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SENIORITY RULES AND THE GAINS FROM UNION ORGANIZATION

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ABSTRACT

This paper examines the optimality of several seniority provisions which are common to U.S. union contracts. The paper focuses on the attempts by the initial union members to maximize their return from organizing the union. An overlapping generations model is used in the analysis. Seniority wage increases are found to serve as implicit initiation fees and thus serve as one means of appropriating rents from future union members. Layoff rules are shown to be optimal only when the organizers are constrained in the types of contracts they can write. Without these constraints, the optimal contract provides full insurance making layoff rules unnecessary. The paper concludes with a plausible set of constraints which organizers may face and discusses the conditions necessary for seniority layoff rules to result.

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I. Introduction

The focus of recent work on unions has switched from the individual union worker to the bargaining pair consisting of the union and the firm. The most prominent feature of the bargaining pair is the explicit contract they negotiate. A careful analysis of the structure of these contracts should aid our understanding of unions. Recent work in this area includes research on COLA provisions (Card, 1983; Ehrenberg, Danziger, and San, 1983) and on contract length (Dye, 1980; Harris and Holmstrom, 1983).

The aim of this paper is to extend the work in this area in two dimensions. First, I summarize existing information on the provisions of major U.S. industrial union contracts (other than COLA clauses and contract lengths). Secondly, I develop a simple contracting model and discuss the optimality of these observed contract provisions. The unique aspect of this model is its emphasis on the initial union organizers rather than the current union members.

The organization of the paper is as follows. Section two presents the summary of characteristics of U.S. union contracts. A simple contracting model is developed in section three for an environment of no uncertainty. Section four adds in demand uncertainty and analyzes the structure of the optimal contract when the firm is risk neutral.

II. Characteristics of U.S. Union Contracts

In the following sections I will use a contract model to attempt to explain three general features of U.S. industrial union contracts. These features are: seniority based wage structures, seniority based layoffs, and the apparent use of non-price mechanisms to ration union memberships.

Union wage structures are typically written into the contract in the form of a wage matrix. The rows of the matrix consist of different job categories or labor grades while the columns consist of steps within a category or grade. An example taken from the 1975 contract between Martin Marietta Aerospace and the Autoworkers is provided in Table 1. Movement between the first and last step occurred automatically every 14 weeks in 5 intervals.

Automatic step-wise movements across the columns of the wage matrix are quite common. The 1978 survey of major collective bargaining agreements by the Bureau of Labor Statistics (BLS) found that "automatic" increases (i.e. within rate ranges at fixed intervals without reference to merit) appeared in 65 percent of their agreements covering 59.6 percent of workers (Bulletin no. 2065).

Medoff and Abraham (1981, p. 5) provide further evidence on this point based on a survey they carried out:

> ". . . virtually none of the very large within-grade or within-job earnings advantage associated with company service could be explained in terms of productivity; once employees are assigned to grades or jobs, the salary advantage that accrue with company service appears to be automatic and hence, independent of performance."

Seniority also plays an important role in movements between job categories as well. A review by the BLS of approximately 1,800 major

contracts in 1971 (Bulletin no. 1425-11) found that seniority was the "sole" or "primary" determinant of promotions in 37.9 percent of all agreements covering 23.4 percent of all workers. In manufacturing, the figure was 40.6 percent of all agreements covering 25 percent of all workers. The Bureau of National Affairs (BNA) investigated this issue in 1983 by surveying a sample of 400 contracts from their file of major union contracts. They found seniority to be the "sole" or "determining" factor in promotions in 45 percent of the total sample and 54 percent of the manufacturing contracts.

Even in contracts where seniority is not the "sole" or "primary" determinant of promotions, it may still be a significant factor. For example, the 1968 agreement between Allegheny Ludlum Steel Corporation and the Steelworkers (U.S.A.) stipulates that:

> "In all cases of promotion, the following factors will be considered: (a) length of service, and (b) ability to perform work. In determining factor (b), an employee with longer continuous service shall not be compelled to show that he has the highest rating in this factor, it will be sufficient for him to show that he has an average rating . . ."

In general, then, industrial union wage structures can be characterized as favouring wage increases that are strongly tied to seniority. This occurs both through movements between job steps and promotions among job categories.

A second interesting feature of industrial union contracts is how the union restricts the manner in which the firm can adjust the total labor input during a downturn. Contracts often place limitations on work-sharing and stipulate that layoffs and recalls be based on seniority. Work-sharing refers to hours restrictions, division of work, and rotation of layoffs.

Table 1: Basic Wage Matrix

Labor Grade	First Step	Last Step
	$	$
Beginners	3.28	4.62
11	4.08	5.43
10	4.19	5.54
9	4.32	5.67
8	4.47	5.83
7	4.60	5.96
6	4.83	6.21
5	4.94	6.40
4	5.12	6.59
3	5.37	6.84
2	5.55	7.04
1	5.79	7.31

Source: Martin Marietta Aerospace and the Autoworkers, 1975, Denver.

Work-sharing provisions range from outright prohibitions against any use of work-sharing to restrictions on the magnitude and duration of its use.

The contract signed in 1973 between the Square D. Co. and the Electrical Workers (IBEW) contained the following prohibition:

> "If work becomes slack, the company shall not reduce the work-week for the plant to less than 40 hours, but shall make layoffs with occupational group and overall seniority . . . so as to maintain a 40 hour week and provide employment to those with the greatest seniority."

An example of restrictions placed on work-sharing is provided in the 1971 contract between the Carrier Corp. and the Sheet Metal Workers:

> "For temporary reductions in production not exceeding 4 weeks in any one year, the normal work-week for a work group, department, plant or all ... plants may be reduced to four 8-hour days without involving a seniority layoff."

The overall result is that labor input adjustments in unionized firms occurs primarily through variations in employment rather than average hours. Medoff (1979) provides a comparison based on May Current Population Survey micro data for the period, 1973-1975. He found that layoffs were 45 percent more important than reductions in average hours for unionized blue collar workers but that layoffs were 9 percent less important for non-union blue collar workers.

When layoffs occur, union contracts often specify that they take place according to seniority. The 1971 review of contracts by the BLS (Bulletin no. 1425-13) found that 25 percent of agreements stated that layoffs must be based <u>solely</u> on seniority. For example, the 1971 contract between the I/A Market's Food Handler's Division and the Meat Cutters (MCBW) states:

> "Seniority will apply to layoffs and rehires. The last employee hired shall be the first laid off, and the last laid off shall be the first rehired."

Approximately 44 percent of the contracts with layoff provisions assign seniority a "predominant" role but allow for considerations of other factors such as ability. The 1971 contract between Crown Cork and Seal Co. and the Steelworkers (U.S.A.) illustrates this type of provision:

> "Seniority shall govern in regard to . . . increases or decreases in forces, provided that the individual has the ability to perform the job."

The more recent survey by the BNA found that seniority is the "sole" or "determining" factor in 88 percent of their sample of contracts and 91 percent of the manufacturing contracts. A common characteristic, then, of industrial union contracts is that they encourage layoffs over work-sharing and the layoffs that occur are tied to seniority.

The final characteristic that I would like to discuss is the apparent absence of rationing of scarce union jobs by a pricing scheme. Becker (1959) noted that the ability of unions to generate rents for their members will create an excess supply of workers for union jobs. This excess supply must be rationed by either price or non-price mechanisms. Becker argued that it would appear to be in the interest of the current union members to use a price mechanism such as initiation fees. However, the typical union initiation fee is very small in comparison to the present value of the estimated wage differentials (see Becker, 1959; Taft, 1946). This has led researchers to examine non-price rationing schemes such as discrimination and queuing (see

Becker, 1959; Abowd and Farber, 1982).

In the remaining sections of the paper, I will describe the optimal contract for the union organizers to write. I will demonstrate how it may contain the seniority characteristics discussed in this section. In addition, I will point out how this contract uses a price mechanism other than initiation fees to ration union jobs.

III. Certainty Case

My aim is to investigate the impact of unionization per se. For this reason, I start from a set of simplifying assumptions which imply that seniority should be irrelevant in the non-union sector. I then analyze what forms of seniority will be optimal for the organizers of the union to include in their first contract. This pinpoints which forms of seniority arise explicitly within a union setting.

Assume that production takes place with an equal number of young and old workers. Each type of worker has the same productivity and value of leisure. There are no fixed hiring costs, no training opportunities, and no problems detecting shirking. Non-union firm pay a constant wage, w_A, to young and old workers. In addition, each worker has the same time separable utility function with identical discount rates. Young workers may save but they can not borrow against future earnings. The only distinction between workers is their remaining number of working periods.

By organizing a union, the workers are given the right to collectively

bargain with the firm. As part of this bargaining process, they may jointly withhold their labor input through calling a strike. It is useful to think of this bargaining process as involving two distinct components. The first consists of an external bargaining between the union as a whole and the firm over a share of the rents accruing to the bargaining pair. This bargaining over rents may involve a strike and the ultimate sharing will depend on relative bargaining strengths of the two sides (see Tracy, 1984). This phase of the bargaining process is not explicitly modelled in this paper.

Given the outcome of this rent sharing, a second phase of internal bargaining commences over the distribution of the union's share of the rents among its members. The analysis begins at this stage of the bargaining. The first case I consider is where the union organizers can commit the union to a long-term contract covering the entire future of the union.

The objective of the initial union members is to structure this explicit long-term contract so as to maximize their return from establishing the union. Two conditions imposed from outside the model as well as two conditions generated from within the model constrain the options open to the organizers. I explicitly prohibit the union from being able to borrow against its future flow of rents. That is, the union can only realize its return by collecting period by period its share of rents in the form of wages. Secondly, union members are assumed not to have property rights in the union. This implies that a member's union card has no asset value and consequently can not be sold when he leaves the union.[1] Finally, the two internal constraints on the

organizers are that they cannot write a contract which violates in any period the initial rent-sharing agreement with the firm. In addition, the contract terms must be structured so that the union can attract new members and retain old members in each subsequent period.[2]

To summarize, initial union members incur some cost in order to organize a union. In return for this investment, these workers gain two things. The first is that the firm pays the union a share of the rents accruing to the bargaining pair each period. Secondly, these workers are given the right to draw up an explicit long-term contract and to commit the union to that contract. The case where the contract is open to renegotiation in each period will be discussed later on in this section. Throughout the analysis, the demand conditions (both present and future) facing the firm are assumed to be known with certainty by both the firm and the union.

In order to explicitly describe the organizer's decision problem, define the following:

w_{yt} = Wage paid to young union workers in period t

w_{ot} = Wage paid to old union workers in period t

w_A = Wage paid to non-union workers

K = Firm's share of total rents

N = Number of workers in the union which is equally divided among young and old members.

R(N) = Total revenues net of non-labor costs

With no uncertainty, contracts simply stipulate the wage to be paid to young and old workers in each period. Denote a particular long-term contract by

$W = \{W_t\}_{t=1}^{\infty}$ where $W_t = (w_{yt}, w_{ot})$.

There is no consensus in the literature on the appropriate objective function for a union. For simplicity, assume that the organizer's objective function is given by the weighted average of the utility of a young and an old organizer. The specific weight used, λ, is determined by the relative bargaining strengths of the young and old organizers. The decision problem for the organizers during this second phase of bargaining can be written as:

$$(1) \qquad \underset{W}{MAX}\ \lambda \left[U(w_{y1}) + \frac{1}{(1+p)} U(w_{o2})\right] + (1-\lambda)\, U(w_{o1})$$

Subject to

$$(2) \qquad (\gamma_t): \quad U(w_{yt}) + \frac{1}{(1+p)} U(w_{ot+1}) \geq \bar{U} \equiv U(w_A)\left[1 + \frac{1}{(1+p)}\right];\ \forall t$$

$$(3) \qquad (\mu_t): \quad w_{ot} \geq w_A;\ \forall t$$

$$(4) \qquad (\eta_t): \quad R(N) - \frac{N}{2}\left[w_{yt} + w_{ot}\right] \geq K;\ \forall t$$

The multipliers for each constraint are indicated in parentheses. The implied first-order conditions are listed below.

$$(5) \qquad w_{y1}: \quad U'(w_{y1})(\lambda+\gamma_1) = \eta_1$$

$$(6) \qquad w_{o1}: \quad U'(w_{o1})(1-\lambda) = \eta_1 - \mu_1$$

$$(7) \qquad w_{y2}: \quad U'(w_{y2})\gamma_2 = \eta_2$$

$$(8) \qquad w_{o2}: \quad \frac{1}{(1+p)} U'(w_{y2})(\lambda+\gamma_1) = \eta_2 - \mu_2$$

(9) w_{yt}: $U'(w_{yt})\gamma_t = \eta_t$; $t \geq 3$

(10) w_{ot}: $\frac{1}{(1+p)} U'(w_{ot})\gamma_{t-1} = \eta_t - \mu_t$; $t \geq 3$

The structure of the optimal long-term contract is summarized in the following two propositions.

Proposition 1:

The optimal contract distributes all of the union's period by period share of rents to its members. In addition, only the initial organizers benefit from the union.

Demonstration

Given that $\lambda > 0$, equation (5) implies that $\eta_1 > 0$. Similarly, with $\lambda > 0$, equation (8) implies that $\eta_2 > 0$. Since $\eta_2 > 0$, equation (7) implies $\gamma_2 > 0$. Setting $t = 3$ in equation (10), $\gamma_2 > 0$ implies that $\eta_3 > 0$. Finally setting $t = 3$ in equation (9), $\eta_3 > 0$ implies that $\gamma_3 > 0$. Repeated use of equations (9) and (10) shows that $\eta_t > 0$ and $\gamma_t > 0$ for $t \geq 3$. Combining this result with the earlier results give us that $n_t > 0$ $\forall t$ while $\gamma_t > 0$ for $t \geq 2$. The rent constraint is binding for each period while the lifetime utility constraint is binding for all new members who join the union in periods following its establishment.

If the union organizers could charge entry fees and if no capital market imperfections existed, then it would not be surprising to find that

proposition one holds. That is, despite the fact that the firm pays the union a share of rents in each period of the contract only the organizers benefit from being in the union. The entry fee would be set equal to the discounted value of this flow of rents. This would allow the organizers to fully appropriate all future rents. What makes proposition one interesting is that it holds even when the organizers can't use explicit entry fees. Given this constraint, the organizers adopt a second-best method of price rationing. The nature of this alternative scheme for appropriating future rents is given in proposition two.

Proposition 2:

The optimal contract involves seniority based wage increases. That is, the union wage profile is steeper than the non-union profile for all members who join the union after it is established.

Demonstration

Assume for simplicity that the magnitude of λ is such that both young and old organizers benefit from setting up the union, i.e. $\gamma_1 = \mu_1 = 0$. The optimal contract is given by

$$W_1^* = (w_{y1}^*, w_{o1})$$
$$W_t^* = (w_y^*, w_o^*);\ t \geq 2$$

These wages are implicitly defined by the following conditions

(i) (w_{y1}^*, w_{o1}^*):

$$(11) \qquad \frac{U'(w^*_{y1})}{U'(w^*_{o1})} = \frac{(1-\lambda)}{\lambda}$$

$$(12) \qquad R(N) = \frac{N}{2}(w^*_{y1}+w^*_{o1}) = K$$

(ii) (w^*_y, w^*_o):

$$(13) \qquad W_s \equiv \{W: U(w_y) + \frac{1}{(1+p)} U(w_o) = \bar{U},\ R(N) - \frac{N}{2}(w_y+w_o) = K\}$$

$$(14) \qquad w^*_o = \underset{W^* \epsilon W_s}{\text{MAX}}\ w_o$$

The optimality of W^*_1 is clear since it exhausts the total rents available to the organizers in the first period and divides these rents in the appropriate manner given the relative bargaining strengths. To show that $W^* = \{W^*_t\}_{t=2}^{\infty}$ is optimal, we must demonstrate two things. First we must show that W^* dominates all other feasible stationary contracts. Secondly, we must show that no non-stationary contract can be optimal.

Consider any stationary contract from period two onwards: $W = \{W_t\}_{t=2}^{\infty}$ where $W_t = (w_y, w_o)$; $t \geq 2$. Proposition one demonstrated that a binding rent and life-time utility constraint are necessary conditions for an optimal contract. Given a stationary contract, this implies that W satisfies

$$(15) \qquad U(w_y) + \frac{1}{(1+p)} U(w_o) = \bar{U}$$

(16) $$R(N) - \frac{N}{2}(w_y + w_o) = K$$

Consequently, for a stationary contract W to be optimal, $W \epsilon W_s$. Which stationary contract out of the set W_s will the organizers prefer? The only wage term in these contracts that enters the organizer's objective function is w_o. This wage is collected by the young organizers during their second period in the union. This implies that the organizers will choose the stationary contract from W_s which has the largest value for w_o. This is summarized in equation (14).[3]

We will now demonstrate that there is no non-stationary contract that can dominate W* and satisfy the two necessary conditions from proposition one. Consider any non-stationary contract $\{W_t\}_{t=2}^{\infty}$. In order to dominate W*, the non-stationary contract must set $w_{o2} > w_o^*$. Again this follows from the fact that w_{o2} is the only contract term in $\{W_t\}_{t=2}^{\infty}$ which enters the organizer's objective function. If $w_{o2} > w_o^*$, then in order for W_2 to satisfy the second period rent constraint, $w_{y2} < w_y^*$. The contract $\{W_t\}_{t=2}^{\infty}$ must also be able to attract young workers in the second period. Since $w_{y2} < w_y^*$ this implies that $w_{o3} > w_o^*$. The magnitude of w_{o3} is illustrated in Diagram One.

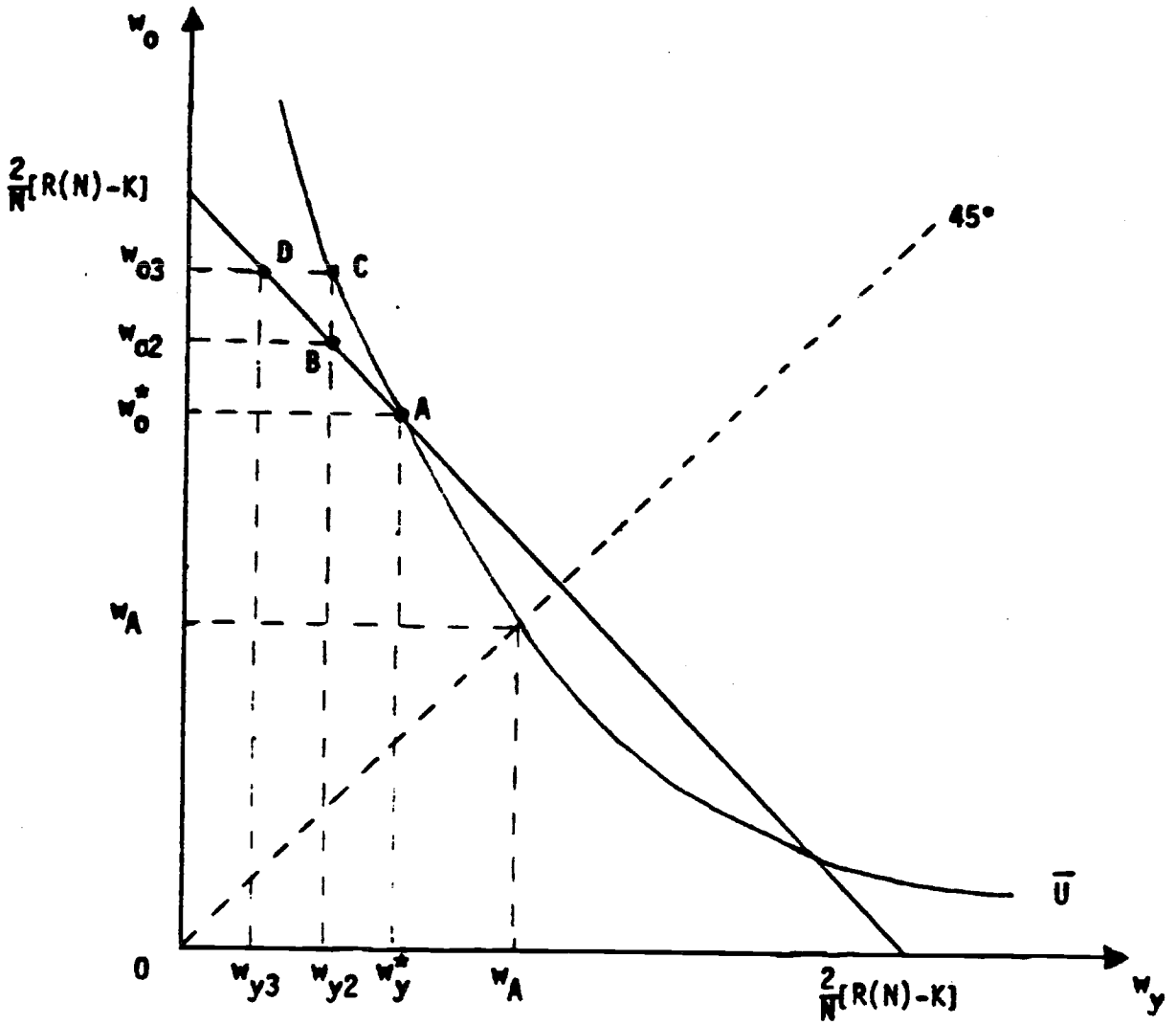
The optimal stationary contract sets W_t^* equal to Point A in the diagram. Suppose that by increasing $w_{o2} > w_o^*$ the non-stationary contract sets w_2 equal to Point B. To satisfy the lifetime utility constraint for new members in the second-period, wages paid to these new members when

they are old must be equal to the level indicated by Point C. Given that the non-stationary contract must also satisfy the rent constraint in period three, W_3 is set to equal to Point D. Continuing with the argument indicates that the non-stationary contract must raise w_{ot} and lower w_{yt} each period from their previous levels in such a way as to move up along the rent constraint. This strategy can not be continued indefinitely given the upper bound of $\frac{2}{N}$ [R(N)-K] for w_{ot} and the lower bound of zero for w_{yt}. Thus, no non-stationary contract can dominate W* and simultaneously satisfy the rent and lifetime utility constraints in each period. The optimal contract, then, is stationary from period two onwards. The proposition is demonstrated by noting that $w_y^* < w_A < w_o^*$.

When commitment is possible, the union organizers find it optimal to write seniority-based wage increases into the contract starting in the second period. Tilting the wage profile in this manner transfers income from new union members to the organizers. However, this form of price rationing creates an inefficiency in the intertemporal consumption pattern of new members. This inefficiency limits the magnitude of the wage tilt. In addition, this explains why new union members are indifferent between joining the union or not despite the fact that the firm is continuing to share the rents in each period.

An interesting comparative static result comes out of this simple model.

DIAGRAM ONE


w_o
$\frac{2}{N}[R(N)-K]$
w_{o3}
w_{o2}
w_o^*
w_A
D
C
B
A
45°
$\bar{U}$
0
w_{y3}
w_{y2}
w_y^*
w_A
$\frac{2}{N}[R(N)-K]$
w_y

Consider the impact of a reduction in the union's flow of rents. This shifts the bargaining constraint inward. Following the argument above, the optimal stationary contract moves from Point A in the diagram to a point southeast along the indifference curve $\bar{U}$. This implies that the wage/tenure profile will be flatter than before. If empirical measures for the total rents available to a bargaining pair and for the union's relative bargaining power were available, then the model predicts that these two variables would interact positively with tenure in a union wage regression.

The remaining aspect of the certainty case to discuss is the structure of union contracts when the union can not commit itself to future contract provisions. In this case, the contract can be changed each period. While it seems natural to assume that current young union members are uncertain about their future relative bargaining strength, I limit myself to the case where the sequence of bargaining strengths is known in advance. Let this sequence be denoted by $\Delta = \{\lambda_t\}_{t=1}^{\infty}$. The optimal contract conditional on Δ that is signed in period t is given by $W_t^* \mid \Delta$ and consists only of a young and old wage for that period.

For any t, $W_t^* \mid \Delta$ solves:

$$(17) \qquad \underset{W_t \mid \Delta}{MAX} \; \lambda_t \left[U(w_{yt}) + \frac{1}{(1+p)} U(w^*_{ot+1})\right] + (1-\lambda_t)\, U(w_{ot})$$

Subject to

$$(18) \qquad (\gamma_t): \; U(w_{yt}) + \frac{1}{(1+p)} U(w^*_{ot+1}) \geq \bar{U}$$

(19) (μ_t): $w_{ot} \geq w_A$

(20) (η_t): $R(N) - \frac{N}{2}[w_{yt} + w_{ot}] \geq K$

where $w^*_{ot+1} \in W^*_{t+1} \mid \Delta$.

The two first-order conditions are listed below.

(21) w_{yt}: $(\lambda_t + \gamma_t)\, U'(w_{yt}) = \eta_t$

(22) w_{ot}: $(1-\lambda_t)\, U'(w_{ot}) = \eta_t - \mu_t$

Rather than discuss the general structure of these contracts, I will focus on two special cases involving specific Δ sequences. The first case is where the only young workers to have any bargaining power are those that help organize the union. That is, $\lambda_t = 0$ for $t \geq 2$.

Proposition 3:

The optimal long-term contract with commitment is identical to the sequence of one-period contracts where no commitment is possible but $\lambda_t = 0$ for $t \geq 2$.

Demonstration

Substituting for λ_t in equation (22) we get that $U'(w_{ot}) = \eta_t - \mu_t$. Since $U'(w_{ot}) > 0$ and $\mu_t \geq 0$, this implies that $\eta_t > 0$. That is, the rent sharing constraint is binding for $t \geq 2$. Now substitute $\lambda_t = 0$ into equation (21) to get that $\gamma_t U'(w_{yt}) = \eta_t$. Since $U'(w_{yt}) > 0$ and $\eta_t > 0$, this implies

that $\gamma_t>0$. The lifetime utility constraint is also binding for $t\geq 2$. These two constraints plus the feasibility constraint for older workers define a stationary sequence of one-period contracts identical to the long-term contract discussed in proposition two.

The optimal long-term contract can be supported even though commitment to future contract terms is impossible if $\lambda_t=0$ for $t\geq 2$. How might we rationalize this particular sequence of relative bargaining strengths? Suppose that all proposed changes in the contract terms must be voted on by the current union members. Given the simple age structure and preferences of the union members, there are only three possible voting outcomes: unanimous opposition, unanimous support, or a split vote along age lines. The sequence $\lambda_t=0$ for $t\geq 2$ would result if all ties were broken in favor of the old union members. Instead of commiting the union to a long-term contract, the union organizers only need to commit the union to this voting rule. This may be possible through adopting a union constitution which embodies this rule and which requires more than a majority vote to amend.

The second case to consider is where the relative bargaining strength of young workers is constant through time. That is, $\lambda_t = \lambda > 0$ for all t.

Proposition 4:

When $\lambda_t = \lambda$ for all t, union organizers can use seniority-based wage increases to extract rents from future members only when older union workers have relatively more bargaining strength, i.e. $\lambda < 1/2$.

Demonstration:

Assume that both old and young union organizers earn some rents from the union. This implies that $\lambda > 0$ and $\gamma_1 = \mu_1 = 0$. The first-period wages, then, satisfy the following two conditions:

$$(23) \qquad \frac{U'(w^*_{y1})}{U'(w^*_{o1})} = \frac{(1-\lambda)}{\lambda}$$

$$R(N) - \frac{N}{2}(w^*_{y1}+w^*_{o1}) = K$$

These wages define a stationary contract which satisfies the first-order conditions for each subsequent period. When $\lambda < 1/2$, $w^*_{y1} < w^*_{o1}$.

To summarize, if the union organizers can commit the union to a long-term contract, then they will structure the contract so that wages increase with seniority. Making the wage profile steeper than the productivity profile allows the organizers to appropriate some of the rents that the firm pays out to future union members. Seniority-based wage increases act as a substitute for initiation fees.[4] Commitment to a long-term contract is not necessary so long as the organizers can commit the union to a voting rule which sets $\lambda_t = 0$ for $t \geq 2$. When the organizers can not commit the union either to a long-term contract or to the appropriate voting rule, then their ability to appropriate future rents is limited by the relative bargaining strength of future union members.

One final point to note in the certainty case concerns the impact of the political nature of unions on the contracts they write. A union contract can

not go into effect until it is "ratified" by the union membership. Differences between union and non-union practices have been viewed as arising from differences in preferences between a "median" union voter and a "marginal" non-union worker. Freeman (1976) explains:

> "If as a first approximation the median voter model is applied to union behavior, trade union policy will be set by the median member (who is the marginal voter) . . . trade unionism transforms the supply side of the job market by making median (or some other average) rather than marginal preferences the 'determinant' of the labor contract." (author's emphasis.)

This model offers two cases where this distinction does not apply. If the organizers can commit the union to a long-term contract or if no commitment is possible but $\lambda_t = 0$ for $t \geq 2$, then the optimal contract is given by point A in diagram one. Given the bargaining constraint, the structure of this stationary contract is determined entirely by the preferences of the "marginal" worker deciding whether to join the union or not. So long as the constraint on hiring new union members is binding (i.e. new union members do not earn rents), "marginal" rather than "median" preferences will play a key role in shaping the form of the contract.

IV. Uncertainty Case

In this section the optimality of different layoff "rules" is examined when the firm faces demand shocks in each period. In order to generate layoffs in the model, a very simple form of uncertainty is used. In each period, the firm is in either a "high" or "low" state of demand. The probability of a high demand state occurring in any period is P and is

independent of previous demand conditions. In low demand states, I assume that it is efficient for the firm and the union to lay off a fraction e of the union workers where $0 < e < 1/2$. That is, it is possible to concentrate all layoffs in one cohort of workers. If a worker is laid off, then he either finds a part-time job paying w_A or receives b in terms of leisure and state unemployment benefits. There are no search costs and the probability of finding a part-time job is given by δ. I assume that b and δ are the same for young and old union workers in order to minimize the need for layoff rules in the non-union sector.

Throughout this section, I assume either that the union organizers can commit the union to a long-term contract or to the appropriate voting rule supporting a long-term contract. The first point that I would like to establish is that the union organizers incorporate layoff rules into the contract only as a means of overcoming restrictions on the types of compensation they can write into the contract. This observation is illustrated through the following two propositions.

Proposition 5:

If the organizers are prohibited from paying any wages to laid off workers, then so long as the probability of finding a part-time job is not too high, the organizers adopt a seniority layoff rule.

Demonstration:

Let α_t index the layoff rule in the t^{th} period. As α_t ranges from zero to one, layoffs occur by strict inverse seniority to strict

seniority. Intermediate values α_t correspond to randomized layoff rules. Contracts consist of four wage terms for each period plus the layoff rule, $W_t = (\alpha_t, w_{yt}, w^e_{yt}, w_{ot}, w^e_{ot})$. Superscript e denotes a wage paid to an employed worker in the bad state. The organizer's decision problem can be summarized as follows.[5]

$$\underset{W}{\text{MAX}}\ \lambda\, EU_{y1} + (1-\lambda)EU_{o1}$$

$$\text{S.T. } EU_{yt} \geq EU_{yA};\ \forall t \qquad (\gamma_t)$$

$$EU_{ot} \geq EU_{oA};\ \forall t \qquad (\mu_t)$$

$$E\pi_t \geq K;\ \forall t \qquad (y_t)$$

where

EU_{iA} = Expected utility for i^{th} cohort in the non-union sector

$$EU^U = \delta U(w_A) + (1-\delta)U(b)$$

$$EU_{ot} = PU(w_{ot}) + (1-P)\{(1-\alpha_t)eEU^U + (1-(1-\alpha_t)e)U(w^e_{ot})\}$$

$$EU_{yt} = PU(w_{yt}) + (1-P)\{\alpha_t eEU^U + (1-\alpha_t e)U(w^e_{yt})\} + \frac{1}{1+p}\, EU_{ot+1}$$

$$E\pi_t = ER_t - \frac{N}{2}\{P[w_{yt} + w_{ot}] + (1-P)[(1-\alpha_t e)w^e_{yt} + (1-(1-\alpha_t)e)w^e_{ot}]\}$$

The first-order conditions for W_t, $t > 2$ imply that the organizers equalize employment wages for each cohort across states of nature. That is, $w_{yt} = w^e_{yt}$ and $w_{ot} = w^e_{ot}$. Consider now the choice of layoff rules. The first-order condition for α_t is

$$(24) \qquad \alpha_t: \left\{w^e_{yt} - \left[\frac{U(w^e_{yt})-EU^u}{U'(w^e_{yt})}\right]\right\} - \left\{w^e_{ot} - \left[\frac{U(w^e_{ot})-EU^u}{U'(w^e_{ot})}\right]\right\}$$

Define a function

$$G(w) \equiv w - \left[\frac{U(w)-EU^u}{U'(w)}\right]$$

The optimal layoff rule depends on the difference $G(w^e_{yt}) - G(w^e_{ot})$. Differentiating,

$$G'(w) = \frac{[U(w)-EU^u]}{U'(w)} \frac{U''(w)}{U'(w)} < 0 \text{ if } U(w) - EU^u > 0.$$

Given that the organizers want to tilt the wage profile in order to appropriate rents, $w^e_{yt} < w_A < w^e_{ot}$. Clearly, $U(w^e_{ot}) > EU^u$. If δ is "small" and $b < w^e_{yt}$, then $U(w^e_{yt}) > EU^u$. In this case, as pointed out by Holmstrom (1983), it is too expensive ex ante to lay off the older workers who receive higher wages. The organizers adopt a strict seniority layoff rule, i.e. $\alpha_t = 1$. The difference between this result and Holmstrom's is in the motivation for the tilted wage profile.

Now consider how the optimal contract changes when the organizers face no restrictions on the types of compensation they can use in the contract. In particular, the contract can pay unemployment wages to young and old workers, these wages can be conditioned on whether the laid off worker finds a part-time job, and these wages can be negative for young workers so long as they still have an incentive to remain in the union.

Proposition 6:

If the union organizers can structure unemployment wages as outlined above, then they are indifferent to the manner in which the firm initiates the layoffs.

Demonstration

Add a second superscript to index whether a laid off worker finds a part-time job or not. This creates eight wages for each period, i.e. $W_t = (\alpha_t, w_{it}, w_{it}^e, w_{it}^{un}, w_{it}^{uj})$, i = y,o. The decision problem for the organizers can be written as in proposition 5 where now[6]

$$EU_{yt}^u = \delta U(w_A + w_{yt}^{uj}) + (1-\delta)U(b + w_{yt}^{un})$$

$$EU_{ot}^u = \delta U(w_A + w_{ot}^{uj}) + (1-\delta)U(b + w_{ot}^{un})$$

$$EU_{ot} = PU(w_{ot}) + (1-P)\{(1-\alpha_t)e\ EU_{ot}^u + (1-(1-\alpha_t)e)U(w_{ot}^e)\}$$

$$EU_{yt} = PU(w_{yt}) + (1-P)\{\alpha_t e\ EU_{yt}^u + (1-\alpha_t e)U(w_{yt}^e)\} + \frac{1}{(1+p)} EU_{ot+1}$$

$$E\pi_t = ER_t - \frac{N}{2}\{P[w_{yt} + w_{ot}] + (1-P)[\alpha_t e(\delta w_{yt}^{uj} + (1-\delta)w_{yt}^{un}) + (1-\alpha_t e)w_{yt}^e + (1-\alpha_t)e(\delta w_{ot}^{uj} + (1-\delta)w_{ot}^{un}) + (1-(1-\alpha_t)e)w_{ot}^e]\}$$

The first-order conditions for W_t imply that it is optimal for the organizers to structure the contract so that each cohort of workers is fully insured across all demand and employment states.

$$w_{yt} = w_{yt}^e = w_A + w_{yt}^{uj} = b + w_{yt}^{un} \quad (w_{yt}^{uj} < 0 \text{ since } w_{yt} < w_A)$$

$$w_{ot} = w_{ot}^e = w_A + w_{ot}^{uj} = b + w_{ot}^{un}$$

Substituting in for these insurance results causes α_t to drop out of both the objective function and each of the constraints. Consequently, the

organizers are indifferent to the layoff rules used.

The need for layoff rules, then, arises from restrictions on the set of feasible contracts available to the organizers. The results of proposition five provide a reasonable explanation for union seniority layoff rules only to the extent that the restrictions placed on the contracting environment also seem reasonable. Previous work on implicit contracts (see: Akerlof and Miyazaki (1980) and Rosen (1983)) has pointed out that there is little theoretical justification for a priori prohibitions against payments made to laid off workers by their firms. In addition, these payments are actually written into U.S. union contracts. A survey by the BLS (Bulletin no. 2065) found that 25 percent of manufacturing contracts examined provided "supplemental unemployment" benefits. These contracts covered 53 percent of unionized manufacturing workers. In addition, Feeman and Medoff (1984) found that unionized firms have a 5 percent higher probability of offering supplemental unemployment insurance benefits and an 81 percent higher expenditure on these benefits.

In light of this evidence, it is important to examine the use of layoff rules in a setting where the union organizers are given more latitude than allowed in proposition five. Specifically, I allow the contract to specify wages to **unemployed workers. These wages can vary depending on the worker's** age cohort. However, the bargaining pair can not verify whether or not a laid off worker secures a part-time job. This implies that unemployment wages can

not be indexed to the worker's subsequent employment status. This provides an intermediate case to those discussed in propositions five and six.

Proposition 7:

Given the set of feasible contracts described above, the specific layoff rule which is optimal for the organizers to write into the contract depends on their attitudes toward risk. The optimal rule is given by

Seniority layoffs	If U(w) displays	increasing	Absolute Risk-Aversion (ARA)
Indifferent to rule		constant	
Inverse seniority layoffs		decreasing	

Demonstration

The organizer's decision problem is given in proposition five where now we have

$$EU^{u}_{yt} = \delta U(w_A + w^{u}_{yt}) + (1-\delta)U(b+w^{u}_{yt})$$

$$EU^{u}_{ot} = \delta U(w_A + w^{u}_{ot}) + (1-\delta)U(b+w^{u}_{ot})$$

$$EU_{ot} = PU(w_{ot}) + (1-P)\{(1-\alpha_t)e\ EU^{u}_{ot} + (1-(1-\alpha_t)e)U(w_{ot})\}$$

$$EU_{ut} = PU(w_{yt}) + (1-P)\{\alpha_t e\ EU^{u}_{yt} + (1-\alpha_t e)U(w^{e}_{yt})\} + \frac{1}{(1+p)}\ EU_{ot+1}$$

$$E\pi_t = ER_t - \frac{N}{2}\{P(w_{yt} + w_{ot}) + (1-P)[\alpha_t e\ w^{u}_{yt} + (1-\alpha_t e)w^{e}_{yt} + (1-\alpha_t)e\ w^{u}_{ot} + (1-(1-\alpha_t)e)w^{e}_{ot}\}$$

First-order conditions for W_t imply that for $t > 2$

$$(25) \qquad U'(w^e_{yt}) = EU^{u'}_{yt}$$

$$U'(w^e_{ot}) = EU^{u'}_{ot}$$

The optimal layoff rule follows from the first-order condition for α_t

$$(26) \qquad \alpha_t: \left\{(w^e_{yt} - w^u_{yt}) - \left[\frac{U(w^e_{yt})-EU^u_{yt}}{U'(w^e_{yt})}\right]\right\} - \left\{(w^e_{ot} - w^u_{ot}) - \left[\frac{U(w^e_{ot})-EU^u_{ot}}{U'(w^e_{ot})}\right]\right\}$$

Since b and δ are the same for young and old workers, $EU^u_{yt} = EU^u_{ot}$ when $w^e_{yt} = w^e_{ot}$. This allows us to define the general function

$$G(w) \equiv w^e - w^u(w^e) - \left[\frac{U(w^e)-EU^u(w^e)}{U'(w^e)}\right]$$

Using this function, equation (26) simplifies to

$$(26)' \qquad \alpha_t: \; G(w^e_{yt}) - G(w^e_{ot}) \quad \text{where } w^e_{yt} < w^e_{ot} \text{ due to seniority wage increases}$$

Differentiating G(w) gives

$$G'(w) = \left[\frac{EU^{u'}(w^e)}{U'(w^e)} - 1\right] \frac{dw^u}{dw^e} + \frac{[U(w^e)-EU^u(w^e)]}{U'(w^e)} \frac{U''(w^e)}{U'(w^e)}$$

Optimal choice of w^u implies from equations (25) that the first term equals zero. Thus,

$$G'(w) = \frac{[U(w^e)-EU^u(w^e)]}{U'(w^e)} \frac{U''(w^e)}{U'(w^e)} \gtrless 0 \quad \text{As } [U(w^e) - EU^u(w^e)] \lessgtr 0$$

Imai, Geanakoplos, and Ito (1981) derive a condition that determines the sign of $U(w^e)-EU^u(w^e)$ given that equations (25) hold.

$$U(w^e) - EU^u(w^e) \begin{matrix} > \\ = \\ < \end{matrix} \text{ as } U(w) \text{ displays } \begin{cases} \text{decreasing} \\ \text{constant} \\ \text{decreasing} \end{cases} \quad \text{ARA}$$

Using this result we have that

$$\alpha_t : \; G(w^e_{yt}) - G(w^u_{ot}) \begin{matrix} > \\ = \\ < \end{matrix} 0 \text{ as } U(w) \text{ displays } \begin{cases} \text{increasing} \\ \text{constant} \\ \text{decreasing} \end{cases} \quad \text{ARA}$$

Seniority layoff rules may be part of an optimal explicit contract even when limited forms of supplemental unemployment benefits are allowed. However, even this restriction on the set of feasible contracts may also be too strong. The basic assumption used is that the state can verify the worker's subsequent employment status while the union (or firm) can not. This informational asymmetry may not exist in practice. For example, the SUB plan adopted for Ford Motor Company and the UAW in the early sixties deducted any outside earnings over $10 per week from the total benefit. (See: BLS Bulletin no. 1425-2).

Two final issues are worth discussing. The first concerns the "enforceability" of the contract. This issue has been raised by several authors recently (see for example Bull, 1983). The fact that union workers can not be forced to fulfill a particular contract has been allowed for by the inclusion of the two utility constraints. However, there still remains the issue of what prevents the firm from firing older workers who are being paid

wages in excess of their productivity. The standard argument is that "reputation" effects are strong enough to rule out this type of behavior (see: Holmstrom, 1981, 1983). In the context of union contracts, collective action by the union may provide a stronger deterrent than reputation effects. Formalized union grievance procedures may be interpreted as a type of enforcement mechanism. This illustrates another example of the "Exit vs. Voice" distinction between non-union and union labor markets (see: Hirscham, 1970).[7]

Finally, I would like to address a potential criticism of the model. A central feature of the model is the desire by the union organizers to increase the tilt of the union wage/tenure profile as a means of appropriating rents from future members. However, most empirical studies (see: Block & Kuskin, 1978; and Duncan & Leigh, 1980, 1985) find that union wage/tenure profiles are flatter than non-union profiles. These findings may still be consistent with the model's predictions. It is important to interpret the wage rate in the model as the total compensation for a period. The above studies ignore non-wage components of the compensation package. Freeman and Medoff (1984) find that for a union and non-union job paying the same wage, fringe benefits are approximately 30 percent higher for the union job. In addition, they find that unions alter the composition of the fringe benefits in a way that benefits older workers. They conclude:

> "We find that, while wages do not rise as rapidly with age or seniority for union workers as for non-union workers, nonwage benefits rise more rapidly with age under unionism, and by more than enough to offset the slower increase in wages with age." (p. 131)

Total compensation/tenure profiles may in fact be steeper for unions as suggested by this model. However, a remaining criticism is that Freeman and Medoff's evidence also indicates that both young and old union workers receive higher levels of total compensation than their nonunion counterparts. This does not substantiate the model's prediction that young union members should not earn rents from being in the union.

Footnotes

1. This is in contrast to the taxi cab market where medallions do have asset value. See Martin (1980) for a discussion of these property right issues.

2. There may arise circumstances in which the union is both willing and able to drive the firm out of business by bargaining for more than the total amount of the rents. I restrict my attention to cases in which the firm has sufficient bargaining power to insure itself a share of the rents into the indefinite future. This implies that it is always important that the union is able to attract new members.

3. An alternative may to see that point A in the diagram is the optimal stationary contract is to notice that the other possible stationary contract is not feasible since it sets $w_O < w_A$. In addition, it is important to note that λ only affects the distribution of the union's first-period rents among the young and old organizers. The shape of the wage/tenure profile from period two on is independent of λ.

4. An additional rationale for unions to tilt their wage profile exists in states with right-to-work laws. These laws allow workers to choose to be covered by a union contract without joining the union. A free-rider problem is created since initiation fees can be collected only from those workers who join the union. This can in part be circumvented if unions implicitly collect the initation fee through a tilted wage profile.

5. Implicitly I've assumed that workers accumulate seniority while on layoff. In a survey of contracts, the BLS (Bulletin no. 1425-14) found considerable variation in the actual treatment of seniority on layoff. Many

contracts allow workers to collect seniority for the entire layoff period regardless of its length. Some contracts specify a maximum possible layoff period for which seniority accumulates. An example of this is given by the contract signed between Dunlop Tire and Rubber Company and the United Rubber Workers in June 1973:

> "A laid off employee subject to recall with 2 years' or more of seniority when laid off shall be carried on the seniority list indefinitely. If rehired, he shall receive credit for seniority held at time of lay-off, plus seniority credit for time laid off not to exceed 2 years."

The BLS, though, also found examples of contracts in which no seniority was collected on layoff.

6. I've assumed here that the firm pays for unemployment wages out of current revenues. This type of "unfunded" plan is actually not used much in practice. Out of a total of 174 supplemental unemployment benefit (SUB) plans examined by the BLS in the early sixties, only three were unfunded. The common practice is for a single employer or group of employers to pay each period a fixed amount per employee into a fund. All SUB payments are paid out of this fund. This type of financing was used in 160 out of the 174 plans examined. So long as you require that the firm's per period contributions equal its expected SUB payments, then the results carry through. A third type of financing is an individual worker account. According to this method, the firm keeps track of all credits and payments made for each employee. Unlike the funded plans, these accounts are vested in that employees can take any surplus in their account (up to some maximum amount) with them when they leave the firm. This third form of financing was found in 11 of the 174 plans (see: BLS Bulleting no. 1425-2).

7. For a more detailed discussion of this point see Kuhn (1982).

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