{7}$$

In the case of the search model, the condition requires

$$\frac{t}{\delta} = \frac{b}{\alpha(1-F(z))} . \tag{8}$$

Hence, in both cases

$$t(1-\phi(z)) = b\phi(z). \tag{9}$$

In practice the tax paid by an employer, if experience rated at all, is related to the benefits paid in the past to that employer's employees. It is clear that such mechanisms do experience rate in the sense defined above in the case of temporary layoff, although generally not fully, because the expected durations of both employment and layoff spells are determined by the employer's choice of the reservation VMP. The same does not appear to be the case for the search model, at least not when the employer is regarded as choosing the reservation VMP and pays the UI tax. However, consider again the conceptualization of how the labor market works. Suppose that each employer chooses a wage offer and a reservation VMP, a pair (y,z) assumed to be known to each worker, and that there are many employers who offer every pair. Given the set available, each worker chooses to search employers offering the pair he or she most prefers at frequency α. Since it follows that the worker when laid off will seek a new job among the firms offering the same z as that of the worker's former employer, the tax rate is experience rated in the sense defined. Specifically, each employer's tax rate will vary with the choice of z according to equation (9).

A competitive equilibrium for contracts can be characterized as follows. Each employer offers a contract (y,z) known to all workers. When workers have identical preferences, the contracts offered by all employers have the same expected utility in equilibrium. The equilibrium contract offer by each firm maximizes that employer's expected profit subject to the restriction that its expected utility is at least as large as the common contract value. Finally, the least profitable employer in the market earns zero expected profit. Hence, the equilibrium expected utility of all contracts is the solution to the problem of maximizing $V(y,z,x+b-c)$ as defined in equation (4) subject to the constraint that $\Pi(y,z,t)$ as defined in equation (5) is non-negative where $F(p)$ is the marginal employer's distribution of VMP. When the tax is fully experience rated, equation (9) is imposed as an additional.

UI as Fair Insurance

We begin by imposing a fully experience rated UI tax for two reasons. Because moral hazard and cross subsidization problems don't exist in this case, the first best socially optimal UI benefit rate can be derived as a useful benchmark. In addition, a positive association between the UI benefit level and both the duration and frequency of unemployment spells is implied when the UI benefit rate is below its social optimum.

As argued in the previous section, a competitive equilibrium in a contract market for labor solves the problem

$$\max_{(y,z)} \{\phi(z)u(x+b-c) + (1-\phi(z))u(y)\} \quad (10)$$
$$\text{s.t. } (1-\phi(z))[w(z) - y] - b\phi(z) \geqslant 0$$

when the UI tax is fully experience rated. The criterion is the typical worker's expected untility of participation in the labor market and the constraint is the marginal employer's non-negative expected profit constraint. The probability of unemployment, $\phi(z)$, is defined by equation (1) in the temporary layoff model and by equation (2) in the search model where in both cases $F(p)$ is the c.d.f. of VMP associated with the marginal employer. Finally, $w(z)$ is the expected acceptable VMP as defined in equation (6).

Let $v(b)$ denote the indirect utility of the solution to equation (10) expressed as a function of the UI benefit. Its value given b can be written as

$$v(b) = \phi(z^{o})u(x+b-c) + (1-\phi(z^{o}))u(y^{o}) + \lambda[(w(z^{o}) - y^{o})(1-\phi(z^{o})) - b\phi(z^{o})] \quad (11)$$

where (y^o, z^o) is the solution to equation (11) and λ is the multiplier associated with the expected profit constraint. At an interior solution, the derivatives of the right side of equation (11) with respect to y^o and z^o vanish.

$$(1-\phi(z^o))[u'(y^o) - \lambda] = 0. \tag{12}$$

$$\phi'(z^o)[u(x+b-c) - u(y^o) + \lambda[y - b - w(z^o) + w'(z^o)(1-\phi(z^o))/\phi'(z^o)]] = 0. \tag{13}$$

Concave utility of income is a sufficient condition for a unique interior solution in the cases considered in the section. In addition, we assume continuous dispersion in the distribution of VMP and a maximal VMP at least as large as the alternative value of time, i.e., $F'(p)$ is continuous and positive on an interval that includes x.

Finally, the UI benefit that workers prefer maximizes v(b). Letting b^* denote the value that is optimal in this sense and (y^*, z^*) the solution to equation (10) when $b = b^*$, we have

$$v'(b^*) = \phi(z^*)[u'(x+b-c) - \lambda] = 0. \tag{14}$$

Notice that equations (12) and (14) imply complete insurance, i.e., $y^* = x + b^* - c$, when the benefit is optimal and workers are strictly risk averse.

Temporary Layoffs

In the pure version of the temporary layoff model, workers do not search (c = 0) and the stationary probability of finding a worker on layoff is equal to the probability that the realized VMP is less than the reservation VMP. Since the definition equation (6) implies

$$w'(z) = \frac{F'(z)}{1-F(z)} \times [w(z) - z], \tag{15}$$

equations (12) and (13) collapse to the efficient contract condition,

$$u(y) - u(x+b) = u'(y)[y - z - b]. \tag{16}$$

The zero expected profit condition can be rewritten in this case as

$$\begin{aligned} &(1-\phi(z))[w(z) - y] - \phi(z)b = \\ &\int_z^\infty (p - y)dF(p) - F(z)b = 0 \end{aligned} \tag{17}$$

by virtue of equations (1) and (6). These two condition, (16) and (17), determine the equilibrium contract, (y^o,z^o), of the marginal firm given the UI benefit.

Condition (16) has the following interpretation. When the realized VMP is z, the employer is indifferent by definition between employing the worker and laying him off. The efficient choice of z is such that the worker's utility gain from employment relative to unemployment, the left side of equation (16), is just balanced by the profit loss attributable to employing him rather than laying him off valued at the worker's marginal utility of income, the right side of equation (16).

This balance of the utility benefits and profit costs of employment characterizes every efficient contract.

Notice that in the special case of risk neutral workers ($u''(.) = 0$), equation (15) implies $z^o = x$, i.e., the reservation VMP is the alternative value of time. In this case, the allocation of the worker's time is always efficient in the sense that expected "output"

$$xF(z) + \int_z^\infty p\,dF(p)$$

is maximized. Furthermore, the probability of being found on layoff, $F(x)$, is independent of the UI benefit rate. This result, attributable in this context to Feldstein (1976), is often interpreted as if it implied that the UI system has no behavioral effects when the UI tax is fully experience rated. This interpretation is incorrect if the system provides any insurance benefit, i.e., the workers are risk averse.

In the risk averse case, the optimal UI benefit is such that income is equalized across employment and unemployment states. For the temporary layoff model, this condition, $y^* = x+b$, together with equation (17) imply that the associated reservation VMP is the alternative value of time, $z^* = y^* - b = x$. Substituting $(x+b,x)$ for (y,z) in equation (17) one obtains the following closed form solution for the optimal UI benefit

$$b^* = \int_x^\infty (p-x)\,dF(p). \tag{18}$$

The optimal UI benefit is the expected gain associated with the efficient employment rule. One can show that it increases in response to either a translation of the VMP distribution to the right (an increase in expected productivity) or an increase in the mean preserving spread of the distribution (an increase in risk). Ofcourse, it decreases with the alternative value of time, the opportunity cost of working.

How do the reservation VMP and earnings when employed vary with the UI benefit in the case of risk aversion? Figure 1 is useful for the purpose of understanding the answer. The curve labled EE in Figure 1 is the locus of combinations of (y,z) that satisfy the efficient contract condition, equation (15). The curve intersects the line $z = y-b$ only once at the point where $y = x+b$ as we have already demonstrated. To establish that z attains its maximum value, $z^* = x$, at that point, we simply note that the slope of the EE curve is given by

$$\left.\frac{\partial z}{\partial y}\right\|_E = \frac{u''(y)[y - b - z]}{u'(y)} .$$

By implication then, the reservation VMP is always less than or equal to the alternative value of time with equality holding only if the UI benefit is optimal in the case of risk averse workers. Over employment generally characterizes a contract equilibrium in the sense that some employment states exist in which the worker's value of productivity is less than the alternative value of his time. This result is the same one which leads to the well known conclusion that there is less unemployment in an Azariadis-Baily contract market equilibrium than would be associated with maximum output.

[Figure 1 about here.]

The preceeding discussion suggests that any change in the UI benefit in the direction of its optimal value will induce an increase in the reservation VMP and in the probability of finding a worker on layoff. This conjecture can be established as follows. The curve PP in Figure 1 represents the locus of points associated with the zero expected profit constraint. By virtue of equation (17), its slope is

$$\left.\frac{\partial z}{\partial y}\right\|_P = \frac{(1-F(z))}{(y-z-b)F'(z)}.$$

Hence, the slope is positive in the region $z < y - b$ as illustrated in Figure 1. In addition, since

$$\left.\frac{\partial y}{\partial b}\right\|_P = \frac{-F(z)}{1-F(z)} < 0,$$

it follows that the intersection of EE and PP lies to the right of the line $z=y-b$ when $b < b^*$ and to the left of the line when $b > b^*$ as illutrated in Figure 1. Finally, because equation (16) and $u''(y) < 0$ imply

$$\left.\frac{\partial z}{\partial b}\right\|_E = \frac{u'(x+b) - u'(y)}{u'(y)} \quad \gtrless \quad 0 \quad \text{as } y \gtrless x + b,$$

we obtain the desired result

$$\frac{\partial z^o}{\partial b} \gtrless 0 \text{ as } b \lessgtr b^* \text{ and } \frac{\partial y^o}{\partial b} < 0 . \tag{19}$$

A positive association between unemployment and the UI benefit signals that social welfare can be improved by increasing the UI benefit when the UI tax is fully experience rated.

Search Unemployment

The cost of search, c, is positive and the stationary probability of unemployment is given by equation (2). By subsitution from

$$\frac{\phi'(z)}{1-\phi(z)} = \frac{F'(z)}{1-F(z)} \times \frac{\delta}{\delta+\alpha(1-F(z))}, \tag{20}$$

an implication of equation (2), and for w'(z) from equations (15), (12) and (13) imply the following characterization of efficient contracts in the search model:

$$u(y) - u(x+b-c) = u'(y)[y - z - b + \frac{\alpha}{\delta} \int_z^\infty (p-z)dF(p)] . \tag{21}$$

This condition together with the zero expected profit restriction for this case, which is

$$(1-\phi(z))[w(z) - y] - \phi(z)b = \phi(z)[\frac{\alpha}{\delta} \int_z^\infty (p-y)dF(p) - b] = 0 \tag{22}$$

by virtue of equations (2) and (6), determine the equilibrium contract, (y^o, z^o), of the marginal firm.

The interpretation of equation (21) is analogous to equation (16). At the reservation VMP, a worker's gain in utility attributable to being hired is equal to the loss in profit the employer experiences by hiring him valued at the worker's marginal utility of income. The particulars of equation (21) differ from equation (16) in two respects. First, the out-of-pocket cost of search, which affects the effective income enjoyed when searching, is included on the left side of equation (21). Second, the return to search is added to the right side.

When the UI benefit is equal to its optimal value, b^*, we know from conditions (12) and (14) that worker income is equalized across employment and unemployment states, i.e., $x+b^*-c = y^*$. This fact and equation (21) imply that the corresponding reservation VMP is the solution to

$$z^* - x + c = \frac{\alpha}{\delta} \int_{z^*}^{\infty} (p-z^*)dF(p). \tag{23}$$

Readers familiar with search theory will immediately recognize this equation as the standard condition defining the "reservation wage." At the reservation VMP, the difference between the value of a worker's time spent working and the alternative value of time plus the out-of-pocket cost of search is equal to the expected gain attributable to continuing to search. Notice that equation (23) determines the reservation VMP for all UI benefit rates in the risk neutral case. Hence, as in the temporary layoff model, the unemployment probability is independent of the UI benefit if the tax is fully experience rated and the workers are indifferent to risk in income.

By virture of income equalization, $y^* = x+b^*-c$, and zero expected profit, equation (22), we obtain

$$b^* = \frac{\alpha}{\delta} \int_{z^*}^{\infty} (p-y^*)dF(p) = y^* - x + c,$$

which is a logical possibility given equation (23) only when $y^* = z^*$. In words, the equilibrium reservation VMP and wage are equal when the UI benefit is optimal. The latter is the expected return to continued search,

$$b^* = \frac{\alpha}{\delta} \int_{z^*}^{\infty}(p-z^*)dF(p). \tag{24}$$

As standard results from search theory, we know that the "reservation wage", z^*, increases in response to a increase in both the mean of the "wage" distribution, in the sense of a translation of F(p) to the right, and risk, in the sense of a mean preserving spread of F(p), holding the other constant, because the expected return to search increases with either. Because $b^* = z^*-x+c$ by virture of equations (23) and (24), the same statement is true for the optimal UI benefit. Similarly, an increase in the ratio of the frequency of receiving offers to the layoff rate, α/δ, increases both the optimal UI benefit and the reservation VMP associated with it. Although the reservation VMP increases with the difference between the alternative value of time and the cost of search by virture of equation (23), the optimal UI benefit decreases with x-c because the two move in opposite directions, _ceteris paribus_, by virtue of equation (24). These results have intuitive appeal if stated as follows: The optimal UI benefit increases in response to an increase in expected productivity, risk in productivity, and the frequency of employment opportunity arrivals relative to layoff arrivals. It decreases in response to an increase in the difference between the alternative value of time and the cost of search.

To determine the behavioral effects of the UI benefit rate, first note that the set of efficient contracts, defined as the combination of (y,z) pairs satisfying equation (21), is a curve with the same qualitative properties as EE drawn in Figure 1. Specifically, because the slope of the curve is

$$\left.\frac{\partial z}{\partial y}\right\|_E = \frac{u''(y)[y-z-b + \frac{\alpha}{\delta}\int_z^\infty (p-z)dF(p)]}{u'(y)[1 + \frac{\alpha}{\delta}(1 - F(z)]},$$

the curve attains its maximum, z^*, when $y = x+b-c$. Again when the UI benefit is not optimal, the reservation VMP is less than z^* in the risk averse case. In other words, the probability of unemployment is generally too low in the same sense as in the temporary layoff model and for the same reason.

The slope of the curve associated with the zero expected profit condition, PP, is positive for values of y in excess of z,

$$\left.\frac{\partial z}{\partial y}\right\|_P = \frac{1-F(z)}{\alpha F'(z)(y-z)},$$

in the search unemployment case. Since in addition

$$\left.\frac{\partial y}{\partial b}\right\|_P = \frac{-\delta}{\delta + \alpha(1-F(z))} < 0,$$

PP intersects EE to the right of its maximum and has a positive slope at the intersection point when the UI benefit is less than optimal as illustrated in Figure 1. Finally, the fact that PP shifts leftward in response to an increase in the UI benefit and EE shifts upward, by virture of the fact that

$$\left.\frac{\partial z}{\partial b}\right\|_E = \frac{u'(x+b-c)}{u'(y)[1 + \frac{\alpha}{\delta}(1-F(z))]} > 0$$

as implied by equation (21), we have

$$\frac{\partial z^{\circ}}{\partial b} \gtrless 0 \quad \text{as} \quad b \lessgtr b^{*} \text{ and } \frac{\partial y^{\circ}}{\partial b} < 0. \tag{25}$$

The qualitative behavior effects of the UI benefit in the search model are identical to those of the temporary layoff model. Again, an increase in the UI benefit induces an increase in the reservation VMP and the probability of unemployment if, and only if, the benefit rate is less than optimal.

The Optimal UI Benefit and Moral Hazard

Moral hazard refers to the lack of incentive on the part of the insuree to take care to avoid an insured loss. It poses a potential problem for the provision of insurance in any context for which the probability of loss occurance is partially controlled by the insuree. Hence, moral hazard exists in all the common cases--the provision of casualty, fire, health and life insurance. As these examples illustrate, the presence of moral hazard does not cause complete market failure. Instead, a competitive equilibrium in an insurance market plagued by moral hazard is characterized by less than complete coverage even in the absence of administrative costs.

To avoid moral hazard when it is present, the premium schedule must reflect the causal relationship between the probability of loss occurance and the actions taken by the insuree. The analogue to the insurance premium in the case of UI is the tax paid to finance benefits. A fully experienced UI tax is precisely the premium schedule needed. In practice, the tax is not fully experience rated because the technological relationship between every individual's action, in our case the choice of a reservation VMP, and the probability of occurance, the probability of being unemployed, simply isn't known. At best, the feed-back mechanisms in place in the U.S. only approximate the appropriate schedule.[6] In most European countries, there is no attempt to experience rate. Given the costs involved in doing so, a fully experience rated tax is not a socially optimal design anyway. The socially optimal system would balance the cost of implementing it against the gains attributable to the reduction in moral hazard.

Although it would be an excellent research topic, our purpose is not to model the problem of determining the optimal extent to which the UI tax should be experience rated. In this section, the behavioral effects of a non-experience rated system are derived and the optimal benefit and tax rates for a non-experience rated UI system are characterized within the context of the unemployment models introduced in Section I. We are looking for the best in a second best situation. Although increases in either the UI benefit or tax rate unambiguously induce more unemployment in both of the models considered, their optimal values are never-the-less strictly positive in both models when the system offers an insurance benefit. Of course, these results are well known but not always well understood. Their derivation within a formal equilibrium micro model will hopefully aid understanding and promote further analysis.

When the UI tax is not experience rated, each employer regards the tax rate per employed worker, t, parametrically. It is not influenced by the decision to employ or not. Consequently, a market for labor contracts serves to solve the problem

$$\max_{(y,z)} \{\phi(z)u(x+b-c) + (1-\phi(z))u(y)\} \tag{26}$$
$$\text{s.t. } (1-\phi(z))[w(z) - y - t] \geq 0$$

where the solution, (y^o,z^o), is the equilibrium contract offered by the marginal employer. Let v(b,t) denote the worker's indirect expected utility of this contract, which is the common value to workers of all contracts offered in equilibrium, expressed as a function of the parameters of the UI system. Its value given (b,t) can be expressed as

$$v(b,t) = \phi(z^{o})u(x+b-c) + (1-\phi(z^{o}))u(y^{o}) \qquad (27)$$
$$\lambda^{o}(1-\phi(z^{o}))[w(z^{o}) - y^{o} - t]$$

where λ is the multiplier associated with the non-negative expected profit constraint. At an interior solution, $(y^{o}, z^{o}, \lambda^{o})$,

$$(1-\phi(z))[u'(y) - \lambda] = 0$$

$$\phi'(z)[u(x+b-c) - u(y) \qquad (28)$$
$$+ \lambda [y + t - w(z) + w'(z)(1-\phi(z))/\phi'(z)]] = 0$$

$$(1-\phi(z))[w(z) - y - t] = 0. \; .$$

The essential difference between these and the analogous conditions in the fully experience rated case is that, mistakenly from a social point of view, the tax paid per employed worker is viewed as a cost of employment while the benefit paid per unemployed worker is not viewed as a cost of not employing the worker.

Under the assumption of homogeneous employers, all of them are marginal, i.e., earn zero expected profit. Hence, an optimal non-experience rated but self-financing UI system is characterized by the benefit and tax pair (b^{*}, t^{*}) that solves the problem

$$\max_{(b,t)\geq 0} v(b,t) \qquad (29)$$
$$\text{s.t. } t(1-\phi(z^{o})) - b\phi(z^{o}) \geq 0$$

where z^o is the common equilibrium reservation VMP associated with the pair (b,t). Of course, the constraint in the problem requires that tax revenues match benefit payments per worker on average. It is clear that the value of the solution to this problem $v(b^*,t^*)$ is less that the value of the optimal UI benefit given a fully experience rated tax, that derived in the previous section. In the fully experience rated case the pair of pairs (y,z) and (b,t) are in effect chosen simultaneously to maximize expected worker utility subject to both the zero expected profit and the self-financing contraints. Here the self-financing contraint is inappropriately ignored in the determination of (y,z).

Temporary Layoffs

Remember that in the temporary layoff model $\phi(z) = F(z)$ and $c = 0$. These facts together with equation (15) imply that the system of equations (28) takes the following form:

$$(1-F(z))[u'(y) - \lambda] = 0$$

$$F'(z)[u(x+b) - u(y) + \lambda(y + t - z)] = 0 \tag{30}$$

$$(1 - F(z))[w(z) - y - t] = 0.$$

Since $w(z) > z$, the equations of system (30) imply

$$y^o + t > z^o \quad \text{and} \quad y^o > x + b. \tag{31}$$

In other words, income cannot be equalized across employment and unemployment states by any choice of the UI benefit. Indeed earnings exceed the alternative value of time plus the UI benefit in equilbrium so that workers always prefer employment *ex ante*.

A complete differentiation of (30) together with an application of (31) yields the following compartive static results:

$$\frac{\partial z}{\partial b} = F'(z)u'(x+b)(1-F(z))(y+t-z)/\Delta > 0 \tag{32}$$

$$\frac{\partial z}{\partial t} = [F'(z)u'(x+b)(1-F(z))-(1-F(z))^2u''(y)](y+t-z)/\Delta > 0 \tag{33}$$

when evaluated at the equilibrium, where

$$\Delta = \lambda F'(z)[1-F(z)]^2 - (1-F(z))u''(y)[y+t-z]^2 > 0$$

is the determinant of the Jacobian of (30). In sum, the reservation productivity and, therefore, the unemployment probability, F(z), increases with both the UI tax and benefit rates when the tax used to finance the benefit is not experience rated in the case of the temporary layoff model.

Search Unemployment

In this case equation (15) implies that the system (28) can be written in the following form:

$$(1-\phi(z))[u'(y) - \lambda] = 0$$

$$\Phi'(z)[u(x+b-c) - u(y) + \lambda(y+t-z+\frac{\alpha}{\delta}\int_z^\infty(p-z)dF(z))] = 0 \tag{34}$$

$$(1-\Phi(z))[w(z) - y - t] = 0.$$

Again the fact that $w(z) > z$ together with the equations of (34) imply

$$y^o + t > z^o \quad \text{and} \quad y^o > x + b - c. \tag{35}$$

Hence, a differentiation of equation system (34) and condition (35) imply

$$\frac{\partial z}{\partial b} = \Phi'(z)u'(x+b-c)(1-\Phi(z))(y+t-z+\frac{\alpha}{\delta}\int_z^\infty(p-z)dF(z)/\Delta > 0 \tag{36}$$

and

$$\frac{\partial z}{\partial t} = [\lambda\Phi'(z)u'(x+b-c)(1-\Phi(z)-(1-\Phi(z))^2u''(y)]\times \tag{37}$$
$$[y + t - z + \frac{\alpha}{\delta}\int_z^\infty(p - z)dF(z)]/\Delta > 0,$$

where

$$\Delta = \lambda\Phi'(z)[1-\Phi(z)]^2-(1-\Phi(z))u''(y)[y+t-z+\frac{\alpha}{\delta}\int_z^\infty(p-z)dF(z)]^2 > 0$$

is the determinant of the Jacobian of the system (34). Again we find that the reservation productivity increases with both the UI tax and benefit rates.

The Optimal UI Benefit

The problem of determining the optimal UI benefit and tax pair is defined in equation (29). As an implication of equations (27) and (28) and as intuition suggests, workers prefer a higher UI benefit and a lower UI tax _ceteris paribus_. Specifically,

$$\frac{\partial v}{\partial b} = \phi(z^o)u'(x + b - c) > 0 \tag{38}$$

$$\frac{\partial v}{\partial t} = -(1-\phi(z^o))u'(w^o-t) < 0 . \tag{39}$$

However, these preferences are constrained by the UI systems budget restriction when the system is self-financing over all.

$$\frac{b}{t} \leqslant \frac{1 - \phi(z^o)}{\phi(z^o)} , \tag{40}$$

In other words, tax collections cover benefit payments on average. Notice that the endogeneously determined reservation VMP, a function of both the UI benefit and tax, is a determinant of the constraint. Therefore, the slope of the boundary of the budget constraint in benefit-tax space is

$$\left.\frac{db}{dt}\right\|_B = \frac{1-\phi(z^o)-(b+t)\phi'(z^o)\partial z^o/\partial t}{\phi(z^o)+(b+t)\phi'(z^o)\partial z^o/\partial b} \leqslant \frac{1-\phi(z^o)}{\phi(z^o)} \text{ as } (b,t)\geqslant 0. \tag{41}$$

The inequality follows by virtue of the previously established fact that the equlibrium reservation VMP increases with both benefit and tax. Note that it is strict if, and only if, one of the two is positive. Finally, this property yields a budget set of the general shape depicted by the shaded area in Figure 2. The slope of the boundary, labled OB, is everywhere less than the slope of a ray drawn from the origin.

The second curve drawn from the origin and labled OV_0 in Figure 2 is meant to depict the indifference curve defined by $v(0,0) = v(b,t)$. By definition, workers are indifferent to any UI benefit-tax system on this curve and no UI, the origin. The important point is that the slope of the indifference curve at the origin is less than that of the budget contraint. In this case the two curves enclose a non-empty set of strictly positive UI benefit-tax combinations that are all strictly preferred to no UI. Below we show that this relative slope condition holds in both the temporary layoff and the search unemployment models if, and only if, the workers are risk averse.

The slope of the typical worker's indifference curve at any benefit-tax combination implied by equations (38) and (39) is

$$\left.\frac{db}{dt}\right\|_{V} = \frac{1-\phi(z^{o})}{\phi(z^{o})} \times \frac{u'(y^{o})}{u'(x+b-c)} \leqslant \frac{1-\phi(z^{o})}{\phi(z^{o})} \text{ as } u''(y) \leqslant 0 \tag{42}$$

by virtue of the fact that net earnings in a market equilibrium are always strictly greater than income while unemployed, condition (31) in the temporary layoff case and condition (35) in the search case. Because condition (41) holds as an equality at the origin, equations (41) and (42) imply that the critical relative slope condition holds in the risk averse case. Futhermore, they also imply that there is no non-empty set of preferred UI benefit-tax rates in the risk neutral case. Hence, the socially optimal UI system, that depicted in Figure 2 as (b^{*},t^{*}), is a strictly positive benefit-tax pair in spite of moral hazard if, and only if, it provides workers with insurance they value in both the temporary layoff model and the search unemployment model.

[Figure 2 about here.]

Unlike the fully experience rated case, little of interest can be derived in the way of comparative static results concerning the effects of changes in taste and technology parameters on the opitimal non-experience rated system. Unfortunately, moral hazard confounds the effects beyond this analyst's ability to sort them out.

Adverse Selection and The Provision of UI

When actuarily fair insurance is offered to a pool of different risk classes, the high risk insurees are subsidized at the expense of the low in the sense that the benefit payments to the former exceed the premiums paid to them on average. As a consequence, high risk insurees have an incentive to over insure and low risk insurees want to buy less than complete coverage in the absence of moral hazard. Although individuals cannot act on these incentives in the context of publicly provided UI, the subsidy implicit in pooled provision is likely to distort the allocation of labor across sectors that differ with respect to unemployment risk because high risk sectors are more attractive than they would otherwise be. This argument suggests that separate provision of UI to each risk sector of the labor market is more efficient or at least not Pareto dominated by pooled provision.

However, if differences in unemployment risk are attributable to unobservable worker heterogeneity, then problems of adverse selection arise. In competitive markets for insurance, Rothschild and Stiglitz have shown that the high risk insuree's incentive to obtain converage at the lower premium rates designed for low risk classes limits the extent of coverage that can be offered to low risk insurees and can prevent the existence of a market equilibrium. Indeed, the market failures associated with adverse selection are often cited as the reason for public provision of many forms of insurance including UI.[7] These claims suggest that public provision of UI might be designed to improve on the market outcome. However, there is little analysis of the form the optimal public provision might take. For example, should it be pooled?

In this section some insights into the answer to this design question are sought within the context an example. In the example, differences in unemployment risk are induced by heterogeneity in worker tastes. Specifically, workers differ with respect to their opportunity costs of working. Adverse selection is shown to limit the extent to which separate provision of UI is possible when the difference is unobservable ex ante. The principal result is that pooled provision can Pareto dominate separate provision as a consequence. To simplify the presentation, only the temporary layoff is considered. However, all the crucial results can be shown to apply in the search model case as well.

Employers are identical and workers are equally productive in all jobs but workers differ with regard to their opportunity costs of working by assumption. Suppose that there are two worker types, denoted as $i = 1$ and 2. Type one workers have alternative value of time x_1 and represent a fraction γ of the total labor force. Type two worker have a higher alternative value of time $x_2 > x_1$. By assumption, workers types are indistinguishable ex ante.

Although workers cannot be distinguished by type ex ante, a competitive market for contracts will act to provide each type with a different contract in equilibrium given pooled provision of UI. In effect, each type selects as its equilibrium contract that which maximizes its expected utility from those that yield zero expected profit. Although type identities are revealed in equilibrium, separate provision is limited by the fact that the high unemployment risk type, which turn out to be those with the higher alternative value of time, may prefer the contract demanded by the low unemployment risk type. In sum, adverse selection complicates separate provision of public as well as private UI.

The analysis of the previous section immediately yields the differences between the contracts selected by the two types in equilibrium given pooled provision. Indeed an inspection of equation (30) reveals that an increase in the alternative value of time has the same effect on the equilibrium contract as an increase in the UI benefit. Hence, $z_2^o > z_1^o$ which implies

$$F(z_2^o) > F(z_1^o). \tag{43}$$

Workers with the higher alternative value of time are unemployed more on average in the temporary layoff model.

Ofcourse, pooled provision implies that the higher alternative value of time workers are subsidized at the expense of the lower in the sense that that the UI tax paid by the former's employers do not cover the UI benefit payments collected by them on average given that the system over all is self-financing. The effect of the subsidy is to induce the former group to experience more unemployment and the latter less than would be the case if UI were separately provided. To establish this assertion, note that the separate self financing constraints are

$$\frac{b_i}{t_i} \leq \frac{1 - F(z_i^o(b_i,t_i))}{F(z_i^o(b_i,t_i))}, \; i = 1 \text{ and } 2 \tag{44}$$

where $z_i^o(b_i,t_i)$ is the equilibrium reservation VMP when employers of type i workers pay the tax t_i and unemployed workers of type i receive the benefit b_i. However, in the pooled case, the set of common UI tax-benefit pairs that satisfy the self financing constraint is defined by

$$\frac{b}{t} \leqslant \frac{\gamma[1 - F(z_1^o(b,t))] + (1-\gamma)[1 - F(z_2^o(b,t))]}{\gamma F(z_1^o(b,t)) + (1-\gamma)F(z_2^o(b,t))} \qquad (45)$$

where γ is the fraction of the total labor force of type one. The shape of both separated constraints is like that depicted in Figure 2 because of moral hazard, i.e., equation (41) holds in both cases because the reservation VMP for type i increases with b_i and t_i.

Consider a benefit-tax pair on the boundary of the type two constraint, the curve labled OB_2 in Figure 3 below. Since equation (43) holds when $(b_i,t_i) = (b,t)$, i = 1 and 2, equation (44) implies that the point selected is strictly inside the self-financing constraint for type one workers, i.e., the boundary of the latters' constraint set, OB_1, is every where above OB_2 as drawn in Figure 3. Ofcourse, the boundary of the pooled containt set, represented by the curve OB in Figure 3, lies between the two. Consequently, the corresponding values of the benefit on the boundaries of the three sets satisfy $b_1 > b > b_2$ given t. Because the probabily of unemployment increases with the benefit for both types, the higher alternative value of time type is unemployed more on average and the lower value of time type is unemployed less when UI is separately provided than when pooled, holding the UI tax rate constant.

[Figure 3 about here.]

Contact equilibrium in the labor market reveals the type indentity of each worker by facilitating a process by which each worker in effect selects the feasible contract preferred given pooled UI provision. Can this kind of self selection be used to design a system of separate provision? If so, is separate provision socially preferred?

Separate provision of UI in the presence of adverse selection is limited by incentive compatibility constraints. These require that each worker prefer the contract offered to his or her type. In addition, every employer must be induced to honestly report the type of worker employed. Together these two conditions are equivalent to

$$v_i(b_i,t_i) \geq v_i(b_j,t_j) \ , \ j \neq i \qquad (46)$$

where $v_i(b,t)$ is the indirect utility associated with the expected utility maximizing zero expected profit contract for type i given the UI benefit-tax pair as defined by equation (27). The subscript on the indirect utility function simply reflects the substitution of x_i for x in equation (27).

A feasible separated UI system is any pair of UI benefit-tax pairs (b_1,t_1) and (b_2,t_2) that satisfy the separate self-financing constraints of equation (44) and the incentive compatibility contraints of equation (46). Define the UI tax-benefit pair (b_i^*,t_i^*) as that which maximizes expected indirect utility of type i workers subject to the separate self-financing contraint (44). In other works, the pair solves

$$\max_{(b,t)\geq 0} \ v_i(b,t) \quad \text{s.t. } (44) \ , \ i = 1 \text{ or } 2. \qquad (47)$$

Each pair has the properties depicted in Figure 3. The pair of pairs so defined form the unique Pareto optimal separated UI system provided that they also satisfy the incentive compatibility conditions of (46). In Figure 3, two cases are illustrated. In panel a of the figure, the incentive compatiblity constraints are satisfied but in panel b they are not.

The curve labled $V_i^*V_i^*$ in each panel is the type i indifference curve associated with the UI benefit-tax pair that is optimal in the sense of equation (47). By virtue of the fact that OB_1 is everywhere above OB_2, it follows that workers of type one prefer (b_1^*,t_1^*) to all pairs that satisfy the self-financing constraint for type two workers. Therefore, equation (46) is satisfied for i = 1 by the pair of pairs (b_1^*,t_1^*) and (b_2^*,t_2^*). However, the second incentive compatability condition, i = 2, requires that only those pairs lying on the OB_1 curve to the right of the point of intersection of OB_1 and $V_2^*V_2^*$, the point labled C in both panels, are feasible UI benefit-tax combination for type one workers when UI is separately provided and the UI benefit-tax pair for type two workers is (b_2^*,t_2^*). Hence, the two pairs satisfying equation (47) for i = 1 and 2 form a feasible separated UI system in panel a but are not feasible in panel b.

When the pair of UI benefit-tax pairs satisfying equation (47) are feasible, then they form the unique Pareto optimal separated UI system. Furthermore, there is no pooled system, a common UI parameter pair (b,t) satisfying equation (45), that Pareto dominates them. Both assertions follow from an inspection of panel a in Figure 3.

More interesting results obtain in panel b where the proposed separated is not feasible. A second best separated system in this case is composed of the UI benefit-tax pair (b_2^*,t_2^*) for type two workers and $(\hat{b}_1,\hat{t}_1)$ for type one workers, the point C in panel b. Although this pair of pairs is a Pareto optimal separated UI system, there exist pooled UI systems that both worker types prefer, those indicated by the shaded area in panel b. In other words, it appears that pooling can Pareto dominate separate provision when more hazard is present.

To establish the point, we must show that panel b illustrates a valid example. A proof is a demonstration that (b_1^*, t_1^*) can be between the origin and the point C on the boundary OB_1 of the type one self-financing constraint. Remember that all workers have the same utility of income function, only their alternative values of time differ. Consequently, in the limiting case in which both types are risk neutral $(u''(y) = 0)$, $(b_i^*, t_i^*) = 0$ for i = 1 and 2 by virtue of moral hazard as we demonstrated in the previous section. Furthermore, the point C is stictly positive in the limiting case because the type two indifference curve from origin has slope equal to the slope of OB_2 at the origin. By continuity, then, panel b represents the situation when the common aversion to risk of both types is sufficiently slight.

The fact that the type one indifference curve $\hat{V}_1\hat{V}_1$ is drawn more steeply sloped than the type two indifference curve at the critical point C in panel b is not required for the conclusion that pooled UI system Pareto dominate. Because the position of OB can be anywhere between OB_1 and OB_2 for an appropriate choice of the fraction of workers who are of type one, γ, by virtue of equation (45) and because none of the other curves depend on γ, there always exist pooled UI pairs that type one workers prefer to $(\hat{b}_1, \hat{t}_1)$ for γ sufficiently close to unity. Never the less, the relative slopes as drawn also hold in the limiting case of risk neutral workers by virtue of equations (27) and (28). In particular,

$$\left.\frac{db}{dt}\right\|_{v_i} = \frac{1 - F(z_i^o)}{F(z_i^o)} \times \frac{u'(w_i^o - t)}{u'(x_i + b)}, \quad i = 1 \text{ and } 2, \tag{48}$$

imply

$$\left.\frac{db}{dt}\right\|_{v_1} > \left.\frac{db}{dt}\right\|_{v_2} \tag{49}$$

by virtue of equation (43) when $u''(y) = 0$. By continuity, this condition holds when the workers are not too risk averse, at least as an inequality.

Although the analysis presented for this example is quite similar to the Rothschild and Stiglitz analysis of the behavior of competitive insurance markets in the presence of adverse selection, there are important differences between the two models. For example, differential risk in their analysis is exogenously given but is endogeneously generated here by heterogeneity with respect to the alternative value of time. Because type two workers find unemployment less odious, they select to bear relatively more unemployment risk when UI is pooled. For the same reason, type one workers benefit most from the provision of UI as the common degree of risk aversion increases. Indeed, when the type one demand price for insurance is sufficiently high in the sense that the additional benefit required per unit increase in the tax is low, then first best separate provision is feasible because type two workers do not find that much insurance to their liking even when not paying its full cost. However, when the type one demand price is low separation is feasible only when type one workers are required to obtain more coverage than they would otherwise demand. This difference in the structures of the two models explains why separate provision constrained by adverse selection yields too much insurance for low risk insurees in our model rather than too little as in the Rothschild and Stiglitz analysis. However, the existence of Pareto superior pooled UI systems arise in our case for the same reason as non-existence of competitive equilibrium does in theirs. Namely, effective separation of two types in the face of adverse selection requires a significant degree of heterogeneity.

FOOTNOTES

*The financial support of the National Science Foundation is gratefully acknowledged.

[1]For a recent review of the extensive literature, see Gustman (1980). Authors who touch on or attempt formal welfare analyses include Feldstein (1978), Baily (1977) and (1978), Stafford (1977), Flemming (1978), Shavell and Weiss (1979), and Lippman and McCall (1980).

[2]Classic papers that empirically identify these three effects are respectively Ehrenberg and Oaxaca (1976), Feldstein (1976), and Hamermesh (1979). More recent efforts to estimate all of them and determine their total effect on unemployment with the same data and a unifying empirical methodology are reported by Clark and Summer (1982) and Topel (1982).

[3]See Rothschild and Stiglitz (1976).

[4]See Holmstrom (1981) on this point.

[5]Because of persistence in each state, V(.) represents an approximation to an individual worker's expected discounted future steam of utility conditional on employment status. It can be shown that the approximation is a good one when employment opportunities given unemployed arrive frequently relative to the discount rate, i.e., when p/h and p/a are small respectively in the temporary layoff and the search models.

[6]See Becker (1972) and Topel (1982) for estimates of the degree of experience rating by state in the U.S.

[7]See the Economic Report of the President, 1982.

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Figure 1: The Efficient Contract (b < b*)

Fully Experience Rated UI Tax

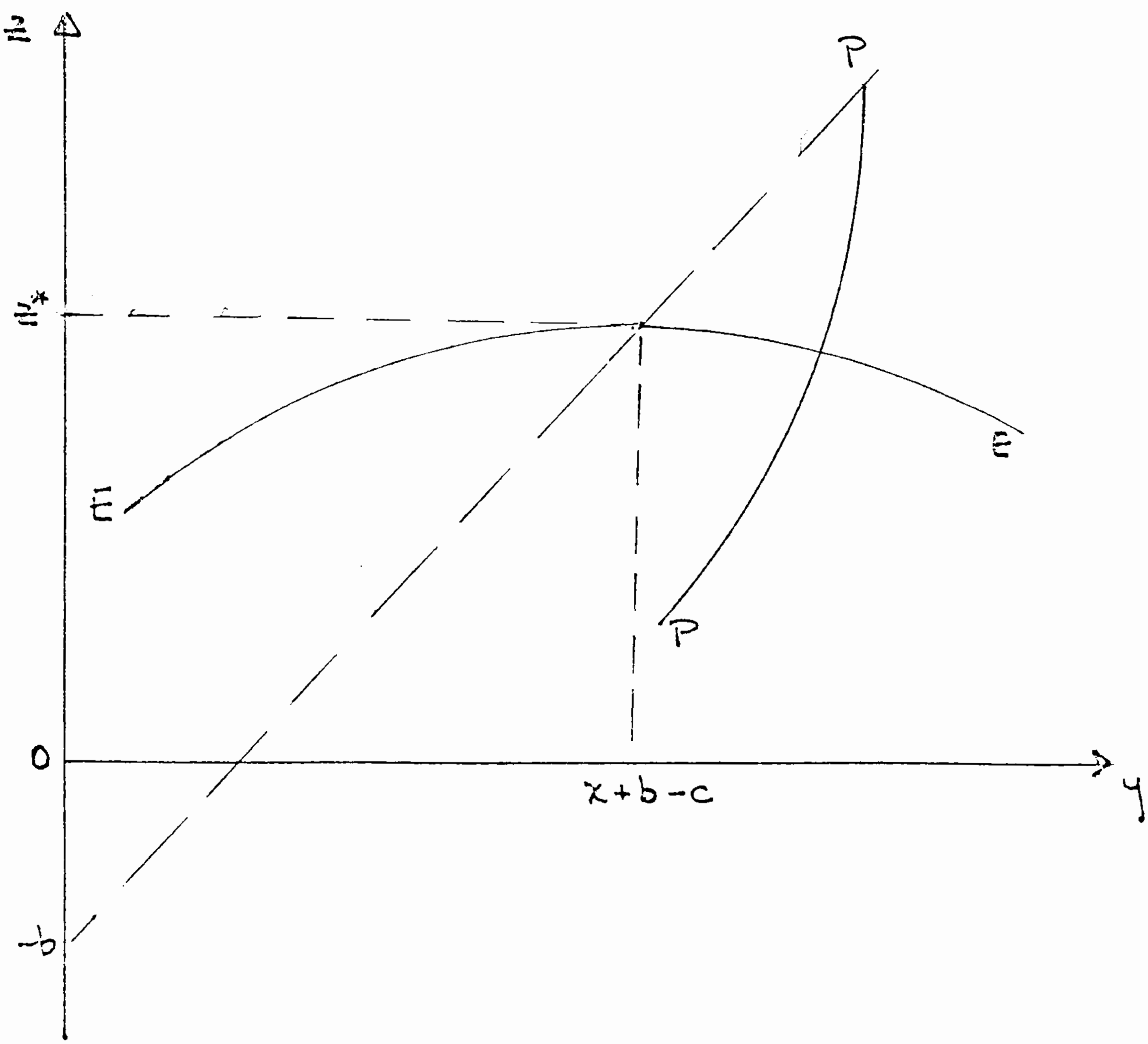

Figure 2: The Optimal UI Benefit

Non-Experience Rated Tax