DISCUSSION PAPER

STRIKE AND LOCK-OUT THREATS AND FISCAL POLICY

by

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ABSTRACT

This paper suggests that a union's wage demands are not merely the outcome of maximizing the union's utility function subject to a labor-demand or minimum-profit constraint as the standard models of union behavior suggest, but that these wage demands also depend on the cost which the union can impose on the firm through a strike and on the credibility of the strike threat. The firm, in turn, can affect the above costs by imposing a lock-out. The paper presents a model of wage formation under strike and lock-out threats and explores the implications for the effectiveness of fiscal policy.

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Table of Contents

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by Assar Lindbeck* and Dennis Snower**

1. Introduction

The existence of strikes and strike threats has long posed a problem for economic theory. Strikes reduce the total gain from productive activity to be shared among the firms and their employees. If there is, then, a common potential interest in avoiding strikes, why do strike threats occur in the first place? What makes strike threats credible and effective in wage bargaining? Furthermore, why do employers sometimes respond to strike threats by issuing lock-out threats? All these questions have received little attention in the theoretical literature on labor markets.

This paper suggests an explanation of strike and lock-out threats in which labor turnover costs play a particularly important role. We consider an economy in which firms engage in wage bargaining with their unionized employees and, in this context, we find that strike and lock-out threats can be explained as rational behavior of the agents. We also find that these threats can make a significant difference to the effectiveness of fiscal policies.

Our paper departs from the standard literature on the theory of labor unions, which has been dominated by two models of union behavior:

(i) In the "monopoly model", the union sets the wage while the firms unilaterally make the employment decisions. Here, the union

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maximizes its utility function subject to its labor demand function.

(ii) In the "efficient bargain model", the wage and employment decisions are made jointly by the union and the firms. In this case, the union may be viewed as maximizing its utility function subject to an iso-profit function.

(These two models are developed and compared in MaCurdy and Pencavel (1982), McDonald and Solow (1981), Nickell (1982), Oswald (1985), and others. In Nickell and Andrews (1983), the union and the firms bargain over the wage, while firms make the employment decisions. Manning's model (1985) encompasses the monopoly model and the efficient bargain model.)

This literature leaves a fundamental question unanswered: What gives unions their clout? In other words, what stops firms from ignoring the unions' demands and dealing with non-unionized workers instead?

Our paper suggests a particularly simple answer: The only way for firms to ignore the strike threats of their unionized employees is to fire them and, in doing so, the firms may incur substantial labor turnover costs, which may take a variety of forms, such as costs of hiring, training, and firing (Lindbeck and Snower (1984a)), effort effects of labor turnover (Lindbeck and Snower (1984b)), and cooperation and harassment activities by incumbent employees (Lindbeck and Snower (1985)). To avoid these costs, the firms may have to make wage concessions to the current employees.

The employees, acting in unison, may manipulate these costs to support their wages. For example, a union may call a strike when the firm rejects its wage proposal. Then, in the event of rejection, the firm has a choice between bearing the worker replacement costs or its strike costs (i.e. the profits foregone on account of the strike). If the latter costs are less than the former, then the firm will negotiate with the strikers while keeping their jobs vacant. (In practice, this is usually the case, since worker replacement in event of a strike is rare.)

The union members may prefer the strike option to the replacement option as well because, when they are uncertain about whether the firm will accept or reject their wage proposal, the strike option may provide the union members with a higher level of expected labor income. To see this, we must take into account the union members' income when they win the strike and when they lose it. In order for the firm's strike costs to be less than its replacement costs, the union members must settle for a lower wage upon winning a strike than upon winning a replacement conflict. On the other hand, whenever the union members lose a strike, their income upon returning to their jobs which have been kept vacant during the strike is usually greater than their income upon being replaced by other workers. Hence, overall the union members may be able to achieve a higher expected income through the strike threat than the replacement threat.

However, this paper is not concerned with the conditions under which the strike option will be preferred to the replacement option. Rather, we assume that the strike option is chosen and that the firm and its employees take the associated costs into account when bargaining over wages.

This straightforward idea has important implications for the theory of union behavior. No longer can wage determination be explained merely in terms of the maximization of union utility subject to a labor demand function or an iso-profit function. The amount of damage which the union is potentially able to inflict on the firms (viz., the profits foregone in the event of a strike) - which we call "union punch" - is of critical significance as well. Herein lies our rationale for strike threats.

This rationale is different from the ones suggested in the literature, where strikes are regarded as

- an "information gathering device" in situations where employees are not perfectly informed about each other's preferences or about

market conditions (e.g. Bishop (1964), Cross (1965), Harsany (1956), Hayes (1984), Reder and Newman (1980)); or

- an "expectations revising device" when union management seeks to convince its rank and file that its wage demands are unacceptably high to employers (e.g. Aschenfelter and Johnson (1969), Farber (1978)).

Not only do we incorporate union punch into our analysis of union behavior, but we also show how the <u>credibility</u> of strike threats is an important, independent influence on wage bargaining. A union which threatens to strike must be able to induce its members to observe the strike once it has been called.

Just as strike threats can give unions leverage in wage bargaining, so lock-out threats can perform an analogous function for the firms. The latter threats are credible whenever the firms find it cheaper to lock strikers out than to exchange them (for non-unionized workers) or retain them without lock-out (in anticipation that the conflict will be resolved).

It will be shown that once strike and lock-out threats are taken into account in the bargaining between unions and firms, the conventional fiscal policy effects on wages need to be modified, in that a new channel of fiscal policy influence arises. We indicate that these effects depend on whether union punch or union credibility constitute binding constraints on the union's wage-setting problem, and we show that variations in fiscal policy instruments (such as unemployment benefits, income taxes, and public employment) affect union punch and credibility in quite different ways.

The paper is organized as follows. Section 2 presents an overview of agents' behavior in our model. Section 3 outlines our model of union behavior. Section 4 is concerned with the formulation of the union's wage proposal and strike threat as well as the firm's lock-out threat. Section 5

examines the effectiveness of fiscal policies under strike threats and lock-out threats. Finally, Section 6 contains our concluding remarks.

2. The Model of Agent's Behavior

In light of the labor turnover costs, workers may be divided into three categories:

    (i) <u>insiders</u>, whose replacement would occasion the full range of turnover costs;

   (ii) <u>entrants</u>, who have just been hired and whose replacement would not give rise to turnover costs; and

 (iii) <u>outsiders</u>, who are currently unemployed.

The turnover costs generate economic rent, which may be seized by the firms and their employees in the wage bargaining process. We assume that the insiders manage to capture some of this rent, whereas the entrants receive their reservation wage (R). Thus, the insider wage (W) is greater than R.

Characteristically it takes time for entrants to achieve a sufficiently strong position in their firms in order to generate labor turnover costs should they be replaced. For simplicity, we suppose that entrants remain such for a finite span of time, which we call the "initiation period".

Next, we assume that wage contracts are implementable only for a limited time period; for simplicity, let it be equal to the initiation period. Thus, at the end of the initiation period, the bargaining position of the entrants is the same as that of the insiders. In fact, the entrants <u>become</u> insiders, receiving the new, higher insider wage.

Our model economy comprises a government and a fixed number of firms and workers. The firms produce a non-durable consumption good by means of labor and capital. They distribute their profits to the workers. The workers buy the consumption good and offer labor services. There are no entries or

retirements from the labor force. The government employs workers to produce public services.

Employment and production decisions are made by the firms and the government. Workers decide how much to consume. The insider wage is determined through a bargaining process, described below. We will analyze the agents' decisions under stationary Nash equilibrium conditions, in which the capital stock is constant and each private agent sets his decision variables under the assumption that all other agents have set their decision variables optimally with regard to their objectives and constraints.

The activities of the various agents may be described as follows:

2a. The Government

The government has three policy instruments:

(i) public employment (L_G);

(ii) unemployment benefits (B per unemployed worker);

(iii) on income tax rate (τ).

Each instrument is parametrially fixed.[1]

For simplicity we assume that the government offers each of its employees the insider wage prevailing in the private sector.[2]

2b. The Firms

The firm produces a homogeneous consumption good (Q) and has three factors of production at its disposal: insider labor (L_I), entrant labor (L_E) and capital (K). All firms in the economy are identical.

Since we are not concerned with factor substitution, let there be a fixed ratio of capital to total labor input, so that [3]

(1) $Q = \min[(L_I + L_E), K]$

where the capital stock (K) is exogenously given.

Let $C_E = C_E(L_E)$ be the firm's cost of acquiring entrants, where C_E', $C_E'' > 0$ for $L_E > 0$, $C_E(0) = 0$, $\lim_{L_E \to 0} C_E' = \tilde{C}_E$ and $\tilde{C}_E$ is a positive constant (i.e. C_E is finitely large for all positive L_E). Let $C_I = C_I(m - L_I)$ be the firm's cost of dismissing insiders, where m is the incumbent workforce (i.e. the number of insiders employed by the firm at the beginning of the current time period), C_I', $C_I'' > 0$ for $m > L_I$, $C_I(0) = 0$, $\lim_{L_I \to m} C_I' = \tilde{C}_I$ and $\tilde{C}_I$ is a positive constant (i.e. C_I is finitely large for all $0 \le L_I < m$).

In making its production and employment decisions (Q, L_I and L_E), the firm faces a given insider wage (W), an entrant wage (R), and the capital stock (K). Assume that the marginal insider or the entrant generates positive profit (π). Assume furthermore that the firm has a one-period time horizon. (The firm's profit-maximizing activities may also be interpretted as the steady state of a multi-period optimization.) Then the firm's profit maximizing problem (viz., maximizing its revenue over its variable labor costs) may be expressed as follows.

(2)   Maximize $\pi = Q - W \cdot L_I - R \cdot L_E$
$$- C_E(L_E) - C_I[m-L_I]$$
subject to $L_I + L_E = K$

(where revenue and costs are all evaluated in terms of the consumption good).

2c. The Workers

Each worker's utility is a function of consumption (C) and labor (ℓ): $U = U(C, \ell)$, where $U_C > 0$ and $U_\ell < 0$. For simplicity, work is taken to be a discrete activity: each employee provides one unit of labor ($\ell = 1$), each outsider provides none ($\ell = 0$). The worker consumes his entire income.

Every worker (whether employed or unemployed) receives the same exogenous, lump-sum profit income, $\sigma \cdot \pi$, where σ (<1) is the ratio of firms to employees. An outsider's disposable income is $(B + \sigma \cdot \pi) \cdot (1-\tau)$; that of an insider is $(W + \sigma \cdot \pi) \cdot (1 - \tau)$; and that of an entrant is $(R + \sigma \cdot \pi) \cdot (1 - \tau)$.

For simplicity, let workers have a two-period time horizon and a zero rate of time discount. Then the entrants' reservation wage (R) (which, we assume, is the same as the wage that entrants are offered) may be defined as follows::

(3a) $\quad U[(R + \sigma\cdot\pi)\cdot(1 - \tau), 1] + U[(W + \sigma\cdot\pi)\cdot(1 - \tau), 1)]$

$\quad\quad = 2\cdot U[(B + \sigma\cdot\pi)\cdot(1 - \tau), 0].$

The tradeoff between W and R (equation (3a)) is pictured by the R locus in Figure 1.

2à. Insider Wage Determination

Our analysis is consistent with several alternative ways in which economic rent may be divided between a firm and its employees through insider wage determination. Quite generally, we only require that the wage bargain satisfy two properties:

(i) insiders capture some of the economic rent generated by the labor turnover costs that would be incurred if they were replaced by entrants, and

(ii) the greater this rent, the greater the insider wage.[4]

Yet this paper is not concerned with the precise way in which wage bargaining schemes split rent between employers and employees, but rather with the rationale for strike and lock-out threats as well as the associated fiscal policy implications. Thus, let us consider a particularly transparent special case of wage bargain: the wage demanded by the insiders is at its maximal level subject to the condition that no insider is fired.

If insiders were to bargain "individualistically" (i.e. each insider acts independently of all other insiders), then each insider would set his wage high enough so that his firm would be indifferent between retaining him and replacing him by entrant. Hence the insider wage is

(3b) $\quad W_i = R + [H(1) + F(1)]$

(where the subscript "i" stands for "individualistic" bargaining).
Under these circumstances, entrants have no opportunity to enter the work-
force. Equation (3b) is pictured by the W_i locus in Figure 1. Here,
W_i^* and R^* are the equilibrium insider and reservation wages, respectively.

3. <u>Labor Union Activity</u>

Let a "union" simply be a collective of workers engaged in some
well-defined economic activity. Since we have assumed that insiders have more
market power than other workers, it is natural for us to restrict our
attention to unions consisting only of insiders. We endeavour to explain the
behavior of such unions in terms of their members' individualistic
interests. (The underlying presumption is that a union which is not
beneficial to its members is unlikely to persist).

We consider only one type of union activity: the strike. This is
given one purpose, namely, to back up the union's wage demands. In other
words, the strike is a "<u>wage-preserving device</u>". (By contrast, Lindbeck and
Snower (1984) examine the strike as a "job-preserving device"). In
particular, we suppose that the union, consisting of all the insiders of a
firm, makes a wage proposal to that firm and it is the firm's rejection of
this proposal that provokes the strike. The strike is "won" by the workers if
the firm is induced to accept the proposal after all; it is "lost" if the
proposal is irrevocably rejected, in which case the wage remains beneath the
union's asking price.

We also consider a common counter-move available to the firm: the
lock-out. We focus on one purpose for this activity: the lock-out enables the
firm to deplete the union's strike fund and thereby diminish the union's
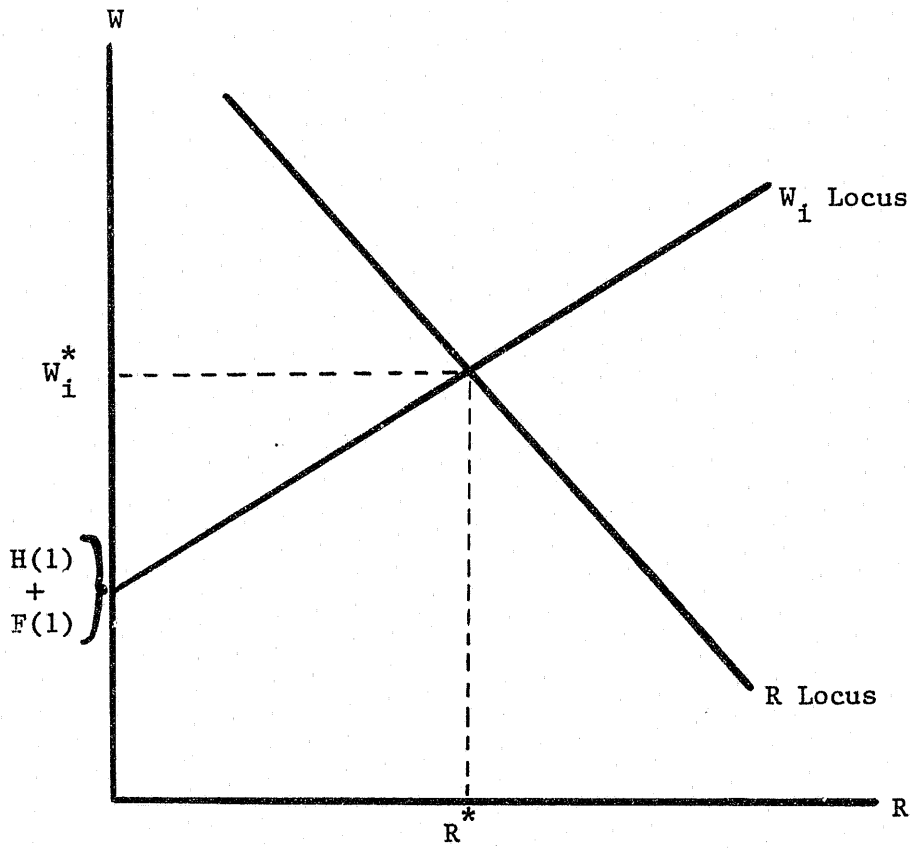bargaining power and moderate its wage proposals.[5,6]

FIGURE 1: The Equilibrium Insider and Reservation Wages

The union's strike threat may be defined in terms of the following implicit contract between the firm and its insiders:

If the firm accepts the union's wage proposal, then none of the employees will strike; yet if the proposal is rejected, then some (possibly all) of the employees will strike.

The steps in the bargaining process under this contract may be set out as follows (see Figure 2). First, the union makes a wage proposal, W. Second, the firm decides whether to accept or reject this proposal. If it is accepted, W becomes the insider wage. Third, if the proposal is rejected, the union decides what proportion (a) of the firm's workforce is to be called out on strike.[7] Fourth, the firm decides whether or not to undertake a lock-out in respone to the strike. Fifth, each union member decides whether to observe or break the strike (given the lock-out decision).

The strike and lock-out decisions are inherently intertemporal. A strike is conducted with a view to achieving a particular wage in the future; a lock-out is imposed in order to reduce the union's wage demands in the future. We can capture the essence of the problem in two time periods. Suppose that the firm and the union have a two-period time horizon and that both are risk-neutral. Let both parties expect a strike, once begun, to last for only one time period. For simplicity (but without loss of generality) we assume that both parties have a zero rate of time discount.

Let ρ be each party's subjective probability that the union will win the strike.[8] We assume that ρ is inversely related to the size of the union's wage proposal: $\rho = \rho(W)$, $\rho' < 0$.

If the strike is observed, the union member receives a strike-fund payment, J, in the first period. His remuneration in the second period depends on whether the strike is won or lost. With probability ρ, he expects to receive W; with probability $(1 - \rho)$, he expects to receive a lower wage -

call it w_L (where "L" stands for a "lost" strike). Thus, the present value of his expected income is $J + [\rho \cdot W + (1-\rho) \cdot w_L]$, as shown in Figure 2.

On the other hand, if the strike is broken (i.e. the union members do not respond to the strike call), then the wage is also lower - call it w_B.

Since we are not concerned with specific mechanisms to divide economic rent between employers and employees, we do not provide choice theoretic foundations for the determination of w_L and w_B. There are, however, obvious upper and lower bounds on these wages. If union members lose or break their strike, they can be expected to give up some of their market power. Consequently, w_L and w_B must fall short of W. Furthermore, union members cannot receive a wage beneath W_i, for were they to face this possibility, they would have an incentive to leave their union and bargain individualistically. In sum, $W > w_L$, $w_B \geq W_i$. For simplicity, we make the plausible assumption that $w_L = w_B = w = g(W, W_i)$, where $W_i \leq w < W$ and g_1, $g_2 \geq 0$. [9]

As in Section 2, we let the union maximize the insider wage subject to the condition that no insiders are fired.[10] In the analysis below, we examine the Nash equilibrium of the bargaining process above (i.e. the firm's decisions are exogenously given to the union and vice versa).

We assume that this equilibrium has the following properties:

(a) The equilibrium strike threat is credible. This means that if the firm rejects the union's wage proposal, the union members have an incentive to observe (rather than break) the strike;

(b) The equilibrium wage proposal is not rejected by the firm and hence does not provoke a strike.

The prerequisites for condition (a) are examined in the next section; those for (b) are given in the Appendix. Whereas condition (a) is plausible and straightforward, condition (b) reflects the selective focus of this paper. We are here concerned only with strike and lock-out threats; the

Union and Membership   Firm   Outcome

Wage proposal: W ──────────→ Accept proposal ─────────────→ W

                            ↘ Reject proposal

Strike decision: a ↙ ──────────→ ┌─────────────────┐
                                  │   Lock-Out   │
                                  │   │
                                  │ No Lock-Out   │
                                  └─────────────────┘

┌─────────────────┐
│ Observe strike │ ────────────────────────────────→ $J + p \cdot W + (1-\rho) \cdot w_L$
│   │
│ Break strike   │ ────────────────────────────────→ w_B
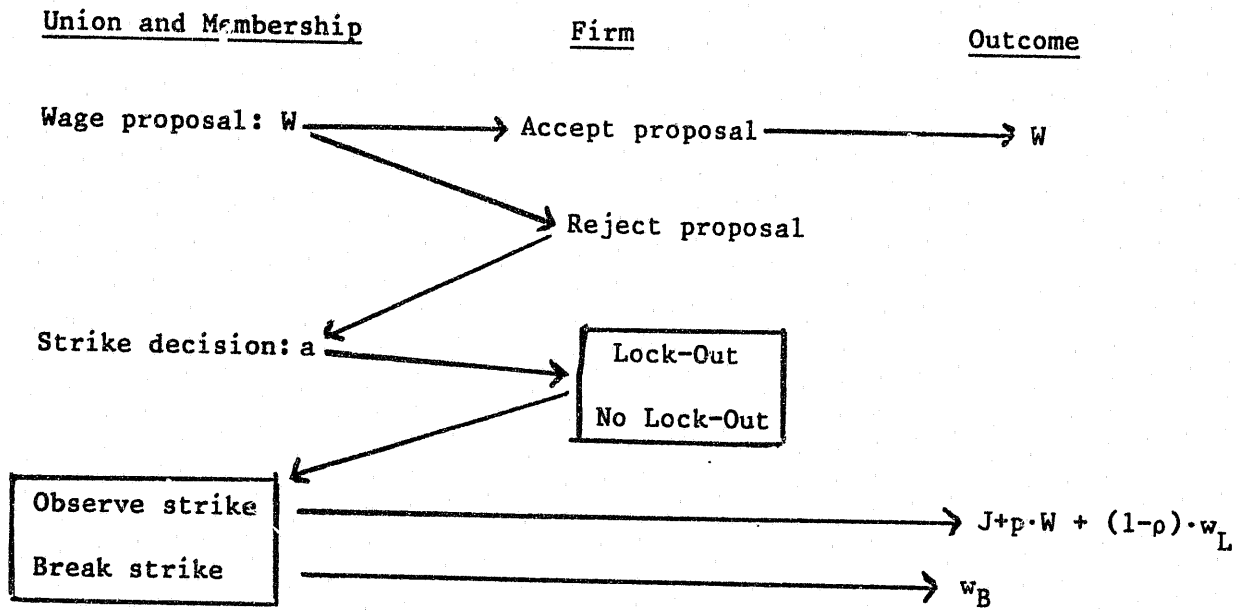└─────────────────┘

FIGURE 2: The Sequence of decisions

actual conduct of strikes and lock-outs is easy to examine within the framework of our analysis, but for the sake of brevity we do not do so. (Our perspective is analogous to that of oligopolistic entry deterrence, where entry into the industry is effectively eliminated: threats are made but need not be carried out).

Of course, the bargaining strategies of the firm and the union depend on their subjective probabilities about the strike outcome; yet since the strike is not provoked, these probabilities do not have objective counterparts. Both parties are assumed to have perfect information about the circumstances under which the threats take effect and both recognise whether the threats are credible.[11]

Having described the salient characteristics of the equilibrium state, we now turn to the way in which the union formulates its wage proposal.

4.   The Wage Proposal and the Lock-Out Decision

The lock-out decision described above is a discrete one: either the firm locks out its non-striking union members or it does not.[12] First (in Section 4a) let us examine the union's wage proposal when the firm chooses the lock-out option in response to the strike threat; second (in Section 4b) we see what happens to this wage proposal when the firm does not choose the lock-out option; third (in Section 4c) we show how the firm makes its lock-out decision.

4a.   Strike Threat with Lock-Out Threat

Suppose that whenever some insiders strike, the firm locks out the rest. Recall that the union's wage proposal (W) is such that the firm has no incentive to fire any insiders. Furthermore, we assume that the labor acquisition and dismissal functions ($H(L_E)$ and $F(m-L_I)$) are such that, in the solution to the firm's profit maximization problem (2), the constraint

$L_I + L_E \leq K$ holds as equality. Thus, the union's wage proposal is set so

that $L_I = K$, which is a positive constant which we hereafter call $\bar{L}$ for short.

Thus, if the firm accepts the wage proposal, then the present value of its profits is

(4) $\pi^a = 2 \cdot [1 - W] \cdot \bar{L}$

(where the superscript "a" stands for "acceptance" of the wage proposal).[13]

On the other hand, if it rejects this proposal, then the union calls a strike, whereupon the firm locks out all the remaining insiders. In that case, the firm's first-period profit is zero. In the second period, the union either wins the strike (in which case the insider wage is W) or it loses it (in which case the insider wage is w). Hence the expected present value of the firm's profit when the union's wage proposal is rejected is

(5) $\pi^\ell = \rho \cdot [1 - W] \cdot \bar{L} + (1 - w) \cdot \bar{L}$

(where the superscript "ℓ" stands for the case of "lock-out").

We can now fully specify the union's wage proposal. The wage is set as high as possible, subject to three conditions: (1) no strike is provoked, (ii) the strike threat is credible, and (iii) no insiders are fired. Let the maximal wage satisfying the first condition (given the lock-out threat) be called the "proposal acceptance wage", W_{PA}^ℓ. Let the maximal wage satisfying the second constraint be the "credible threat wage", W_{CT}^ℓ. The third constraint is simply a non-negativity condition on profit and the maximal wage associated with it is the "zero-profit wage", W_{ZP}^ℓ.

Hence, the union's wage proposal must be

(6) $W^\ell = \min(W_{PA}^\ell, \ W_{CT}^\ell, \ W_{ZP}^\ell)$.

The zero-profit wage is not analytically intereesting; so let us assume that it is never binding: $W_{ZP}^\ell \geq \min(W_{PA}^\ell, \ W_{CT}^\ell)$.

The proposal acceptance wage (W_{PA}^ℓ) is sufficiently high so that the firm's profit from accepting this wage is the same as the profit from rejecting it: $\pi^a = \pi^\ell$. In other words,

$$[1 - W^\ell_{PA}] \cdot \bar{L} \cdot \{1 + (1 - \rho)\} = [1 - w] \cdot \bar{L} \cdot (1 - \rho).$$

Thus,

$$W^\ell_{PA} = 1 - [(1 - w) \cdot (1 - \rho) / (2 - \rho)].$$

We call this the "proposal-acceptance constraint" in the event of a lock-out.[14]

The credible-threat wage (W^ℓ_{CT}) is such that, if the union's wage proposal is rejected, then each union member is just on the margin of indifference between observing and breaking the strike. This is the case when the worker's ex-post utility from striking (i.e. his utility once the proposed wage is rejected) is equal to his ex-post utility from not striking.

Let X be the (exogenously given) portion of the union's total strike fund made available to the union members in the current time period. Let J be the payment per worker from this available fund. Since both the strikers and the lock-out victims are entitled to the payments, $J = (X/\bar{L})$.

Suppose that each worker observes the strike. Then, in the first period, each receives the strike fund payment (J) and profit income[15] $(\sigma \cdot \pi)$; in the second period, each receives W if the strike is won, or w if it is lost, in addition to profit income $(\sigma \cdot \pi)$. Thus, each worker's ex-post utility from observing the strike is

(8a) $\quad U^s = U\{(J + \sigma \cdot \pi) \cdot (1 - \tau), 0\} + \rho \cdot U\{(W^\ell + \sigma \cdot \pi) \cdot (1 - \tau), 1\}$

$\quad\quad + (1 - \rho) \cdot U\{(w + \sigma \cdot \pi) \cdot (1 - \tau), 1\}.$

Now suppose instead that each worker breaks the strike. Then they receive w in both periods. The associated ex-post utility is

(8b) $\quad U^b = 2 \cdot U\{(w + \sigma \cdot \pi) \cdot (1 - \tau), 1\}$

at the credible-threat wage (W^ℓ_{CT}),

(9) $\quad U^s - U^b = 0.$

Let us call this the "credible-threat constraint".

Equations (8a), (8b), and (9) indicate what makes the strike threat credible in our model. Supposing (quite plausibly) that $J \leq w$ (so that a

worker's first-period income is less when he observes the strike than when he breaks it), then our model allows only one reason why a worker may find it worthwhile to observe a strike: namely, that his second-period income from doing so $(\rho \cdot W + (1 - \rho) \cdot w)$ is sufficiently large relative to that from breaking the strike (w).

This rationale for observing the strike rests on our assumption that all union members are identical (having the same utility function and facing the same $J \cdot \pi$, τ, J, W^{ℓ}, w, and ρ), so that the strike is either observed; by all members or broken by all members. By implication, whenever the strike is broken, <u>all</u> members receive w in both periods.

In practice, however, union members are heterogeneous and thus some may observe a strike while others break it. If the strikers win, the strike breakers may well receive the same wage as the strike observers. Then there is a "free rider" problem (since the strike breakers reap the benefits of the strike without paying the cost).

Nevertheless, there are practical circumstances in which this free rider problem does not occur. For example, in firms with few workers, each worker may realize that by breaking the strike, he reduces the chances of winning the strike and thereby reduces his expected income. In addition, workers may expect that, after the strike is won, those who observed the strike may harass the strike breakers (athereby raising each strike breaker's marginal disutility of work) or refuse to cooperate with them in the process of production (thereby reducing each strike breaker's productivity, perhaps in sufficient magnitude to induce the firm to lay off the strike breaker). ((Lindbeck and Snower (1985) have analyzed how insiders use cooperation and harassment activities to prevent underbidding by outsiders; here we suggest that insiders may do so to prevent underbidding by strike breakers.)

Extending our model to include cooperation and harassment activities and to make ρ dependent on the number of strike breakers would complicate our

analysis without shedding new light on the ways in which the union's wage proposal (W) and its strike fund payments (J) affect its strike threat credibility. Thus, we simply retain our assumption that strike breakers receive w in both periods and therefore do not become free riders.

For expositional purposes, it is convenient to think of credibility as a matter of degree and let $\Omega = U^s - U^b$ measure how credible the strike threat is (viz, the greater Ω, the "more credible" the threat). In these terms, it is clear that a rise in J makes the threat more credible, since the utility from observing the strike is increased while the utility from breaking it remains unchanged:

$$(\partial\Omega/\partial J) = U_C \cdot (1 - \tau) > 0 \text{ (by equations (8a), (8b), and (9)).}$$

On the other hand, a rise in the wage proposal (W^ℓ) has counterveiling effects on credibility:

$$\frac{\partial Q}{\partial W^\ell} = U_C \cdot (1 - \tau) \cdot [\rho + (1 - \rho) \cdot g_1 - 2 \cdot g_1] + \rho' \cdot \Gamma,$$

where $\Gamma = U\{(W^\ell_{CT} + \sigma \cdot \pi) \cdot (1 - \tau), 1\} - U\{(w + \sigma \cdot \pi) \cdot (1 - \tau), 1\} > 0.$

For a given probability of winning the strike (ρ), U^s rises when the strike is won (by the amount $\delta \cdot U_C \cdot (\Gamma - \tau)$) and when the strike is lost (by the amount $U_C \cdot (1 - \tau) \cdot g_1$). U^n rises as well (by the amount $2 \cdot U_C \cdot (1 - \tau) \cdot g_1$). Moreover, ρ falls and this reduces U^s (since the chance of receiving W falls relative to the chance of receiving w).[16]

Thus a rise in the wage proposal (W) makes the strike threat less credible (i.e. $(\partial\Omega/\partial W^\ell_{CT}) < 0$) when

$$g_1 > \frac{\rho' \cdot \Gamma}{U_C \cdot (1 - \tau) \cdot (1 + \rho)} + \frac{\rho}{(1 + \rho)}$$

and the threat becomes more credible when the inequality runs the other way.

In sum, there are two possible ways in which the wage can affect strike threat credibility.

(a) The "credibility-reducing wage": When the wage falls, workers have a greater inducement to observe the strike, on the grounds that they are more likely to win the strike. We call this the "bird-in-the-hand" case, because the reasoning is that "one bird in the hand is worth two in the bush".

(b) The "credibility-enhancing wage": When the wage rises, workers have a greater inducement to observe the strike, on the grounds that their wage income is higher when they win the strike. We call this the "pie-in-the-sky" case, because the workers are being induced to strike through the chance of "a pie in the sky".

Figure 3a illustrates the "bird-in-the-hand" case. The credible-threat constraint (W_{CT} of Equation (9)) is upward-sloping since W reduces credibility whereas J raises it:

$$(\partial W_{CT}^{\ell}/\partial J^{\ell}) = -(\partial \Omega/\partial J^{\ell})/(\partial \Omega/\partial W_{CT}^{\ell}) > 0.$$

The proposal-acceptance constraint (W_{PA}, of Equation (7)) is pictured as well. (It is horizontal since J has no direct effect on the firm's profit.) The union's feasible region is given by the shaded area. The wage proposal which the union makes depends on what the existing level of J is. If $J^{\ell} < \tilde{J}^{\ell}$, then $W^{\ell} = W_{CT}^{\ell}$; and if $J^{\ell} > \tilde{J}^{\ell}$, then $W^{\ell} = W_{PA}^{\ell}$.

Figure 3b deals with the "pie-in-the-sky" case. Here the credible-threat constraint is downward sloping since W and J both raise credibility:

$$(\partial W_{CT}^{\ell}/\partial J) = (\partial \Omega/\partial J)/(\partial \Omega/\partial W_{CT}^{\ell}) < 0.$$
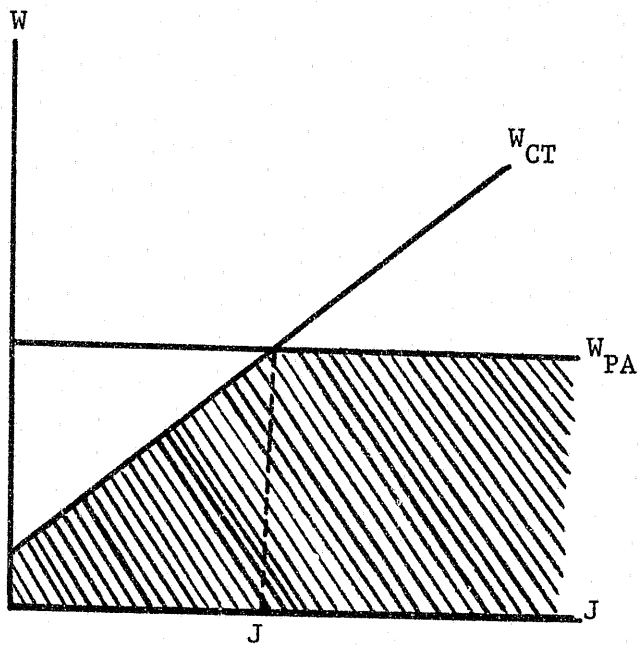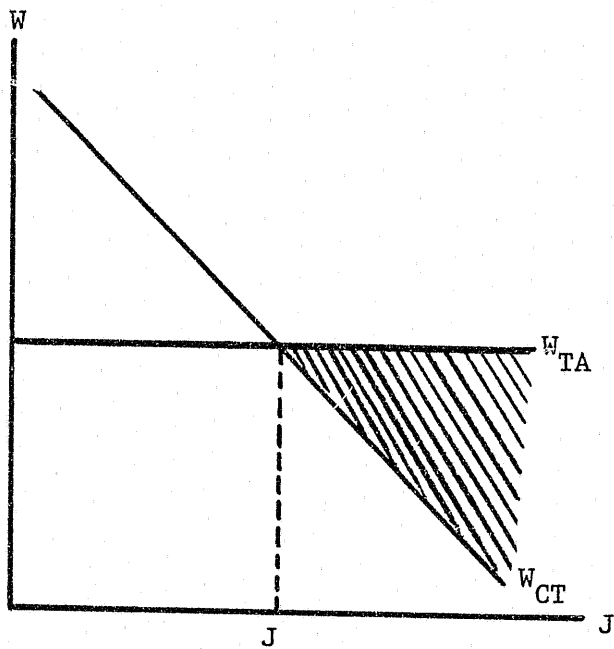
FIGURES 3: The Wage Proposal in the Event of a Lock-Out.

(Once again, the feasible region is the shaded area). If the union's strike fund is so small that $J^\ell < \tilde{J}^\ell$ then it is impossible to establish threat credibility (i.e. $Q < 0$). (In this case, union members are unable to gain economic rent from their strike threat). If $J^\ell > \tilde{J}^\ell$ then $W^\ell = W^\ell_{PA}$. Note that the credible-threat constraint is never binding in this case.

(It is interesting to note that the relation between W^ℓ_{CT} and J need not be monotonic and thus, for a unique set of functional forms U and ρ, the wage may be credibility-reducing at some levels and credibility-enhancing at others.)

4b. Strike Threat without Lock-Out Threat

Now suppose that the firm decides not to impose a lock-out. In the event of a strike, the firm keeps all the remaining employees on the production line. As above, if the firm accepts the union's wage proposal (W), its profit is given by π^a of equation (4). Yet if it rejects this proposal, the union now calls $a \cdot L$ of the firm's workforce out on strike. As a result, the firm's first-period profit is generated wholly by the remaining employees $((1 - a) \cdot \bar{L})$. These workers receive a wage w, which is lower than the one the firm rejected. In the second period, all employees receive W if the union wins the strike, or w if the union loses. Thus, the expected present value of the firm's profit, after rejection of the union's wage proposal, is

$$(10) \qquad \pi^n = [1 - w] \cdot (1 - a) \cdot \bar{L} + \rho \cdot [1 - W] \cdot \bar{L}$$
$$+ (1 - \rho) \cdot [1 - w] \cdot \bar{L}$$

(where the superscript "n" stands for the case of "no lock-out" threat).

Once again, the proposal-acceptance wage (W^n_{PA}) sets $\pi^a > \pi^n$. Consequently, the proposal-acceptance constraint in the absence of a lock-out is

$$(11) \qquad [1 - W^n_{PA}] \cdot \bar{L} \cdot \{1 + (1 - \rho)\} = [1 - w] \cdot \bar{L} \cdot \{1 - a + (1 - \rho)\}.$$

In contrast to the lock-out case, the number of workers threatening to strike makes a difference to the proposal-acceptance wage. The greater $(a \cdot \bar{L})$, the smaller the firm's first-period profit in the event of a strike, and thus the higher W_{PA}^{n} (at which the firm is indifferent between accepting and rejecting the wage proposal). Furthermore, the greater $(a \cdot \bar{L})$, the smaller the strike fund payment (J) (for recall that $J = [X/(a \cdot \bar{L})]$, where X - the overall strike fund available to union members in the current period - is exogenously given). Thus, there is an inverse relation between W_{PA}^{n} and J as pictured in Figures 4. Whereas J is fixed in the case of lock-out at $J^{\ell} = (X/\bar{L})$, it is now endogenous to the union's decision making.

The credible-threat constraint remains the same as in the case of lock-out; viz (9). (Thus $W_{CT}^{n} = W_{CT}^{\ell}$). Figure 4a depicts the "bird-in-the-hand" case and Figure 4b is about the "pie-in-the-sky" case. (The latter figure is illustrative only, since the proposal-acceptance constraint need not be flatter than the credible-threat constraint.)

The shaded areas in the figures are the union's feasible regions for the wage proposal. The union chooses the maximal attainable wage, lying at the intersection of the two constraints in Figures 4a and b: $W^{n} = \hat{W}^{n}$. [17]

4c. The Lock-Out Decision

Having examined the union's wage proposal in the presence and absence of the lock-out threat, we now find the conditions under which this threat will and will not be used.

A firm which stages a lock-out earns less profit in the current period than one which does not.[18] Consequently, the firm can be induced to lock-out union members only if this provides a future profit advantage which outweighs the current profit loss. In our model, the only conceivable future advantage lies in the possibility that the lock-out threat may enable the firm

to achieve a lower insider wage than it could otherwise have done. There is only one way for this to work, namely, that

    (a) the lock-out threat reduces the strike fund payment, J, and

    (b) a reduction in J leads to a fall in the union's wage proposal,[19] W.

Condition (a) holds only if the credible-threat constraint is binding in wage determination. Condition (b) holds only if the wage proposal is credibility-reducing (and, by implication, W and J have opposite effects on Ω).

    In sum,

Proposition 1: In the bargaining process above, the lock-out threat is used only if

    (a) credible-threat constraint (9) is binding i.e. $W = W_{CT} < W_{PA}$, and

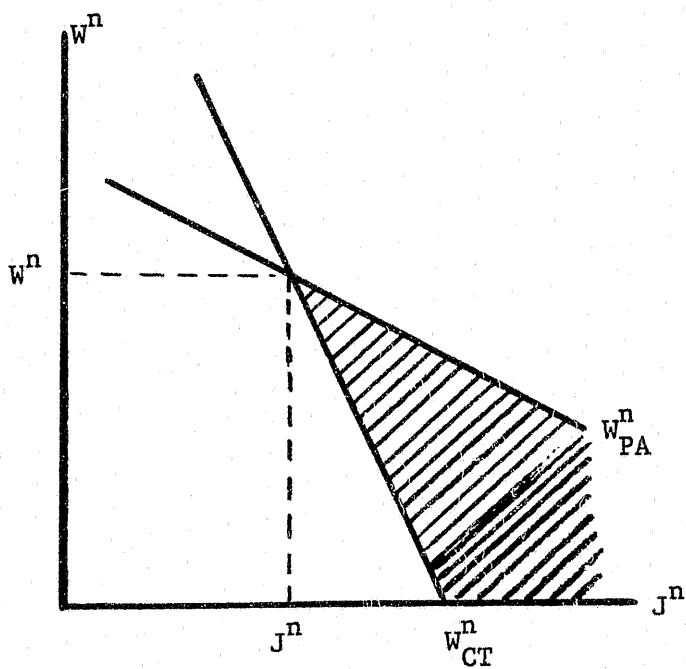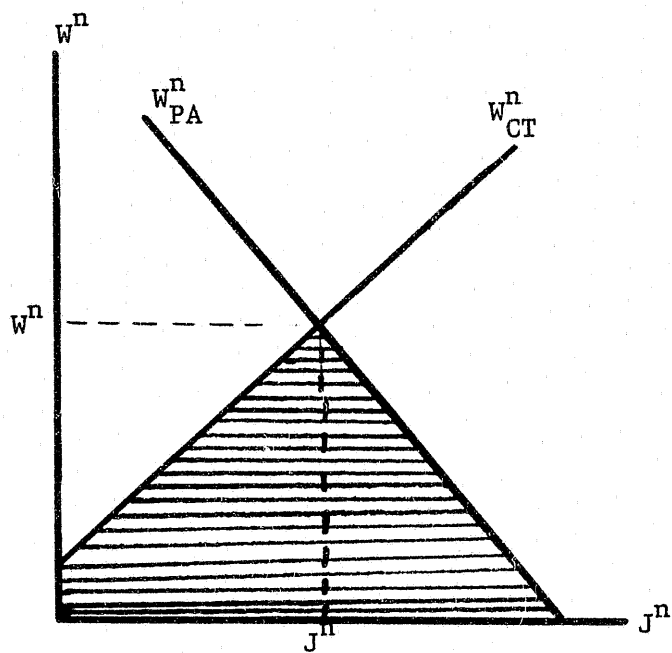   (b) the union's wage proposal is credibility-reducing.

    In this light, it is convenient to examine the lock-out decision under two different circumstances:

    - a credibility-enhancing wage proposal; and

    - a credibility-reducing wage proposal.

    When the wage proposal is credibility-enhancing, the strike threat will not provoke a lock-out threat (by Proposition 1(b)) and then the proposal is determined as shown in Figure 4b. Here, $W^n = W^n_{PA} = W^n_{CT}$.

    On the other hand, when the wage proposal is credibility-reducing, this proposal is made as shown in Figure 5. Here the proposal-acceptance and credible-threat constraints in the presence and absence of lock-out are superimposed on each other. Observe that if $a = 1$, then $W^\ell_{PA} = W^n_{PA}$. [20]

    The figure pictures a well-known rationale for lock-out in the real world conduct of labor conflict: it is meant to reduce the union's ability to support their members during the conflict and consequently make it more desirable for these members to break the strike than to observe it. In order

FIGURES 4: The Wage Proposal in the Absence of a Lock-Out

for the union to re-establish its strike-threat credibility (i.e. to convince the firm that a strike call would be heeded), the wage proposal is reduced.

The lock-out threat is used if $\pi^\ell > \pi^a$, which implies (by Equations (4) and (5)) that

$$[12] \qquad W^n > W^\ell \cdot (\frac{\rho}{2}) + (\frac{1 - \rho}{2}) \cdot w + \frac{1}{2}$$

This condition is contained in Figure 5. When W^n lies above the $\pi^\ell = \pi^n$ line, the lock-out threat is operative; otherwise it is not.[21]

In this way, our model of wage determination is closed: having shown how the union formulates its wage proposal in the presence and absence of a lock-out threat, we find in Equation (12) the condition under which this lock-out threat becomes operative.

5. The Effectiveness of Fiscal Policies

We now examine the implications of our analysis above for the influence of fiscal policies on wage determination. The fiscal policies take the form of changes in the policy instruments enumerated in Section 2a: public employment (L_G); unemployment benefits (B), and the income tax rate (τ).

With respect to public employment, it is instructive to make a distinction regarding the security of job tenure which it provides. At one extreme is "permanent" public employment, where the available government jobs remain in the hands of an indentifiabale, invariant group of workers (viz, permanent tenure). At the other extreme is "rotating" employment, where the government jobs rotate randomly among the outsiders, so that each applicant has an equal chance of receiving such a job (viz., limited tenure). The realism of both extremes is open to question. In practice, current increases in government employment raise the employment chances of some, but not all, workers who are currently unemployed.
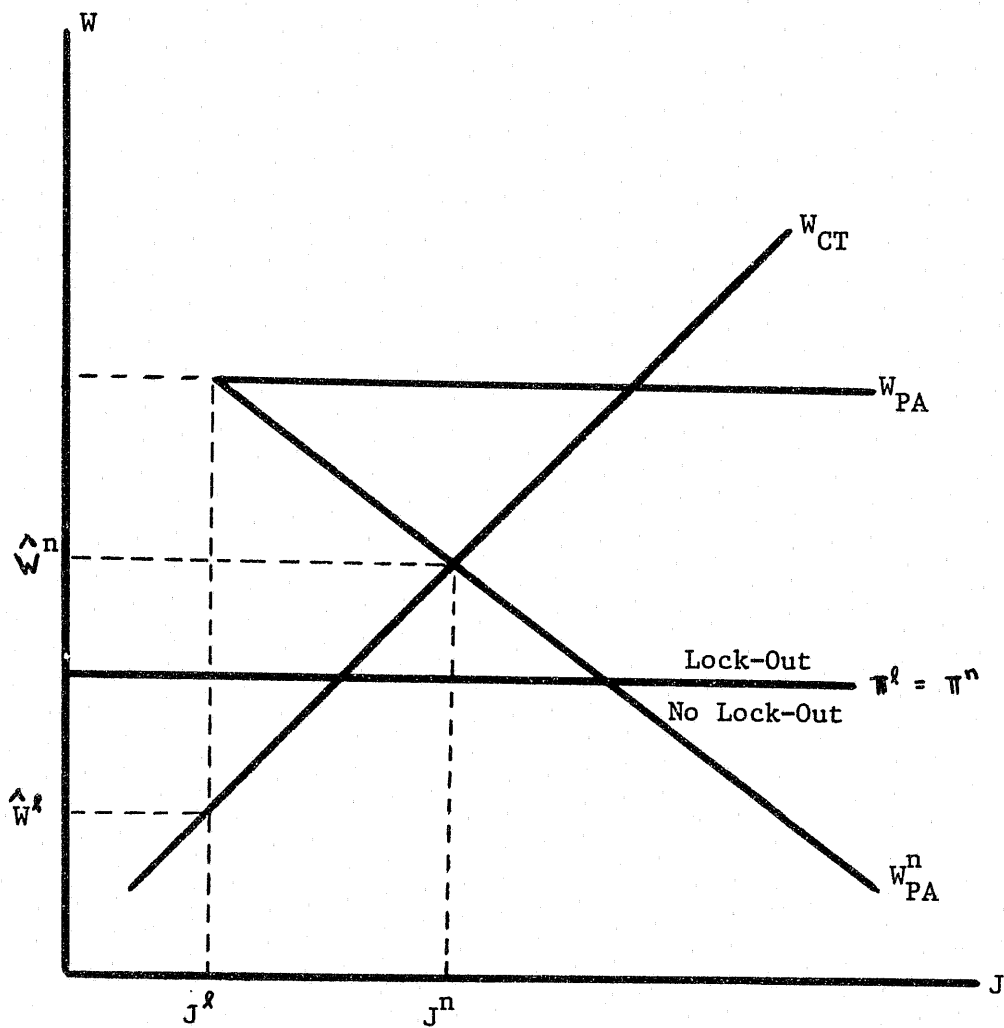
FIGURE 5: The Lock-Out Decision and the Corresponding Wage Proposals
(when these proposals are credibility-reducing)

We are concerned with how the fiscal policies above affect the labor market directly, but not indirectly via other markets, such as the product market. The reason for this emphasis is that we intend to compare the impact of fiscal policies in the presence and absence of strikes and lock-outs and these forms of work disruption have their proximate influence on the labor market.

The effect of the fiscal policies on wages will be examined under our three different bargaining scenarios:

(i) individualistic bargaining;

(ii) union bargaining under combined strike and lock-out threats; and

(iii) union bargaining under strike threat alone.

(i) Individualistic bargaining:

Increases in unemployment benefit (B), the income tax rate (τ), and rotating government employment (L_G), all raise the entrants' reservation wage (R) for any given level of W_1. (However, an increase in permanent government employment does not affect the employment probability of the currently unemployed workers and thus leaves R unchanged, for any given W_i.) In terms of Figure 1, these policies shift the R locus upwards.[22] The W_i locus remains unchanged (since the policies do not directly affect the labor turnover costs. Thus, the equilibrium insider and entrant wages

$(W_i^*$ and R^*, respectively) both rise.

Proposition 2: Under individualistic bargaining (as described above), an increase in unemployment benefits (B), the income tax rate (τ), or rotating government employment (L_G) raises the insider wage (W).

Here, marginal productivity considerations dominate wage determination: insider wages are bid up to the point at which insiders are just as profitable as entrants.

(ii) <u>Union bargaining under combined strike and lock-out threats</u>:

Under these circumstances, <u>strike credibility considerations</u> dominate wage determination. As we have seen, a lock-out threat is not made in our economy unless it succeeds in reducing the union's strike threat credibility and thereby reduces the insider wage. Here marginal productivity considerations lose their influence over wage determination: even if it were possible to raise the wage without inducing firms to replace insiders with entrants (ceteris paribus), unions nevertheless do not do so in order to preserve the credibility of their strike threat.

Now, it is interesting to observe that the fiscal policies above <u>reduce</u> this credibility. The reason is that, by raising the individualistic wage (i.e. the wage achievable under individualistic bargaining), these policies improve the expected remuneration the insiders would receive in the event of losing a strike. Thus, the utility from observing the strike falls relative to the utility from breaking it. Recalling that the lock-out threat is used only when the wage is credibility-reducing, it is clear that the union can regain their lost strike-threat credibility by reducing their wage demands. In order to regain strike threat credibility, the unions must reduce their wage demands.

Let us see how this works concretely in our model.

By Proposition 1, when the strike and lock-out threats occur together, the credible-threat constraint is binding (i.e. $W = W_{CT}$) but the proposal-acceptance constraint is redundant (i.e. $W < W_{PA}$). This means that union members are on the margin of indifference between observing and breaking a strike, but they do not face the prospect of dismissal.

From inspection of the credible-threat constraint (9), it is evident that the only way in which increases in B and rotating L_G can affect the union wage proposal (W) is via the individualistic wage (W_i). Recall that W_i may be positively related to W, the wage received after a strike is lost or broken.

Note that strike breakers are more likely to receive W than strike observers.[23]

An increase in B or rotating L_G raises W_i which, in turn, raises the utility from breaking a strike by more than the utility from observing it. In this manner, the fiscal policies rob the strike threat of credibility. Since the union members were initially on the margin of indifference between observing and breaking a strike, after the fiscal policies have been imnplemented, the strike threat is no longer credible. By Proposition 1, under combined strike and lock-out threats, the wage proposal is credibility-reducing. Thus, the only way for the union to restore its strike threat credibility is by reducing its wage proposal (W). Thus, the credible-threat constraint shifts downwards. As shown, given the strike fund payment under lock-out (J^{ℓ}), the wage proposal (W) falls.

An increase in the income tax rate (τ) has the same, dampening effect on W via W_i. In addition, it has a direct, negative impact on strike threat credibility (see Equation (9)), leading to a further fall in W.

Proposition 3: Under unionized bargaining with combined strike and lock-out threats (as described above), an increase in unemployment benefits (B), the income tax rate (τ), or rotating government employment (L_G) reduces the insider wage.

These are startling results. Here the effect of the above fiscal policies on wages is the opposite of that under individualistic bargaining. The reason is that whereas these policies raise the proposal-acceptance wage (which is relevant to individualistic bargaining), they reduce the credible-threat wage (which is relevant to unionized bargaining under combined strike and lock-out threats). Of course, it is well to remember that this chain of causation is merely one channel whereby fiscal policies may influence wage

determination. Other channels, e.g. those identified in neoclassical and Keynesian macro models, may be operative as well.

(iii) Union bargaining under strike threat alone:

Now both marginal productivity and strike credibility considerations become relevant to wage determination. The reason for this may be found in the fact that the union's decision concerning the number of potential strikers now plays a role in the union's wage proposal.[24] If a strike occurs, a rise in the number of precommitted strikers reduces expected profits as well as the strike fund payment (ceteris paribus). The lower the expected profits (viz., the higher the cost of the strike to the firm), the greater the wage which the firm is willing to pay. The lower the strike fund payments, the less credible is the strike, and (if the wage proposal is credibility-reducing) the lower the wage which the union can credibly demand. Here the union faces a tradeoff. It will set the number of potential strikers so that the wage gain from threatened profit reduction is exactly offset by the wage loss from credibility reduction. In other words, marginal productivity and strike credibility considerations are weighed off against each other.

Concretely, we have seen in Section 4, the strike threat can occur in the absence of a lock-out threat when the wage proposal is either credibility-reducing (as in Figure 4a) or credibility-enhancing (as in Figure 4b). In either event, the equilibrium insider wage (W^n) is given by the intersection of the proposal-acceptance constraint and the credible-threat constraint.

The fiscal policies above stimulate the individualistic wage and thereby they (a) reduce strike credibility; and (b) reduce expected profit (by raising the reservation wage). The first effect lowers the union's wage demand; the second stimulates it. The overall fiscal policy impact on wages depends on which of these effects is dominant.

In particular, increases in B, τ and rotating L_G all raise the equilibrium insider wage (W_i^*, as shown in Section 5a). Consequently, they shift the proposal-acceptance constraint upward (by Equation (10)). If the wage proposal is credibility-reducing, the credible-threat constraint shifts downwards; yet if the proposal is credibility-enhancing, this constraint shifts upwards. In either case, the effect on the equilibrium insider wage W^n) is ambiguous.

Proposition 4: Under unionized bargaining with strike threat but no lock-out threat (as described above), an increase in unemployment benefits (B), the income tax rate (τ) or rotating government employment (L_G) has an <u>ambiguous effect</u> on the insider wage.

The result is in line with our observations concerning the way in which marginal productivity and credibility considerations influence the effectiveness of fiscal policies. The two considerations pull the insider wage in opposite directions; and since they are both operative when the strike threat occurs alone, the movement of the insider wage is ambiguous.

The results of all the policy exercises above are summarized in Figure 6.

Bargaining scenario	Wage determination	Effect of expansionary fiscal policies
Individualistic	Marginal productivity conditions	Rise in wages
Combined strike and lock-out	Strike credibility conditions	Fall in wages
Strike threat alone	Marginal productivity and strike credibility conditions	Ambiguous change in wages

Figure 6: The Effect of Fiscal Policies on Wage; Determination

6. Concluding Remarks

The main thrust of this paper lies in its contribution to the theory of union behavior. As noted, the theory thus far has been dominated by models in which the union sets the wage so as to maximize its utility function subject to a labor-demand constraint or a minimum-profit constraint. This literature overlooks the fact that the union's influence over the wage depends on (a) its ability to "punish" firms which do not accede to its wage demands (i.e. "union punch") and (b) its ability to fulfill its threats under the appropriate conditions (i.e. "union credibility"). This paper has focused on the influence of union punch and credibility on wage formation. In this context, a rationale for strikes and lock-out threats has been developed. We have indicated that when the costs and hiring and firing generate economic rent which workers can exploit through their wage demands, strike threats and lock-out threats may be explained as rent-seeking devices.

As shown, the partial-equilibrium effects of fiscal policies are quite different depending on whether there is individualistic bargaining, unionised bargaining in the presence of strike and lock-out threats, or unionised bargaining in the presence of strike threat alone. The case of individualistic bargaining generates conventional results. The unconventional results under unionised bargaining all stem from a single source: the union's formulation of wage proposals so as to preserve strike threat credibility. Since the mainstream literatures on fiscal policy and wage formation (both the perfect competition and the union models of the labor market, e.g. Dixon (1986) and Layard and Nickell (1986)) do not take the issue of strike threat credibility into account, it is not surprising that they get different results from ours.

It is worth emphasizing that the policy exercises above are concerned only with the direct effects of fiscal policies on the labor market (and not with the direct effects operating through other markets). The reason for this focus of attention is that in this way the role of strike threats and lock-out threats in wage formation can be brought into sharp relief. In other words, the main purpose of our fiscal policy exercises is to high-light the operation of our union model, rather than to serve as a foundation for policy recommendations.

Another word of warning regarding the practical applications of our analysis is vital as well. We have dealt with economies in which wages are determined entirely through individualistic bargaining, or entirely through unionised bargaining under strike and lock-out threats, or entirely through such bargaining under strike threats alone. However, real-world economies comprise many sectors in which bargaining proceeds in different ways. In some sectors the bargaining is individualistic; in others it is unionised. In some instances (in West European countries rather than the United States) employers make regular use of lock-out threats; in others they do not. The macroeconomic effectiveness of fiscal policies in economies with such sectoral differences lies beyond the scope of this paper. Moreover, our analysis has considered only a limited set of reasons for the strike and lock-out threats. As noted, strike threats may be more than wage preserving devices and lock-out threats may be aimed at more than depleting unions' strike funds. The other reasons functions also lie beyond the paper's scope. In view of these caveats, our analysis should be seen as only a first step in explaining strike and lock-out threat and in exploring the effectiveness of fiscal policies when unions play an active role in wage determination.

APPENDIX

The following are sufficient conditions for the absence of strikes for the Nash equilibrium.

Whenever the union's wage proposal exceeds a critical value - call it W^* - the firm rejects it (and thereby provokes a strike) and whenever the proposal lies beneath W^*, the firm accepts it. Given that the strike threat is credible, rejection of the proposal implies that the insider receives an expected income of $Y = J + [\rho \cdot W + (1 - \rho) \cdot W]$. We assume that $\rho' < - [1/(W - w)]$, so that $[\partial Y / \partial W) < 0$. In other words, whenever the firm rejects the wage proposal, the union has an incentive to reduce the proposed wage.

Let $Y^* = J + [\rho \cdot W^* + (1 - \rho) \cdot w]$. We assume that the levels of J, w, and ρ are such that $Y^* < W^*$. In other words, the maximal labaor income under rejection of the wage proposal falls short of the maximal income under acceptance.

Under these circumstances, the union has an incentive to make a wage proposal which does not provoke a strike. The relation between the worker's expected income and the wage proposal is pictured in the following figure:
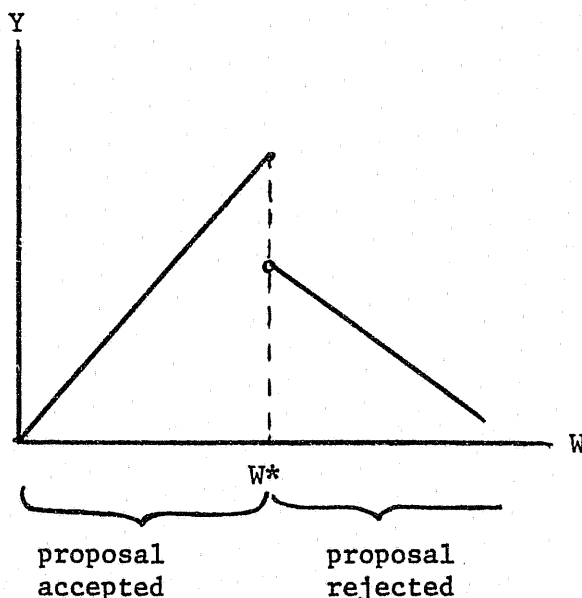
FOOTNOTES

1. To bring our comparative statics results of Section 5 into sharp relief, we do not explicitly consider the government budget constraint. However, inclusion of this constraint would introduce no underlined conceptual diffi- culties. We could think of a change in one government policy parameter to be financed through money or debt creation, whose feedback effects on the labor market could then in principle be considered. Alternatively, we could let a change in one parameter be matched by a counterveiling change in another parameter and we could then amalgamate our comparative statics results accordingly.

2. Allowing the government to offer a different wage would not affect our conclusions, provided that the government wage is at least as large as the reservation wage, so that the government is able to attract the labor it requires.

3. Naturally, entrants may be expected to be less productive than insi- ders. A straightforward way of accounting for this in the production function would be to write $Q = \min[(L_I + \alpha \cdot L_E), K]$, where $0 < \alpha < 1$. In our analysis, however, we instead include the entrants' productivity shortfall $((1 - \alpha) \cdot L_E)$ in the costs of hiring and training.

4. These conditions are fulfilled in the solutions to a variety of bargaining models, both of the "sequential" and "axiomatic" variety. (See, for example, the literature summarized in Sutton (1986)).

5. Of course, the lock-out can serve other purposes as well, e.g. to enable the firm to avoid paying for labor services (of non-strikers) which have become unprofitable.

6. This idea is related to the literature on "wars of attrition" (e.g. Fudenberg and Tirole (1986)). In our model, however, there is perfect information whereas in that literature the players have imperfect information about each other's costs and each player grows increasingly pessimistic about his opponent's costs with the passage of time.

7. In the real world we often find that unions call out on strike only a fraction of firm's workforces (e.g. workers in a limited number of occupations or a limited number of plants may be called out on strike). A potentially important reason for such behavior is (as suggested by our analysis below) that unions weigh the strike's harm to the firm against its harm to themselves through the depletion of strike funds.

8. We could equally well assume that the firm and the union have different subjective probabilities, so long as there is an inverse relation between each of these probabilities and the wage proposal W.

9. There are further bounds on w_L and w_B: the firm's profit-maximizing wage offer in the event that the union members lose or break their strike. It can be shown that this profit-maximising offer satisfies the restrictions of g.

10. Recall that all insiders are alike. The union is assumed to pursue the same wage objectives as those of the individual insiders it represents, but - given its ability to threaten a strike - it can do so more effectively.

11. Note that the lock-out threat is not the only conceivable response by the firm to the strike threat. Another is the threat of replacing all the strikers with new entrants. In practice, this replacement strategy is hardly ever followed. Presumably the reason is that the firing-hiring costs associated with this strategy are usually so high that lock-outs, or no response at all, represent a smaller drain on firms' profits. President Regan's replacement of air traffic controllers in 1982 is a rare exception. In this case, the availability of military personnel with the requisite skills meant that the associated firing-hiring costs were manageable. In the light of its rarity, we omit an analysis of the replacement strategy.

12. This simplifying assumption is not one of substance in the context of our analysis.

13. The firm (like the union) is assumed to have a zero rate of time discount. In stationary equilibrium, if the firm has an incentive to accept the wage proposal in the first period, then it will continue to do so in the second period. Thus, we need not consider the case of first-period acceptance and second-period rejection.

14. Observe that the union's decision regarding the proportion of strikers in the firm's workforce (a) is not relevant to the proposal-acceptance wage. Since the firm locks out all the non-strikers, variations in the proportion of strikers have no effect on π^{ℓ}.

15. Here we assume that the union members derive only a negligible proportion of their profit income from the firm for which they work or whose products they consume. In addition, they make the Nash equilibrium assumption that all other unions do not call strikes. Thus, their profit income is taken to be independent of their strike activity and equal to what they would earn in the absence of strikes.

16. The relative strength of these influences depends (among other things) on the magnitude of ρ' and g_1. The smaller ρ' (i.e. the stronger the impact of W^{ℓ}_{CT} on ρ) the more U^S falls relative to U^b and the less credible the strike. The greater g_1 (i.e. the stronger the impact of W on w), the more U^b rises relative to U^S (since there is a greater chance of receiving w when the strike is broken than when it is observed) and the more credible the strike.

17. Note that if the credible-threat constraint is flatter than the proposal-acceptance constraint, the maximal wage is attained at $J = 0$. This is not an interesting case and thus we do not pursue it. If there are multiple intersections between the two constraints, the union chooses either the one associated with the highest wage (whenever the credible-threat constraint is steeper than the proposal-acceptance constraint at J

= 0) or the one associated with $J = 0$. As indicated by the analysis below, these possibilities make no difference to our qualitative conclusions.

18. In particular, the former firm earns no current profit, while the latter generates some through the non-strikers.

19. Recall that the union sets its first-period wage claim in (rational) anticipation of the size of J which it may receive in the second period. This is the way in which a change in J can affect W.

20. If $a = 1$, then the firm's profit is the same regardless of whether all its employees strike or whether some strike and the rest are locked out. Thus, the proposal-acceptance wage must be the same in both cases as well. Moreover, at $a = 1$, the strike fund payment J reaches its minimal level, J^{ℓ}. Accordingly, in Figure 5 the proposal-acceptance constraints W_{PA}^{ℓ} and W_{PA}^{n} meet at $J = J^{\ell}$.

21. As Figure 5 happens to be drawn, W^{n} is above the $\pi^{\ell} = \pi^{n}$ line and thus the threats of strike and lock-out occur together. In this case, the credible-threat constraint (W_{CT}) is binding and, given the strike fund payment J^{ℓ}, the insider wage is W^{ℓ}. On the other hand, had the $\pi^{\ell} = \pi^{n}$ line passed above the intersection of the constraints W_{CT} and W_{PA}, then there would have been no lock-out and therefore the insider wage would have been W^{n}.

22. Recall that the government offers employment at the insider wage (W). An increase in rotating government employment shifts the R locus upwards, since outsiders now face an increased probability of employment

    $(\theta = [L_{G}/(L_{F} + L_{G})]$ where L_{F} is total employment by firms). The R locus under rotating government employment is defined as follows:

    $U[R + \sigma \cdot \pi) \cdot (1 - \tau), 1] + U[(W + \sigma \cdot \pi) \cdot (1 - \tau), 1]$

    $= 2 \cdot A \cdot U[(W + \sigma \cdot \pi) \cdot (1 - \tau), 1] + 2 \cdot (1 - A) \cdot U[(B + \sigma \cdot \pi) \cdot (1 - \tau), 0].$

23. Workers who break a strike receive w in both periods, whereas workers who observe a strike receive w only in the second period and only if the strike is lost.

24. By contrast, in the case of union bargaining under combined strike and lock-out threats, this decision is irrelevant to wage determinations. No matter how many workers are called out on strike, the firm locks out the rest. Thus, variations in the number of potential strikers make no difference to the firm's expected profits or the union's strike fund payments, in the event of a strike.

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