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LAYOFFS, WAGES AND UNEMPLOYMENT INSURANCE*

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The influence of unemployment insurance on wage and layoff behavior is analyzed in the context of optimal labor contracts. Responses of contract terms to changes in economic parameters are shown to depend in general on the nature of the initial contract, the degree of workers' risk aversion, and the resolution of bargaining conflict. Layoffs are not necessarily reduced by an increase in experience rating or a reduction in the UI benefit. Product demand fluctuations tend to induce procyclical employment fluctuations but not wage fluctuation. An implication of optimal contracts with private insurance suggests a reason for government intervention in UI provision.

1. Introduction

In this paper we examine the determinants of unemployment in the microeconomic context of labor contracts. The contracts considered are those between an individual firm and its pool of attached workers, in an environment of uncertainty about the product demand conditions that will prevail. The basis for the analysis will be the 'implicit contract' framework developed in papers by Azariadis (1975), Baily (1974, 1977), Feldstein (1976) and Gordon (1974), among others. [See Azariadis (1979) for a survey and references.] In this context wages, and possibly a broader set of job-related conditions, are agreed upon in the knowledge that some fraction of the workers may be laid off during periods of depressed demand for the firm's product. The expectation of both the firm and these workers, however, is that such layoffs will be temporary in nature and that laid-off workers will subsequently be rehired when demand improves sufficiently. The firm's labor force is viewed as attached in the sense that the occasional spells of

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unemployment are brief enough, and the probability of rehire great enough, that a laid-off worker does not have an incentive to seek employment with another firm. The unemployment being considered is therefore the 'temporary layoff' unemployment which, in the United States, accounts for a significant fraction of observed unemployment, as much as 75 percent of all layoffs in manufacturing. [See, for example, Feldstein (1976) for evidence of the empirical importance of temporary layoffs in the United States.]

Our particular focus is the influence of unemployment insurance (UI) on the structure of optimal contracts and hence on the pattern of wages and layoffs. We are concerned with the manner in which the parameters of the UI system condition the response of wages and layoffs to changes in the economic environment and with the response to changes in the UI parameters themselves. The relevance of UI has been recognized informally in most analyses of labor contracts, and has been treated formally in implicit contract models by Baily (1977) and Feldstein (1976). At one level, our analysis can be compared most directly with the latter. We model the UI system in the same way as Feldstein, but depart from him in the treatment of workers' attitude towards risk-bearing and their access to capital markets. This distinction is found to have consequences for the validity of Feldstein's conclusions.

At a more general level, our analysis differs from antecedents in regarding the actual contract as being selected from among the set of optimal contracts by some bargaining process.[1] In Feldstein (1976), for instance, the response of the contract is restricted by maintaining the constraint of a given expected profit level for the firm, against which workers' expected utility is to be maximized. Any gain or loss resulting from a change in the economic environment thus accrues solely to the workers. In Baily (1977) and Azariadis (1975), by contrast, the contract is determined by the maximization of expected profit for the firm while maintaining a given expected utility level for the workers. Any gain or loss then accrues solely to the firm. In order to remain agnostic with respect to the details of the bargaining process and its solution, we consider both of the polar cases just described. If the optimal responses of any particular variable in the contract are qualitatively the same in the two cases, there is no ambiguity with respect to the nature of the final outcome. However, if the desired directions of response are different, as we show may indeed be the case, even the qualitative outcome of the conflict will be sensitive to the bargaining process.

In the course of the analysis we shall have occasion to compare the

[1]In a paper published since this was written, McDonald and Solow (1981) adopt a similar approach in a related context. In particular, they examine several alternative explicit bargaining solutions for labor contracts in an environment with no uncertainty. Although their emphasis and context differ from those here, there are some structural similarities and, to the extent that the analyses overlap in focus, the conclusions are mutually supportive, as noted below.

implications of a UI system whose structure is exogenous to the firm with those of an endogenous, or private, UI scheme. This will suggest, among other things, an explanation of why one might expect to observe a government-administered system rather than the apparently more efficient private arrangement.

The plan of the paper is as follows. In section 2 we comment briefly on the nature and role of the UI system prevalent in the United States. In section 3 we set out the decision problems of the firm and workers, and characterize the set of optimal contracts. The responses of optimal contracts to changes in the economic environment are analyzed in section 4. Results are summarized in section 5 and an appendix provides mathematical details of the analysis.

2. Unemployment insurance

Provided that workers have accumulated sufficient assets and have access to a perfect capital market they can, without penalty, modify their income stream to achieve the desired profile over any given period of time. Their consumption stream can thus be smoothed so that at any time it will depend on the average combined receipts of wages and unemployment benefits over the period, but not on the current state of employment. This is an important premise of Feldstein's (1976) analysis. However, to the extent that workers who frequently experience unemployment have relatively few assets and, when employed, earn relatively low wages, they may well find borrowing both difficult and costly. In this case unemployment insurance may perform an important role in the smoothing of consumption streams, thus alleviating economic hardship resulting from loss of income during periods of unemployment. Such was the primary goal expressed for the UI system on its introduction in the United States. Indeed, if the imperfections in the UI system that have been emphasized by Feldstein were eliminated, it is not clear what other role would formally justify its existence.

In this paper we wish to highlight the insurance role of the UI system. To do so, we make the assumption that workers are unable to borrow or save. The extreme form of this assumption is adopted for simplicity. What is essential is an imperfection in the capital market that makes borrowing and lending less costly for firms than for workers.

The UI system in the United States has two main elements: the payments to eligible unemployed workers and the financing of these payments. The latter is done through a payroll tax on firms, with the majority of states using a 'reserve ratio' formula. [See Becker (1972) for a detailed description of the many variants of the system used in different states.] According to this method, a firm has a UI account with the state which is credited with its tax payments and debited for the benefits paid to its laid-off workers. The *rate* at which the firm is taxed in a given period is negatively related to its reserve ratio at the beginning of the period, the ratio of its initial UI balance to its taxable payroll. This dependence of the UI tax on the firm's layoff performance is referred to as 'experience rating'. In general, this experience rating is imperfect, in the sense that a firm is usually not liable for the exact amount of the UI benefit payments to its ex-employees; i.e. there may be a chronic tendency for a firm's UI balance to grow or decline.

We follow Feldstein (1976) in describing the taxes that result from a firm's layoffs during a period as $eB+T$, where e $(0 \leqq e \leqq 1)$ is a constant parameter that reflects the firm's experience rating, B is the amount of benefits paid out to laid-off employees during the period, and T is a constant parameter representing taxes paid at a flat rate when the firm has reached the exogenously specified upper or lower limit of the range of tax rates. If b is the UI benefit per period for an eligible unemployed worker and l is the number of workers laid off for the period, then $B=bl$ and the UI tax payment is $ebl+T$. This tax function is derived from a consideration of periodic tax payments in a steady state of layoffs. The more imperfect is a firm's experience rating (the smaller is e), the slower will be the adjustment to the new steady-state reserve ratio following a change in the layoff rate. During the transition from one steady state to another, the firm is less than exactly liable for the benefits paid to its laid-off workers. This subsidization of the firm's layoffs when $e<1$ is captured in the variable term of the tax function.

3. Optimal contracts

The environment we consider for the labor contract is essentially that described by Azariadis (1975). Throughout the analysis, all rates of flow refer to a given period (say a month or year).

The firm is a price taker in the market for its output. A large homogeneous group of workers are attached to this firm in the sense that they perceive the firm as being their employer, although it does not always employ them all. Without loss of generality, we let the number of workers in this group be 1. Frictions in the labor market are such that, in the short run at least, the firm only employs workers from this group, and workers in the group have no alternative employment opportunities. The price per unit of the firm's output during the next period is uncertain. It is believed that one of two states will occur; in state i $(i=0, 1)$, assigned probability λ_i, the price will be p_i, with $p_0>p_1$ and $\lambda_0+\lambda_1=1$.

The workers and the firm are to negotiate a contract for the next period, before the state of demand is known. This contract will be represented by a vector of real numbers (y_0, y_1, q_0, q_1, b), where y_i is the wage (income per period) paid to an employed worker in state i, q_i is the number of workers employed in state i, and b (as above) is the UI payment to an unemployed worker. The general price level is assumed to be stable, so that specification of the money wage is equivalent to specification of the real wage. If layoffs are randomly selected in any state with unemployment, $(1-q_i)$ can be interpreted as the probability that a representative worker will be laid off in state i. If the UI system is exogenously specified, then b will be a parameter in the contract. It will be important, however, to know the nature of contracts in which b is a choice variable, as when the firm provides UI privately to its work force. For simplicity, we assume that the number of hours, h, worked by an employed worker is fixed.

A worker's utility for the period is a function of the net income received and of the hours worked. This utility function, u, is assumed to be differentiable, concave, strictly increasing in income and strictly decreasing in hours worked, so that $u_1(\cdot)>0$, $u_2(\cdot)<0$, $u_{11}(\cdot)\leqq 0$, $u_{22}(\cdot)\leqq 0$, and $u_{11}(\cdot)u_{22}(\cdot)-u_{12}^2(\cdot)\geqq 0$. It is assumed that labor income is taxed at a constant rate t while, as in the United States, UI payments are untaxed. So the utility of a worker who earns income y for h hours work is $u((1-t)y, h)$, and that of an unemployed worker is $u(b,0)$. A worker's expected utility from a contract (y_0, y_1, q_0, q_1, b) is thus

$$U(y_0, y_1, q_0, q_1, b)=\sum_{i=0}^{1} \lambda_i[q_i u((1-t)y_i, h)+(1-q_i)u(b,0)]. \tag{1}$$

Let $G(q)$ denote the firm's output when q workers are employed. It will be assumed that $G(\cdot)$ is differentiable, strictly increasing and strictly concave, with $G'(0)=\infty$. The firm's expected profit from the contract (y_0, y_1, q_0, q_1, b) is then

$$\Pi(y_0, y_1, q_0, q_1, b)=\sum_{i=0}^{1} \lambda_i[p_i G(q_i)-y_i q_i-eb(1-q_i)-T]. \tag{2}$$

A contract is optimal if no adjustment in its terms can increase the expected utility of a worker without decreasing the expected profit for the firm, and vice versa. The set of optimal contracts will be further constrained by having to provide a minimal level of expected utility to workers and a minimal level of expected profit for the firm. For example, workers will have no interest in a contract unless expected utility is at least as great as the utility expected from alternative employment opportunities, and the firm will want at least zero expected profit. There will in general be infinitely many contracts that are optimal in this way. Which contract is ultimately settled upon will then also reflect the relative bargaining strengths of workers and firm.

Regardless of the bargaining procedure, an optimal contract will be characterized by a pair (U^*, Π^*) such that:

$$U^* = \max_{(y_0, y_1, q_0, q_1)} U(y_0, y_1, q_0, q_1, b) \tag{3}$$

subject to (i) $\Pi(y_0, y_1, q_0, q_1, b) \geqq \Pi^*$

and (ii) $1 - q_i \geqq 0, \quad i = 0, 1,$

and

$$\Pi^* = \max_{(y_0, y_1, q_0, q_1)} \Pi(y_0, y_1, q_0, q_1, b)$$

subject to (i) $U(y_0, y_1, q_0, q_1, b) \geqq U^*$

and (ii) $1 - q_i \geqq 0, \quad i = 0, 1.$ (4)

The set of optimal contracts, and hence the (U^*, Π^*) combinations, will be affected by a change in any of the environmental parameters: p_1, t, e, b or T.

It will be convenient to characterize the optimal contract decisions first taking b as a choice variable. The corresponding necessary condition can then be discarded for situations in which b is parametric. If the case with b variable is to be interpreted as that of a purely private UI scheme, it will be required also that $e = 1$ and $T = 0$. Furthermore, in that situation, UI benefits would be subject to the same tax as wage income. Although we shall not modify the formal statement of the problem by introducing another tax parameter to cover this latter point, the interpretation of first-order conditions must be made with this in mind.

Consider first the problem, (3), of maximizing the expected utility of the representative worker, subject to the constraint of an expected profit level, Π^*, to be achieved by the firm. (This is the problem considered by Feldstein, who takes 3(i) to hold as an equality, with $\Pi^* = 0$, on the basis of competitive behavior.)

Corresponding to (3) is the Lagrangian

$$\mathscr{L} = \sum_{i=0}^{1} \lambda_i [q_i u((1-t)y_i, h) + (1-q_i)u(b, 0)]$$

$$+ \mu \left\{ \sum_{i=0}^{1} \lambda_i [p_i G(q_i) - y_i q_i - eb(1-q_i) - T] - \Pi^* \right\}$$

$$+ \sum_{i=0}^{1} \eta_i (1 - q_i).$$

Since we shall be concerned only with nontrivial contracts, in which both wage and employment are strictly positive in each state, and since the profit constraint will be binding, the necessary conditions for a solution to (3) can be written:

$$\mathscr{L}_{y_i}=q_i\lambda_i[(1-t)u_1((1-t)y_i,h)-\mu]=0;\quad i=0,1, \tag{5a}$$

$$\mathscr{L}_{q_i}=\lambda_i[u((1-t)y_i,h)-u(b,0)]+\mu\lambda_i[p_iG'(q_i)-y_i+eb]-\eta_i=0;\quad i=0,1, \tag{5b}$$

$$b\geqq 0;\quad \mathscr{L}_b=\sum_{i=0}^{1}\lambda_i(1-q_i)u_1(b,0)-\mu\sum_{i=0}^{1}\lambda_i e(1-q_i)\leqq 0;\quad b\mathscr{L}_b=0, \tag{5c}$$

$$\mathscr{L}_\mu=\sum_{i=0}^{1}\lambda_i[p_iG(q_i)-y_iq_i-eb(1-q_i)-T]-\Pi^*=0, \tag{5d}$$

$$\eta_i\geqq 0;\quad \mathscr{L}_{\eta_i}=1-q_i\geqq 0;\quad \eta_i\mathscr{L}_{\eta_i}=0;\quad i=0,1. \tag{5e}$$

The necessary conditions for a solution to the firm's problem (4) are, with a relabeling of multipliers, the same as those for the dual problem (3), except that the expected profit constraint (5d) is replaced by the expected utility constraint:

$$\sum_{i=0}^{1}\lambda_i[q_iu((1-t)y_i,h)+(1-q_i)u(b,0)]=U^*. \tag{6}$$

It follows from (5a) that $u_1((1-t)y_0,h)=u_1((1-t)y_1,h)$. If workers are risk averse ($u_{11}<0$) an optimal contract must therefore have the fixed wage property, $y_0=y_1$. However, even if workers are risk neutral ($u_{11}=0$), if there exists an optimal contract then there exists one with the fixed wage property. So we shall henceforth assume that optimal contracts have this property, and let y denote the fixed wage.

Since $p_0>p_1$ by assumption, it follows from (5b) and (5c) that $q_0\geqq q_1$. Furthermore, if there are layoffs in state 1, the number of layoffs will be greater than in state 0, i.e. $0<q_1<1$ implies $q_0>q_1$. From now on we shall confine our attention to solutions with $q_0=1$ and $0<q_1<1$. Consequently, if b is parametric, we may characterize contracts by the pair (q_1,y) and depict problems (3) and (4) in a q_1–y diagram.

Given that $y>0$, it can be shown that if b is a choice variable it will be positive provided $u_{12}\leqq 0$, i.e. if marginal utility of income increases with leisure or is independent of leisure. Even if $u_{12}>0$, it may be the case that $b>0$. Assuming then that $b>0$, (5c) implies, using (5a):

$$u_1(b,0)-e(1-t)u_1((1-t)y,h)=0. \tag{7}$$

In the particular case where the firm is fully experience rated ($e=1$), we see that an optimal contract will have a wage and UI payment such that the marginal utility of income when employed equals that when unemployed. (Recall that b would be taxed as regular income if this were a private UI scheme.) This condition is familiar from the economic literature on insurance markets.

It will be useful to have a geometric picture of the dual contract problems (3) and (4), taking b as a parameter. The family of curves of constant expected profit are shown in fig. 1. The slope of the isoprofit curve passing through the general point (q_1, y) is:

$$\left.\frac{\partial y}{\partial q_1}\right|_{\Pi} = \frac{\lambda_1}{\lambda_0+\lambda_1 q_1}[p_1 G'(q_1) - y + eb]. \tag{8}$$

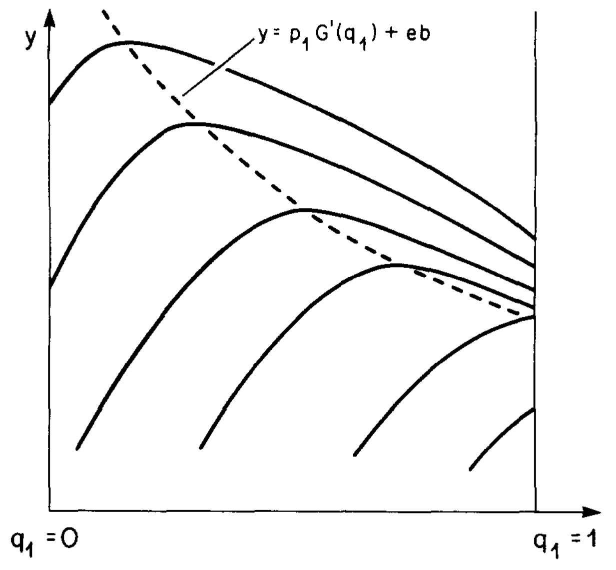


Fig. 1.

The family of curves of constant expected utility, $U=U_0$ (constant), is shown in fig. 2. The fact that q_1 enters linearly into the expected utility function, through the probabilities, imparts additional structure to these indifference curves.

It is apparent that, for workers, the tradeoff between salary and probability of layoffs, while not discontinuous, is qualitatively different on either side of the indifference curve $U=u(b,0)$. At this critical level, the salary is such that the utility of after-tax income with h fewer hours of leisure is equal to the

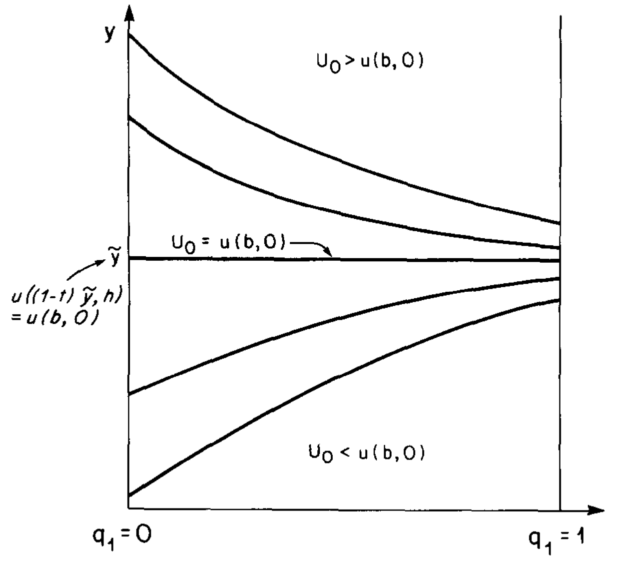


Fig. 2.

utility from the UI benefits; workers are then indifferent to the possibility of being laid off. At any higher level of U, and correspondingly of y, a lower layoff probability comes at the expense of a lower salary when employed. This tradeoff is reversed at levels of $U < u(b, 0)$, where the combination of wage rate and disutility of working is such that a temporary layoff is preferable to working.

The configuration of the indifference curves suggests that the nature of the change in contract terms, in response to an exogenous change, may depend on whether the initial (q_1, y) position is above or below the critical level, where $u((1-t)y, h) = u(b, 0)$. (Compare the contracts labeled A and B in fig. 3.) With this in mind, we define an endogenous measure:

$$Z(y, b, t) \equiv \frac{u((1-t)y, h) - u(b, 0)}{(1-t)u_1((1-t)y, h)}, \tag{9}$$

which can be interpreted as the utility gain, in equivalent units of pretax income, from being employed rather than temporarily unemployed. Equivalently, $Z(y, b, t)$ is defined to the first-order approximation by the condition

$$u((1-t)(y-Z), h) = u(b, 0). \tag{9'}$$

The contract space can be partitioned according to the sign of Z, as

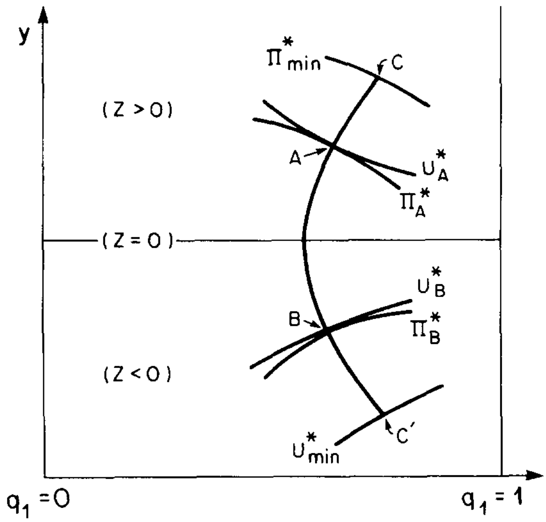


Fig. 3.

indicated in fig. 3. The slope of the indifference curve passing through the general point (q_1, y) is:

$$\left.\frac{\partial y}{\partial q_1}\right|_U = -\frac{\lambda_1 Z}{\lambda_0 + \lambda_1 q_1}. \tag{10}$$

At an optimum, the common marginal rate of substitution of y for q_1 for the firm (MRS_Π) and the workers (MRS_U) is therefore:

$$MRS_\Pi \equiv -\frac{\lambda_1}{\lambda_0 + \lambda_1 q_1}[p_1 G'(q_1) - y + eb] = \frac{\lambda_1 Z}{\lambda_0 + \lambda_1 q_1} \equiv MRS_U, \tag{11}$$

as implied by (5b).

While contracts with $Z > 0$ (working is ex post preferred to being temporarily laid off) are more likely to be the normal case, there are reasons for taking seriously the possibility that a contract might be such that $Z < 0$. First, the state of layoff unemployment being considered here is a temporary one. It is in the nature of a paid vacation, without the stigma or disutility that attaches to a permanent job loss. That such spells of unemployment might be more attractive than working is evidenced by the inverse seniority provisions often observed in contracts, whereby the option of being temporarily laid off is to be offered first to the most senior workers. Furthermore, Feldstein (1978) has presented a representative calculation which indicates that the net income loss from unemployment can be very small and easily outweighed by the value of leisure.

There is another tendency favoring $Z<0$, which has implications for the provision of UI and may, paradoxically, make $Z<0$ a less likely occurrence. If the UI benefit, b, could be set optimally by the firm and workers, it would satisfy (7). If other features of the UI system are unchanged, in particular the fact that benefits are untaxed, (7) implies that the optimal b, b^*, satisfies:

$$u_1(b^*, 0) < u_1((1-t)y, h). \tag{12}$$

Therefore, if $u_{12} \leqq 0$ (marginal utility of income does not decrease as leisure increases) it must be the case that $b^* > (1-t)y$ and so $u(b^*, 0) > u((1-t)y, h)$; thus $Z(y, b^*, t) < 0$. We shall make further use of this fact in the analysis below.

If the UI scheme were private, so that $e=1$ and benefits were taxed at the rate t, then (9) implies that the optimal private benefit, $\hat{b}$, satisfies:

$$u_1((1-t)\hat{b}, 0) = u_1((1-t)y, h). \tag{13}$$

Again it follows that if $u_{12} \leqq 0$, then $\hat{b} > y$, so that $u((1-t)\hat{b}, 0) > u((1-t)y, h)$ and therefore $Z(y, \hat{b}, t) < 0$.

So it would be ex ante optimal for a private UI scheme to provide a UI benefit in excess of the wage and therefore workers would prefer being laid off to working. On the other hand, such a state is not ex post preferred by the firm; layoffs have zero productivity but are more costly than continued employment. There is thus an incentive for the firm to agree to such a contract (we show below that the wage is likely to be lower than if the UI benefit were smaller) but then conceal a shortfall in product demand in order to avoid layoffs. This moral hazard problem may explain in some degree the prevalence of government intervention in the provision of UI.

The complete picture of the contract choice is obtained by combining figs. 1 and 2, although it is immediately apparent that the precise form of the resulting configuration depends on the location of the ridge line, $y = p_1 G'(q_1) + eb$ in fig. 1, relative to the horizontal indifference curve, $u((1-t)y, h) = u(b, 0)$ in fig. 2. In other words, the 'contract curve' or optimal contract set, defined in part by the tangencies of indifference and isoprofit curves, will depend on all those exogenous factors influencing profit or utility. When workers are risk averse, a typical contract curve is shown as CC' in fig. 3. Risk neutrality on the part of workers straightens CC' into a vertical line, so that relative bargaining strength is reflected solely in the wage. (Formal derivatives are given in the appendix.)

The tangencies determining optimal contracts occur with a negative or positive slope according as Z is positive or negative. The sign of Z is endogenous, however, and depends in particular on how large an expected profit Π^* is achieved by the firm. Ceteris paribus, higher values of Π^* are associated with lower wages and smaller (or more negative) values of Z. So while the chosen contract might imply $Z<0$, and therefore be such that workers would benefit from a temporary layoff, this does not signify a general 'preference for unemployment'. Workers would rather have a contract that implies $Z>0$ and, accordingly, a preference for being employed rather than laid off. Note also that it does not follow from the condition $Z<0$ that workers will be able to bribe the firm to lay them off. At an optimum [see (11)] the net gain to the firm from employing an additional worker $(p_1G'-y+eb)$ is exactly equal to the net loss $(-Z)$ that would be received by that additional worker. (Indeed, as observed above, ex post the firm then has an incentive to conceal the occurrence of a state entailing layoffs.) A fortiori, workers who have been laid off cannot bribe the firm not to rehire them in the event that the higher state of demand occurs.

4. Wage and layoff responses

If there is any change in the economic environment, the set of optimal contracts will change. There will be a new (U^*, Π^*) possibility frontier and the contract actually selected will depend on the bargaining solution adopted. Without specifying the latter, the effect of a parameter change cannot be made precise even if the initial position is fixed. If it is assumed, however, that the final contract will reflect a Pareto change (i.e. will not be such as to make one party better off and the other worse off, relative to the initial position) then the actual change will be intermediate between the changes consistent with a constant U^* and a constant Π^*. So we analyze the contract response for both of these alternative conditions.

The effects of a small parameter change on employment and the wage are completely described by the comparative static derivatives for problems (3) or (4). But it will be useful to set out in geometric terms the consequences of at least one parameter change, particularly since one outcome of the analysis is the ambiguity of some responses. In general terms, the considerations are these. A parameter change will affect one or other of the families of level curves (indifference curves in the case of t or b, isoprofit curves in the case of p_1, e, b or T). For the affected family, not only will the corresponding marginal rate of substitution at each point be different (except in the case of T), but so also will be the level curve identified with the maintained (Π^* or U^*) constraint. The ultimate effect on q_1 or y can be determined by a comparison of marginal rates of substitution at appropriate points.

For later reference, we collect here some general properties of these marginal rates of substitution. It follows from (8) and (10) that, in the vicinity of an optimal contract, the marginal rates of substitution of y for q_1 for the firm (MRS_{Π}) and for the workers (MRS_U) vary with y and q_1 according to:

$$\frac{\partial}{\partial y}(MRS_U)=\frac{\lambda_1}{\lambda_0+\lambda_1 q_1}\left[1-\frac{(1-t)u_{11}Z}{u_1}\right], \tag{14}$$

$$\frac{\partial}{\partial q_1}(MRS_U)=\frac{-\lambda_1^2 Z}{(\lambda_0+\lambda_1 q_1)^2}, \tag{15}$$

$$\frac{\partial}{\partial y}(MRS_{\Pi})=\frac{\lambda_1}{\lambda_0+\lambda_1 q_1}, \tag{16}$$

$$\frac{\partial}{\partial q_1}(MRS_{\Pi})=-\frac{\lambda_1}{(\lambda_0+\lambda_1 q_1)^2}\left[(\lambda_0+\lambda_1 q_1)p_1 G''+\lambda_1 Z\right], \tag{17}$$

making use of (11). [Here and henceforth, to simplify expressions, u_1 and u_{11} are understood to be evaluated at $((1-t)y, h)$ unless otherwise stated, and G' and G'' are evaluated at q_1.] It follows that the differential rates of change of MRS_U and MRS_{Π} with respect to y and q_1 are given by:

$$\frac{\partial}{\partial y}(MRS_U-MRS_{\Pi})=-\frac{\lambda_1 Z}{\lambda_0+\lambda_1 q_1}\frac{(1-t)u_{11}}{u_1},$$

which has the sign of Z when $u_{11}<0$, and:

$$\frac{\partial}{\partial q_1}(MRS_U-MRS_{\Pi})=\frac{\lambda_1}{\lambda_0+\lambda_1 q_1}p_1 G''<0,$$

which is independent of Z.

As noted above, these relative rates of change are potentially crucial determinants of the net impact of an exogenous change. Observe that, in the y-direction, the sign of the rate differential depends on Z and the magnitude is directly proportional to the measure of workers' absolute risk aversion $(-(1-t)u_{11}/u_1)$, a characteristic of the utility function. In the q-direction, by contrast, the magnitude of the differential depends on the rate of change of the marginal product of labor, a property of the production function. The magnitude of each differential can thus be altered, no matter what the initial optimum, by the specification of parameters in the utility and production functions, respectively. This fact underlies the occasional ambiguity that will be shown to exist in comparative static effects.

4.1. Product demand conditions

Consider first the effects of a change in product demand conditions. Suppose there is an increase in p_1, i.e. the lower state of demand is increased. When Π^* is the maintained constraint, the situations before and after the change are as illustrated in fig. 4(a) for the case of a contract with $Z>0$, and in fig. 4(b) for the case of $Z<0$. With an increase in p_1, Π^* is associated with a higher isoprofit curve (Π_1^*) than initially (Π_0^*), since the firm can afford a higher wage for any given layoff probability. The horizontal and vertical

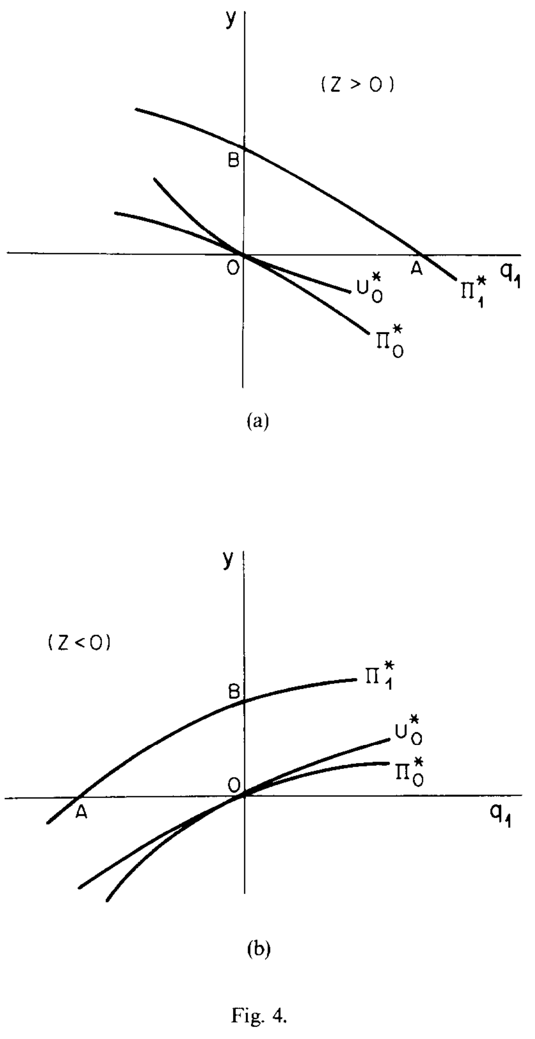


Fig. 4.

shifts (OA and OB) are derived from the differential of the isoprofit constraint (5d):

$$OA = \mathrm{d}q_1 \Big|_{\mathrm{d}\Pi^* = 0} = \left(\frac{-G}{p_1 G' - y + eb} \right) \mathrm{d}p_1 = \frac{G}{Z} \mathrm{d}p_1 \tag{18}$$

$$OB = \mathrm{d}y \Big|_{\mathrm{d}\Pi^* = 0} = \frac{\lambda_1 G}{\lambda_0 + \lambda_1 q_1} \mathrm{d}p_1 \tag{19}$$

The net effects on y and q_1 are determined by comparison of MRS_U and MRS_Π at A and B, respectively. Specifically:

$$\frac{\partial y}{\partial p_1} \gtreqless 0 \quad \text{as} \quad \begin{cases} MRS_U^A \lesseqgtr MRS_\Pi^A, & \text{if} \quad Z > 0, \\ MRS_U^A \gtreqless MRS_\Pi^A, & \text{if} \quad Z < 0, \end{cases} \tag{20}$$

and

$$\frac{\partial q_1}{\partial p_1} \gtreqless 0 \quad \text{as} \quad MRS_U^B \gtreqless MRS_\Pi^B, \quad \text{if} \quad Z > 0 \quad \text{or} \quad Z < 0. \tag{21}$$

From (11):

$$\frac{\partial}{\partial p_1} (MRS_\Pi^O) = -\frac{\lambda_1 G'}{\lambda_0 + \lambda_1 q_1} < 0. \tag{22}$$

So, together, (15), (17), (18) and (22) yield the condition that:

$$\frac{\partial y}{\partial p_1} \gtreqless 0 \quad \text{as} \quad G' + \frac{p_1 G G''}{Z} \quad \begin{cases} \lesseqgtr 0, & \text{if} \quad Z > 0 \\ \gtreqless 0, & \text{if} \quad Z < 0. \end{cases}$$

This is confirmed by the comparative static derivative,

$$\frac{\partial y}{\partial p_1} = \frac{\lambda_1}{|B|} [Z G' + p_1 G G''], \tag{23}$$

where

$$|B| = \lambda_1 Z^2 \frac{(1-t) u_{11}}{u_1} + (\lambda_0 + \lambda_1 q_1) p_1 G'' < 0.$$

Thus,

$$\frac{\partial y}{\partial p_1} = \begin{cases} > 0, & \text{if} \quad Z \leqq 0, \\ (?), & \text{if} \quad Z > 0. \end{cases}$$

The sign of $\partial y/\partial p_1$ depends on that of $ZG'+p_1GG''$ or, equivalently, $q_1Z/p_1G(q_1)+q_1G''(q_1)/G'(q_1)$, i.e. it depends on the magnitude of the elasticity of the marginal product of labor in state 1 relative to the ratio of the money value of employment (Z) to the money value of the average product of labor in state 1. Alternatively, the sign of $\partial y/\partial p_1$ is that of

$$-\frac{GG''q_1}{G'(G-q_1G')}-\frac{Zq_1}{p_1(G-q_1G')},$$

which is the difference between the inverse of the elasticity of substitution and the ratio of the money value of employment to those who are, to the money value of competitive profits.

Similarly, combining (14), (16) and (19), we find that:

$$\frac{\partial q_1}{\partial p_1}\gtreqless 0 \quad \text{as} \quad -(\lambda_0+\lambda_1q_1)G'+\frac{\lambda_1(1-t)u_{11}ZG}{u_1}\gtreqless 0.$$

This is confirmed by the comparative static derivative,

$$\frac{\partial q_1}{\partial p_1}=\frac{1}{|B|}\left[-(\lambda_0+\lambda_1q_1)G'+\frac{\lambda_1(1-t)u_{11}ZG}{u_1}\right]. \tag{24}$$

Thus,

$$\frac{\partial q_1}{\partial p_1}=\begin{cases}>0, & \text{if} \quad Z\geqq 0 \quad \text{or} \quad u_{11}=0,\\ (?), & \text{if} \quad Z<0 \quad \text{and} \quad u_{11}<0.\end{cases}$$

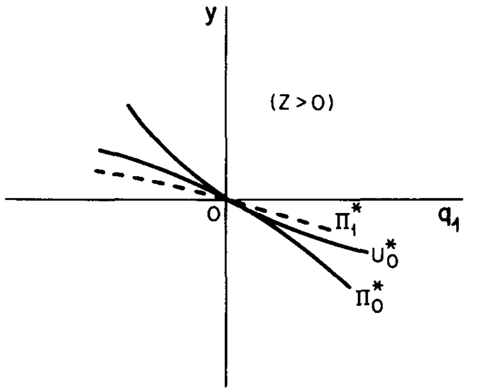
The sign of $\partial q_1/\partial p_1$ is that of

$$\frac{q_1G'}{G}-\left(\frac{\lambda_1}{\lambda_0+\lambda_1q_1}\right)\frac{(1-t)u_{11}}{u_1}q_1Z,$$

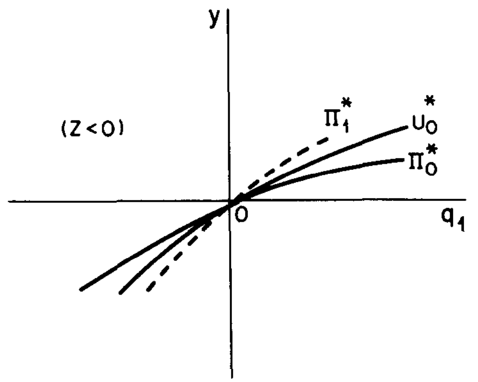
which is the difference between the employment elasticity of output in state 1 and the product of terms involving the money value of employment to those who are and the worker's absolute risk aversion.

The response to a variation in product demand conditions is quite different, however, when U^* is the maintained constraint. Then the situations before and after a change in p_1 are as illustrated in fig. 5(a) for a contract with $Z>0$, and in fig. 5(b) for $Z<0$.

In the case $Z>0$ it must happen that y and q_1 move in opposite directions, whereas in the case $Z<0$ they must move in the same direction. Everything is determined by how MRS^{O}_{Π} changes with p_1, which is negatively, according to (22). So, if $Z>0$, then $\partial y/\partial p_1<0$ and $\partial q_1/\partial p_1>0$; while if $Z<0$,



(a)



(b)

Fig. 5.

then $\partial y/\partial p_1 > 0$ and $\partial q_1/\partial p_1 > 0$; i.e.

$$\frac{\partial y}{\partial p_1} \lesseqqgtr 0 \quad \text{as} \quad Z \gtreqqless 0$$

and

$$\frac{\partial q_1}{\partial p_1} > 0, \quad \text{for any } Z.$$

These conclusions are confirmed by the comparative static derivatives:

$$\frac{\partial y}{\partial p_1} = \frac{1}{|B|} \lambda_1 G'(q_1) Z \tag{25}$$

and

$$\frac{\partial q_1}{\partial p_1} = \frac{-1}{|B|}(\lambda_0 + \lambda_1 q_1)G'(q_1). \tag{26}$$

Comparing the optimal adjustments to a change in demand conditions under the alternative maintained constraints, it is seen that there are potential conflicts between the firm and the workers with respect to the qualitative (as well as quantitative) nature of the desired adjustments. In particular, starting from a contract with $Z > 0$, the firm wants to respond to an increase in product price by lowering the wage (and increasing employment), whereas workers may prefer an increase in the wage (together with an increase in employment). On the other hand, starting from a contract such that $Z < 0$, the firm and workers will agree that the wage should respond positively to an improvement in product demand conditions but they may disagree on the employment response. The potential for disagreement in this latter context, it is worth noting, does not exist unless workers are risk averse.

The general picture that emerges from these comparative statics results is one in which an improvement in product demand conditions creates a desire for increased employment, on the part of both the firm and the workers, but no systematic tendency for wages. Taking a large but tentative leap to the macro level, this could be viewed as suggesting that product demand fluctuations are likely to be accompanied by procyclical fluctuations in employment but relatively stable wages.[2]

The preceding analysis of the effects of product price on wages and layoffs illustrates the potential importance of three essentially different considerations:

(i) the choice of maintained constraint or bargaining solution;
(ii) the nature of the initial conditions, as characterized by the sign of Z; and
(iii) the presence or absence of risk aversion.

These factors have a bearing on the effects of changes in every parameter of the present model.

4.2. Income tax rate

A change in the income tax rate alters the workers' indifference curves but not the isoprofit curves. Thus, if Π^* is the maintained constraint, the

[2]Employment and wage behavior in fluctuating product demand conditions is the central focus of McDonald and Solow. They also conclude, for structurally similar reasons, that demand fluctuations tend to produce correlated employment fluctuations but no systematic movement in real wages.

necessary adjustment in y and q_1 will take place around the unchanged Π^* curve. The directions of change for y and q_1 are then the same or opposite according as the contract is one with $Z<0$ or $Z>0$. The directions in either case are determined by the effect of t on MRS_U at the initial contract position. This is given by

$$\frac{\partial}{\partial t}(MRS_U)=\frac{\lambda_1}{\lambda_0+\lambda_1 q_1}\left(\frac{Zyu_{11}}{u_1}+\frac{Z-y}{1-t}\right),$$

i.e.

$$\frac{\partial}{\partial t}(MRS_U)=\frac{\lambda_1}{\lambda_0+\lambda_1 q_1}\cdot\frac{Z}{1-t}\left[\frac{(1-t)yu_{11}}{u_1}-\frac{y-Z}{Z}\right]. \tag{27}$$

Since, from (5b), it is always the case that $Z-y<0$ at an optimum, MRS_U unambiguously decreases with t when $Z>0$ and hence, in this case, the changes in y and q_1 are respectively positive and negative. If $Z<0$, however, the effect of t on MRS_U depends, from (27), on the difference between the workers' relative risk aversion and the percentage gap between the wage and the money value of being employed. So long as the workers are not risk neutral, there will therefore be potential ambiguity in the responses.

These conclusions, when Π^* is the maintained constraint, are confirmed by the comparative static derivatives:

$$\frac{\partial y}{\partial t}=\frac{\lambda_1 Z}{|B|}\left(\frac{Zyu_{11}}{u_1}+\frac{Z-y}{1-t}\right) \tag{28}$$

$$=\begin{cases}\gtreqqless 0 & \text{as} \quad Z\gtreqqless 0,\\ <0, & \text{if} \quad Z<0 \text{ and } u_{11}=0,\\ (?), & \text{if} \quad Z<0 \text{ and } u_{11}<0,\end{cases}$$

and

$$\frac{\partial q_1}{\partial t}=-\frac{\lambda_0+\lambda_1 q_1}{|B|}\left(\frac{Zyu_{11}}{u_1}+\frac{Z-y}{1-t}\right) \tag{29}$$

$$=\begin{cases}<0, & \text{if} \quad Z\gtreqqless 0 \text{ or } u_{11}=0,\\ (?), & \text{if} \quad Z>0 \text{ and } u_{11}<0.\end{cases}$$

If U^* is the maintained constraint, the new optimum is a tangency of different indifference and isoprofit curves. The analysis of the change, in terms of marginal rates of substitution, is given in the appendix. The results are summarized here in the comparative statics derivatives:

$$\frac{\partial y}{\partial t}=\frac{1}{|B|}\left[\lambda_1 Z\left(\frac{Zyu_{11}}{u_1}+\frac{Z-y}{1-t}\right)+(\lambda_0+\lambda_1 q_1)p_1 G''\frac{y}{1-t}\right] \tag{30}$$

$$=\begin{cases} >0, & \text{if} \quad Z \geqq 0, \\ (?), & \text{if} \quad Z<0. \end{cases}$$

The potential ambiguity observed when Π^* is maintained (with both $Z<0$ and $u_{11}<0$) is reinforced here by the term involving the second derivative of the production function, which is basically unrelated to the terms involving utility and income. However,

$$\frac{\partial q_1}{\partial t}=-\frac{1}{|B|}(\lambda_0+\lambda_1 q_1)\frac{Z-y}{1-t}<0, \tag{31}$$

without ambiguity.

4.3. *Unemployment insurance*

It is generally regarded as a plausible proposition that unemployment would be reduced by either an increase in a firm's experience rating or a decrease in the level of insurance benefits. An increase in experience rating, ceteris paribus, makes layoffs more expensive for the firm; a reduction in benefits, ceteris paribus, makes the unemployment state less attractive to the workers. It will be shown here that, in the context of the present model, a negative relationship between layoff unemployment and experience rating obtains except, possibly, in a situation that might well be regarded as the most typical. On the other hand, there is no prevalent relationship between benefits and layoffs. Wages are found to be negatively related to benefits but not systematically influenced by experience rating.

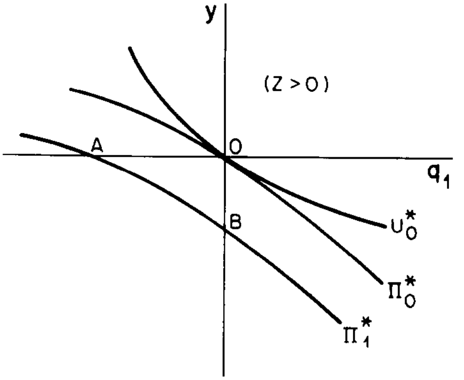
4.3.1. *Experience rating and taxes*

Consider first the effects of a change in experience rating, holding Π^* constant. Let $U(e,b)$ denote the maximum value function for problem (3), and let a caret ($\hat{}$) indicate values associated with an optimal contract. A standard result yields:

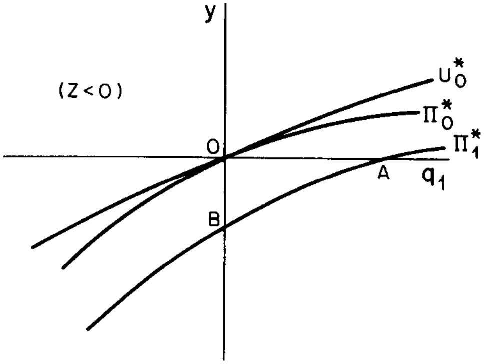
$$\frac{\mathrm{d}U(e,b)}{\mathrm{d}e}=-\lambda_1(1-\hat{q}_1)b(1-t)u_1((1-t)\hat{y},h),$$

which is negative. Thus, ceteris paribus, the expected utility of workers attached to a given firm will be increased by a reduction in that firm's experience rating. It does not follow from this, however, that a reduction of e is an appropriate policy, since a reduction in UI contributions by one firm must be compensated for by an increase in contributions of other firms whose workers correspondingly suffer a loss of utility. Only if $e=1$ for all firms is there no cross-subsidization.

The optimal contract configurations before and after an increase in e are illustrated in fig. 6(a) (case $Z>0$) and fig. 6(b) (case $Z<0$). Comparisons of MRS_U and MRS_Π at the critical points (detailed in the appendix) show that



(a)



(b)

Fig. 6.

employment in the second state will rise, remain constant, or fall according as

$$\left[-\frac{(1-t)u_{11}}{u_1}\right]\lambda_1(1-q_1)Z \lesseqgtr \lambda_0+\lambda_1 q_1$$

or, equivalently,

$$\left[-\frac{(1-t)yu_{11}}{u_1}\right]\lambda_1(1-q_1)Z \lesseqgtr (\lambda_0+\lambda_1 q_1)y, \tag{33}$$

i.e. as the product of workers' absolute (respectively, relative) risk aversion and expected money value of the utility loss due to layoffs is less than, equal to, or greater than expected employment (respectively, expected wage bill). It follows from (33) that an increase in experience rating might lead to an increase in layoffs if (and only if) both $Z>0$ and $u_{11}<0$. We shall return to this point below.

Similar considerations show (see the appendix for details) that if $Z>0$ the wage will fall as e rises, while if $Z<0$ the wage will rise, remain constant or fall according as

$$Z \lesseqgtr (1-q_1)p_1 G''. \tag{34}$$

The ambiguity of response in this case can be seen by elaborating the right-hand side of (34). When $Z<0$, the wage change will depend on the sign of

$$\frac{(G-q_1G')}{G}\cdot\frac{(-GG''q_1)}{G'(G-q_1G')}-\frac{q_1(-Z)}{(1-q_1)p_1G'},$$

which is the difference between the ratio of the competitive share of capital to the elasticity of substitution and the ratio of the money valuation of employment to the competitive wage times the proportion unemployed.

The precise effects of a small change in experience rating, with Π^* held constant, are given by:

$$\frac{\partial q_1}{\partial e}=-\frac{b}{|B|}\left[\lambda_1(1-q_1)Z\frac{(1-t)u_{11}}{u_1}+(\lambda_0+\lambda_1 q_1)\right] \tag{35}$$

$$=\begin{cases} >0, & \text{if} \quad Z\leqq 0 \quad \text{or} \quad u_{11}=0, \\ (?), & \text{if} \quad Z>0 \quad \text{and} \quad u_{11}<0, \end{cases}$$

and

$$\frac{\partial y}{\partial e}=\frac{\lambda_1 b}{|B|}[Z-(1-q_1)p_1 G''] \tag{36}$$

$$=\begin{cases} <0, & \text{if} \quad Z\geqq 0, \\ (?), & \text{if} \quad Z<0. \end{cases}$$

The most interesting among these results is the effect of experience rating on layoffs when $Z>0$ (i.e. in situations where workers prefer to be working rather than laid off). A major conclusion of Feldstein's (1976) analysis, in which $\Pi^*=0$ is the maintained constraint, is that expected employment will increase with an increase in the firm's experience rating, since the UI subsidy to the firm would be diminished. The preceding results demonstrate that, without Feldstein's assumption of risk neutrality, this conclusion need not hold. It will be shown next, however, that regardless of the degree of workers' risk aversion an increase in the firm's experience rating will definitely lead to fewer layoffs if U^* is the maintained constraint. On these grounds a negative correlation between experience rating and layoff unemployment can be more confidently accepted as the prevalent tendency.

Since e is not a parameter for the isoutility curves, a change in e when U^* is maintained involves a movement of (q_1, y) around the given U^* curve. The changes in q_1 and y will therefore be opposite in sign for contracts with $Z>0$, and of the same sign when $Z<0$. Since MRS_Π declines when e rises, independent of Z, it follows that employment will rise with e regardless of the sign of Z; the wage will decrease when $Z>0$, increase when $Z<0$. The precise effects, when U^* is held constant, are given by:

$$\frac{\partial q_1}{\partial e}=-\frac{b}{|B|}(\lambda_0+\lambda_1 q_1)(1-t)u_1>0 \tag{37}$$

and

$$\frac{\partial y}{\partial e}=\frac{\lambda_1 b}{|B|}(1-t)u_1 Z \lesseqgtr 0 \quad \text{as} \quad Z \gtreqless 0. \tag{38}$$

Combining the two sets of results (Π^* constant and U^* constant) it is seen that increasing experience rating tends to reduce unemployment but has no clear impact on wages. This conclusion parallels that for the effects of changes in product price, with employment appearing more responsive than wages, but the macroeconomic implications are less obvious here.

Experience rating is effectively nonexistent for those firms whose reserve ratios lie outside a specified range. Such firms are taxed at a flat rate, i.e. e

$=0$ and $T>0$. The effects of a change in T (as, for example, with a change in the maximum or minimum UI tax rate) are easily derived since only the family of isoprofit curves is affected, and then only by a relabelling of the curves. The contract curve does not shift. It is therefore immediate that, if U^* is maintained, an increase in T will have no effect whatsoever on layoffs or wages; the firm's profit will be reduced by the amount of the increase.

On the other hand, if Π^* is the maintained constraint, a change in T is equivalent to an equal change in Π^* and therefore results simply in a movement along the contract curve. Recall that the contract curve is vertical when workers are risk neutral and positively or negatively sloped, according as $Z>0$ or $Z<0$, when workers are risk averse. In either case, a change in T results in a change in the wage in the opposite direction. With risk neutrality there is no effect on employment (as when U^* is maintained). When there is risk aversion an increase in T results in fewer layoffs if $Z<0$, but more layoffs if $Z>0$. The increase in layoffs due to an increase in a lump-sum tax, occurring in the 'normal' circumstances of workers' risk aversion and preference for being employed rather than laid off, is likely to be an unforeseen consequence of upward shifts in the UI tax schedule.

4.3.2. Unemployment benefits

A priori, determination of the effects of a change in the level of the UI benefit is more complicated than for any of the other parameters, in the sense that only b influences both indifference curves and isoprofit curves. The potential for indeterminacy is therefore increased. Indeed, as will be shown below, the effects of benefits on layoffs is not independent of other considerations even when initial conditions have been well chosen to permit a precise determination of the response.

When b is a parameter and Π^* is the maintained constraint, the local effects on layoffs and wages are given by

$$\frac{\partial q_1}{\partial b}=-\frac{1}{|B|}\left[\lambda_1(1-q_1)eZ\frac{(1-t)u_{11}}{u_1}-(\lambda_0+\lambda_1 q_1)f\right] \tag{39}$$

and

$$\frac{\partial y}{\partial b}=-\frac{\lambda_1}{|B|}[Zf+e(1-q_1)p_1G''], \tag{40}$$

where

$$f=f(y,b,e)\equiv\frac{u_1(b,0)}{(1-t)u_1((1-t)y,h)}-e. \tag{41}$$

Furthermore, the maximum value function responds according to:

$$\frac{\mathrm{d}U}{\mathrm{d}b} = \lambda_1(1-q_1)f(1-t)u_1((1-t)y, h). \tag{42}$$

It is evident that the directions of these responses depend on the signs of both Z and f.

Consider first what would happen if b were a contract choice variable rather than a parameter. [Although, in the following analysis, we continue to suppose that b is untaxed, the principle and the essence of the conclusions would be the same if b were taxed as regular income. If b were taxed at the rate t, for example, b would be replaced by $(1-t)b$ inside the utility function and $(1-t)$ would multiply the first derivative of the utility function whenever the marginal utility of b occurs.] Then an optimal contract is specified by a vector (y^*, q_1^*, b^*) and clearly, for any given Π^*, the expected utility from this contract is greater than that from an optimal contract when b is a parameter. For this reason, in what follows we shall refer to b^* as the optimal UI benefit.

From the analysis of section 3 [see, in particular, eq. (7)] we know that

$$u_1(b^*, 0) - e(1-t)u_1((1-t)y^*, h) = 0, \tag{43}$$

which implies that $f(y^*, b^*, e) = 0$. It follows from (42) that, in the neighborhood of b^*, $f(y, b, e) \gtrless 0$ as $b \lessgtr b^*$.

In section 3 it was also established that $Z(y^*, b^*, t) < 0$. So for b in a neighborhood of b^*, $Z(y, b, t) < 0$ and eqs. (39) and (40) then yield the following conclusions:

$$\frac{\partial q_1}{\partial b} = \begin{cases} >0, & \text{if} \quad u_{11} < 0, \\ \operatorname{sgn}(b - b^*), & \text{if} \quad u_{11} = 0, \end{cases}$$

and

$$\frac{\partial y}{\partial b} < 0.$$

Parallel conclusions follow when U^* is the maintained constraint. The effects of the UI benefit on layoffs and wages are described by:

$$\frac{\partial q_1}{\partial b} = -\frac{1}{|B|}\left[\lambda_1(1-q_1)Z\frac{(1-t)u_{11}}{u_1}\frac{u_1(b, 0)}{(1-t)u_1((1-t)y, h)} - (\lambda_0 + \lambda_1 q_1)f\right] \tag{44}$$

and

$$\frac{\partial y}{\partial b} = -\frac{\lambda_1}{|B|}\left[Zf + \frac{u_1(b,0)}{(1-t)u_1((1-t)y,h)}(1-q_1)p_1G''\right]. \tag{45}$$

In a neighborhood of b^*, then, as before:

$$\frac{\partial q_1}{\partial b} = \begin{cases} >0, & \text{if} \quad u_{11}<0, \\ \operatorname{sgn}(b-b^*), & \text{if} \quad u_{11}=0, \end{cases}$$

and

$$\frac{\partial y}{\partial b}<0.$$

So the desired responses of firm and workers are reinforcing. At this level, an increase in benefits results in a lower wage and, if workers are risk averse, *fewer* rather than more layoffs. Only if workers are risk neutral and the benefit level is below the optimum will the conventional prediction of an increase in layoffs be justified.

In practice, the legislated UI benefit only partially replaces lost wage income, i.e. $b<(1-t)y$. If additional leisure enhances the utility of consumption ($u_{12}\leqq 0$) then, since the experience rating factor is bounded above by unity, it follows from (41) that $f>0$. It is then apparent from (39) or (44) that the response of employment to a change in the UI benefit is potentially affected by the combination of two factors: whether or not there is risk aversion ($u_{11}<0$) and whether the initial contract is such that $Z>0$ or $Z<0$. Specifically, when $f>0$:

$$\frac{\partial q_1}{\partial b} = \begin{cases} <0, & \text{if} \quad Z\geqq 0 \quad \text{or} \quad u_{11}=0, \\ (?), & \text{if} \quad Z<0 \quad \text{and} \quad u_{11}<0. \end{cases}$$

Thus, when workers are risk neutral (the Feldstein case) or when working is ex post preferred to a temporary layoff, a reduction in the UI benefit will result in fewer layoffs. In order for the reverse effect to occur when $f>0$, it is necessary that there be both risk aversion and an ex post preference for being laid off. In these circumstances, as can be seen from (39) and (44), $\partial q_1/\partial b$ increases (it is more likely that layoffs will rise when b is reduced) with the workers' absolute risk aversion. Finally, from (40) and (45), when $f>0$,

$$\frac{\partial y}{\partial b}=\begin{cases} <0, & \text{if} \quad Z\leqq 0, \\ (?), & \text{if} \quad Z>0. \end{cases}$$

Thus, a determinate wage response tends to occur when the employment response is indeterminate, and vice versa.

It is worth noting explicitly that the objectives of reducing temporary layoff unemployment and making the workers under contract better off, are not necessarily harmonious. Changing b away from b^* reduces the workers' utility but may be what is required in order to reduce unemployment.

5. Summary

We have investigated the microeconomic influence of unemployment insurance on wage and temporary layoff behavior, using a two-state model of optimal labor contracts that encompasses the pertinent features of the models of Azariadis (1975) and Feldstein (1976). At a formal level the main distinction from these lies in the analytical approach. Instead of treating the contract problem from the point of view of either the firm or the workers, we consider these as dual problems and allow the contract to be selected from the optimal set according to some bargaining rule or process. The possible responses to any change in the economic environment are then delimited by the respective dual solutions.

The set of contract choice variables, when the UI parameters are exogenously specified, is shown to reduce to the wage (which will be state independent) and the probability of employment in the state with layoffs. The configuration of the set of optimal contracts (the contract curve) is then derived from the characteristics of the families of indifference curves and isoprofit curves. The key observation here is that the qualitative nature of an optimal contract, and thus potentially of the response to exogenous change, depends on the sign of a measure (Z) of the equivalent money value of being employed rather than temporarily unemployed, taking into account the UI benefits and additional leisure. In addition to the empirical evidence that Z might be negative, we demonstrate that an optimal contract would imply a negative Z if the level of unemployment benefits were a choice variable (as in the case of private UI schemes). We also show that this feature of (ex ante) optimal contracts may generate moral hazard and in turn lead to government intervention in the provision of UI.

Our results concerning the direct effects of both experience rating and the

UI benefit level raise some questions about the general validity of the conventional wisdom. We show that, without the assumption of workers' risk neutrality, Feldstein's (1976) conclusion that layoffs would be reduced by an increase in experience rating does not necessarily hold. The same is true of a reduction in the UI benefit. But we do also show that a negative correlation between experience rating and layoff unemployment is supported by a consideration of the bargaining context, and that a positive relationship between layoffs and the UI benefit level is likely to obtain in the empirically relevant circumstances.

The other parameter of the UI system is the lump-sum tax, which becomes operative when the firm is not experience rated and is subject to UI tax at a flat rate. A change in this tax, as would result from any vertical displacement of the UI tax schedule, tends to result in a wage change in the opposite direction. If workers are risk neutral there is no incentive for any layoff response. But if workers are risk averse there will be a layoff response and it is likely to be perverse: if workers prefer employment to temporary layoffs, an increase in the lump-sum UI tax will result in more layoffs.

When the product price changes, reflecting a change in the lesser state of demand, both the firm and the workers will typically seek a positively related change in employment. On the other hand, there is no prevalent tendency in the wage response. The latter is sensitive to initial circumstances and to the resolution of bargaining conflict. Considering these results in the longer term context of a succession of such contracts, there is at least a hint of the macroeconomic consequence that product demand fluctuations are likely to be accompanied by procyclical fluctuations but relatively stable wages.[3]

Appendix

Comparative static derivatives are based on (5a) and (5b), taking b as a parameter, $y>0$ and $0<q_1<1$ (hence $\eta_1=0$), together with either (5d) when the expected profit constraint is maintained, or (6) when the expected utility constraint is maintained. For each maintained constraint, the system reduces to a pair of equations:

$$Z+p_1G'(q_1)-y+eb=0, \tag{A1}$$

and either

$$\lambda_0p_0G(1)+\lambda_1p_1G(q_1)-(\lambda_0+\lambda_1q_1)y-\lambda_1eb(1-q_1)-T=\Pi^* \tag{A2}$$

or

$$(\lambda_0+\lambda_1q_1)u((1-t)y,h)+\lambda_1(1-q_1)u(b,0)=U^*. \tag{A3}$$

[3]See footnote 2.

The total differentials of (A1)–(A2) and (A1)–(A3) yield, respectively, the systems:

$$B\begin{bmatrix} \mathrm{d}y \\ \\ \mathrm{d}q_1 \end{bmatrix} = \begin{bmatrix} G'\,\mathrm{d}p_1 - f\,\mathrm{d}b + b\,\mathrm{d}e + \left(\dfrac{Z-y}{1-t} + \dfrac{Zyu_{11}}{u_1}\right)\mathrm{d}t \\ \\ \lambda_1 G\,\mathrm{d}p_1 - \lambda_1 e(1-q_1)\,\mathrm{d}b - \lambda_1 b(1-q_1)\,\mathrm{d}e - \mathrm{d}T - \mathrm{d}\Pi^* \end{bmatrix} \tag{A4}$$

and

$$B\begin{bmatrix} \mathrm{d}y \\ \\ \mathrm{d}q_1 \end{bmatrix} = \begin{bmatrix} G'\,\mathrm{d}p_1 - f\,\mathrm{d}b + b\,\mathrm{d}e + \left(\dfrac{Z-y}{1-t} + \dfrac{Zyu_{11}}{u_1}\right)\mathrm{d}t \\ \\ -\dfrac{\lambda_1(1-q_1)}{u_1}u_1(b,0)\,\mathrm{d}b + (\lambda_0+\lambda_1 q_1)\dfrac{y}{1-t}\,\mathrm{d}t + \dfrac{1}{(1-t)u_1}\,\mathrm{d}U^* \end{bmatrix} \tag{A5}$$

where

$$B \equiv \begin{bmatrix} Z\dfrac{(1-t)u_{11}}{u_1} & -p_1 G'' \\ \lambda_0 + \lambda_1 q_1 & \lambda_1 Z \end{bmatrix}$$

and

$$|B| = \lambda_1 Z^2 \frac{(1-t)u_{11}}{u_1} + (\lambda_0 + \lambda_1 q_1)p_1 G'' < 0.$$

Shape of contract curve (see section 3)

From (A4):

$$\frac{\partial y}{\partial \Pi^*} = -\frac{1}{|B|}p_1 G'' < 0$$

and

$$\frac{\partial q_1}{\partial \Pi^*} = -\frac{1}{|B|}Z\frac{(1-t)u_{11}}{u_1} \begin{cases} \lesseqqgtr 0 & \text{as} \quad Z \gtreqqless 0, \quad \text{if} \quad u_{11} < 0, \\ = 0, & \textit{if} \quad u_{11} = 0. \end{cases}$$

Alternatively, from (A5):

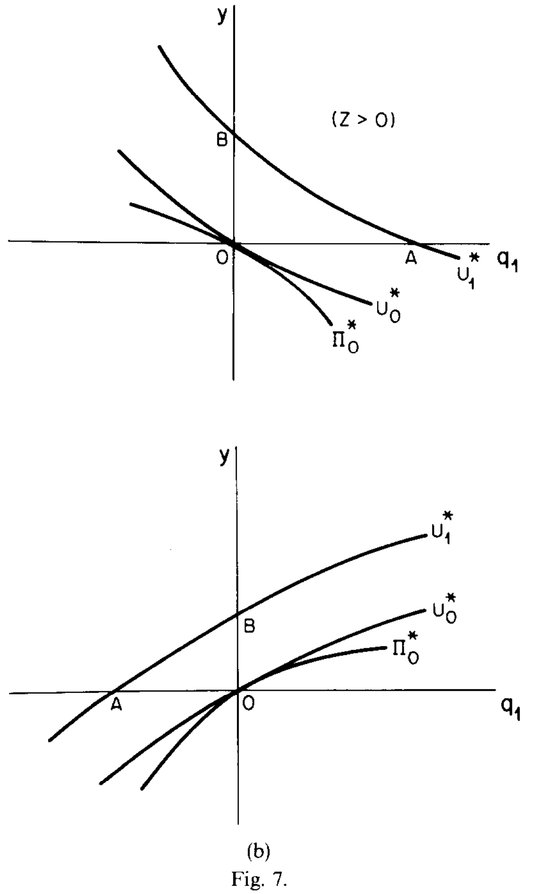
$$\frac{\partial y}{\partial U^*} = \frac{1}{|B|}\frac{p_1 G''}{(1-t)u_1} > 0$$

and

$$\frac{\partial q_1}{\partial U^*}=\frac{1}{|B|}Z\frac{u_{11}}{u_1^2}\begin{cases}\gtreqless 0, & \text{as} \quad Z\gtreqless 0, \quad \text{if} \quad u_{11}<0,\\ =0, & \textit{if} \quad u_{11}=0.\end{cases}$$

Effect of income tax rate, with expected utility constant (see subsection 4.2)

When U^* is the maintained constraint, the situations before and after an increase in t are as illustrated in fig. 7(a) (case $Z>0$) and fig. 7(b) (case $Z<0$). U^* is associated with a higher indifference curve (U_1^*) than before (U_0^*), since workers require a higher before-tax wage for any given layoff probability. The horizontal and vertical shifts (OA and OB) are derived from the



(b)
Fig. 7.

differential of the isoutility constraint (6);

$$OA = \mathrm{d}q_1\Big|_{\mathrm{d}U^*=0} = \left[\frac{\lambda_0+\lambda_1 q_1}{\lambda_1}\frac{y}{(1-t)Z}\right]\mathrm{d}t, \tag{A6}$$

$$OB = \mathrm{d}y\Big|_{\mathrm{d}U^*=0} = \left[\frac{y}{1-t}\right]\mathrm{d}t. \tag{A7}$$

The net effects on y and q_1 are determined by a comparison of MRS_U and MRS_Π at A and B:

$$\frac{\partial y}{\partial t} \gtreqqless 0 \quad \text{as} \begin{cases} MRS_U^A \lesseqqgtr MRS_\Pi^A, & \text{if} \quad Z>0, \\ MRS_U^A \gtreqqless MRS_\Pi^A, & \text{if} \quad Z<0, \end{cases}$$

and

$$\frac{\partial q_1}{\partial t} \gtreqqless 0 \quad \text{as} \quad MRS_U^B \gtreqqless MRS_\Pi^B, \quad \text{for} \quad Z>0 \quad \text{or} \quad Z<0.$$

From (11):

$$\frac{\partial}{\partial t}(MRS_U) = \frac{\lambda_1}{\lambda_0+\lambda_1 q_1}\left(\frac{Z-y}{1-t}+\frac{Zyu_{11}}{u_1}\right). \tag{A8}$$

Together, (15), (17), (A6) and (A8) yield the condition that:

$$\frac{\partial y}{\partial t} \gtreqqless 0 \quad \text{as} \quad \frac{\lambda_1}{\lambda_0+\lambda_1 q_1}\left(\frac{Z-y}{1-t}+\frac{Zyu_{11}}{u_1}\right)+\frac{p_1 G'' y}{(1-t)Z} \begin{cases} \lesseqqgtr 0, & \text{if} \quad Z>0, \\ \gtreqqless 0, & \text{if} \quad Z<0. \end{cases}$$

So

$$\frac{\partial y}{\partial t} = \begin{cases} >0, & \text{if} \quad Z>0, \\ (?), & \text{if} \quad Z<0. \end{cases}$$

Similarly, (14), (16) and (A7) yield:

$$\frac{\partial q_1}{\partial t} \gtreqqless 0 \quad \text{as} \quad \frac{\lambda_1}{\lambda_0+\lambda_1 q_1}\frac{Z}{1-t} \gtreqqless \frac{\lambda_1}{\lambda_0+\lambda_1 q_1}\cdot\frac{y}{1-t}.$$

Since $Z-y<0$ at an optimum, $\partial q_1/\partial t<0$ regardless of Z.

Effect of experience rating, with expected profit constant (see subsection 4.3.1)

The analysis of an increase in e parallels the preceding, with the situations illustrated in fig. 6(a) ($Z>0$) and fig. 6(b) ($Z>0$). The horizontal and vertical shifts of the Π^* curve are derived from the differential of (5d):

$$OA = \mathrm{d}q_1\Big|_{\mathrm{d}\Pi^*=0} = -\frac{b(1-q_1)}{Z}, \tag{A9}$$

$$OB = \mathrm{d}y\Big|_{\mathrm{d}\Pi^*=0} = -\frac{\lambda_1 b(1-q_1)}{\lambda_0+\lambda_1 q_1}. \tag{A10}$$

The net effects on y and q_1 are given by:

$$\frac{\partial y}{\partial e} \gtreqless 0 \quad \text{as} \quad \begin{cases} MRS_U^A \lesseqgtr MRS_\Pi^A, & \text{if} \quad Z>0, \\ MRS_U^A \gtreqless MRS_\Pi^A, & \text{if} \quad Z<0, \end{cases}$$

and

$$\frac{\partial q_1}{\partial e} \gtreqless 0 \quad \text{as} \quad MRS_U^B \gtreqless MRS_\Pi^B, \quad \text{if} \quad Z>0 \quad \text{or} \quad Z<0.$$

From (11):

$$\frac{\partial}{\partial e}(MRS_\Pi) = -\frac{\lambda_1 b}{\lambda_0+\lambda_1 q_1}. \tag{A11}$$

Combining (15), (17), (A9) and (A11) yields:

$$\frac{\partial y}{\partial e} \gtreqless 0 \quad \text{as} \quad \frac{(1-q_1)p_1 G''}{Z} - 1 \begin{cases} \gtreqless 0, & \text{if} \quad Z>0, \\ \lesseqgtr 0, & \text{if} \quad Z<0. \end{cases}$$

Thus, $\partial y/\partial e<0$ if $Z>0$, and $\partial y/\partial e$ has the sign of $(1-q_1)p_1G''-Z$ if $Z<0$.
Similarly, (14), (16), (A10) and (A11) yield:

$$\frac{\partial q_1}{\partial e} \gtreqless 0 \quad \text{as} \quad \lambda_1(1-q_1)Z\frac{(1-t)u_{11}}{u_1} + (\lambda_0+\lambda_1 q_1) \gtreqless 0.$$

Thus, $\partial q_1/\partial e>0$ if $Z<0$ or $u_{11}=0$, but there is ambiguity when $Z>0$ and $u_{11}<0$.

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