

Topel, Robert H.

Working Paper

Unemployment Insurance, Experience Rating, and the Occurrence of Unemployment

Working Paper, No. 21

Provided in Cooperation with:

George J. Stigler Center for the Study of the Economy and the State, The University of Chicago
Booth School of Business

Suggested Citation: Topel, Robert H. (1982) : Unemployment Insurance, Experience Rating, and the Occurrence of Unemployment, Working Paper, No. 21, The University of Chicago, Center for the Study of the Economy and the State, Chicago, IL

This Version is available at:

<https://hdl.handle.net/10419/262423>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

CENTER FOR THE STUDY OF THE ECONOMY AND THE STATE
WORKING PAPER SERIES

UNEMPLOYMENT INSURANCE, EXPERIENCE RATING,
AND THE OCCURRENCE OF UNEMPLOYMENT

Robert H. Topel

Working Paper No. 021

March 1982

CENTER FOR THE STUDY OF THE ECONOMY AND THE STATE

The University of Chicago
1101 East 58th Street, Chicago, Illinois 60637

UNEMPLOYMENT INSURANCE, EXPERIENCE RATING, AND THE
OCCURRENCE OF UNEMPLOYMENT

Robert H. Topel
The University of Chicago

January, 1982

I am grateful to the Center for the Study of the Economy and the State for financial support. This paper has benefited from comments by D. Coppock, J. Hotz, C. Kahn, S. Rosen, G. Stigler, and F. Welch as well as from members of the Money Workshop at the University of Rochester, the Labor Workshop at UCLA, and Applications and Labor Workshops at The University of Chicago. Joe Tracy provided excellent research assistance. The errors are my own accomplishments.

Introduction

The problem studied in this paper is how current systems of legislated unemployment insurance (UI) affect the private decisions that generate unemployment. It has long been recognized that UI may affect the search strategies of jobless individuals by raising reservation wages, and therefore influence the duration of unemployment spells. More recently, theoretical research has focused on the connection between UI and transitions to unemployment, with considerable emphasis on the importance of temporary layoffs as a type of unemployment.¹ Current methods of UI financing, which effectively subsidize the benefit costs of many employers, have figured prominently in this discussion. This paper extends research on these issues in two important ways.

First, in the theoretical analysis, I show that the allocative role of legislated UI cannot be analyzed separately from factors that determine the demand for insurance. The extent of privately financed UI prior to the advent of government programs in the 1930's, and of supplemental benefit programs today,² indicate the existence of important incentives for firms to provide income for their unemployed workers. Within a framework implied by these incentives, both the level of benefits that workers receive while unemployed and the cost to employers of providing them will affect employment decisions. Specifically, when UI costs are subsidized, an increase in benefits will increase both the frequency and the duration of temporary layoff spells. This occurs because UI reduces the costs of unemployment to workers in terms of the risks they bear, and also to firms in terms of reduced turnover among valuable workers on lay-off. A non-subsidized increase in benefits will normally have the opposite effect, however. Thus, in evaluating the impact of UI on unemployment, it

is important to separate the effect of UI subsidization from that implied by the (legislated) level of UI per se.

In light of this framework, in the empirical analysis I use data on individuals from the 1975 Current Population Survey to estimate the effects of UI (and other variables) on transitions to and from temporary layoff unemployment. An important feature of this analysis is that I estimate the value of the UI subsidy to unemployment that is relevant for each individual's employer. This estimate is based on the structures of state UI financing laws, and the results indicate an important, positive impact of the subsidy on the frequency and duration of temporary layoffs. I estimate that about one-fourth of the sample's layoffs are attributable to the subsidy. In contrast, once the subsidy is controlled for, the level of available UI per se has a relatively minor impact on layoffs.

The paper is organized as follows. The next section presents some empirical foundation for the problem studied here. Section 2 develops a simple dynamic model that characterizes jointly optimal layoff, insurance and search strategies in the absence of public UI, and also analyzes the effects of mandated insurance on these strategies. The empirical analysis appears in Section 3, and concluding remarks are in Section 4.

1. Empirical Background

At any point in time, among unemployed workers who have left or lost their previous jobs, temporary layoffs and discharges dominate quits, accounting for nearly three-fourths of this category on average.³ Since quits are the major share of this category who are ineligible for UI under state laws, it is clear that the large majority of passages from employment to unemployment are, in principle, compensable. In fact, tabulations of a

special questionnaire administered with the May, 1976 Current Population Survey indicate that 69 percent of permanent job losers had either received UI benefits or had an application pending. The corresponding figures for temporary layoffs and for quits were 75 and 41 percent, respectively.

A more disaggregated view reveals large and systematic discrepancies in average unemployment rates and reasons for entering unemployment by industry of origin. For example, in Table 1 fully 32 percent of all persons on temporary layoff were from the construction trades in a typical "low" unemployment year, but this share declines during a recession. In contrast, auto and metals workers experience strongly cyclical unemployment, and temporary layoffs dominate this pattern. The most important message of these data, however, is that there are large and persistent differences among industries in propensities to generate unemployment. How do these differences interact with the UI system?

In the United States, as in no other country, UI benefits are financed by taxes on employers that are related to their history of generating unemployment. This system of experience rating is highly imperfect, and it is almost universally true that employers do not pay in incremental taxes the full value of benefits received by their unemployed workers. This fact underlies the UI subsidy to unemployment; however, some employers are more heavily subsidized than others. Table 2 reports some characteristics of the distribution of UI-compensated unemployment and tax liabilities in 1967, based on data collected by Joseph Becker (1972). An important feature of state programs is that tax rates are bounded, implying that firms with high average unemployment may consistently accumulate deficits of tax payments relative to benefit withdrawals. For these firms, the marginal cost of benefits is zero, since an increase in layoffs can cause no incremental

TABLE 1

UNEMPLOYMENT RATES BY REASON AND YEAR: FULL TIME PARTICIPANTS IN SELECTED INDUSTRIES
(Figures in parentheses are percentages of U.S. totals)

	Compensated Rate 1973-1976	Layoff		Discharge		Quit	
		1973	1975	1973	1975	1973	1975
1. Construction	9.39	3.87 (32.22)	8.02 (18.87)	3.65 (16.50)	7.69 (17.64)	0.73 (6.76)	0.69 (6.15)
2. Fabricated Metals	4.50	1.27 (3.34)	7.05 (5.06)	2.42 (3.47)	3.94 (2.76)	0.58 (1.69)	0.48 (1.29)
3. Machinery	3.10	0.23 (0.91)	3.36 (3.77)	1.08 (2.31)	1.98 (2.17)	0.77 (3.38)	0.84 (3.56)
4. Autos	5.40	0.30 (0.61)	16.42 (8.40)	0.90 (0.99)	2.68 (1.34)	0.45 (1.01)	0.17 (0.32)
5. Printing	2.45	0.57 (1.22)	0.96 (0.51)	1.56 (1.82)	2.24 (1.17)	0.28 (0.68)	0.48 (0.97)
6. Chemicals	2.50	0.29 (0.61)	2.32 (1.37)	0.58 (0.66)	2.75 (1.59)	0.58 (1.35)	1.01 (2.27)
7. Petroleum	2.77	0.00 (0.00)	3.33 (0.34)	0.00 (0.00)	0.83 (0.08)	0.66 (0.34)	0.83 (0.32)
8. Retail Sales	2.28	0.42 (5.47)	1.26 (4.55)	1.48 (10.40)	3.26 (11.45)	1.11 (15.88)	0.78 (10.68)
9. Finance - Insurance	N.A.	0.33 (1.22)	0.61 (0.69)	0.41 (0.83)	2.15 (2.34)	0.98 (4.05)	1.07 (4.53)
10. Banking	N.A.	0.28 (0.91)	0.29 (0.26)	0.38 (0.66)	2.29 (2.01)	0.57 (2.03)	1.24 (4.21)
11. Education	N.A.	0.14 (1.52)	0.19 (0.60)	0.41 (2.48)	0.49 (1.51)	0.38 (4.73)	0.41 (4.85)
Total		0.79	2.87	1.46	2.95	0.71	0.76

Source: Tabulations of March Current Population Surveys for indicated years. N.A. = data not available. Compensated unemployment rates are taken from U.S. Department of Labor, Unemployment Insurance Statistics, various issues.

TABLE 2

SUMMARY STATISTICS FOR SELECTED STATE PROGRAMS: THE DISTRIBUTION OF COMPENSATED UNEMPLOYMENT (1967)

	California	Massachusetts	Michigan	New York	Ohio	Wisconsin
A. Percent of State ^a Taxable Payroll						
a) At minimum tax rate	0.1	5.2	NA	22.9	4.6	6.0
b) At maximum tax rate	18.0	6.4	NA	12.9	3.7	5.7
B. Proportion of Total Taxable Wages Paid by Negative Balance Firms ^a	14.2	11.8	3.6	13.8	4.4	8.5
C. Proportion of Total Charged ^a Benefits Charged to Negative Balance Firms	51.8	55.3	34.8	61.6	34.2	60.8
D. State Compensated ^b Unemployment Rate	3.9	2.9	2.6	2.9	1.6	2.1
E. Estimated Average Compensated ^c Unemployment Rate for Employees of Negative Balance Firms	12.9	11.2	10.9	11.9	8.0	10.3

^aBecker (1972, pp. 86-87, 112).^bAverage weekly insured unemployment divided by the sum of average covered employment and unemployment. The source for the numbers is Handbook of Unemployment Insurance Financial Data (1970).^cBenefits charged to negative balance firms as a proportion of their taxable wages, times the state average ratio of weekly taxable wages to benefits.

taxes for firms at the maximum allowable tax rate.

The potential importance of this subsidy is illustrated in row B of the table, which shows that in 1967 only about 10 percent of covered employment occurred in firms whose accumulated past tax contributions were smaller than benefit withdrawals, yet roughly half of all benefits were received by their employees. Evidently, firms that entered 1967 with negative balances due to high past unemployment had higher than normal unemployment during 1967 as well. In fact, as rows D and E show, unemployment rates for deficit employers averaged about five times the implied average for positive balance firms. These data indicate extensive cross-subsidization of benefit payments within state UI financing systems. Since most firms with negative balances pay the maximum allowable tax rates, it follows that the marginal cost of benefits for a large proportion of unemployment is also heavily subsidized. The empirical issue of whether the incentives implied by these subsidies have substantially contributed to unemployment is deferred to Section 3. First, I examine the theoretical effects of legislated UI and methods of financing on the probabilities of entering and leaving unemployment.

2. A Model of Insurance, Search, and Layoff Decisions

This section develops a model for analyzing private search, employment, and insurance decisions. A central feature of the model is a demand for unemployment insurance arising from the joint incentives of firms and workers to mitigate employment risks and to maintain the value of job-specific investments. I show that in the presence of these incentives, an exogenous, publicly administered, UI program will alter the set of employment contracts which would exist in its absence, and so will change the relative costs of employment decisions. In this framework, the model examines the effects of UI and UI financing on (i) attitudes toward employment risk and their interaction with layoff decisions; (ii) search activity and the value of job specific capital; and (iii) the likelihood of rehire and the duration of unemployment spells.⁴

The model is essentially an interaction between principle (firm) and agent (worker). Workers control their search strategies while unemployed, but search effort and the reservation wage are not observable by the firm. If search effort confers costs (foregone job-specific capital) or benefits on the firm, then non-observability precludes a first-best solution for insurance and employment decisions. In particular, the firm may partially control worker search behavior via appropriate choices of wages, benefits, and layoff and rehire probabilities; and so these are adjusted in light of search strategies. A central result from the point of view of the subsequent empirical analysis is that while the subsidized (non-experience rated) component of UI always increases the incidence of unemployment and the duration of temporary layoffs, non-subsidized benefits

may decrease the probability of layoffs and their duration. The magnitude of the latter effect depends on the difference between mandated levels of UI and the level that workers and firms would jointly agree upon. The human capital value of a worker to his employer and the search externality play an important role at this stage. As an empirical matter, this implies that in analyzing the impact of UI on decisions that generate unemployment, it is quite important to separate the effects of UI subsidization from other behavioral effects of providing benefits.

The theoretical analysis has two stages. First, I outline the dynamic search strategy of a worker faced with employment risks and who has some degree of job attachment (a non-negligible rehire probability). This behavior is then integrated with that of a wealth maximizing employer to determine Pareto-efficient wage, insurance, and layoff and rehire strategies. The resulting solution is then displaced by an exogenous system of UI benefits and implicit subsidies. Throughout, I assume a stationary economic environment in that alternative job offers for workers on layoff and demand prices for firms are drawn from fixed, time-invariant distributions.

2.1. Workers

In any period, a worker may be either employed or unemployed with a positive probability of rehire to his previous job. Instantaneous utility is a strictly concave, twice continuously differentiable function of income and leisure, $u(c, L)$. In addition to concavity, I will assume that consumption and leisure are complementary in the sense of $u_{12} > 0$. This condition is sufficient to guarantee a positive income elasticity of leisure in a static labor supply problem and, as will become clear, it is

necessary for normality in the present case.⁵ While not working the individual may sample job offers alternative to the one offering rehire prospects, and acceptance of these offers is irreversible. The distribution of offers is $G(x)$, and these yield continuous future employment (commencing from the start of next period) at a constant wage, x .⁶ To generate offers, the worker incurs time cost s of search and offers arrive via a Poisson process with parameter λ . Thus, the probability of receiving an offer during an unemployed period is λs .⁷ Rehire offers are made at the beginning of next period, and are unavailable if x has been accepted. Thus, the worker must decide whether to accept an offer or to wait for possible rehire to his old job.

To highlight the role of UI, I specify the budget constraint to require that workers consume out of income; they may neither borrow nor save. The model may be extended to include self-insuring (saving) behavior by workers, though this complicates the analysis.⁸ Finally, I abstract from hours decisions by assuming that the individual has one unit of leisure which is enjoyed only while unemployed. With these assumptions, the functional equations describing the value of each state are

$$(1) \quad U^e = \text{Max}_{s, \xi} \{u(w, 0) + \beta V\}$$

if currently employed and, if on layoff,

$$(2) \quad U^l = \text{Max}_{\xi, s} \left\{ u(b, 1-s) + \beta V + \frac{\beta \lambda s}{r} \int_{\xi}^{\infty} u(x, 0) - rV \, dG(x) \right\}$$

where w and b are the per-period wage and benefit flows, ξ is the reservation wage, and $\beta = \frac{1}{1+r}$ is a discount factor. The value of proceeding optimally from the beginning of next period, V , is not equal to U^l because the worker may be recalled to his old job, which I assume is acceptable ($U^e > U^l$).

Calling the rehire probability ϕ , the worker faces a future lottery with payoffs U^e and U^l , so

$$(3) \quad V = \phi U^e + (1 - \phi) U^l.$$

By construction, U^e and U^l take stationary values through time. Note that in this simple framework the probability of future re-employment is independent of the current state.

The necessary conditions for an optimal search strategy are that s and ξ solve

$$(4) \quad u_2(b, 1-s) = \frac{\beta\lambda}{r} \int_{\xi}^{\infty} u(x, 0) - rV \, dG(x)$$

$$(5) \quad u(\xi, 0) = rV.$$

Thus the marginal gain from search intensity equals the marginal utility of leisure, and the utility of ξ equals the flow value of continuing with the current employer. Letting $J(\xi) = 1 - G(\xi)$, applying the envelope theorem in (4) and (5) and using (1), (2) and (3) yields

$$(6) \quad s'_b = \frac{u_{12}}{u_{22}} + \frac{\lambda J(\xi)(1-\phi)\beta u_1(b, 1-s)}{K u_{22}} < 0; \quad \xi'_b = \frac{r(1-\phi)u_1(b, 1-s)}{K u_1(\xi, 0)} > 0$$

where $K = 1 - \beta + \beta(1-\phi)\lambda sJ > 0$ converts flows into expected present values. The effect of benefits on time devoted to search has a direct labor supply effect because current benefits are higher, and also a capitalized effect of expected future benefits. The effect on labor supply of a change in current benefits depends on the sign of u_{12} ; hence the assumption of complementarity. As usual, anticipated future UI increases the value of continuing in unemployment, V . Therefore, benefits reduce search effort and make workers more selective among alternatives. Inspection of (6) also

reveals that the magnitude of these effects is positively related to the probability of experiencing future unemployment in the current job, $1-\phi$. Similar derivations for the recall probability yield

$$(7) \quad s'_{\phi} = \frac{\lambda J(\xi)(U^e - U^l)}{K u_{22}} < 0; \quad \xi'_{\phi} = \frac{r(U^e - U^l)}{K u_1(\xi, 0)} > 0$$

so a greater rehire probability also reduces search effort and makes workers more selective. These comparative dynamics, in conjunction with (1)-(5), characterize worker behavior, which is to be integrated with that of employers.

2.2. Decisions by Firms

Given this behavior by workers, firms must choose conformable wealth maximizing strategies. I assume that these strategies are Pareto-efficient in the sense that they maximize the sum of the returns to an employment match for worker and employer: for any given profit flow to the firm, the value received by workers must be maximized (or conversely). The problem of firms is to choose a triplet of controls $c = \{w(p), b(p), p^*\}$ where $w(p)$ and $b(p)$ are the wage and benefit rates which hold when state of nature (price of output), p , is realized, and p^* is the critical level of price at which layoffs commence. These fully reflect the state of demand and are drawn from a fixed distribution $F(p)$. To isolate a representative worker, I assume no interdependencies in production and that the value of the i^{th} workers product is $p q_i$ if employed. For technological reasons not given expression here, I assume that labor is used in indivisible units.⁹ Without loss of generality, I set $q_i = 1$.

The worker's behavior is partially controllable through choices of $w(p)$ and $b(p)$, so it is important to specify the supply conditions for

these payments. UI has two components, the level which would be supplied privately, b_f ; and the level required by law, b_g . Because workers hold a large proportion of their wealth as illiquid human capital, employers are assumed to have a comparative advantage in providing income insurance via their access to the capital market. Despite this advantage, insurance is not costless. The per dollar cost of private UI benefits is $1 + \alpha_f$ where $\alpha_f > 0$ is a loading introduced to reflect the fact that a large share of employment risk is non-diversifiable, and hence non-insurable.¹⁰ The cost of public benefits is $1 + \alpha_g$. Empirically, the structure of current UI financing guarantees that α_g is rarely as large as zero, and it is this negative loading in the marginal cost of public benefits that underlies the UI subsidy to unemployment.

Given this structure, the value of the firm's employment strategy to the worker is

$$(8) \quad V = \text{Max}_{p^*} \int_{p^*}^{\infty} \{u(w(p), 0) + \beta V\} dF(p) \\ + \int_0^{p^*} \{u(b(p), 1-s) + \beta V + \beta \lambda s \int_{\xi}^{\infty} \frac{u(x, 0)}{r} - V dG(x)\} dF(p)$$

and the value received by the firm is

$$(9) \quad \pi = \text{Max}_{p^*} \int_{p^*}^{\infty} \{p - w(p) + \beta \pi\} dF(p) \\ + \int_0^{p^*} \{-b_f(p)(1 + \alpha_f) - b_g(1 + \alpha_g) + (1 - \lambda s J(\xi)) \beta \pi\} dF(p).$$

In (9) π represents the expected capital value received by the firm if the employment relationship continues. This rent from job or individual specific human capital plays an important role in the analysis, since it is lost if the worker accepts an alternative offer. Various contractual forms

--for example vested pensions, bonds, or positively inclined wage profiles--may serve to shift some of this cost to workers, but with borrowing constraints and concave utility a first-best solution is not attainable. (For a detailed discussion, see Lazear 1980.) Here, I abstract from other dimensions of contracts and concentrate on the interaction between UI and the externality created by search.

A Pareto-efficient employment-compensation strategy maximizes (8) for any value of (9). Associating a multiplier δ with (8) and invoking the envelope theorem yields a necessary condition for setting $w(p)$:

$$(10) \quad u_1(w(p), 0) = -\delta/(1-\eta) = -\delta^*$$

where

$$\eta = \delta \left\{ \frac{-\lambda \beta J(\xi)}{u_{22}} + \frac{g(\xi) s \pi}{J(\xi) u_1(\xi, 0)} \right\} \frac{F(p^*) \lambda \beta \pi J(\xi)}{K}.$$

Similarly, if UI benefits, b_f , are positive:

$$(11) \quad u_1(b(p), 1-s) = -\delta^* \left\{ 1 + \alpha + \frac{u_{12}}{u_{22}} \lambda \beta J(\xi) \pi \right\}$$

where $b(p) = b_f(p) + b_g$. Combining (10) and (11) yields the necessary condition for wages and privately optimal UI

$$(12) \quad \frac{u_1(b, 1-s)}{u_1(w, 0)} = 1 + \alpha_f + \frac{u_{12}(b, 1-s)}{u_{22}(b, 1-s)} \lambda J(\xi) \beta \pi.$$

Condition (12) plays an important role in the subsequent analysis. It equates the worker's rate of substitution in consumption across the two relevant states (e, l) to the net marginal cost of allocating income across states. The appearance of the last term on the right is important, since it represents the marginal effect of UI in reducing the expected loss

from a dissolved match. It is the worker's labor supply response to a change in this period's UI (u_{12}/u_{22}) times the firm's expected cost ($\lambda J(\xi)\beta\pi$). If leisure is a normal good so that greater income reduces time allocated to search, then the optimal benefit level depends positively on the value of the worker to his employer. Therefore, with $\pi > 0$, UI plays a dual role in the optimal contract: it insures risk by reducing the variation in marginal utility of income across states, and it provides a disentive to search for offers whose acceptance implies the loss of job specific assets. The latter function of UI is clarified if we consider the case where ξ and s are controllable by the firm. In that case, ξ and s solve

$$(4') \quad u_2(b, 1-s) = \frac{\beta\lambda}{r} \int_{\xi} u(x, 0) - r(V + u_1(w, 0)\pi) dG(x)$$

$$(5') \quad u(\xi, 0) = r(V + u_1(w, 0)\pi)$$

which differ from (4) and (5) by the appearance of $u_1\pi$. Thus, in the first-best solution the search strategy depends on the joint return, in units of utility, of continuing the employment relationship.¹¹ Consequently, in the worker's private decision s is set too high, and ξ too low, relative to (4') and (5'). Of course, in the first best contract the last term of (12) does not appear, and so UI solely insures employment risk.

The critical price for entering or remaining on layoff, p^* , is similarly derived. After some rearrangement, it is

$$(13) \quad p^* = w - b_f(1 + \alpha_f) - b_g(1 + \alpha_g) - \frac{1}{u_1(w, 0)} \{u(w, 0) - u(b, 1-s) \\ - \lambda s \beta \int_{\xi}^{\infty} \frac{u(x, 0)}{r} - (V + u_1(w, 0)\pi) dG(x)\}.$$

The linear terms in w and b are easily interpreted as elements of the marginal cost of employment, though they are endogenous. The bracketed term is the utility risk faced by a worker, $U^e - U^l$, plus the firm's expected loss from a layoff, $\lambda s J(\xi) \beta \pi$. This sum represents a joint cost to firm and worker of expanding the set of layoff states at the p^* margin. Surprisingly, the form of this expression, in contrast to (12), does not depend on the controllability of s and ξ by the firm. Nevertheless, the layoff probability is directly affected by the search externality. To understand why this is true, consider a small increase in π which leaves the total return to worker and firm fixed, i.e., $V' + u_1 \pi' = 0$. This reallocation does not affect s and ξ if they are controllable [see (4') and (5')], but when they are not s increases and ξ falls [see (4) and (5)]. Part of the effect on s is internalized via (12), but the decline in ξ increases the cost of a layoff to the firm. The layoff probability is therefore reduced. The formal analysis of this point is appended, where I show that an increase in the firm's share of the return generates $dp^* = 0$ if s and ξ are controllable, so only jointly efficient layoffs occur, but $dp^* < 0$ otherwise. Therefore, when the worker's search strategy depends only on his private returns, the optimal UI benefit level is increased, while the probability of entering unemployment is lower and the rehire probability higher than otherwise. Adjustments on these margins are made in an effort to protect firm-specific assets, and they are larger the greater the value of those assets to the firm.

This analysis of private UI incentives is important to an understanding of the interaction between public UI and the private decisions which generate unemployment. Government programs effectively set two parameters via legislation: b_g , the mandated level of benefits, and α_g , the

implicit subsidy per dollar of b_g . To this point we have assumed that b_g is not a binding constraint on decisions, yet this is not generally true in practice. Only a small portion of all employment contracts are covered by private, supplemental UI (SUB) plans. This is not surprising, since with $\alpha_f > \alpha_g$ firms have no incentive to exceed the public level unless that level is less than what would have been offered privately. Evidently, the constraints implied by UI legislation are often binding on contractual agreements, and thus will affect layoff decisions.

When b_g exceeds the level that would be agreed upon, the marginal value of benefits falls below their private cost, and so an inequality holds in (12). In either case, equation (13) determines p^* so the utility-constant effect on p^* of b_g is (noting that (4) and (5) hold for the worker's search strategy)

$$p_b^* = \frac{u(b, 1-s)}{u(w, 0)} (b_f' + 1) - (1 + \alpha_f)b_f' - (1 + \alpha_g) - \lambda \beta J(\xi) \pi s' \\ - \frac{u_{11}(w, 0)}{u_1(w, 0)^2} \Delta U w'$$

where $\Delta U = U^e - U^l$ and $b' = b_f' + b_g'$. Substituting for s' from (6) this may be written

$$(14) \quad p_b^* = \left\{ \frac{u_1(b, 1-s)}{u_1(w, 0)} - (1 + \alpha_f) - \frac{u_{12}}{u_{22}} \lambda \beta J(\xi) \pi \right\} b_f' \\ + \left\{ \frac{u_1(b, 1-s)}{u(w, 0)} - (1 + \alpha_g) - \frac{u_{12}}{u_{22}} \lambda \beta J(\xi) \pi \right\} + \frac{u_{11}(w, 0)}{u_1(w, 0)^2} \Delta U w'.$$

In evaluating this expression, there are two relevant cases to consider. The first is $b_f > 0$, which corresponds empirically to an explicit or implicit firm-operated SUB plan. In this case where the firm offers UI above

the mandated level, equation (12) holds since b_g is a non-binding constraint. The first term in (14) vanishes because of this optimality condition. In the second case, the legislated level of benefits exceeds what worker and firm would agree upon, and the value of UI falls below its private cost. Private benefits are zero and the first term again vanishes. This leaves the second bracketed term as the direct effect of an increase in b_g .

Consider the case where $b_f > 0$, so a SUB plan operates. Total benefits are $b = b_f + b_g$, and holding b fixed a \$1 increase in government benefits generates an exact quid pro quo for private ones. Additionally, an increase in b_g generates an infra-marginal subsidy of $\alpha_f - \alpha_g$, which increases the relative value of unemployment and encourages layoffs. Formally, solving for the utility-constant change in the wage in the case of $b_f > 0$ and using (12) yields

$$(15) \quad p_b^{*'} = \frac{\alpha_f - \alpha_g}{1 + R \left(\frac{\Delta U}{u_1(w, 0)} \right)^2 \frac{f(p^*)}{1 - F(p^*)}}$$

where $R > 0$ is the Arrow-Pratt measure of absolute risk aversion. The expression carries the sign of $\alpha_f - \alpha_g$, so the infra-marginal subsidy increases the layoff probability. Because firms have fully optimized on the income-insuring and job search dimensions of UI when $b_g > 0$, the effects of the worker's search intensity do not appear in (15). So, when private benefits are positive the only effect on unemployment is due to the subsidy. However, for any given per dollar subsidy, the impact of UI on p^* is smaller the larger is the marginal risk borne by workers (ΔU), the greater the costs of risks R , or the greater the hazard $d \log(1-F)/dp^*$. In effect, workers will pay a risk premium to avoid layoffs, which increases the cost of changing

the layoff probability and dampens the incentive effect of UI.

The alternative, and possibly more common, case is $b_f = 0$, so mandated UI is a binding constraint on employment decisions. In this situation, $b'_f = 0$ and the inequality holds in (12). Again solving for the utility constant change in the wage yields

$$(16) \quad p_b^{*'} = \frac{\left\{ \frac{u_1(b, 1-s)}{u_1(w, 0)} - \frac{u_{12}}{u_{22}} \lambda \beta J(\xi) \pi - (1 + \alpha_g) \right\} + R \frac{\Delta U}{u_1(w, 0)} \frac{f(p^*)}{1-F(p^*)} \frac{u_1(b, 1-s)}{u_1(w, 0)}}{1 + R \left[\frac{\Delta U}{u_1(w, 0)} \right]^2 \frac{f(p^*)}{1-F(p^*)}}.$$

The denominator of (16) has the same interpretation as above, while the numerator shows two effects on employment decisions. The second term reflects a simple substitution of benefits for wages in employee compensation. This reduces the risk premium demanded by workers facing uncertain employment, and so reduces the cost of layoffs. The first term reflects the relative supply and demand conditions for UI. Since the marginal cost of public benefits is rarely as large as unity, this term will also be positive if marginal utility of consumption is greater when unemployed and if the net future value of the worker to his current employer is non-negative.¹² In the extreme case of $\alpha_g = -1$, so that there is no experience rating, this term is just the marginal private value of benefits

$$(17) \quad m = \frac{u_1(b, 1-s)}{u_1(w, 0)} - \frac{u_{12}}{u_{22}} \lambda \beta J(\xi) \pi$$

which combines the value of an extra dollar of UI to the worker and the value to the firm of reduced search. Both of these values encourage unemployment. At the other extreme, if firms are forced to pay larger benefits and to finance them from their own resources ($\alpha_f = \alpha_g$), then this term is negative, and so unemployment is discouraged.

More generally, both of these incentives will operate in the constrained case, and the direct effect of UI will be smaller than in the unconstrained case. To see this, define m^* as the desired marginal value of UI in the absence of the constraint, i.e., $m^* = 1 + \alpha_f$. Then the first term in the numerator of (16) is simply

$$(18) \quad \alpha_f - \alpha_g + m - m^*$$

where m is defined by (17). Since $m - m^* < 0$ with overinsurance, expression (18) indicates offsetting effects of UI. The pure subsidy, $\alpha_f - \alpha_g$, is the same as in the unconstrained case and it encourages both layoffs and longer average duration of spells. The non-subsidized effect, however, increases the cost of unemployment and reduces layoffs. Both of these incentives may operate, but this analysis suggests that the marginal impact of UI on employment decisions will be largest when the discrepancy $m - m^*$ is small. This is more likely when the firm-specific value of workers, π , is large since this value increases the relative demand for UI. Therefore, in terms of traditional categories of unemployment, we may expect that the incentive toward unemployment is greatest for temporary layoffs, since these imply the existence of firm-specific assets by definition.¹³

This analysis implies three related points that are important in evaluating the empirical impact of UI on unemployment. First, and most obviously, it is important to separate the UI subsidy from the level of benefits per se. With regard to the subsidy, all one can reasonably hope for is an estimate of the firm's cost per dollar of public UI, $1 + \alpha_g$, while α_f is unobserved. Even with full experience rating in the usual sense ($\alpha_g = 0$), an increase in benefits may either increase or decrease unemployment. This is because the effect $\alpha_f + m - m^*$ is unsigned, while

the reduction in consumption risk caused by UI will encourage layoffs.¹⁴ Controlling for the effect of imperfect experience rating must reduce the partial impact of benefits, however. Second, it is important to distinguish the effects of UI on transitions both to and from unemployment. For temporary layoffs, UI subsidization increases the probability of being laid off and prolongs spells, but little is known about the magnitudes of these effects. Third, it is important to distinguish permanent and temporary layoffs as states of unemployment. The overinsurance effect of legislated UI should be strongest for potential spells that would end in a job change, and so fully experience rated UI may inefficiently reduce turnover by reducing permanent layoffs. The subsidy softens this effect and encourages unemployment, which may be a point in favor of imperfect rating given any level of benefits. The first two of these points are addressed in the empirical analysis while the third is left for future research.

3. Empirical Analysis

The empirical analysis of UI effects on unemployment utilizes a single cross section of individuals from the March 1975 Annual Demographic File of the Current Population Survey (CPS) (described in more detail below). As above, the assumption of stationarity is maintained, and I adopt the following econometric framework to analyze transitions to and from layoff unemployment.

In a sample of full time labor force participants, a worker's current status may be categorized into one of three states: employed (e), on temporary layoff (l), or unemployed without prospect of recall to the previous job (n).¹⁵ Workers may transit from e into l or n, from l into e or n, or from n into e. For simplicity, I maintain the framework developed above and assume that transitions among these states are ^{first-order} markovian, i.e., that the probability that spell of type k_1 ends at length S in a transition to state k_2 is independent of S .¹⁶ Denote these constant hazard rates as $h_j(k_1, k_2)$ for the j^{th} individual. Thus, for example, $h_j(e, l)$ is the hazard from employment to temporary layoff.

The CPS reports the duration of unemployment spells in progress as of the sample period. However, to the extent that workers in state n transited from temporary layoff ($h_j(l, n) > 0$), their reported durations overstate time spent in n. I therefore concentrate on temporary layoffs and seek the probabilities that an individual is either employed or in the T^{th} week of a layoff spell. Denote the mean lengths of employment and layoff spells by $m_{je} = (h_j(e, l) + h_j(e, n))^{-1}$ and $m_{jl} = (h_j(l, e) + h_j(l, n))^{-1}$, and the probability that an employment spell ends in a layoff by $\pi_j(e, l)$. Then, in a sample of individuals either employed or on layoff, the conditional probability of observing person j on layoff is simply the proportion of total time in e and l that is spent in l (Cox, 1962):

$$(19) \quad P_j(\ell | e \text{ or } \ell) = \frac{\pi_j(e, \ell) m_{j\ell}}{m_{je} + \pi_j(e, \ell) m_{j\ell}} = \frac{h_j(e, \ell)}{h_j(e, \ell) + h_j(\ell, \cdot)}$$

where $\pi_j(e, \ell) = h_j(e, \ell) m_{je}$ and $h_j(\ell, \cdot) = h_j(\ell, e) + h_j(\ell, n)$ is the total transition rate from temporary layoff. With constant hazards, it is well known that the density function of completed spell lengths must be exponential.¹⁷ Thus, letting $\Lambda_{j\ell}(S)$ be the cumulative density of layoff spell durations (the probability that a spell ends prior to length S), the probability of observing the T^{th} week of a layoff spell is¹⁸

$$(20) \quad \begin{aligned} \mathcal{L}_j &= P_j(\ell | e \text{ or } \ell) \cdot \frac{1 - \Lambda_{j\ell}(T)}{m_{j\ell}} \\ &= \frac{h_j(e, \ell) h_j(\ell, \cdot) \exp[-T h_j(\ell, \cdot)]}{h_j(e, \ell) + h_j(\ell, \cdot)}. \end{aligned}$$

Therefore, if person j is in the T^{th} week of a layoff, (20) is j 's contribution to the sample likelihood function. If j is employed, however, duration is not observed and so the contribution is simply

$$(21) \quad \mathcal{L}_j = \frac{h_j(\ell, \cdot)}{h_j(e, \ell) + h_j(\ell, \cdot)}.$$

Functional forms for the hazards will close the statistical model.

These must be non-negative, and I adopt the parameterizations

$$(22) \quad \begin{aligned} h_j(\ell, \cdot) &= \exp \{X_j \theta^\ell\} \\ h_j(e, \ell) &= \exp \{X_j \theta^e\} \end{aligned}$$

where X_j is a vector of exogenous variables assumed to affect transitions and the θ are vectors of unknown parameters. The likelihood function defined by (20), (21) and (22) is globally concave, and so standard algorithms (e.g., Newton-Raphson) are effective. The model identifies the total impact of X_j on the unemployment probability as the combination of effects $\theta^e - \theta^l$ (in effect, a logistic given (19) and (22)), and the layoff hazard, θ^l , from the empirical distribution of incomplete spell lengths. Note, however, that θ^e estimates the effect on transitions into temporary layoff only, while θ^l may include transitions to state n as well as recall and search behavior.

The Data and Imputation Procedures

The sample studied here was restricted to individuals who were full time-full year¹⁹ labor force participants, between the ages of 20 and 65, whose most recent employer was in one of 29 two-digit SIC industries. These included all manufacturing industries plus trade, construction, and mining.²⁰ Since variation in state-specific UI variables is fundamental to the analysis, individuals were only included if their state of residence could be exactly identified. The CPS aggregates state codes for smaller states, and so these observations were excluded unless residence could be established on the basis of SMSA. In addition, only states that use the benefit-ratio or reserve-ratio methods of experience rating (described in the appendix) were included. The resulting sample consisted of 7,806 individuals from 19 states.²¹ Of these, 555 or 7.1 percent were on temporary layoff. Since the economy-wide temporary layoff rate was only about 2 percent in 1975, it is clear that this sample faces larger unemployment risk than the general population. A summary of these data appears in Table 3.

I focus on two UI variables as determinants of employment status: the ratio of potential UI benefits to after tax weekly earning--the benefit replacement ratio--and the amount of benefits that are subsidized by methods of

TABLE 3

VARIABLE DEFINITIONS AND SUMMARY STATISTICS, MARCH, 1975 CPS SAMPLE

Variable Name	Definition	Mean	Standard Deviation
Subsidy	Total UI subsidy as proportion of weekly earnings (imputed)	.31	.19
Replacement Ratio	Potential UI benefits as proportion of weekly after-tax earnings (imputed)	.56	.15
Growth Rate	Predicted rate of growth of state, private, non-agricultural employment from auxiliary regressions (percent)	1.27	1.86
Weekly Wage	Annual earnings ÷ weeks worked last year	202.49	98.02
Age	Age in years	39.50	
Education	Years of completed schooling	12.20	2.50
Sex	= 1 if individual is male, = 0 otherwise	.73	.45
Race	= 1 if individual is white, = 0 otherwise	.90	.31
T	Duration of a temporary layoff sep11 in progress (weeks)	10.50	7.50
Layoff	= 1 if worker on temporary layoff = 0 otherwise (percent)	7.11	25.70
Observations		7,806	

of financing. The former variable is common in empirical work on UI, whereas the latter requires some discussion. Let \hat{a} be the proportion of an individual's UI benefits for which his firm is liable--the degree of experience rating.²² Thus $1-\hat{a}$ is the proportion subsidized. In addition to this financing subsidy, UI benefits are not normally subject to income taxation,²³ which increases the value of UI relative to wages. As shown by Feldstein (1976), this combination of financing and taxation effects leads to the marginal UI subsidy to unemployment for person j

$$b_j \left(\frac{1}{1-t_j} - \hat{a} \right)$$

where t_j and b_j are the marginal tax rate and (weekly) benefit amount. Therefore, in order to impute a UI subsidy for each observation, we require information on potential benefits and taxes in addition to an estimate of the degree of experience rating for each person's employer.

For each observation, benefits and taxes were imputed from retrospective information on employment and earnings in the previous year and on family structure. Tax rates are the sum of state, federal, and social security taxes, while benefits are derived from UI qualifying provisions in each state. Due to the vagaries of state UI and tax laws, the imputation procedures are complex; a listing of the relevant computer program is available on request.²⁴ The mean value for the replacement ratio of .56 means that for a typical individual, UI would replace 56 percent of weekly consumable earnings.

This leaves the degree of experience rating, \hat{a} to be imputed. In this paper I concentrate on the benefit ratio and reserve ratio methods of accounting because they are the most common (accounting for over 80 percent of covered employment) and because their structures are easily summarized for empirical analysis. These methods share two general characteristics which limit experience rating: tax rates are bounded from above and interest

is neither charged nor credited to employer accounts. Technical aspects of experience rating accounting are developed in Brechling (1981), Topel and Welch (1980), and Topel (1981). Here, we outline essential features and relegate derivations to an appendix.

Assume that each employer possesses a long run average unemployment rate, μ , representing his average annual propensity to generate benefit payments. In a steady state, if the employer's tax contributions are to equal benefit payments then there must exist a tax rate, τ^* , such that $\tau^*W = B\mu$ where W is the legislated taxable wage per employee and B is UI benefits expressed at an annual rate. Therefore, in order that μ be "sustainable" by a financing system, it must lie in an interval defined by the state maximum and minimum tax rates: $[\mu_{\min}, \mu_{\max}] = [\tau_{\min} W/B, \tau_{\max} W/B]$. If μ is outside this range, then the employer pays τ_{\max} or τ_{\min} and tax contributions do not balance benefit withdrawals. Small changes in layoff behavior have no tax consequences in such a case, so there is zero experience rating. Empirically, all of τ_{\min} , τ_{\max} , B , and W vary across states. Some calculated values of μ_{\min} and μ_{\max} are shown for a representative sample of 5 reserve-ratio and 5 benefit-ratio states in Table 4. Others are appended.

In contrast, if μ lies in the range $[\mu_{\min}, \mu_{\max}]$ then taxes are normally sensitive to layoff behavior. I define the degree of experience rating, $\hat{a}(\mu)$, as the ratio of the present value of incremental taxes caused by an increase in layoffs to the value of UI received by workers. Normally, these taxes are spread over time and, because of the failure to charge interest, only the nominal value of UI benefits is repaid in future taxes. $\hat{a}(\mu)$ therefore depends on the speed of tax adjustment in response to a change in layoff behavior, and state systems vary in these dynamics. Technical details of tax dynamics in response to transitory and permanent changes in layoffs are appended, but the relevant aspects

aspects of $\hat{a}(\mu)$ may be summarized by reference to Figure 1 and Table 4.

Figure 1 illustrates the marginal cost of benefits as a function of μ .

Experience rating is positive only between μ_{\min} and μ_{\max} , and in a typical state rated firms are charged about 80 cents in taxes for each dollar of incremental benefits.²⁵ The cross-state variation in the degree of experience rating for rated firms and the range of equilibrium unemployment rates that are rated provide the leverage needed to identify the empirical effects of UI subsidization.

Given $\hat{a}(\mu)$ in each state, precise imputation of the subsidy requires information on μ for each person's employer. This is obviously unavailable, but we do know the monthly UI-compensated unemployment rate at the two-digit industry level, and the CPS reports the two-digit classification of each person's most recent employer. This information is used as follows. Assume that the industry average of μ is well approximated by the two-digit mean, $\bar{\mu}_i$.²⁶ The larger is $\bar{\mu}_i$, the greater the potential for within-industry variation of μ across individuals. I assume that the within-industry density of μ , $f_i(\mu)$, is triangular with base proportional to the mean: $\lambda \bar{\mu}_i$. Thus

$$(23) \quad f_i(\mu) = \begin{cases} \frac{1}{\lambda \bar{\mu}_i} \left(1 - \frac{1}{\lambda \bar{\mu}_i} (\mu - \bar{\mu}_i)\right), & \mu \in (\bar{\mu}_i, \bar{\mu}_i(1 + \lambda)) \\ \frac{1}{\lambda \bar{\mu}_i} \left(1 - \frac{1}{\lambda \bar{\mu}_i} (\mu - \bar{\mu}_i)\right), & \mu \in (\bar{\mu}_i(1 - \lambda), \bar{\mu}_i). \end{cases}$$

The expected degree of experience rating for person j in industry i is imputed using density (23) and $\hat{a}(\mu)$ for each state. There are therefore $29 \times 19 = 551$ separate state-industry cells for the imputation. A value of $\lambda = 0$ assigns point mass at $\bar{\mu}_i$, and so each worker in i would be assigned $\hat{a}(\bar{\mu}_i)$ in his state. Larger values of λ assign positive mass to values of μ different than $\bar{\mu}_i$, so imputed experience rating may be positive

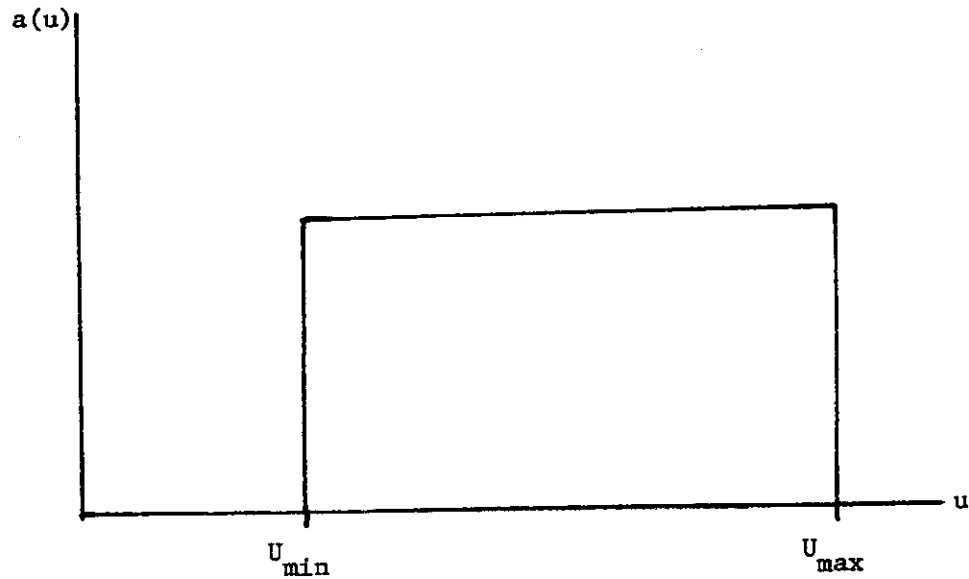


Fig. 1.--Marginal Cost of a Layoff Relative to Charged Benefits, Reserve Ratio and Benefit Ratio States.

TABLE 4

EXPERIENCE RATING PARAMETERS FOR ILLUSTRATIVE STATE PROGRAMS, 1975

	Experience Rating Method	u_{min}	$a(u)$	u_{max}
California	R.R.	0.9	.58	3.8
Connecticut	B.R.	0.8	.83	7.0
Florida	B.R.	0.0	.99	6.2
Indiana	R.R.	0.0	.91	4.3
Maryland	B.R.	0.8	.83	4.1
New Jersey	R.R.	0.9	.74	5.3
New York	R.R.	1.5	.71	5.3
Pennsylvania	B.R.	1.1	.83	4.1
Rhode Island	R.R.	3.0	.49	5.1
Texas	B.R.	1.5	1.14	6.5

Notes: u_{min} and u_{max} are calculated using maximum and minimum tax rates in effect and the state ratio of average weekly benefits to average weekly taxable wages. The data are from Handbook of UI Financial Statistics (1978), Comparisons of State Unemployment Insurance Laws, and unpublished data. R.R. denotes reserve ratio accounting, and B.R. denotes benefit ratio.

when μ_i is not in $[\mu_{\min}, \mu_{\max}]$. Table 5 illustrates cross-industry differences in the replacement ratio and the imputed subsidy as a proportion of weekly earnings. The reported values for the subsidy are based on a value of $\lambda = .25$, which implies a within-industry standard deviation of μ of about 15 percent of the mean. This value yielded the best overall fit in the estimation procedure, and the results reported below are based on it. As in Table 2 above, industries with more unemployment (e.g., apparel) have less experience rating since more of $f_i(\mu)$ lies outside the rated interval. In fact, in the last three industries of the table, the imputed subsidy accounts for more than 80 percent of the after-tax value of UI. While this illustrates that high unemployment industries are more heavily subsidized, it reveals nothing about the causal effect of UI on unemployment, which is our main concern. To get at this problem, we will exploit the variation in experience rating across individuals within an industry that is generated by differences in state experience rating parameters.

Estimation

In estimating the model, the weekly UI subsidy is measured as a proportion of the wage,

$$\frac{b_j}{w_j} \left(\frac{1}{1-t_j} - \hat{a}_j \right),$$

so the only variation in the subsidy that is independent of the replacement ratio is caused by experience rating, \hat{a}_j . Including both of these variables in the specification therefore offers a strong test of the importance of experience rating, and also allows for independent effects of the level of UI. To account for the fact that high unemployment industries have lower average experience rating by construction, I estimate the model with fixed industry effects on the hazards. Thus $X_j \theta^\ell = Z_j \beta^\ell + \alpha_i^\ell$ where α_i^ℓ is an industry effect on the probability of leaving layoff. The employment hazard is specified

TABLE 5

MEAN VALUES OF THE REPLACEMENT RATIO AND IMPUTED SUBSIDY ÷ WEEKLY
WAGE: SELECTED INDUSTRIES

Industry	μ_i^a	$u_{\max} < \mu_i^b$	Replacement Ratio	Subsidy ÷ Weekly Wage ^c
Wholesale Trade	1.82	0.0	.600	.328
Machinery	1.92	1.0	.565	.318
Chemicals	1.96	0.0	.545	.317
Retail Trade	1.99	1.3	.602	.273
Primary Metals	2.43	0.6	.514	.230
Electrical Machinery	3.10	6.5	.594	.294
Fabricated Metals	3.31	5.5	.570	.270
Automobiles	3.88	17.3	.515	.253
Food	4.73	38.6	.555	.356
Misc. Manufacturing	6.77	89.4	.622	.607
Apparel	7.65	82.0	.654	.566
Construction	8.33	<u>82.1</u>	<u>.490</u>	<u>.420</u>
Total (all industries)		19.7	.561	.310

^aCalculated from average monthly UI compensated unemployment rate within industry, 1972-1974. Source: U.S. Department of Labor, Unemployment Insurance Statistics, various issues.

^bWithin industry proportion of individuals for whom μ is greater than u_{\max} in state of residence.

^cImputed using $\lambda = .25$ in density (23).

conformably. Differences in levels of exogenous variables across industries (including the subsidy) are captured by the fixed effects, and so only within industry variation in Z_j is used in estimating β^e and β^l .²⁷

For purposes of comparison with previous results (e.g., Feldstein 1978) the first specification of the model ignores any information on experience rating. Thus, all UI effects are summarized by the replacement ratio, and so the impact of this variable will reflect the average degree of subsidization of UI in addition to any independent effects of the benefit level. Indeed, the estimates in specification A of Table 6 show a strong positive effect of UI on unemployment. The dominant share of this effect is due to an increased probability of entering layoff unemployment, and the point estimate of 1.82 implies that the probability of entering layoff is unit elastic with respect to benefits (at means).²⁸ In fact, the effect of the replacement ratio on transitions from temporary layoff is of the wrong sign. Nevertheless, at means the estimate in column (4) implies that a 10 percent reduction in the benefit level would eliminate about $(.112 \times .56 \times .1) / .071 = 8.8$ percent of all observed layoff spells in this sample, and the effect is highly significant. For comparison, Feldstein's (1978) estimates imply a reduction of 5 percent of all spells in his more heterogeneous sample. I have allowed for various non-linear effects of the ratio via quadratics and linear splines, but the results are not materially affected.

The effects of other exogenous variables in model A are fairly self-explanatory. Since the usual statistical determinants of earnings are controlled for in the specification, the coefficient on the weekly wage might be interpreted as the effect of unobserved components of individual- or job-specific productivity. There is no evidence, for either transition, that unemployed workers are less productive on this account than their employed counterparts. This is not too surprising, since most of these people

TABLE 6

DETERMINANTS OF TEMPORARY LAYOFF UNEMPLOYMENT, 1975

Exogenous Variables: Z_j	Specification A			Specification B		
	Entering Layoffs ^a	Leaving Layoffs ^b	Total Effect ^c	Entering Layoffs	Leaving Layoffs	Total Effect
Subsidy				.683 (1.35)	-.402 (-1.05)	1.09 (3.29)
Replacement Ratio	1.82 (2.66)	.117 (.241)	1.70 (3.54)			
Weekly Wage + 100	.047 (.404)	.065 (.794)	-.018 (.217)	1.01 (1.24)	.414 (.729)	.603 (1.02)
Age	-.058 (-1.52)	.034 (1.27)	-.092 (-3.38)	-.023 (-.193)	.061 (.730)	-.084 (-.967)
Age ² + 100	.036 (.761)	-.047 (-1.39)	.083 (2.51)	-.058 (-1.50)	.036 (1.29)	-.094 (-3.45)
Age = 25 ^e	-.040 (-2.67)	.011 (1.03)	-.051 (-4.85)	.036 (.752)	-.048 (-1.39)	.084 (2.49)
Age = 40 ^e	-.029 (-5.25)	-.003 (-.829)	-.026 (-6.23)	-.040 (2.63)	.011 (1.01)	-.051 (-4.82)
Education	-.050 (-4.28)	-.068 (-8.90)	.018 (.204)	-.003 (5.20)	-.003 (.819)	-.026 (-6.20)
Education ² + 100	-.066 (-1.19)	.405 (1.08)	-.471 (-7.32)	-.046 (-.389)	-.072 (-9.30)	.026 (.299)
Education = 12 ^e	-.066 (1.96)	.027 (1.15)	-.093 (-3.88)	-.086 (-1.54)	.432 (1.15)	-.519 (-1.24)
Race (White)	-.092 (-4.91)	.044 (.388)	-.136 (-1.00)	-.066 (1.96)	.031 (1.32)	-.097 (4.05)
Sex (Male)	.177 (1.00)	.224 (1.79)	-.047 (-3.75)	-.107 (-.563)	.050 (.385)	-.157 (1.14)
Industry Effects	Yes	Yes	Yes	.199 (1.22)	.226 (1.79)	-.027 (-2.19)
$\ln \sigma^2$	-3636.5			Yes	Yes	Yes
Unemployment Rate	.071			-3631.2		

Note: Asymptotic normal statistics in parentheses.

^a Estimate of β^e . ^b Estimate of β^l . ^c Estimate of $\beta^e - \beta^l$.^d Derivative of unemployment probability at sample mean.^e Age and education quadratics evaluated at the indicated level.

will return to their old jobs. The effects of age and education, however, are strong: A 25 year old is about 50 percent more likely to be unemployed than a 40 year old (wage constant) and an extra year of schooling reduces unemployment by over half a point.²⁹ Again, these effects are concentrated on the probability of entering layoff. Finally, there are no important effects of race or sex on unemployment rates, though males do appear to have somewhat longer spells. These results are not sensitive to changes in the specification of UI effects, and so they will not be referred to below.

The imputed UI subsidy to unemployment is controlled for in model B. Interestingly, the total effect of the replacement ratio declines by over 60 percent from model A, and is no longer statistically significant.³⁰ In contrast, the subsidy has a powerful independent effect on the layoff unemployment rate. The average subsidy is equal to 31 percent of the weekly wage, and so the point estimate implies that the subsidy accounts for $.070 \times .31/.071 = 30$ percent of the sample's layoffs. In other words, if the subsidy were entirely eliminated, the layoff rate in this sample would fall by more than one fourth. Of course, the pooled estimate implies that the hypothetical elimination of the subsidy would have a larger impact in high unemployment industries. Thus, in Apparel, layoff unemployment would fall by nearly four points from a level of 12.54, while in Primary Metals the impact would be only 1.6 points from a level of 7.4. This occurs because, though Primary Metals is cyclically volatile, its average level of unemployment is fairly low, so that experience rating is more relevant.

The effects of the subsidy on the probabilities of entering and leaving layoff are also of the expected signs, though they are only slightly larger than their standard errors. Sixty-two percent of the total effect is due to increased transitions from e to l, while the point estimate of $-.402$ in layoff transitions implies that the average level of the subsidy

lengthens spells by about 1.3 weeks. Again, the effects will be larger in poorly experience rated industries.

Local labor market conditions may play an important role in layoff, search, and rehire decisions, and may affect the results for two reasons. First, an examination of state UI laws reveals that rapidly growing areas tend to have less liberal criteria for determining benefits, and so their replacement ratios may be lower on average. Second, experience rating may be stronger in these states. For example, Texas is widely reputed to be a "strong" labor market, and rated employers pay \$1.14 per dollar of benefits in that state, considerably above the average. I therefore attempt to control for local market conditions via a measure of the private, non-agricultural employment growth rate in an individual's state. These are annual rates of change imputed from quadratic trend regressions for each state. The results of including this variable are shown in Table 7.

Rapidly growing states have fewer layoffs, which is again attributable to the probability of entering layoff. At means, a one percentage point increase in growth reduces the layoff rate by about .5 points. Most importantly, controlling for local market conditions reduces the total impact of the replacement ratio by more than 25 percent in the specification that ignores experience rating, and by more than half when the subsidy is controlled for. The effect of the replacement ratio in model B is negligible. In contrast, the effect of the subsidy is not materially changed from Table 6, declining by only about 8 percent. Therefore, when local market conditions are ignored, the impact of UI is overstated, but this bias falls mostly on the replacement ratio and not on the UI subsidy.

In terms of the theoretical discussion, these are important results. Since benefits have only minor effects on layoffs, net of the subsidy, it appears that the level of UI is not a binding constraint with respect to

TABLE 7

DETERMINANTS OF TEMPORARY LAYOFF UNEMPLOYMENT, 1975: CONTROLLING FOR STATE-SPECIFIC GROWTH

Exogenous Variables: Z_j	Specification A			Specification B		
	Entering Layoff	Leaving Layoff	Total Effect Marginal Probability	Entering Layoff	Leaving Layoff	Total Effect Marginal Probability
Subsidy				.612 (1.21)	-.396 (-1.04)	1.007 (3.01)
Replacement Ratio	1.52 (2.07)	.268 (.517)	1.25 (2.40)	.861 (1.01)	.559 (.949)	.302 (.491)
Growth Rate	-.530 (-1.47)	.207 (.890)	-.738 (2.68)	-.426 (-1.18)	.205 (.874)	-.631 (-2.28)
Weekly Wage + 100	.004 (.035)	.087 (1.01)	-.083 (-.950)	-.051 (-.406)	.083 (.954)	-.133 (-1.48)
Age	-.056 (-1.43)	.034 (1.25)	-.088 (-3.28)	-.056 (-1.43)	.035 (1.28)	-.091 (-3.32)
Age ² + 100	.032 (.666)	-.047 (-1.35)	.079 (2.34)	.033 (.676)	-.048 (-1.38)	.081 (2.37)
Age = 25	-.039 (-2.58)	.011 (1.00)	-.050 (-4.82)	-.039 (-2.56)	-.011 (1.06)	-.050 (-4.63)
Age = 40	-.030 (-5.28)	-.003 (-.825)	-.027 (-6.18)	-.029 (-5.16)	-.003 (-.721)	-.027 (-6.73)
Education	-.048 (-.414)	-.070 (-1.903)	.021 (.244)	-.046 (-.386)	-.074 (-1.948)	.028 (.318)
Education ² + 100	-.075 (-1.33)	.407 (1.08)	-.481 (1.15)	-.090 (.159)	.434 (1.15)	-.524 (-1.25)
Education = 12	-.067 (-1.96)	.027 (1.15)	-.094 (3.89)	-.067 (-1.98)	.031 (1.26)	-.098 (-4.21)
Race (White)	-.088 (-.465)	.040 (.311)	-.129 (.936)	-.101 (-.533)	.047 (.361)	-.148 (-1.08)
Sex (Male)	.167 (.940)	.234 (1.85)	-.067 (.539)	.191 (1.07)	.237 (1.87)	-.046 (-3.67)
Industry Effects	Yes	Yes	Yes	Yes	Yes	Yes
$\ln \alpha$	-3631.4			-3626.2		
Unemployment Rate	.071					

Note: See notes to Table 6.

temporary layoffs. In other words, changes in benefit levels affect temporary layoff unemployment only to the extent that they are subsidized, and have no other direct effect on employment decisions. Therefore, without changing benefit levels for unemployed workers, a significant reduction in layoff unemployment may be achievable by implementing more complete experience rating. [For a discussion of possible reforms in experience rating accounting, see Topel and Welch (1980).] In addition, since UI is (normally) a self-financing system, such reform would reduce total benefit costs and hence the average employer tax rate required to finance benefits. A reduction in benefits holding experience rating constant could achieve similar effects on taxes and unemployment, but at the cost of less insurance for unemployed workers. And a reduction in benefits could achieve these results only because UI is subsidized.

Summarizing the empirical results of this section, the analysis has found that: (i) There is a strong positive association between the probability that an individual is on layoff at a point in time and the proportion of his after-tax earnings that are "replaced" by UI. This effect is due to an increased probability of entering unemployment, rather than to (more traditional) UI effects on the duration of spells. (ii) This effect of UI on transitions is reduced when local labor market variables are controlled for, so part of the relationship between UI and layoffs is explained by the empirical fact that benefits tend to be lower in strong "local" markets. (iii) The remaining effect of UI on temporary layoffs is explained by the experience rating subsidy. The subsidy increases the layoff unemployment rate via positive effects on both the probability of initiating a spell and on spell duration. A non-subsidized increase in UI would have only negligible effects on layoff unemployment in this sample, indicating

that UI may not be an important constraint on employment decisions for workers subject to temporary layoff.

4. Summary and Concluding Remarks

The majority of employer-initiated spells of unemployment involve the payment of UI benefits. In the theoretical discussion I showed that, in general, the effects of these legislated payments on unemployment depend on more than just methods of UI financing; the interaction of the UI system with the private, joint demand for UI by workers and firms may also play an important role. I therefore distinguished the subsidized and non-subsidized components of UI. Both of these will affect layoff and rehire decisions, and probably with opposite signs if UI is a constraint on contractual agreements. Thus, even the sign of the total UI effect on unemployment is an empirical question.

The empirical analysis focused on two basic issues related to these points. First, I decomposed the total impact of UI into a subsidized component and one that depends only on the level of available UI. Second, I further decomposed these effects into effects on the frequency of layoff spells and their duration. Concentrating on temporary layoffs, with respect to the first issue the results imply that the UI subsidy accounts for nearly the total impact of UI on layoffs, while the benefit replacement ratio has a negligible impact once the subsidy is controlled for. With respect to the second issue the results are more tentative, but they indicate a positive impact of the subsidy on the probability of being laid off and on the duration of spells. Together, the results suggest that the impact of UI financing methods on unemployment may be as important as the more widely studied effects of UI in the search decisions of job-changing individuals.

This analysis may be extended in several ways. First, I focused in this paper on a particular year of C.P.S. data (1975). This was a year of weak aggregate demand, and theory indicates that the impact of UI will be strongest under such conditions (which affected my choice of that year). My simplifying assumption of first-order Markov transitions may also be sensitive to these data (see Flinn and Heckman 1980). It is therefore important to extend the analysis to other years and other, possibly longitudinal, data, particularly in light of the documented decline in experience rating over time (Topel and Welch 1980). Second, I focused in this paper on temporary layoffs as a state of unemployment, both as a matter of convenience in the statistical analysis and because the role of the UI subsidy should be most relevant for temporary spells. Transitions to (and from) permanent layoff should also be affected by UI however, especially since the constraint of employers paying benefits is more likely to be binding. UI may actually reduce the incidence of these spells. Finally, an analysis that includes other methods of experience rating than the reserve- and benefit-ratio systems would be useful, as would be a more refined and precise estimate of the size of UI subsidies for individual employers. For example, most states have a variety of tax schedules that depend on the condition of the state UI fund. In my approximations to cost schedules I assumed that firms expect these schedules to remain fixed. Otherwise, if the relevant parameters change through time, expectations of tax liabilities depend not only on the firms own decisions, but also on the dynamics of state-wide unemployment and the expected decisions of those who administer UI funds.

TECHNICAL APPENDIX

1. The effect of the search externality on the layoff probability.

The marginal condition for p^* is given by (13). Consider a change in the rent received by the firm $\pi' > 0$. Then $v' = u_1 \pi'$ holds the total value to firm and worker constant. Differentiating and simplifying,

$$\begin{aligned}
 (A.1) \quad p^{*'} &= b' \left\{ \frac{u_1(b, 1-s)}{u_1(w, 0)} \right\} - \frac{1}{u_1(w, 0)} \{ u_2(b, 1-s) - \lambda \beta \int_{\xi} \frac{u(x, 0)}{r} - v - u_1(w, 0) \pi \, dg(x) \} s' \\
 &\quad - \frac{\lambda s \beta}{u_1(w, 0)} \left\{ \frac{u(\xi, 0)}{r} - v - u_1(w, 0) \pi \right\} g(\xi) \xi' + \frac{\eta s \beta J(\xi)}{u_1(w, 0)} (v' - u_1(w, 0) \pi') \\
 &\quad + \frac{\Delta U}{u_1(w, 0)^2} u_{11}(w, 0) w'.
 \end{aligned}$$

The last term in (A.1) is a wealth effect caused by shifting the return. Neglecting this term, if the worker engages in first-best behavior then each term in (A.1) is zero due to (4') and (5'). But if s and ξ are beyond the firm's control, then ξ is set too low and s too high. From (4) and (5)

$$(A.2) \quad s' = \frac{u_{12}}{u_{22}} b' + \frac{\lambda \beta J(\xi) v'}{u_{22}}$$

$$(A.3) \quad \xi' = \frac{r v'}{u_1(\xi, 0)}$$

Substituting these expressions into (A.1), and using (12) and () from the text yields (aside from the wealth effect)

$$(A.4) \quad p^{*'} = v' \lambda \beta J(\xi) \pi \left\{ \frac{g(\xi) r}{J(\xi) u_1(\xi, 0)} - \frac{\lambda \beta J(\xi)}{u_{22}} \right\} < 0$$

since $v' < 0$. Thus, the larger the firm's share of the total value $v + u_1\pi$, the lower the layoff probability when search is not controllable by the firm.

2. Experience Rating Dynamics for Reserve Ratio and Benefit Ratio Systems

A. Reserve Ratio System

Under this method of accounting, each employer's tax rate, τ , depends on the ratio of total funds in its account to its total taxable payroll--the reserve ratio. If R_t is total reserves credited to the employer's account in year t , w the taxable wage base per employee and N the total number of employees, then the reserve ratio is $r_t = R_t/wN$. Assuming WN_t is approximately constant (most state programs use weighted averages over several years), r_t follows

$$(A.5) \quad r_t = r_{t-1} + \tau_t - \rho u_t$$

where $\rho = B/w$.

Between the maximum and minimum rates, τ_t is defined as a function of r_t as in Figure A.1. In the range of this function with small steps, I treat the function as linear: $\tau = \eta_0 - \eta_1 r$. Then taxes follow the difference equation

$$\tau_{t+1}W = \bar{\tau}_{t+1} = (1-\eta_1)\bar{\tau}_t + \eta_1 b u_t.$$

Using this equation, a current increment to u_t generates future taxes worth $b\eta_1/(\eta_1 + i)$ where i is the rate of interest. Thus, dividing by the value of benefits received,

$$(A.6) \quad a = \eta_1/(\eta_1 + i).$$

In a typical system, $\eta_1 = .3$ so with $i = .1$, $a = .75$.

For a step in the tax function at ratio \hat{r} , the linear approximation is less appropriate. In general, the step may be characterized as $\tau = \tau_1$ for $r < \hat{r}$ and $\tau = \tau_0$ for $r > \hat{r}$. The tax rate that would support a steady state value of μ is $\tau^* = \rho\mu = \tau_0 + \phi(\tau_1 - \tau_0)$ where $0 < \phi < 1$. Thus, when $\tau = \tau_0$, reserves decline at rate

$$\begin{aligned} r_t - r_{t-1} &= \tau_0 - \rho\mu_t = -\phi(\tau_1 - \tau_0) \\ &= -\phi \Delta\tau. \end{aligned}$$

Conversely, if $\tau = \tau_1$, reserves accumulate at rate

$$r_t - r_{t-1} = \tau_1 - \rho\mu_t = (1-\phi) \Delta\tau.$$

Now the tax authority sets τ on the basis of r at annual evaluations. A firm with $\tau_0 < \tau^* < \tau_1$ will find that its taxes alternate between τ_0 and τ_1 as its reserve ratio is above or below \hat{r} at the evaluation dates. Define the beginning of such a cycle, \hat{t} , as the first instant where r_t crosses \hat{r} from above, and let α be the proportion of a year remaining from \hat{t} to an evaluation. Assuming $\phi < .5$ (derivations for $\phi > .5$ are symmetrical), reserves decline to $\hat{r} - \Delta\tau\phi\alpha$ at the first evaluation, they rise for one year to $\hat{r} + \Delta\tau(1 - \phi(1+\alpha))$, and then decline to \hat{r} after $\phi^{-1} - (1+\alpha)$ periods. Thus, the length of a cycle is ϕ^{-1} , of which $\phi^{-1} - 1$ periods have a tax of τ_0 and one has a tax of τ_1 . As of the first evaluation, the present value of the surcharge $\Delta\tau$ for one period is $\Delta\tau(1 - e^{-i})/i$. Assuming that α is uniformly distributed on the unit interval, the expected present value of the tax surcharge as of the period \hat{t} is

$$(A.7) \quad \int_0^1 \Delta\tau \frac{(1-e^{-i})}{i} e^{-i\alpha} d\alpha = \Delta\tau \left(\frac{1-e^{-i}}{i} \right)^2.$$

Since this surcharge occurs every ϕ^{-1} periods, the present value of the firm's future tax rate is

$$(A.8) \quad \frac{\tau_0}{i} + \Delta\tau \left(\frac{1-e^{-i}}{i} \right)^2 + \Delta\tau \left(\frac{1-e^{-i}}{i} \right) \frac{e^{-i/\phi}}{1-e^{-i/\phi}}.$$

Now consider a change in unemployment that lasts exactly one period and generates change in reserves $dr = -\rho du$. This change implies that the end of the cycle occurs $dr/\phi\Delta\tau$ periods sooner, and so the change in the present value of taxes as measured from the point where the cycle would have ended is

$$(A.9) \quad \beta = \Delta\tau \left(\frac{1-e^{-i}}{i} \right)^2 \left(\frac{(\exp(i dr/\phi\Delta\tau) - 1)}{1-e^{i\phi^{-1}}} \right).$$

Discounting this value to the period t_0 , where the shock commences, and assuming that t_0 is uniformly distributed on $(0, \phi^{-1})$, i.e., that layoffs can begin at any time, yields an expected present value of the tax increment of

$$(A.10) \quad \beta \int_0^{\phi^{-1}} \phi e^{-i(\phi^{-1}-t_0)} dt_0 \\ = \left(\frac{1-e^{-i}}{i} \right)^2 (\exp(i dr/\phi\Delta\tau) - 1) \frac{\phi\Delta\tau}{i}.$$

The change in benefits received per unit of taxable payroll is just dr , so dividing () by dr and letting $x = (\phi\Delta\tau/i dr)^{-1}$ we have an expected marginal cost of benefits

$$(A.11) \quad \hat{a} = \left(\frac{1-e^{-i}}{i} \right)^2 \frac{e^x - 1}{x}.$$

Now $x \rightarrow 0$ as $dr \rightarrow 0$, and so as increments to unemployment become small we have

$$\lim_{dr \rightarrow 0} \hat{a} = \left(\frac{1-e^{-i}}{i} \right)^2 \approx \frac{1}{1+i}.$$

Therefore, the reserve ratio system generates approximately a one year interest free loan for UI payments made by firms located in the step of the tax function. Consequently, the marginal cost of benefits in reserve ratio states jumps from $b/(b+i)$ to $1/(1+i)$ for equilibrium unemployment rates in the range $(\tau_0/\rho, \tau_1/\rho)$.

B. Benefit Ratio System

In benefit ratio systems, an employer's tax rate depends on the ratio of total benefits charged to the employer's account over the past T years to total taxable wages for the same period. This is the benefit ratio:

$$BR = \frac{\sum_{j=1}^T B u_{t-j} N_{t-j}}{\sum_{j=1}^T W N_{t-j}},$$

or

$$BR = \rho \sum_{j=1}^T n_{t-j} u_{t-j}$$

where, again, $\rho = B/W$ and $n_{t-j} = N_{t-j}/\sum N_{t-k}$ is the share of year $t-j$ employment in total employment over the past T years. Thus, the benefit ratio is just a share weighted average of past unemployment rates, times the "charge rate," ρ . In some benefit ratio states the firm's tax rate is just $\tau_t = BR_t$, but in others BR_t is multiplied by a factor of proportionality, λ , equal to the ratio of total state benefit payments to those which are

charged to firm accounts. Thus $\tau_t = \lambda BR_t$ with $\lambda \geq 1$. The present value of taxes caused by a transitory change in u relative to benefits received may then be calculated to be

$$(A.12) \quad a = \frac{\lambda(1 - (1+i)^{-T})}{T_i}$$

where i is the rate of interest. This marginal cost of benefits is less than unity (for $\lambda = 1$) and is declining in T because the implicit interest free loan is repaid over a longer period when T rises. In most states, $T = 3$ years, while the currently operating system in Michigan sets $T = 5$ years. Thus, with $T = 3$ and $i = .1$, $a = .828\lambda$ while with $T = 5$ $a = .758\lambda$.

Table A.1 lists the values taken by UI financing parameters for the 19 reserve-ratio and benefit-ratio states in the CPS sample.

TABLE A.1

SUMMARY OF EXPERIENCE RATING PARAMETERS FOR RESERVE RATIO AND
BENEFIT RATIO STATES, 1975

State	System	τ_{\min}	τ_o	τ_{\max}	$a(u)$	λ	ρ
California	R.R.	0.7	2.7	3.0	.58	--	.79
Colorado	R.R.	0.0	0.5	3.5	.91	--	.96
Connecticut	B.R.	1.5	--	6.0	.83	1.0	.73
Florida	B.R.	0.1	--	4.5	.83	1.19	.62
Georgia	R.R.	0.08	--	2.2	.70	--	.73
Indiana	R.R.	0.08	2.1	3.10	.91	--	.64
Louisiana	R.R.	1.0	--	3.0	.80	--	.74
Maryland	B.R.	0.7	--	3.6	.83	1.0	.89
Massachusetts	R.R.	2.9	3.7	4.1	.90	--	.90
Michigan	R.R.	0.1	4.0	6.3	.86	--	.90
Minnesota	B.R.	0.9	--	5.0	.83	1.7	.78
Missouri	R.R.	0.0	2.5	3.6	.66	--	.81
New Jersey	R.R.	0.7	3.1	4.3	.74	--	.81
New York	R.R.	1.30	3.9	4.5	.83	--	.85
North Carolina	R.R.	0.2	2.7	4.7	.90	--	.71
Ohio	R.R.	0.2	3.6	3.8	.75	--	.94
Pennsylvania	B.R.	1.0	--	4.0	.83	1.0	.98
Rhode Island	R.R.	2.2	3.5	3.9	.49	--	.77
Texas	B.R.	1.0	--	4.0	.83	1.38	.63
Wisconsin	R.R.	0.0	3.5	4.5	.81	--	1.01

Note: R.R. = Reserve Ratio Accounting

B.R. = Benefit Ratio Accounting

τ_{\min} = minimum tax rate as a proportion of taxable payrolls

τ_{\max} = maximum tax rate as a proportion of taxable payrolls

$a(u)$ = calculated marginal cost per dollar of benefits

λ = state adjustment factor

ρ = ratio of average state weekly benefits to weekly taxable wages.

FOOTNOTES

¹See Feldstein (1976, 1978), Baily (1977), Brechling (1981), and Topel and Welch (1980). Only Brechling has tested for the effects of UI financing on layoff unemployment and other dimensions of turnover. For a useful summary of UI literature to 1978, see Hamermesh (1979).

²Private UI covered a small but growing proportion of the labor force prior to 1930. According to Nelson (1965), this included such major companies as Proctor and Gamble, Kodak, and General Electric. These plans usually provided for employer contributions to a private fund, with benefits geared to the size of the fund. From 1931 to 1934, General Electric paid out \$3.6 million in UI benefits to "people whom we expect to call back into the industry as soon as we can find work for them." Today, about percent of all collective bargaining agreements provide for supplemental UI.

³In the Current Population Surveys that form the basis of government unemployment statistics, a temporary layoff is a firm-initiated spell that, at the time of the survey, is expected to terminate in a rehire. These are further broken down into those expected to end within thirty days and those of indefinite duration. Discharges have lost their previous jobs and do not expect to be recalled, while quits are on-going spells that were initiated by the individual. In a typical year, layoffs, discharges and quits account for about 60 percent of total unemployment, and this percentage rises slightly in a recession. The data are from tabulations of the March 1971-77 CPS files.

⁴There is a dichotomy in the theoretical literature. Those contracting models which emphasize employee risk aversion (e.g., Azariadis 1975, Baily 1974) ignore issues of UI altogether. In contrast, papers which address UI issues (Feldstein 1976, Baily 1977) usually assume that there is no demand for insurance, i.e., that workers are indifferent toward employment risk.

⁵This condition also arises in the analysis of Mortensen (1977).

⁶If layoff probabilities in alternative jobs are allowed for, then alternatives will be valued according to the joint value of wages and employment risks. I abstract from this situation to simplify the analysis.

⁷That is, I assume (i) that probability of one offer in a period of length $h(=1)$ is $\lambda h + o(h)$, (ii) the probability of two or more offers is $o(h)$, and (iii) the number of offers in non-overlapping periods are independent. The construction follows Mortensen (1977). See Mood, Graybill, and Boes (1975, pp. 94-95).

⁸Saving behavior renders the workers search strategy non-stationary, i.e., search intensity increases through a spell as assets decline. Because of workers self-insuring ability, optimal UI may include a waiting period before benefits commence.

⁹Without this indivisibility, all employment variation would be achieved by varying hours.

¹⁰Except for salaried workers with variable employment, full market UI has rarely been observed. If UI were costless, then the marginal utilities of income across states would be equalized. The assumption of positive costs of supplying UI precludes this full insurance solution. For some evidence, see Topel and Welch (1980).

¹¹For a parallel result in the context of job matching and turnover, see Mortensen (1978). See also Becker, Landes, and Michael (1977).

¹²One way to interpret a permanent change in demand conditions is that π may become negative. In this case, the firm wishes to encourage search and, because of moral hazard, desires a lower benefit level than in the first-best contract.

¹³The most obvious case where the constraint is non-binding is in SUB plans, which are now fairly common in union contracts. Empirically, it is well known that union workers are more likely to experience temporary layoffs than are non-union workers.

¹⁴In many cases, workers fired for cause may collect UI. Thus, an increase in benefits may encourage workers to shirk or otherwise increase their chances of being fired. This moral hazard increases unemployment even when benefits are fully rated, though it is probably not important for temporary layoffs.

¹⁵Temporary layoffs are individuals with a job to which they are anticipating recall. Employed individuals include persons not at work but receiving a salary (on vacation).

¹⁶That is, if $f_k(s)$ is the density of completed spell durations for spells of type k , markov transitions require that the hazard rate $f_k(s)/(1 - F_k(s))$ be constant. The only density with this characteristic is the exponential. This assumption is widely used in the empirical analysis of labor force dynamics (e.g., Kiefer and Neumann 1981, Clark and Summers 1980), though it is quite strong. For analyses with non-constant hazards, see Flinn and Heckman (1981) or Coppock (1981).

¹⁷See Cox (1962) or Flinn and Heckman (1981) for proofs.

¹⁸Since workers with longer spells are over-represented in the observed stock of unemployed workers, the density of completed spells in the observed sample is $S \Lambda'_{j\ell}(S)/m_{j\ell}$ (Salant 1978). The density of incomplete spells is simply $f(T|S) = 1/S$ for $T < S$. Thus $f(T) = (1 - \Lambda_{j\ell}(T))/m_{j\ell}$.

¹⁹These are individuals who worked or were unemployed for at least forty weeks last year.

²⁰Excluded were all agricultural workers, service industries, finance, insurance, and real estate, private household workers, public employees, and professionals.

²¹These were California, Colorado, Connecticut, Florida, Georgia, Indiana, Louisiana, Maryland, Massachusetts, New Jersey, Michigan, Minnesota, Missouri, New York, North Carolina, Ohio, Pennsylvania, Texas, and Wisconsin.

²²In terms of the notation in Section 2, $\hat{a} = 1 - \alpha_g$.

²³Currently, persons with incomes above \$25,000 have their benefits taxed. In 1975, there was no taxation of UI.

²⁴For comparison, however, the mean value of the replacement ratio of .56 is very close to values imputed by others in similar samples (Feldstein 1978).

²⁵As the appendix shows, in reserve ratio states there may be a discontinuity in $a(u)$ at a level between u_{\min} and u_{\max} . These "jumps" in the cost function are taken into account in the imputation of $a(u)$.

²⁶Calculated over the three years 1972-74.

²⁷The maximum likelihood routine estimates $2 \times 29 = 58$ fixed effects in addition to θ^{ℓ} and θ^e . The routine is written in the SAS matrix procedure, and a listing may be obtained from the author.

²⁸That is, $d \log h_j \cdot d \log b_j = 1.82 \times .86 = 1.0$.

²⁹Since these effects hold earnings constant, an increase in age or education must be compensated by a decrease in some other, unobserved, determinant of productivity. A possible explanation is that age (experience) and education are correlated with the proportion of one's human capital that is job specific. Indeed Mincer and Jovanovic (1981) find that education significantly reduces job mobility.

³⁰There is some evidence that the replacement ratio continues to increase the probability of entering unemployment, but the effect is not significant.

REFERENCES

- Azariadis, Costas. "Implicit Contracts and Underemployment Equilibria." Journal of Political Economy, December 1975.
- Baily, Martin Neil. "Wages and Employment Under Uncertain Demand." Review of Economic Studies, Vol. 41, No. 125, January 1974.
- _____. "On the Theory of Layoffs and Unemployment." Econometrica, July 1976, pp. 1043-1063.
- Becker, G. S.; Landes, E., and Michael, R. "An Economic Analysis of Marital Instability." Journal of Political Economy, Vol. 85, December 1977.
- Becker, J. Experience Rating in Unemployment Insurance: An Experiment in Competitive Socialism. Baltimore and London: Johns Hopkins University Press, 1972.
- Brechling, Frank. "Layoffs and Unemployment Insurance." In Studies in Labor Markets. Edited by S. Rosen. Chicago: University of Chicago Press for the National Bureau of Economic Research, 1981.
- Coppock, David. "Multiple Spell Data and the Duration of Unemployment: What Can We Learn." Unpublished paper, University of Chicago, May 1981.
- Cox, D. R. Renewal Theory. London: Methuen and Co., 1962.
- Feldstein, Martin. "The Importance of Temporary Layoffs: An Empirical Analysis." Brookings Papers on Economic Activity, Washington, D.C., 1975, pp. 725-45.
- _____. "Temporary Layoffs in the Theory of Unemployment." Journal of Political Economy, August 1976, pp. 937-57.
- _____. "The Effect of Unemployment Insurance on Temporary Layoff Unemployment." American Economic Review, December 1978, pp. 834-46.
- _____. "The Economics of the New Unemployment." Public Interest, No. 33, Fall 1973, pp. 3-42.

- Flinn, C. and Heckman, J. "Models for the Analysis of Labor Force Dynamics." Unpublished Working Paper, National Opinion Research Center, 1980.
- Hamermesh, Daniel. Jobless Pay and the Economy. Baltimore: Johns Hopkins University Press, 1979.
- Lazear, Edward. "Agency, Earnings Profiles, Productivity, and Hours Restrictions." American Economic Review, September 1981, pp. 606-620.
- Lippman, S. A. and McCall, J. "Search Unemployment: Mismatches, Layoffs and Unemployment Insurance." Working Paper No. 297, University of California, Los Angeles, September 1979.
- _____. "The Economics of Job Search: A Survey." Economic Inquiry, 1976.
- Mincer, J. and Jovanovic, B. "Labor Mobility and Wages." In Studies in Labor Markets. Chicago: University of Chicago Press for the National Bureau of Economic Research, 1981.
- Mood, A., Graybill, A., and Boes, D. Introduction to the Theory of Statistics. New York: McGraw-Hill, 1974.
- Mortensen, Dale. "Unemployment Insurance and Job Search Decisions." Industrial and Labor Relations Review, Vol. 30, No. 4, July 1977.
- _____. "Specific Capital and Labor Turnover." Bell Journal of Economics, 1978, pp. 572-589.
- Nelson, Daniel. Unemployment Insurance: The American Experience, 1915-1935. Madison, Milwaukee, and London: The University of Wisconsin Press, 1969.
- Salant, S. "Search Theory and Duration Data: A Theory of Sorts." Quarterly Journal of Economics, 91, No. 1 (February 1977): 39-57.
- Topel, R. and Welch, F. "Unemployment Insurance: What the Theory Predicts and What the Numbers (May) Show." Paper presented at the Joint U.S.-U.K. Conference on the Economics of Unemployment, London, May 1979. Also Discussion Paper No. 162, Department of Economics, University of California, Los Angeles, September 1979.
- _____. "Unemployment Insurance: Survey and Extensions." Economica, August 1980.

Topel, Robert. "Inventories, Layoffs, and the Short Run Demand for Labor."

American Economic Review (forthcoming, September 1982).

U.S. Department of Labor. Bureau of Labor Statistics. Employment and Earnings, States and Areas, 1909-75.

_____. Unemployment Insurance Service. Handbook of Unemployment Insurance Financial Data [1938-1970], 1971.

_____. "Significant Provisions of State Unemployment Insurance Laws," January 1979. (Prepared for ready reference.)

_____. Handbook of Unemployment Insurance Financial Data [1938-1976], 1978.

_____. Unemployment Insurance Service. "Unemployment Insurance Tax Rates by Industry." Various issues.

_____. "Unemployment Insurance Statistics." Various issues.