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A MULTIPARTY COLLECTIVE BARGAINING MODEL
AND ITS IMPLICATIONS

by

John Michael Swint

A THESIS SUBMITTED
IN PARTIAL FULFILLMENT OF THE
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CHAPTER I

The purpose of this study is to develop a more realistic theory of the factors shaping the labor-management bargaining process by deriving and testing hypotheses concerning changes in the level of strike activity and the duration of strikes.

The motivation for doing research in the area of collective bargaining stems from three types of considerations. First, as has been stressed by Ashenfelter and Johnson [2], given the relatively frequent disruption of economic activity by strikes it would be quite useful to know whether they are an inevitability of the present system or rather are a function of what Hicks [15] termed faulty negotiations, and thus subject to correction. Our analysis leads to some interesting conclusions on this matter.

Second, there has been no rigorous collective bargaining study which fully incorporates the self-serving motivations of the actual bargaining parties. To realistically investigate the underlying causes of strikes, the preference (utility) functions of the actual bargaining
parties must be an integral part of the analysis. The present study represents an attempt to do this.

Third, very little empirical work has been done in the area of collective bargaining to take advantage of a relatively large body of available data. To our knowledge there have only been three such econometric studies completed. One, a forthcoming publication by Grubert [12], is done on a cross-sectional basis and is primarily concerned with the ability of either bargaining party to inflict losses on his opponent. The Ashenfelter and Johnson study [2], uses time-series data to test a set of equations related to the absolute number of strikes per quarter, but it is not at all clear that their reduced form equations are tests of hypotheses derived from their model; i.e., the connection between their model and empirical work is tenuous at best. Thirdly, Pencavel [23] has tested the Ashenfelter and Johnson hypotheses with U.K. data. He has done so, however, without extending the theoretical justification of their hypotheses.

As such there persists a need for meaningful empirical work in this area--this study attempts to provide such a contribution.

Theories of collective bargaining have traditionally been preoccupied with the confrontation in bilateral monopoly situations. Beginning with Edgeworth [9], there has
been a series of models of substantially the same nature—essentially static, two-party, and unconcerned with any self-motivated actions of the active bargaining parties. The theories of Zeuthen [36], Pen [22], Shackle [28], and Hicks [15] exemplify this. Harsanyi [13] has since translated Zeuthen's theory into modern utility terms, but he has done so without regard to the time dimensions of labor-management negotiations.

The first contribution of a non-static nature was that by Cross [7] in which the players in his two-party model both learn with the passage of time and have time-discounted utility functions. Cross asserts that the influence of time upon bargaining may assume three different forms. First, it appears naturally in a discounting function if the players discount future benefits (a reflection of their impatience). Second, the utility of the agreement itself may change with the calendar date. Third, there is a fixed cost of bargaining which recurs in each time period of the negotiations. This cost may vary from the simple personal inconvenience of having to spend time in this rather than other occupations, to the immense cost in terms of the loss of profit and fixed cost of the temporarily closed plant of a strike-bound firm.

Similarly, Contini [5,6] has developed a two-party theory with time explicitly introduced in the utility
function of each bargainer. In doing so he has arrived at a number of interesting theoretical implications. For example, he has shown that the outcome of a bargaining process may be stable (agreed upon by both parties) and yet not be efficient (Pareto optimal) and that the lower any given bargainer's time preference, the better off in relative terms he will emerge in the negotiated solution.

While these non-static theories of Cross and Contini are significant improvements over the traditional "pure" bargaining theories, they nevertheless fail to capture any self-motivation in the decisions of the parties actively involved in the negotiations.

Ashenfelter and Johnson [2], in an apparent attempt to overcome this, have constructed a three-part model consisting of union members, union leaders, and management. However, in their model, union leaders are primarily concerned with satisfying the expectations of the union members and the interests of the management group perfectly coincide with those of the stockholders. From the viewpoint of bargaining motivations this theory must, therefore, be considered of essentially a two-party nature, i.e., one of union members and management.

In contrast to these theories, we develop a four-party collective bargaining model in which the self-serving motivations of the actual negotiating participants are
explicitly incorporated into their time-discounted utility functions. Union leaders and management are the active bargainers and are ultimately responsible to their constituencies, union members and stockholders respectively.

The general motivations for the participants are assumed to be the following:

For union leaders

A. Personal political survival, including power and prestige within the union, beyond that amount necessary for their own job security.

B. Survival and growth of the union as an institution. This implies the maintenance of a union-nonunion wage differential and the maintenance of a given percent of the relevant industry, firm or occupation unionized.

C. Promotion of the financial welfare of the present union members.

For management

A. Personal political survival within the firm; i.e., job security.

B. The opportunity to exercise expense preference with the firm's expenditures (à la Williamson [35]).
In essence then, the hypothesis is that for many bargaining situations there exists a reasonably systematic pattern of behavior on the part of the active bargaining participants and that, in the simplest terms, this conforms to the (joint)\(^1\) maximization of their own utility functions, subject of course to certain economic and political (or psychological) constraints on their bargaining freedom.

In Chapter II we develop the bargaining constraints which are imposed upon the participants by their constituencies and we then present the specific union leader and management utility functions which are designed, in conjunction with the bargaining constraints, to reflect their general motivations as listed above. The composite model and its theoretical implications are given. Chapter III is a qualitative analysis of various exogeneous influences on the outcomes of the bargaining process (both the level of

\(^1\)Aside from the obvious union leader-union member and management-stockholder coalitions (see Cyert and March [8],) we are assuming that a third coalition, that between union leaders and management, exists and has as its collective goal the joint utility maximization of its members. This assumption explicitly recognizes the mutual dependence which the active bargaining participants must have. That is, it takes both parties to reach a settlement and if one decides to be non-cooperative he can force an extended strike (lockout) in which all parties lose. By assuming this coalition then, the bargainers will be restricted to pareto efficient solutions. Some additional implications of this coalition will be discussed later in the paper, as well as its possible dissolution by either party due to "non-equitable" settlements imposed by the opposition.
strike activity and the duration of strikes) and a number of specific testable hypotheses are derived. Chapter IV presents and interprets the results of our econometric tests of these hypotheses. And lastly, Chapter V lists the conclusions of the analysis as well as some suggestions for future research in the area.
CHAPTER II

In this chapter we develop the two bargaining constraints which are imposed on union leaders by union members and a profit constraint which is imposed on management. From this we derive a "rational" cause of strikes, regardless of the union leader and management utility function arguments. Given the particular forms of these constraints on the bargaining freedom of union leaders and management, we specify their utility functions as representative of their general motivations as listed in Chapter I.

I. UNION LEADERS' CONSTRAINTS

1. A Union Member Wage Gain Constraint

It is assumed that there exists a minimum amount of gain in the present value of their wage bill (or maximum loss) that union members (UM) demand from the negotiations and that below this their dissatisfaction is such that the union leaders (UL) are voted from office, i.e., an absolute personal political survival constraint.

To arrive at this function the discounted present
value of the UM future wage stream under the original contract net of any secondary income earned by UM during a strike which would not otherwise have been earned, \(^1\) is deducted from the present value of the UM wage stream under the new contract. Call this gain \(x_1\).

The size of this minimal gain demanded by UM is dependent upon such things as UM productivity changes, cost of living changes, and settlements achieved by other "competing" union and nonunion groups. Normally, we would anticipate its level to equal zero such that only a decrease in UM financial welfare would violate the constraint. Depending upon the factors just listed however, the minimal \(x_1\) can be either positive or negative.

Given a minimal level of \(x_1\), \(\bar{x}\), for each length of strike there will exist a wage rate such that \(\bar{x}\) is exactly maintained. \(^2\) Hence, in Figure 1 as the length of the strike increases from zero the amount of foregone earnings, net of secondary income of UM, increases necessitating a greater wage rate to maintain \(\bar{x}\). As the strike grows long and secondary income sources such as strike funds disappear,

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\(^1\)For example, strike funds, unemployment compensation, food stamps, income from part-time work which is available to the UM on strike, and income from secondary sources within the family, e.g., work by a wife or teenager.

\(^2\)It is assumed throughout that all fringe benefits and other non-wage items are imputed into the contracted wage rate.
the foregone earnings net of this secondary income will increase at even a greater rate. Thus \( \bar{X} \) increases non-linearly with increases in the length of the strike.\(^3\)

\(^3\)This is consistent with the view expressed by Liver-nash [18] that "As a strike lengthens, it commonly bears more heavily on the union and the employees than on management. Strike relief is no substitute for a job. Even regular strike benefits, which few unions can afford, and which usually exhaust the union treasury quite rapidly (with some exceptions), are no substitute for a job." In terms of \( \bar{X} \), this means that as \( s \) grows large and \( \bar{X} \) approaches a vertical line, union leaders realize there remains little negotiating time for them and hence become susceptible to relatively low \( w \) offers from management.
The vertical axis intercept of $\bar{x}$, $w_{\bar{x}_0}$, here shown at the origin, is defined as the minimum wage rate which UM will tolerate regardless of the length of the strike. The level of $w_{\bar{x}_0}$, as a part of $\bar{x}$, will of course depend upon the various exogenous factors as previously listed. For a mathematical development of $\bar{x}$ see Appendix A.

2. A Union Member Political (or Psychological) Constraint

In addition to the foregoing constraint, union leaders (UL) are also constrained in their bargaining freedom by the level of UM expectations for wage increases, UME. That is, UM have expectations as to how large a wage increase (if any) can and should be achieved by the UL at the bargaining table. UME are more a function of UM conceptions of the relative bargaining strengths (which, of course, are formed on the basis of very incomplete and, at times, incorrect information) than of those factors determining their minimum financial gain, $\bar{x}$, as defined for Figure 1.

Let UME decline exponentially in $w,s$ space as a function of the difference between $w_0$, the level of UME at the contract expiration date, and $w_{\bar{x}_0}$ as previously defined. The rate of decline in UME is then given by,
\[ w = w_{x_0} + (w_0 - w_{x_0})e^{-\sigma t}, \forall s \geq 0,^{4} \]

where \( \sigma \) = the relevant decay or learning rate, i.e., the rapidity with which UM revise their wage expectations downward in light of the more accurate appraisal of management bargaining resistance which the inception and lengthening of the strike provides.

A meaningful comparison can be drawn between the slope of the UME function and the willingness of unemployed workers as the period of unemployment lengthens. Kasper [37] has shown "that (1) the average asking wage of the unemployed is significantly less than their former wage, and (2) the average asking wage of the unemployed significantly declines over the duration of unemployment."\(^5\) In the sense that workers on strike are unemployed during the strike, an analogous reduction in their "asking price," i.e., their expectations (UME), over the duration of the strike will occur. Hence we have UM wage expectations for wage increases from the negotiations declining monotonically from their initial (contract expiration date) level.

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\(^{4}\) This formulation of union member wage change expectations was first utilized by Ashenfelter and Johnson [2].

As the length of strike increases, $s \to \infty$, UME asymptotically approaches $w_{X_0}$, i.e., as $(w_0 - w_{X_0})e^{-\sigma t} \to 0$, $w_0 \to w_{X_0}$ (Figure 2).

In general, we would expect $w_0$ to be greater than $w_{X_0}$, given the minimal nature of $w_{X_0}$. As stated, from its initial level of $w_0$, UME will decline substantially due to the shock of the firm's resistance as the strike materializes, and as the strike lengthens the UM become increasingly
realistic in their assessment of the attainable w—one major function of a strike is to set this learning process in motion.

In sum, UME is a purely psychological function in that it defines what the UM believe the UL should be able to achieve in the new contract for various values of s. A settlement below UME will result in a contract ratification rejection by the rank and file.⁶ This is naturally politically embarrassing to the UL and will create doubts in their own minds about their job security. As such, we are assuming that UME will be treated with the reverence of a constraint on their negotiating behavior.

Thus in Figure 2 the feasible set of solutions is confined to the shaded area. A solution outside this would violate the UL job security constraint.

It should be noted here that the passage of the Landrum-Griffin Act of 1959, designed to promote intra-union democracy by regulating the internal affairs of labor unions, makes the UL more responsive to the UM and thus would tend to underscore the validity of both of the UM imposed bargaining constraints, \( \bar{X} \) and UME.

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⁶As the UM are not homogeneous, UME is being defined in terms of that level of w below which a sufficient number of votes to reject a settlement will be forthcoming from the rank and file.
II. MANAGEMENT'S CONSTRAINT

The Profit Constraint

It is assumed that there exists a minimum level of the discounted present value of the future profit which will satisfy the stockholder group and that below this the management (M) will be forced from office. As with $\bar{x}$ and UL, this is an absolute personal political survival constraint.

Given a minimum level of profit (maximum loss), $\bar{v}$, for each length of a strike there exist a wage rate which will maintain $\bar{v}$. As a strike lengthens the discounted present value of profits will diminish due to the decline in sales (inventories decline) and the firm's fixed costs of production. As such the wage increase which a given level of profits can absorb will decline with a resultant negative $\bar{v}$ slope in $w,s$ space. In Figure 3 $\bar{v}$ is seen to have been declining non-linearly from its vertical axis intercept, $w_{\bar{v}1}$. As the length of the strike becomes large the likelihood of the firm losing a portion of its present market share increases such that the present value of its future profits will decline more than the current loss of sales indicates. That is, as inventories disappear customers are forced to find new sources of supply. Hence the
w which $\bar{V}$ can absorb will decline at an increasing rate as the strike length grows.

For a mathematical development of $\bar{V}$, see Appendix A.

A "Rational" Cause of Strikes

Given the constraints we have just developed, we can deduce a cause of strikes which does not result from a lack of information on the part of either active bargaining party,
from either party misjudging the opposition's intentions, or from irrationality from union leaders or management.

That is, if \( w_0 > w_{V_1} \) (as seen in Figure 3 and reproduced here in Figure 4), such that the intersection of the \( V \) and UME constraints (point A in Figure 4) occurs at positive value of \( s \), it is completely in the best interests of the bargainers to allow a strike to occur. In fact, to avoid a strike either or both parties will have to violate a constraint. Even if union leaders have perfect information (as distinct from the very imperfect information which the union members and stockholders possess) and hence realized that a strike would yield a solution at point A, it would still behoove them to allow a strike and then achieve \( w_A \) with a point A settlement, vis-à-vis settling for \( w_A \) at \( s = 0 \) (Figure 4). While clearly the latter alternative is the preferred one from the viewpoint of the union member's financial position (not to mention the firm), it is due to their own lack of information and the resultant learning function, UME, that this alternative will not be achieved.

Perhaps it should be reemphasized that it takes only one bargaining party to cause a work stoppage, not

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7In fact, we are assuming perfect knowledge on the part of the union leaders and the management group, whereas the union members and the stockholder group suffer from incomplete and even incorrect information.
both, and the fact that at least one part must violate a political survival constraint is a sufficient condition to preclude a non-strike settlement (in fact, the difficulty in determining the primary responsibility for a strike is reflected by the fact that strikes and lockouts are normally not distinguished from each other in published statistics on industrial conflicts).

To be sure, the great majority of contract expira-
tions do not result in situations as the one represented in
Figure 4. More commonly, we would expect $w_0 < w^*_V$ as of course the great majority of contract negotiations result in non-strike settlements. As seen in Figure 5, the entire range of $w$ values falling between $w^*_V$ and $w_0$ with $s = 0$ represent feasible non-strike solutions. However, as will be seen when the union leader and management utility functions are developed, the existence of a $w^*_V > w_0$ segment on the $w$ axis is by no means a sufficient condition for a non-strike solution.

At this point in the analysis we can state the following conditions concerning the occurrence of strikes:

1. Point A (Figure 4), $s > 0$ → A sufficient condition for a strike. A settlement without a strike would violate the UME and/or the $V$ constraint.

2. Point A (Figure 4), $s = 0$ → Not sufficient to force a strike, i.e., a settlement at $w^*_V = w_0$ is possible. It is a unique non-strike solution.

3. Point A (Figure 4), $s \leq 0$ → Necessary to preclude a strike. This follows from (1) above.

4. Point C (Figure 5), $s = 0$ → Sufficient for a non-strike solution. Any solution involving a strike

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8This refers to the $w^*_V > w_0$ situation where the UME and functions are extended into the second quadrant such that their intersection would occur with $s < 0$.

9Point C (as seen in Figure 5) is defined as the
would violate the \( \bar{V} \) and/or the \( \bar{X} \) constraints.

III. UNION LEADERS' UTILITY FUNCTION

Let the union leader (UL) utility function be

intersection of the \( \bar{X} \) and \( \bar{V} \) functions. This is the last point in \( s \) where there exists a solution which violates no constraints.

Point C could theoretically occur at \( s = 0 \) if the cost of a strike were so great to union members and the firm that the \( \bar{X} \) and \( \bar{V} \) functions, respectively, were vertical and coincide with the \( w \) axis.
\[ U(UL) = U_1(X_1, X_2) \], with the arguments defined as follows:

1. \( X_1 \) = the net financial gain of the UM as previously defined (p. II-2).

This argument corresponds to the general UL motivation (p. I-5) of "the promotion of the financial welfare of the present union members" and clearly asserts that there exists a certain degree of empathy on the part of the UL toward their constituents, i.e., the UL desire wage increases beyond those necessary to satisfy the UM imposed constraints. Given that the \( \bar{X} \) constraint sets a floor on the level of the financial gain which will be allowed (and permit the UL to retain their jobs), the argument \( X_1 \) captures the UL utility which is achieved due to settlements in excess of this minimum necessary for their job security.

In essence then, we have a situation where the UL are constrained in their bargaining to achieve a specified minimum level of a given variable (UM financial gain), but are in fact rewarded (in utility terms) for settlements which exceed this minimum. As such, this is somewhat analogous to a goal programming situation wherein "any constraint incorporated in the functional is called a goal."\(^{10}\)

2. $X_2 = (w, \hat{s}) - (w, \hat{s})_{UME}$, the excess of the wage settlement over the expected settlement, à la union member expectations, UME, at the time of the final settlement, $\hat{s}$. That is, a settlement which exceeds the expectations of the UM will result in an increased level of power and prestige for the UL within the union.

The argument corresponds to the first UL general motivation as stated on p. I-5, i.e., that the UL desire personal power and prestige within the union beyond that amount necessary for their own job security. Our assertion is that the UM judge UL objectively on their performance where it is most explicit--at the bargaining table--and that the UL can improve themselves in the opinions of the UM only by exceeding the UM expectations. $X_2$ is designed to correspond to our belief that union leaders are essentially politicians.

Geometrically, if a strike is settled, say, at point $A$ in Figure 6, the UME constraint is fully satisfied by the wage rate $w_A$. Any wage rate greater than $w_A$ for an $s_1$ settlement will exceed UME and serve to enhance the UL position within the union, e.g., a settlement at point $B$ leaves $X_2 = w_B - w_A$.\(^{11}\)

\(^{11}\)While it will not be included in the analysis, for the purist's sake a third argument could be included in the UL utility function, $X_3$, the employment effect of wage settlements. In effect, this variable simply shifts some of
the emphasis from concern for the presently employed rank and file UM to the employment of future entrants in the UM ranks. Given the self-serving nature of the UL general motivations and utility function as specified, it is our contention that efforts to increase the financial welfare of present UM must take precedence over long run concerns about substitution of capital for labor. True, this means that the growth of the union in terms of absolute numbers of UM may be to a small extent sacrificed, but the survival of the union as an institution cannot but help being enhanced by the maintenance of the union-nonunion wage differential which results from UL preferences for large wage increases. To be sure, this does not always mean that UL are to allow decreases in employment of the present UM, for in an expanding economy the tradeoff should be between increases in wages or increases in employment (or both), not between an increase in one factor at the expense of a decrease in the other.

As such define $X_3 =$ the rate of growth of the employment of UM, in terms of man hours worked, $X_3(w, P, MPPL) =$, where $w =$ the wage rate achieved in the new contract; $P =$ the average price per unit of the firm's output; and $MPPL =$ the marginal physical product of the UM labor.
Given the definitions of $X_1$ and $X_2$, we can determine the characteristics of the UL utility function in $w,s$ space.

$$U(UL) = U_1(X_1, X_2) \rightarrow X_1 = X_1(w,s), X_2 = X_2(w,s).$$

The UL utility indifference curve in $w,s$ space has its slope given by,

$$dw = - \frac{\frac{\partial U}{\partial X_1} \cdot \frac{\partial X_1}{\partial s} + \frac{\partial U}{\partial X_2} \cdot \frac{\partial X_2}{\partial s}}{\frac{\partial U}{\partial X_1} \cdot \frac{\partial X_1}{\partial w} + \frac{\partial U}{\partial X_2} \cdot \frac{\partial X_2}{\partial w}} \cdot ds. \quad (2)$$

Given that $\frac{\partial U}{\partial X_1} > 0$, $\frac{\partial U}{\partial X_2} > 0$ by assumption, $\frac{\partial X_1}{\partial s} < 0$, $\frac{\partial X_1}{\partial w} > 0$ by definition of $X_1$, and that $\frac{\partial X_2}{\partial s} > 0$, $\frac{\partial X_2}{\partial w} > 0$ by definition of $X_2$, we see that the denominator of the slope is positive. With the two elements of the numerator being of opposite sign, $\frac{\partial U}{\partial X_1} \cdot \frac{\partial X_1}{\partial s} < 0$ and $\frac{\partial U}{\partial X_2} \cdot \frac{\partial X_2}{\partial s} > 0$, the slope of the indifference curve becomes a function of the marginal rate of substitution (MRS) of $X_1$ for $X_2$, $-\frac{\partial U}{\partial X_1}/\frac{\partial U}{\partial X_2}$, as well as the size of $\frac{\partial X_1}{\partial s}$ and $\frac{\partial X_2}{\partial s}$. 12

The indifference maps for the two extreme cases are

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12 While we do not pretend to be able to explain or predict changes in the MRS of $X_1$ for $X_2$ within the UL utility function, changes in $\frac{\partial X_1}{\partial s}$ and $\frac{\partial X_2}{\partial s}$ become very important in the empirical work. The change in the slope of the UME function becomes particularly relevant. That is, in (2) above we see that an increase in the UME slope will
given in Figures 7a and 7b. If \( \frac{\partial U}{\partial x_2} = 0 \), the full weight is given to \( x_1 \).

Figure 7a

Figure 7b

the net financial gain to the UM. This of course results in a family of indifference curves with the same slope as

increase \( \frac{\partial x_2}{\partial s} \) and hence either increase the (absolute values) size the UL indifference curves' negative slopes or decrease the size of their positive slopes. The converse is true of a decline in the UME slope. For a proof of this and its relation to the likelihood and duration of a strike see 5a in Appendix A, p. A-8.
the $X$ function (p. II-2). These are seen in Figure 7a. In such a situation it is clearly in the best interests of the UL to settle without a strike, i.e., at $s = 0$, unless they can attain a wage rate significantly above the initial offer from management.

In the second case, where $\frac{\partial U}{\partial X_1} = 0$, the full weight in the utility function is given to $X_2$, the excess of the wage rate achieved over the expectations of the UM at that point in time. The indifference curves in this case will have the UME function slope. Because the UME function asymptotically approaches the $w_{X_0}$ wage rate level (p. II-5), each indifference curve will also asymptotically approach its own base wage rate (Figure 7b). This set of curves actually places a cost on the UL for settling without a strike, unless of course they achieve a wage rate settlement substantially below the management's offer at contract expiration date.

We would expect the great majority of cases to fall somewhere between these extremes, with both $\frac{\partial U}{\partial X_1}$ and $\frac{\partial U}{\partial X_2}$ greater than zero. The corresponding shape of the UL indifference map will become very important in determining the location of the pareto efficient set of solutions (contract curve) in $w,s$ space.
prices, and the level and change in the profit rate. With quarterly data for the 1948-1960 period, Perry found that the variables enumerated above explained much of the variance in the rate of change of average hourly earnings in the manufacturing sector of the United States economy and in two subaggregates, durables and nondurables.

Perry's work probably exemplifies the popular view of the Phillips curve and of the inflation-unemployment tradeoff. An inverse relation between the rate of wage increase and the unemployment rate exists, and hence there is an implicit tradeoff between inflation and unemployment. Moreover, the goals of relatively stable prices and low unemployment are incompatible but, on the other hand, "it appears that reasonably low unemployment rates could be maintained without leading to exceptional rates of inflation." 23 The key word here is maintained; this suggests that Perry is describing a long run, permanent, inflation-unemployment tradeoff.

A family of Phillips curves exists in Perry's model, each curve depending upon profit rate conditions. Of particular interest for this research, however, is the estimate of the coefficient of the lagged price term. This coefficient was found to be about .37, substantially less than unity. This has prompted the interpretation that labor suffers from a money illusion, since price increases induce less than proportionate wage increases. 24 Such an interpretation may be seriously misleading if the expected, rather than the actual, rate of inflation is in fact the appropriate explanatory variable. In this case, if the expected rate of

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24. Kuh (1967) also endorses this view. See p. 348.
IV. MANAGEMENT UTILITY FUNCTION

Let the management (M) utility function be,

\[ U(M) = U_2(y_1, y_2, y_3) + y_1 = y_1(V), \quad y_2 = y_2(V), \]

\[ y_3 = y_3(V) + V = V(w, s) \]

where \( V \) is the discounted present value of the future profit stream.

The arguments are defined as follows:

1. \( y_1 = \) staff (including management salaries)
2. \( y_2 = \) discretionary spending for investments. Discretionary spending derives from an excess of reported profits over the minimum profits as represented by the constraint, \( \bar{V} \). In effect, \( \bar{V} \) sets a zero floor on discretionary investment—a negative \( \bar{V} \) would cut into what Williamson [34] calls "necessitous investments" and/or dividend demands. To the extent that the profit constraint is not binding, management enjoys increased utility above and beyond that yielded by simply satisfying the \( \bar{V} \) constraint.
3. \( y_3 = \) emoluments or management slack absorbed as cost; for example office improvements and
inflation were approximated by a distributed lag of past rates, the coefficient of the percentage change in prices lagged one period should indeed be less than one. Hence, the evidence presented by Perry concerning the money illusion issue should not be construed as conclusive.

Perry recognized that expectations have a role to play in the wage adjustment process. To account for their impact, he used a variable expressing the change in the profit rate. Although there is some mild ad hoc justification for this procedure, it is unfortunate that a more straightforward approach was not taken toward the measurement of expectations. As an externality, this might have cast some light on the money illusion problem described above.

Perry's equation performed rather well in the initial 1948-1960 period for which it was fitted. However, in the mid-1960's, the equation tended to regularly overpredict the quarterly percentage changes in nominal wages. Perry attributed this result to the effects of the wage-price guideposts, but alternative explanations abound. While a thorough examination of the guidepost controversy will not be pursued here, the issue is mentioned because the empirical work associated with this thesis includes the guidepost period and hence may provide some evidence on that experience.

Kuh (1967)

In this piece, Kuh presented an alternative to the standard Phillips curve equations of Perry and/or of Eckstein and Wilson. The point of departure is the role of the profit variable in Perry's formulation. According to Kuh,

25. See p. 22, above.

26. Much of the relevant literature is contained in the American Economic Review, June 1969. Also, see Perry (1967) and Simler and Tella (1968).
expense accounts.

This utility function is essentially an adaptation of O. E. Williamson's theory of managerial discretionary spending [34, 35] and as such is derived from the general management motivations as previously listed [p. I-5].

The slope of the M utility indifference curve in w,s space is given by,

\[
\frac{3U}{3v_1} dv_1 \frac{3U}{3v_2} dv_2 \frac{3U}{3v_3} dv_3 \frac{3U}{3s} ds.
\]

Given that

\[
\frac{3U}{3y_i} > 0, \quad (i=1,2,3) \text{ by assumption, } \frac{3^2U}{3y_i^2} < 0 \text{ by assumption, } dv_i/dv > 0 \quad (i=1,2,3), \text{ by definition, } 3v/3w < 0,
\]

by definition of v, 3v/3s < 0, by definition of v, we see that the slope of v is negative throughout the positive range of s, nonlinearly decreasing in w due to 3^2U/3y_i^2 < 0.\textsuperscript{13}

The resultant set of indifference curves is seen in Figure 8.

\textsuperscript{13}This subsumes the temporary increases in profits which may result if a firm's inventories are large upon the inception of a strike; i.e., for a short period at the beginning of a strike the firm may enjoy continued full scale sales accompanied by zero variables costs, until of course inventories decline.
"profits might be a proxy for a more fundamental determinant of wages, the marginal value productivity of labour..." To explore this hypothesis, Kuh constructed a wage adjustment equation where the independent variables were the unemployment rate, the consumer price index, a measure of labor productivity, and a lagged wage term.

This model consistently outperformed the Perry equation over the 1950-1960 estimation period. In addition, Kuh discovered that the unemployment rate did not exert important explanatory influence on the rate of change of wages. This was clearly regarded as refutation of the basic adjustment mechanism proposed by Phillips and Lipsey. Secondly, the results were quite favorable to the productivity hypothesis, so that the productivity specification did indeed appear superior to the profits version. Finally, the consumer price index proved to be a significant determinant of the percentage change in wages, confirming the belief in a strong interrelationship between price and wage changes.

Simler and Tella (1968)

The major thrust of this effort was to provide an explanation of the behavior of money wages in the mid-1960's, in light of evidence that the Perry equation consistently overpredicted wage increases in these years. Simler and Tella claimed that the existence of unreported labor force reserves was a decisive factor in the pattern of wage rate fluctuations and accounted for much of the discrepancy between actual wage changes and predictions from Perry's model.


28. Despite emphasis on productivity, Eckstein (1968) considered Kuh's model a direct descendant of the Perry equation rather than a major innovation.

Some Implications for the Causes and the Duration of Strikes

Earlier it was shown that under certain circumstances we can have sufficient conditions for a strike without the UL or M suffering from a lack of information, from misjudging each other's bargaining intentions, or from irrationality. To recall, when the union member expectation function's vertical axis intercept, \( w_0 \), is greater than the
On a theoretical level, Simler and Tella argued that unreported labor reserves tend to moderate or neutralize upward pressure on money wages because, first, unemployment understates the amount of excess supply in the labor market. Secondly, in a cyclical upswing, reserves enter the labor market, so that effective supply expands along with demand and the market does not tighten as quickly as it would in the absence of reserves.

In order to explore these presumptions, Simler and Tella had to construct a labor force reserves series. By calculating the labor force participation rate of secondary workers, assuming a constant participation rate for primary workers, and combining these with the appropriate population figures, a measure of the potential labor force was created. Subtraction of the actual labor force from the potential yields reserves, and in turn reserves plus unemployment gives adjusted unemployment. The adjusted unemployment series can then be introduced into an equation such as Perry's to determine its impact on the rate of change of nominal wages.

The regression results obtained when this was accomplished were striking. The addition of a variable which denoted labor reserves improved the explanatory power of the equation and, in particular, markedly reduced the magnitude of the overpredictions after 1962. Hence, the labor reserves hypothesis represents a serious challenge to the guidepost interpretation of the wage experience in the 1962–1966 interval.

Eckstein (1968)

In this effort, Eckstein reviewed and compared the performance of alternative empirical Phillips curve equations, and also tested the "employment mix" hypothesis. Since the novelty of this piece is its investigation of the effects of changes in the employment mix on the rate of change of money wages, this discussion will focus on the results of tests of that relation.

Eckstein's results apply only to the durable manufacturing sector, 1950–1960. The employment mix variable used is
profit constraint's intercept \( w_{V_1} \), the first feasible solution was with \( s > 0 \).

With \( w_{V_1} > w_0 \) there was a range of feasible solutions on the \( w \) axis which would yield non-strike settlements. Yet, as was stated (p. II-12), this is only a necessary and not a sufficient condition for a non-strike settlement. The explanation for this and an investigation of the related possibilities can now be provided in light of the UL and M utility functions which have just been developed. The analysis will be organized around the two types of situations provided by the bargaining constraints, \( w_{V_1} > w_0 \) and \( w_{V_1} < w_0 \), and each of these will be applied to the two extreme UL utility function cases, \( X_1 \) given zero weight (\( \frac{\partial U}{\partial X_1} = 0 \)) and \( X_2 \) given zero weight (\( \frac{\partial U}{\partial X_2} = 0 \)) as arguments (in conjunction of course with the M utility function).

A. \( w_{V_1} > w_0 \)

Case 1. \( X_1 \) is given zero weight (\( \frac{\partial U}{\partial X_1} = 0 \)).\(^{14}\) This is the extreme in which the UL put intraunion political ambitions totally ahead of the best interests of the rank and file. The result is seen in Figure 9.

\(^{14}\)To recall, \( X_1 = \) the net UM financial gain, \( X_2 = (w,s) - (w,s)_{UMB} \).
The feasible solution set is $w_{\forall 1} CD w_0$, i.e., there exists both strike and nonstrike feasible solutions. Given the union leader-management coalition as previously discussed (p. I-5), and the resultant joint utility maximization approach of the bargaining parties, we see that the final settlement will fall somewhere on the utility contact curve, $\lambda \lambda'$. In effect we have the traditional solution to two-person cooperative (nonconstant sum) games as solved by
von Neumann and Morgenstern [31]. That is, if the players (UL and M) are rational the potential settlements must be confined to that undominated set of solutions, in utility terms, which the given set of negotiations offers, i.e., the contract curve. The point $\lambda$ is the maximum utility achievable by M without causing either party to violate a constraint. The point $\lambda'$ is the same for the UL. Given the degree of cooperation necessary to maintain such a coalition, it is evident that either party will be risking its (the coalition's) dissolution by attempting to force a "non-equitable" settlement--a settlement at either extreme of the contract curve--on the other party. The outcome of such a maneuver could easily be degeneracy in the solution, i.e., it takes two parties to sign an agreement and if either refuses to do so, so as to protest inequitable demands by the opposition, then the solution will degenerate to point C, the intersection of the $\bar{X}$ (minimum UM financial gain) and $\bar{V}$ (profit) constraints. A settlement after point C (in s) would violate the personal political survival constraints of both parties. Point C represents a noncooperative settlement which must be dominated in both parties' utility functions for a potential contract curve solution to be part of the relevant solution set. Thus the $\lambda'\lambda''$ segment of the contract curve is the relevant solution set. A settlement
on the \( \lambda \lambda' \) segment is inferior to point C for the UL and hence is considered to be dominated. In addition to von Neumann and Morgenstern, techniques for "narrowing down" the relevant range of contract curve solutions have been suggested by Henderson [14], Nash [19,20] and Harsanyi [13].

In sum, there will be a strike, followed by pareto efficient non-unique solution.

Case 2. \( X_2 \) is given zero weight \( \left( \frac{\partial U}{\partial X_2} = 0 \right) \). This is the situation when the best financial interests of the rank and file are given full priority by the UL. In Figure 10 we see that the negative slope of the M utility curves and the (monotonically) positive slope of the UL utility curves result in no tangencies (contract locus) with \( s > 0 \). That is, each point on the \( w \) axis generates one set (1 UL and 1 M) of indifference curves which do not intersect at a positive \( s \). Any \( s > 0 \) settlement then will entail a loss in utility to one or both parties as compared

\[ \text{The theories by Nash and Harsanyi have achieved unique solutions. However uniqueness does not concern us here as we are interested primarily in the aggregate level of strike activity and the duration of strikes, not the } w \text{ level finally settled upon.} \]

In addition, it appears that the various techniques used to achieve uniqueness are somewhat arbitrary. Wagner [32, p. 384], states "The various treatments purport either to characterize how people react dynamically in conflict situations, or to suggest a system of fair and reasonable principles by which the conflict should be arbitrated . . . As might be anticipated, the solutions themselves differ from theorist to theorist. . . .there is a wide variety of theories from which to select."
Preference Ordering: U(UL) 1 > 2 > 3; U(M) 1' > 2' > 3'

to the same w solution at s = 0. Hence $w_0w_{\overline{V}}$ segment of the w axis becomes the contract curve and provides a range of pareto efficient non-strike feasible solutions.\(^\text{16}\)

As such, we have a situation where there will be a

\(^{16}\)The maintenance of the UL-M coalition is such that the decision to strike will be made by the bargaining parties only if a pareto efficient solution cannot otherwise be achieved. As such, the $w_0D$ segment of the UME function is not considered to pareto efficient (in this situation) by the coalition.
non-unique, pareto efficient, non-strike settlement.

These two cases represent the extreme in the shapes of the UL utility function. While the latter seemingly will be much more common than the former, it also seems evident that the great majority of cases will fall somewhere in between; i.e., both of the arguments, \( X_1 \) and \( X_2 \), receiving some weight. Naturally, the full range of slopes between the two extremes is possible with the result that the outcome can go either way--strike or non-strike pareto efficient solution (including the interest possibility of a set of UL indifference curves which for a brief time after the inception of a strike coincide with the M indifference curves; the result of course is an entire pareto efficient area or "thick contract curve.")\(^{17}\)

B. \( w_0 > w_{V_1} \)

Case 1. Again, \( X_1 \) is given zero weight \( \left( \frac{\partial U}{\partial X_1} = 0 \right) \).

In Figure 11 we see that the outcome of the bargaining will be the same as that for Case 1 with \( w_{V_1} > w_0 \). The major

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\(^{17}\) The effect of changes in the UME function's slope on the positioning of the contract curve are considered on pp. III-3,4. Parallel shifts of the UME function will of course not change the UL utility indifference curve slope or the contract curves position. There is merely a change in the level of utility that UL receive from a particular indifference curve in \( w_i \)'s space.
The difference is that here we have point A as the first feasible solution such that there will be a strike regardless of the weights given $X_1$ and $X_2$; whereas, in the previous two cases $\bar{V}$ and UME intersect only to the right of the $\bar{X}$ constraint. As stated on p. II-12, point A at $s > 0$ is sufficient, but not necessary for a strike to materialize. Overall then, we will have a strike followed by a non-unique, pareto efficient settlement.
Case 2. $x_2$ is given zero weight ($\frac{\partial U}{\partial x_2} = 0$). In Figure 12 we see that the result in this case will be in

Figure 12

effect to use the AD segment of the UME function for the role which the w axis played in the analogous $w_{v_1} > w_0$ case (Figure 10). That is, each point on the segment AD will generate one UL and one M indifference curve which of course do not intersect after they emanate from AD. Hence, as
with \( w_0 w_{V_0} \) in Figure 10, AD becomes the contract curve and a settlement will be reached somewhere on it. Again, if either party is non-cooperative, then the solution at point C can be threatened. The UL utility level at point C is the same as at point D, while the M utility level at C is considerably lower than at D. If M was non-cooperative in settling on AD before \( S_D \), the UL can merely follow the \( X \) constraint up to point D. And similarly, if M were convinced that the UL were not maintaining their portion of the coalition, it only has to be noted that points A and C represent the same utility to the M and yet C is a much lower utility level for the UL. Realizing this, a compromise pareto efficient solution will be found somewhere on the segment AD under the threat of the solution degenerating to point C.

As with the \( w_0 > w_{V_1} \) situation these two cases are the extremes and the majority of cases will of course fall somewhere between them, with the only major variation being the positioning of the contract curve. The greater the relative weight given to the UL utility function argument \( X_1 \), the closer the contract curve to the \( w \) axis. The greater the relative weight given to \( X_2 \), the further to the right the contract curve will lie and the greater will be the duration of the strike.
Some Implications and Results of the Model

Before turning to Chapter III's investigation of the exogeneous factors which cause some of these bargaining situations to materialize, it is appropriate here to list some theoretical implications of the model and to answer some of the questions raised earlier.

1. As alluded to in Chapter I, Hicks [15] has stated that "Under a system of collective bargaining, some strikes are more or less inevitable...; but nevertheless the majority of actual strikes are doubtless the result of faulty negotiation." The conclusions reached in our theory are quite to the contrary. That is, faultless negotiations by the UL and M will lead to equitable strike and non-strike settlements on the (pareto efficient) contract curve. In both cases where \( \bar{V} \) and UME functions intersected at \( s_1 > 0 \) and in one case where they did not (i.e., with the UL utility function argument \( X_1 = 0 \)), these settlements entailed strikes. Indeed, from the UL and M points of view, these are rational strikes. As such, we are forced to conclude that many strikes, rather than being a function of imperfections of the
bargaining process, are an inevitable result of the collective bargaining system as an institution as it exists today.

2. In our model, the higher the time preference of each bargainer, i.e., the higher their discount rates \( r_1 \) and \( r_2 \), the faster a stable solution will be found and thus the shorter any given strike will be.\(^{18}\) That is, a higher discount rate reduces the present value of any given wage increase which is achieved (or profit level for \( M \)) so that it takes a higher wage increase (or lower wage increase for \( M \)) at any given \( s_i \) to maintain a given utility level. The result is of course a contract curve which is shifted to the left in \( w, s \) space and accordingly a shorter duration for a strike.

3. a) \( \frac{d}{ds} U(UL)/ds \text{ constant} = \frac{d}{ds} U(M)/ds \text{ constant at } s = 0 \), is a necessary condition for a non-strike settlement. This cannot occur if \( X_1 \) is given zero weight \( \left( \frac{\partial U}{\partial X_1} = 0 \right) \).

b) Point A, the \( \nabla \) and UME functions' intersection

\(^{18}\)This conclusion was reached by Contini [5,6] in his model. Also note that stability as used in this sense merely refers to non-violation of the UL-M coalition by agreeing to equitable pareto optimal solutions. In the pure sense of course one cannot speak of stability when dealing with a comparative static system.
at $s \leq 0$, is a necessary condition for a non-strike settlement.

... a and b together are necessary and sufficient for a non-strike solution, no one factor by itself is a sufficient condition.

c) $\frac{d U(UL)}{ds}$ constant = $\frac{d U(M)}{ds}$ constant at $s > 0$, is a sufficient condition for a strike. This cannot occur if $x_2$ is given zero weight ($\frac{\partial U}{\partial x_2} = 0$) in the UL utility function.

d) Point A (the $\bar{V}$ and UME intersection) at $s > 0$ is a sufficient condition for a strike. There is not necessary for a strike per se as either of the factors which enter the decision process, the bargaining constraints and the utility functions of the UL and M, can be by themselves sufficient to cause a strike.

4. The greater the weight that the UL give to their political ambitions (within the union) vis-à-vis the best interests of the UM, i.e., the present value of the wage bill, the greater the duration of the strike. The positive slope of the UL utility function is smaller (or the negative slope greater), the smaller weight given the UM net financial gain from the strike in the UL utility
function. Thus the tangency with M the utility indifference curve farther to the right in w,s space and the result is a greater duration for the strike. 19

5. a) The greater the initial disparity between the UME function w axis intercept, \( w_0 \), and the \( X \) function w axis intercept, the greater will be the negative slope of the UME function, and

b) The greater the negative slope of the UME function, the greater the likelihood of a strike and the greater the strike's duration if it does occur. This result becomes particularly relevant in the empirical work in Chapters III and IV. Proof of both of these is provided in Appendix A.

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19 This is subject to the qualification that the M indifference curve is continuous and negatively sloped throughout. This is consistent with the function as developed earlier. Only if the firm's inventory position were so large as to negate profit loss during the early portion of the strike, does the M indifference curve become positively sloped and reverse the result.
APPENDIX A

1. Union Members' Minimum Financial Gain

Constraint, $\bar{X}$

If we let $r_1$ = the relevant discount rate, a constant
$w$ = the rate in the new contract
$H$ = the number of "straight-time" hours
worked per day by UM--overtime hours
are translated into "straight-time"
equivalents
$s_i$ = the various lengths of the strike
$k$ = the average retirement date for
present UM
$ar{w}$ = the wage rate in the old contract

then

$$\int_{0}^{k} Hw e^{-r_1 t} \, dt = \text{the discounted present value of the}$$
$$\text{future wage bill at contract date.}$$
We have assumed that the contracts
are not renegotiated at a future
date. This is merely to simplify

A-1
the analysis and could readily be changed by defining \(k\) = the next contract expiration date.

However, if there is a strike, the discounted present value of the future wage bill becomes

\[
e^{-r_1 s_i} \int_{s_i}^{k} H w e^{-r_1 t} dt.
\]

Defining foregone earnings as

\[
\int_{0}^{k} H w e^{-r_1 t} dt,
\]

we arrive at

\[
e^{-r_1 s_i} \int_{s_i}^{k} H w e^{-r_1 t} dt - \int_{0}^{k} H w e^{-r_1 t} dt =
\]

the gross financial gain enjoyed by UM from the new contract. Note that we are assuming that \(H\), hours worked per day by the UM, is the same constant before and after the strike, but of course zero during it. As such the problem of post-settlement adjustments of hours worked is not addressed.
This type of adjustment can be upward in the short-run haste of the firm to fill back-orders, but in general we would anticipate a downward adjustment as capital is substituted for labor, presuming of course an increase in wages which exceeds any increase in the price of capital.

To achieve the net financial gain which the UM receive from the new contract, the secondary income earned by the UM during the strike, which would not have been earned without a strike, must be deducted from the foregone earnings,\(^1\)

\[
\int_0^k H \omega e^{-r_1 t} \, dt - \int_0^{s_i} \bar{y} e^{-r_1 t} \, dt = \text{the net foregone earnings; where } \bar{y} = \text{the secondary income for the UM.}
\]

Thus,

\[
e^{-r_1 s_i} \int_{s_i}^k H \omega e^{-r_1 t} \, dt - (\int_0^k H \omega e^{-r_1 t} \, dt)
\]

\(^1\)The UM are of course not a homogeneous group and in particular the differences in their ages are relevant. That is, as the older UM near retirement the wage rate gains become less important as they are applicable to a shorter time horizon. As such, the foregone earnings penalize the worker near retirement relatively more.
\[- \int_{0}^{s_i} ye^{-r_1 t} dt = X_1, \text{ the net UM financial gain from the strike.} \]

\[X_1 = X_1(w,s), \text{ and with a constant } X_1, \text{ i.e., } \bar{X}, \]

given by \[dX_1 = \frac{\partial X_1}{\partial w} dw + \frac{\partial X_1}{\partial s} ds = 0, \]
then

\[- \left[ \frac{\partial X_1}{\partial s} / \frac{\partial X_1}{\partial w} \right] \text{ is the } \bar{X} \text{ function slope in } w,s \text{ space.} \]

To evaluate the slope we see that:

1. \[\frac{\partial X_1}{\partial s} < 0, \text{ as the strike lengthens foregone earnings increase as well as the discount factor in the present value of the future wage bill.} \]

2. \[\frac{\partial^2 X_1}{\partial s^2} < 0, \text{ as the strike lengthens some sources of secondary income will become exhausted, e.g., strike funds and unemployment compensation.} \]

3. \[\frac{\partial X_1}{\partial w} > 0, \text{ by definition of } X_1. \]

The slope of \( \bar{X} \) is thus positive in \( w,s \) space, with the non-linearity (Figure 1 in the text) due to \( \frac{\partial^2 X_1}{\partial s^2} < 0. \)
2. Management's Minimum Profit Constraint

Define $V$ as the discounted present value of the future profit stream, then,

$$V = e^{-r_2 s_i} \int_{s_i}^{\infty} (PQ_1 - HW - F)e^{-r_2 t} \, dt$$

$$+ \int_{0}^{s_i} (PQ_2 - F)e^{-r_2 t} \, dt,$$

where

$r_2 = \text{The relevant discount rate, a constant}$
$p = \text{the per-unit price of the firm's output}$
$Q_1 = \text{units of output sold by the firm, per-unit of time, after the strike settlement.}$
$Q_2 = \text{units of output sold per-unit of time during the strikes, } Q_2 = Q_2 (s)$
$F = \text{fixed costs}$
$H = \text{hours worked per day by the UM.}$

... Note that $H$ is equal to zero during the strike such that $HW$ has dropped from the second element of $V$.

Given $V$, then for each $s_i$, the various potential strike lengths, there exists at $w \ni V = \tilde{V}$; where, $\tilde{V}$ is the
for the perfectly elastic supply of labor schedule is that, due to the inability to control prices, labor cannot significantly raise its real wage, especially in imperfectly competitive product markets where prices are determined by markups and wages are a major determinant of variable costs. On the other hand, labor is likely to prove intransigent in the face of real wage declines resulting from a fall in nominal wages, for essentially Keynesian reasons. That is, Kuh argues that labor unions, and labor in general, will oppose real wage reductions resulting from a decline in money wages because of their adverse impact on the distribution of income. If the real wage demand elasticity for labor is small, then a fall in real wages would increase employment but reduce total labor income.

An advantage of the peculiar labor supply function advanced here is that it is compatible with the concept of involuntary unemployment and easily lends itself to graphical representation. Granted this IS-LM model, what happens when the authorities attempt a dose of monetary stimulus?

Suppose that in Diagram III, expansionary monetary policy shifts the LM curve from $LM_o$ to $LM_1$. There will be excess demand in the market for commodities (excess aggregate demand) since $Y_1 > \bar{Y}_o$. Prices will rise in response to this situation, and firms will grant money wage increases, so that employment increases to $N_1$ on the relevant supply schedule $N^S_1$. The original demand for labor curve is still applicable, and the increase in employment occurs because the actual real wage $(W/P)_1 < (W/P)_o$ (the initial real wage), although the expected real wage $(W/P)^* > (W/P)_o$. Labor supply responds to the expected real wage; in fact, if labor realized that $(W/P)_1 < (W/P)_o$ and curve $N^S_1$ was relevant, no labor would be forthcoming.
minimum acceptable V. This refers to the discounted present value of the level of profits which Williamson [34] calls "minimum profits."

With \( V = V(w,s) \), the slope of \( V \) in \( w,s \) space is determined as follows:

With a constant \( V \) given by

\[
dV = \frac{\partial V}{\partial w} \cdot dw + \frac{\partial V}{\partial s} \cdot ds = 0 ,
\]

\[- \left[ \frac{\partial V/\partial s}{\partial V/\partial w} \right] = \text{the slope of } V.\]

To determine its sign, \( \frac{\partial V}{\partial w} \) and \( \frac{\partial V}{\partial s} \) are evaluated as follows:

\[
\frac{\partial V}{\partial s} = \frac{\partial V}{\partial \pi_1} \cdot \pi_1/\pi_1 + \frac{\partial V}{\partial \pi_2} \cdot \pi_2/\pi_2 ,
\]

\[
\frac{\partial V}{\partial w} = \frac{\partial V}{\partial \pi_1} \cdot \pi_1/\pi_1 + \frac{\partial V}{\partial \pi_2} \cdot \pi_2/\pi_2 ,
\]

where

\[
\pi_1 = e^{-r_2s_i} \int_{s_i}^{\infty} (PQ_1 - Hw - F) e^{-r_2t} dt
\]

\[
\pi_2 = \int_0^{s_i} (PQ_2 - F) e^{-r_2t} dt .
\]
a. $\partial V / \partial \pi_1 > 0$, by definition

b. $\partial V / \partial \pi_2 > 0$, by definition

c. $\partial \pi_1 / \partial s < 0$, the range of integration decreases and the discount factor, $e^{-\tau Z s_1}$, increases. We would expect a $\partial^2 \pi_1 / \partial s^2 < 0$ as well due to the increased likelihood of a loss of a portion of the present market share as the strike lengthens. That is, as $Q_2 \to 0$, because of diminishing inventories, customers are forced to find new sources of supply.

d. $\partial \pi_2 / \partial w = 0$, by definition as $H = 0$ during strike, and $\partial \pi_1 / \partial w > 0$, also by definition.

Thus, $\partial V / \partial w < 0$, and the slope of $V$, $-\frac{\partial V / \partial s}{\partial V / \partial w}$, is negative in $w, s$ space.

To maintain $V$ at the $\nabla$ level as $s$ increases from zero we have, $\partial V / \partial w \cdot dw = \partial V / \partial s \cdot ds$, and given that, $\partial \pi_1 / \partial s < 0$; $\partial^2 \pi_1 / \partial s^2 < 0$; $\partial \pi_2 / \partial s < 0$, the negative slope of $\nabla$ will be nonlinearly decreasing $w$ as $s$ grows.

3. Proof of Implication 5a, b, p. II-35:

5a) The greater the initial disparity between the UME function $w$ axis intercept, $w_0$, and the $X$ function $w$ axis intercept, $w_{X_0}$, the greater
will be the negative slope of the UME function.

From

$$w_{UME} = w_{X_0} + (w_0 - w_{X_0}) e^{-\sigma s}, \forall s \geq 0,$$

we have,

$$\frac{\partial w}{\partial s} = -\sigma (w_0 - w_{X_0}) e^{-\sigma s}$$

and

$$\frac{d(-\sigma [w_0 - w_{X_0}] e^{-\sigma s})}{d(w_0 - w_{X_0})} = -\sigma e^{-\sigma s} < 0.$$

5b) The greater the negative slope of the UME function, the greater the likelihood of a strike and the greater the strike's duration if it does occur. That is, given that

$$X_2 = w - w_{UME} = w - w_{X_0} - (w_0 - w_{X_0}) e^{-\sigma s},$$

we see that

$$\frac{\partial X_2}{\partial s} = \sigma (w_0 - w_{X_0}) e^{-\sigma s},$$

then
\[ \frac{d[aX_2/s]}{d(w_0 - w_X^0)} = \sigma e^{-\sigma s} > 0, \]

then, from the definition of the U(UL) indifference curve

\[ dw = - \frac{\partial U \partial x_1 + \partial U \partial x_2}{\partial x_1/\partial s \partial x_2/\partial s} \cdot ds \]

and its evaluation on p. II-17,\(^2\) the

\[ d[aX_2/s]/d(w_0 - w_X^0) > 0, \]

implies that the UL indifference curves will be of greater negative or lesser positive slope due to the increase in \(w_0 - w_X^0\). This in turn will of course result in a contract curve farther to the right in \(w,s\) space and hence increase the likelihood and the duration of a strike.

---

\(^2\)That is, \(\partial U/\partial x_1 > 0; \partial U/\partial x_2 > 0; \partial x_1/\partial s < 0; \partial x_1/\partial w > 0; \partial x_2/\partial s > 0;\) and \(\partial x_2/\partial w > 0.\)
APPENDIX B

A STOCKHOLDER GROUP EXPECTATION CONSTRAINT

Although it is not used in the empirical analysis, the stockholder group's (SG) analogue to the union member expectation constraint will be given here for conceptual purposes—in actuality, the responsiveness of management to the expectations of the SG is at best doubtful in all but the most extreme cases.

Assume there is a maximum $w$, call this $w_*$, which the SG will allow regardless of the length of the strike, toward which their expectations, SGE, will rise from their initial level, say $W_M$, at $s = 0$.

The decay function then will take the form,

$$w = W_M + (w_* - W_M) e^{-pt}, s \geq 0,$$

with $w$

asymptotically approaching $w_*$; as

$$t \to \infty \Rightarrow w_* - W_M \to 0 \text{ and } w \to w_*$$

(Figure 13).

As with UME, the stockholder expectation function is best considered as a learning function whereby the SG gradually overcome their lack of information concerning the

B-1
bargaining situation.

Again, the set of feasible solutions is confined to the shaded area; a solution outside of this would theoretically violate the management group personal political survival constraint.

Again, as with UME, this is a purely psychological function in that it defines what the SG believes management should be able to achieve in the new contract for the
various values of $s$ (as distinguished from the minimum profit level which they demand).

CHAPTER III

In this chapter we use the geometrical framework of the model to derive a set of testable hypotheses by analyzing the effects of various exogenous influences on the outcome of the negotiations, i.e., on the level of aggregate strike activity and the duration of strikes. The approach used is to examine the impact of qualitative changes in these exogenous influences on the union leader utility function and three bargaining constraints and then to qualitatively synthesize each variable's net effect.

Changes in the following exogenous variables will be considered:

1. The unemployment rate, private wage and salary workers in nonagricultural industries.
2. Compensation, private nonagricultural sector--all persons.
3. Consumer price index, private nonagricultural sector--all persons.
4. Corporate profits after tax, excluding the inventory valuation adjustment.
5. Change in business inventories.

III-1
6. Personal savings.

In addition, dummy variables are used to test the impact of

1. The Landrum-Griffin Act
2. Seasonal variations, quarterly
3. Time.

I. THE UNEMPLOYMENT RATE

Within the framework we have developed an increase in the unemployment rate would manifest itself through several changes.

First, there would be a downward shift of the union member expectation function's w axis intercept, w₀, in w,s space, i.e., the UM will have a lower wage expectation as of the contract expiration date. To recall, the UME function is solely dependent upon what the UM believe the union leaders should be able to achieve for them in the negotiations--their conception of the relative UL and management (M) bargaining strengths. With an increase in the unemployment rate the UL are constrained in their wage demands because large wage increases will aggravate the (already poorer) unemployment situation within the union. The UM
presumably will realize this and expect smaller wage gains.¹

In addition, during periods of increased unemployment the UM will suffer from a decreased ability to withstand a strike financially. That is, during such periods part-time work for striking UM and/or their families will become more difficult to find. This results in a decrease in the bargaining strength of the UL as M realizes the union's reduced ability to sustain a strike. This too will serve to lower the UME function's w axis intercept.²,³

With the increase in the unemployment rate we would expect an upward shift in the $\bar{X}$ function in w,s space. As previously stated, with increased unemployment secondary income sources (part-time work for strikers and/or their families) will diminish in availability. Therefore any given w (wage rate) will result in a lower $X_i$, such that a

¹In effect then, a maximum allowable unemployment level is implicit in the UME function. In instances where the wage change--employment tradeoff is involved the UM will revise their wage expectations to allow what they believe to be the appropriate emphasis on (un)employment.

²Also, with an increase in layoffs being an indication of a reduction in output and sales, firms will accordingly be less able to afford large wage increases (technological unemployment being an exception). In such situations the UL will do their best to disseminate information designed to convince the UM that circumstances do not warrant high wage expectations. Naturally UL will always try to lower UME, except where $\partial U/\partial X_2 = 0$ in their utility function, but in these circumstances their probability of success is much higher.

³Changes in the UME function slope will be considered shortly.
higher \( w \) at each \( s_i \) (strike length) is necessary to maintain \( \bar{X} \). To recall,

\[
X = X[e^{-r_1 s_i} \int_{s_i}^{k} Hw e^{-r_1 t} dt]
\]

\[- ( \int_{0}^{k} Hw e^{-r_1 t} dt - \int_{0}^{s_i} \bar{y} e^{-r_1 t} dt ) , \]

... with a reduction in

\[
\int_{0}^{s_i} \bar{y} e^{-r_1 t} dt ,
\]

\( \bar{X} \) is restored by an increased \( w \).

The shift in the \( \bar{X} \) function, coupled with the downward shift of the UME function's \( w \) axis intercept, causes a change in the slope of the UL utility function. As was shown in 5a, b, pp. II-34, 35, the greater (smaller) the initial disparity between the UME and \( \bar{X} \) function's \( w \) axis intercepts, the greater (smaller) will be the negative slope of the UL utility function or the smaller (greater) will be its positive slope.\(^4\) As such, the decrease in \((w_0 - w_{X_0})\),

---

\(^4\)To recall, the UME function is defined as,

\[ w = w_{X_0} + (w_0 - w_{X_0})e^{-\sigma t}, \forall s_i \geq 0. \]
as is the case here, will result in a set of UL utility contours which will be of a greater positive or smaller negative slope than before the change in the unemployment rate. And as seen in 5b, pp. II-34, 35, this implies a shift of the contract curve to the left in $w_s$ space and thus results in both a decreased likelihood of strikes occurring and a shorter duration for those strikes which do occur.\(^5\)

Geometrically, the overall effect of the increase in unemployment is seen in Figures 14 and 15.\(^6\) In Figure 14 suppose that the first feasible solution, before the increase in unemployment, is at point D such that any feasible solution will involve a strike. The solution space is the area DEF. With the change in unemployment the UME function shifts downward to UME' and assumes a smaller negative slope, while the $\overline{X}$ function shifts upward to $\overline{X}$. With the UME' function

\(^5\)The opposite outcome is of course true for a decline in the unemployment rate, i.e., UME increase such that $(w_0 - w\overline{X}_0)$ increases, leaving a higher likelihood of strikes and a longer duration for those which do occur. Intuitively this means that there is a positive cost to UM, in terms of more frequent and longer strikes, associated with highly inflated wage expectations at contract expiration date.

\(^6\)While a change in the unemployment rate itself will not affect the slope of the $\overline{V}$ function or the $M$ utility indifference curves, there are events associated with a change in unemployment (e.g., a change aggregate output) which are indirectly related to $\overline{V}$ and $U(M)$; however, it is the direct effects which interest us. Where an interest persists, any indirect effects can be tested directly by other variables.
intercept on the w axis at point \( w_0' \), in the w segment \( w_0'w_{\bar{V}_1} \) there exists a set of feasible non-strike solutions. This of course is true for any \( w_0' \leq w_{\bar{V}_1} \). Therefore in such cases we can state that the increase in unemployment leads to a reduction in the likelihood of strikes.

In addition, if the shift of the UME function were to a w axis intercept between \( w_0 \) and \( w_{\bar{V}_1} \) the result would be an UME-\( \bar{V} \) intersection (D') at a smaller strike length
s. With the first feasible solution at an earlier point in the strike, we can say that the increase in unemployment will at least not increase the average duration of strikes and could conceivably even shorten them.

In Figure 15 we illustrate a shift in the UME function w axis intercept from \( w_0 \) to \( w_0' \), such that feasible

Figure 15
non-strike solutions exist both before and after the change in unemployment. The accompanying increase in the positive slope, or decrease in the negative slope, of the UL utility indifference curves has the effect of shifting any contract curve, with previously positive s values, toward the horizontal axis, i.e., earlier settlements. If the change in the slope of the UL utility indifference curve is large enough such that its slope is positive at all values of s, this is sufficient to place the contract curve on the horizontal axis and thus insure a pareto-optimal non-strike solution.

Hence we see that the increase in unemployment has the same qualitative impacts on the outcome of the negotiations through its effect on the UL utility function and through its effect on the UME and \( V \) constraints, i.e., a decreased likelihood of strikes and a shorter average duration for the strikes which do occur.\(^7\)

II. COMPENSATION, PRIVATE NONAGRICULTURAL SECTOR--ALL PERSONS, PERCENT CHANGE FROM PREVIOUS QUARTER

Lagged increases in the percentage change of the

\(^7\)All of the foregoing has been concerned solely with increases in unemployment. The arguments which have been made can easily be reversed for situations involving decreases in unemployment such that it would be redundant to trace through them here. The same is true for the remainder of the variables we consider.
nominal wage compensation of labor should be felt through their effects on the expectations and the $\bar{X}$ demands of the UM. First, we would in general anticipate a downward revision of UME. That is, to the extent that any cumulative wage expectations which the UM entertain are fulfilled, the result will be a decrease in what the UM believe the UL can exact from management in the current negotiations. As such, the UME function's w axis intercept will shift downward.

Given that the minimum wage rate that the UM will tolerate (regardless of the length of a strike) from the negotiations, $w_{\bar{X}_0}$, is a function of recent settlements by other union or nonunion groups, in addition to cost of living changes and increases in UM productivity, we would expect it to shift upward on the w axis to the extent that these recent increases in percentage wage gains refer to successes by other competing groups. For example, wage increases achieved by nonunion groups would necessitate a higher $w_{\bar{X}_0}$ so as to maintain the union-nonunion wage differential.

Thus we have a situation similar to that described for increases in the unemployment rate, i.e., there is a decrease in the $(w_0 - w_{\bar{X}_0})$ element of UME, $w = w_{\bar{X}_0} + (w_0 - w_{\bar{X}_0})e^{-\sigma t}$, $\forall s \geq 0$, and there is a shift of the contract curve to the left in w,s space (see Figure 15).
We hypothesize therefore that positive wage changes in recent periods will have the effect of lowering the likelihood of strikes and of lowering the average duration of those strikes which do occur (both because of the downward shift of the UME function and the leftward shift of the contract curve in w,s space).

III. CONSUMER PRICE INDEX, PRIVATE NONAGRICULTURAL SECTOR--ALL PERSONS

In the absence of money illusion we would expect on an a priori basis for wage increases and consumer price increases to have opposite effects on the UL and UM functions in our model. We find that this is not quite the case.

With recent increases in prices UM realize that they are not as well off in real terms and accordingly revise their wage gain expectations upward, i.e., any cumulative wage (real) expectations which the UM entertain are dealt a setback. This shift is just the opposite of that for the increase in wages.

However, the minimum wage which the UM will tolerate, $w_{X_0}$, is, as we have stated, a function of cost of living changes. The effect of the price increase will be to cause an upward shift in $w_{X_0}$ as a higher nominal wage is required
to yield the same real wage. To recall, \( w_{X_0} \) also shifted upward for recent wage increases. This is due to the fact that recent price increases have an effect on all workers, whereas recent wage increases apply only to those workers having just completed their negotiations, leaving the workers currently negotiating that much "behind" the others.

Overall we have little change in \( (w_0 - w_{X_0}) \) as both \( w_0 \) and \( w_{X_0} \) increase (Figure 16). Accordingly, there will be little change in the slope of the UL utility indifference curves and the position of the contract curve. Hence the net result is a parallel upward shift of the UME function such that if the contract curve is on the \( w \) axis there will be a small increase in the likelihood of and the average duration of strikes, i.e., the probability of the UME - \( V \) intersection being at an \( s_1 > 0 \) is increased.\(^8\)

IV. CHANGE IN CORPORATE PROFITS AFTER TAX, EXCLUDING INVENTORY VALUATION ADJUSTMENT

Lagged increases in corporate profits will affect the model in the following ways. With lagged increases in profits, expectations for profits in the immediate future are likely to be optimistic as the firm expects to share in an expanding market. Given the definition of \( V \), we see that

\(^8\)Again, this is in the absence of money illusion.
However, in the trials attempted here with lags of up to ten periods (quarters), the results of estimation of the Phillips relation including an unconstrained distributed lag were not particularly encouraging. The pattern and size of the coefficients of the lagged price terms fluctuated widely from one trial to the next as additional lagged terms were included. Moreover, no $R^2$ exceeded about .60, and the unemployment rate, provisionally assumed to be a proxy for (negative) excess demand for labor, did not perform impressively, since its coefficient, although of the correct sign, was never statistically significant. At any rate, little confidence should be placed in these results because direct estimation of an unconstrained distributed lag encounters serious difficulties due to multicollinearity. In fact, the unpredictable nature of the lagged price coefficients probably stems directly from this problem.

III

In an effort to surmount some of these difficulties, wage adjustment equations were also estimated with the Almon lag technique, with the weights constrained to satisfy a second degree polynomial. Tables I-III summarize the results, but further comments are in order. Table I contains the regression coefficients for a simple wage adjustment equation where the independent variables are the lagged unemployment rate and the expected rate of inflation, as measured by past rates of change of prices.

In light of the low $R^2$s and rather disturbing Durbin-Watsons, the results in Table I are hardly cause for jubilation. Nevertheless, evidence on a number of issues can be gleaned from the information in the Table. First, the unemployment rate performed satisfactorily; its coefficient was negative and significant throughout these trials. Secondly, if the coefficients on the price terms are at all reliable, consistently declining weights are implied, at least for the up-to-eight period lag used here. Perhaps more importantly, the coefficients do not sum to unity, but to amounts substantially less. Hence,
larger expected future profits will be reflected by an increased first element of V such that any given $w_{V_1}$ can absorb a larger w, i.e., there is an upward shift of $w_{V_1}$ in w,s space.

With increased corporate profits it is also quite natural that the UM should expect to share in them. Hence the UME function's w axis intercept, $w_0$, will shift upward some fraction of the increase in $w_{V_1}$, i.e., the UM have a
Table I

Percentage Changes in Money Wages Regressed on the Unemployment Rate and Lagged Percentage Changes in Prices—Almon Lag, 2nd Degree Polynomial

1954I - 1969IV

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<td>Constant</td>
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<td>7.17</td>
<td>7.86</td>
<td>8.19</td>
<td>8.23</td>
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<td>$U_{t-1}$</td>
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<td>-0.58*</td>
<td>-0.72*</td>
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<td>(-3.7)</td>
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</tr>
<tr>
<td>$t-1$</td>
<td>0.48*</td>
<td>0.29</td>
<td>0.14</td>
<td>0.07</td>
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<td></td>
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<td>(1.8)</td>
<td>(1.0)</td>
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<tr>
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</tr>
<tr>
<td></td>
<td>(1.1)</td>
<td>(1.6)</td>
<td>(1.1)</td>
<td>(0.8)</td>
<td>(0.6)</td>
</tr>
<tr>
<td>$t-3$</td>
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<td>0.01</td>
<td>0.03</td>
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<tr>
<td></td>
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<td>(-0.7)</td>
<td>(0.3)</td>
<td>(0.8)</td>
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<td>$t-4$</td>
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<td>(-0.3)</td>
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<td>0.00</td>
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<tr>
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<td>(-0.5)</td>
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<tr>
<td>$t-6$</td>
<td></td>
<td>-0.03</td>
<td>0.00</td>
<td>0.01</td>
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<tr>
<td>$t-8$</td>
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<td></td>
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<td>(0.1)</td>
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$R^2$ = 0.3956  0.3676  0.3595  0.3382  0.3063

$DW$ = 0.46  0.46  0.49  0.47  0.49

$\Sigma$ = 0.17  0.15  0.14  0.16  0.16

$R^2$ = Coefficient of determination
$DW$ = Durbin-Watson statistic
$\Sigma$ = Summation of regression coefficients on price variables t values are in parentheses.
*Coefficients significant at 5 percent level.
right to expect the UL to acquire a portion of the higher profits in the form of wage gains, but certainly not all of them. As such, the remaining fraction of the profit increases represents a net upward shift of $w_{\nu_1}$ over $w_0$. This would of course indicate a lower likelihood of strikes.

Given the increase in $w_0$ and nothing to indicate a change in $w_{\bar{X}_0}$ we also have an increase in $(w_0 - w_{\bar{X}_0})$ and hence a rightward shift of the contract curve in $w,s$ space. This means that the strikes which do occur will be of larger duration.

In sum we would expect fewer strikes, but those which do occur to be of greater average duration.

V. CHANGE IN BUSINESS INVENTORIES

With a positive change in business inventories the UME function will shift downward in $w,s$ space as the increase in inventories reduces the cost of a strike to the firm, thereby weakening the UL bargaining position. The UM will therefore anticipate a smaller initial $w$. Given that there is no reason to believe that the $\bar{X}$ function's $w$ axis intercept will change, the net result is a decline in $(w_0 - w_{\bar{X}_0})$ and thus a leftward shift of the contract curve in $w,s$ space. Both the shift in the UME function and the contract curve are indicative of a lower likelihood and
despite the preliminary nature of these findings, they do cast doubt on the validity of one of the major conclusions of the strong expectations hypothesis. More explicitly, the strict expectations model predicts that the coefficients of the past rates of change of prices will sum to one, so that if a constant rate of inflation were established, money wages would perfectly adjust to it. However, the sum of the price coefficients in Table I ranges from .14 to .17.³

Tables II and III present the regression results for slightly more elaborate wage adjustment equations. In general, these results provide support for those of the simple model of Table I. The unemployment rate again performed well, and the lagged price coefficients sum to less than unity. The equation tested in Table II contains output-per-manhour as an additional independent variable. This variable was introduced in a rather rough attempt to explore the familiar price theory conclusion that wages are determined by the marginal value productivity of labor.⁴ In Table II, the coefficients of the productivity variable always possess the right sign and are sometimes statistically significant. Moreover, the improvement in R²'s from Table I to Table II appears to be due to the influence of the productivity variable. However, as defined in Table II, the productivity measure is probably picking up cyclical influences and hence another variation was tried in Table III. Here, the productivity variable is expressed in first difference form. As anticipated, the R²'s decline, although the coefficient of the productivity variable maintains its positive sign and is occasionally significant.⁵

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³ In various experiments, the lag was extended through twenty-four periods, but these trials were not particularly successful and are not reported.

⁴ Ideally, the marginal output-labor ratio should be used here, but the average is employed as a reasonable substitute. For justification, see Kuh (1966).

⁵ Productivity variables lagged one period were also tried, and the results were basically similar to those described here.
shorter average duration of strikes.

In addition, the increases in business inventories will cause an upward shift of $\bar{V}$ as the sales during the strike are increased, i.e., at any given $s_i$ the $\bar{V}$ function can absorb a higher $w$. With the upward shift of its $w$ axis intercept, $w_{\bar{V}_1}$, this too is indicative of a lower likelihood of strikes.

VI. PERSONAL SAVINGS, NATIONAL INCOME ACCOUNTS

With lagged increases in personal savings we would expect an upward shift of the UME function in $w,s$ space. That is, increases in personal savings will increase the ability of the UM to financially withstand a strike. This in turn has the effect of raising the relative bargaining strength of the UL, which of course is the determinant of UME.

The increase in $w_0$, the UME function's $w$ axis intercept, with no change in $w_{X_0}$, leaves a larger $(w_0 - w_{X_0})$ and thus a contract curve shifted to the right in $w,s$ space.

Both factors, the upward shift of the UME function and the rightward shift of the contract curve lead to a greater likelihood of strikes and a greater average duration of strikes.
VII. THE LANDRUM-GRiffin ACT

The model would predict that the passage of the Landrum-Griffin Act in 1959 would have a positive impact on both the likelihood and the average duration of strikes. This law was designed primarily to regulate the internal affairs of unions so as to further "assure" intraunion democracy. In effect, it is to make the UL more responsive or sensitive to the desires of the UM.

As such, the UL should adhere more closely to UME than previously. That is, before this Act, attempts by the UL to lower the expectations of the UM so as to avoid a strike (and/or to increase their own utility level at the expense of the UM) may have been substantial, but with its passage such attempts should be reduced. In fact the Act may go so far as to encourage an increase in the militancy of the UL by implicitly encouraging the growth of dissident groups within the union, i.e., in effect make the UL more receptive to some of the less realistic wage demands of the UM.\(^9\)

This will result in a higher UME function in \(w, s\) space, including its \(w\) axis intercept, \(w_0\), and hence a larger \((w_0 - w^*_0)\) and a rightward shift of the contract curve.

\(^9\)Arguments to this effect have previously been made by Estey [11] and have been since reiterated by Ashenfelter and Johnson [2].
in w,s space. Thus, as stated, we would anticipate a greater likelihood and greater average duration of strikes.

VIII. SEASONAL DUMMY VARIABLES

The use of seasonal dummy variables is designed to remove the seasonal fluctuations from the two dependent variables, with the seasonal fluctuations in the independent variables having already been removed by the use of season-alized data. The seasonal dummies we use are for the first, second, and fourth quarters, leaving the third quarter as the base. By removing the seasonal fluctuation in the level of aggregate strike activity the coefficients on the dummy variables will give us an indication of the seasonal pattern of contract expirations and the likelihood of strikes.

From the model we would expect fewer contract expira-tions in the late fall (QIV) and winter(QI) quarters as unions will force their expirations to occur at other times.\textsuperscript{10} That is, in the late fall season there is both a large number of paid holidays and the Christmas demand for liquidity by the UM, and hence the union will attempt to force the contract expiration to occur during other periods of the year.

\textsuperscript{10}Simkin [29] has presented grounds for arguing that the union usually has had the major say in the determination of the contract expiration date.
As regards the increase liquidity demand by the UM, this will be reflected by an increased discount rate, $r_1$, in the $X$ function for positive values of $s$, the length of the strike, as their interests tend toward present wage payments vis-à-vis future higher wages. The effect of this will be to rotate the $X$ function counterclockwise, maintaining its $w$ axis intercept. The degree of this rotation is a function of the magnitude of the change in $r_1$ and in the limit the $X$ function will be coincidental with the $w$ axis, thereby eliminating any feasible solutions which entail strikes. Regardless, there will be some decrease in the feasible solution space for the UL's bargaining and hence a decline in their bargaining power.

In Figure 17 the decline in the feasible solution space is from $BAw_0$ to $w_1B'A'w_0$ and as such clearly puts the UL at a disadvantage. They are forced to achieve a settlement with $s \leq s_B$ or violate their personal political survival constraint, $X$. Therefore the unions will allow fewer contract expirations in the fourth quarter.

---

We assume $\frac{\partial X}{\partial r_1} < 0 \mid s > 0$ and $\frac{\partial X}{\partial r_1} = 0 \mid s = 0$, as a settlement without a strike leaves us no a priori reason to believe that a higher $w$ is required to maintain $X$ constant, even with the increase in $r_1$. For positive $s$ values the $\frac{\partial X}{\partial r} < 0$ requires that $w$ increase over its pre-$\Delta r_1$ levels if we are to keep $X$ constant. Hence the $X$ function will rotate counterclockwise from its $w_0$ intercept.
In the winter quarter (QI) we normally observe a post-holiday slump occurring in many industries and inclement weather prevailing in others (e.g., logging or construction industries) such that production is either halted or at least slowed. It is then that these firms are least vulnerable to a strike as their production loss in the event of a work stoppage would be minimal. The effect of this would be to shift the $V$ constraint down in $w, s$ space such that there is a much lower wage gain possible for the UL to
achieve. For example, in Figure 18 the shift is from $\bar{V}$ to $\bar{V}'$, leaving the maximum achievable wage rate at $w_{\bar{V}_1}$.

Figure 18

Overall then, we would expect fewer contract expirations in the first and fourth quarters.\(^{12}\)

In both of these quarters we would also see a

\(^{12}\)With conditions essentially reversed in the second and third quarters they would of course have the majority of contract expirations.
reduction in UME for the same reasons that we expect fewer contract expirations. Coupled with a constant \( w_{X_0} \), this results in a smaller \((w_0 - w_{X_0})\) a leftward shift of the contract curve in \(w, s\) space, and hence a smaller likelihood and duration of strikes.

Therefore both the expected fewer contract expirations and a lower likelihood of strikes in those expirations which do occur, lead us to anticipate strong negative coefficients on the QI and QIV dummy variables when the level of aggregate strike activity is regressed on them. Similarly, we would expect negative coefficients on the QI and QIV dummy variables when the average duration of strikes is regressed on them.\(^{13}\)

IX. TIME TREND

We used a time trend to capture what we believe is a downward bias in the aggregate level of strike activity over our sample period, 1953 Q1 to 1969 QIV. This bias exists because of 1) the secular decline in institutional strikes and 2) the trend toward multiple-employer bargaining. As such, we would expect a negative coefficient on

\(^{13}\)The argument is reversed for the second and third quarters such that we would anticipate a positive coefficient on the QII dummy variable (the QIII dummy variable is the base).
the time trend variable when the level of aggregate strike activity is regressed on it.

Our hypotheses are summarized in Table I.

In addition to the hypotheses which will be tested econometrically, there are two others which are of particular interest. First, we believe that a change in union leaders would increase both the probability and the duration of a strike. Given the political nature of the UL function, the new UL appointee will be in a position where he feels he must prove himself, particularly if his predecessor was voted from office for failure to satisfy the rank and file. As we have asserted, the method by which the UL can increase their job security and intraunion power and prestige is to achieve settlements in excess of the expectations of the UM. As such, a change in the leadership would likely call for an added emphasis to be put on \( X_2 \) in,

\[
U(UL) = U_1(X_1, X_2)
\]

where

\[
X_2 = (w, \hat{s}) - (w, \hat{s})_{UME}
\]

The decline in \( \frac{\partial^2 U}{\partial X_1 \partial X_2} \) will of course result in UL utility indifference curves of greater negative or lesser
### TABLE 1

<table>
<thead>
<tr>
<th>Given an Increase in</th>
<th>The Level of Aggregate Strike Activity Will</th>
<th>The Average Duration of Strikes Will</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The unemployment rate</td>
<td>Decrease</td>
<td>Decrease</td>
</tr>
<tr>
<td>2. Percentage wage change</td>
<td>Decrease</td>
<td>Decrease</td>
</tr>
<tr>
<td>3. Consumer price index&lt;sup&gt;14&lt;/sup&gt;</td>
<td>Increase</td>
<td>Increase</td>
</tr>
<tr>
<td>4. Corporate profits</td>
<td>Decrease</td>
<td>Increase</td>
</tr>
<tr>
<td>5. Change in business inventories</td>
<td>Decrease</td>
<td>Decrease</td>
</tr>
<tr>
<td>6. Personal savings</td>
<td>Increase</td>
<td>Increase</td>
</tr>
<tr>
<td>7. The Landrum-Griffin Act</td>
<td>Increase</td>
<td>Increase</td>
</tr>
</tbody>
</table>

**DUMMY VARIABLE**

<table>
<thead>
<tr>
<th></th>
<th>Coefficient When the Dependent Variable is the Level of Aggregate Strike Activity</th>
<th>Coefficient When the Dependent Variable is the Average Duration of Strikes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Q1 dummy variable</td>
<td>Negative</td>
<td>Negative</td>
</tr>
<tr>
<td>2. QII dummy variable</td>
<td>Positive</td>
<td>Positive</td>
</tr>
<tr>
<td>3. QIV dummy variable</td>
<td>Negative</td>
<td>Negative</td>
</tr>
<tr>
<td>4. Time trend dummy variable</td>
<td>Negative</td>
<td>Not Applicable</td>
</tr>
</tbody>
</table>

<sup>14</sup>In the absence of UM money illusion.
positive slope (see pp. III-4,5), and thus increasing in both the probability and the average duration of strikes.

Secondly, if one accepts the basic concepts of the model as developed, the prospects for successful fifth party (government) intervention, on the union side, in a given set of negotiations are poor. There are no functions--$X$, $UME$, or $U(UL)$--which, as defined, will be appreciably shifted or altered due to "moral suasion." That is, the UL are politicians and are responsible to their UM constituents, not to the general public as effective "moral suasion" would require. In addition, as previously stated, policies which try to induce the UL to attempt a lowering of $UME$ are likely to result in internal union dissention.

Management, however, is not so closely responsible to the stockholder group that complying with governmental wishes would raise concerns about their job security. Also the firm, unlike the union, is to a certain extent dependent upon public opinion for its sales and as such may not be willing to risk its goodwill by ignoring a public governmental request.

Thus governmental pressures to alter the outcome of a set of collective bargaining negotiations are more likely to meet with success if directed toward the firm.
CHAPTER IV

In this chapter we present and interpret our empirical work and its results. In all we tested three sets of equations econometrically, two of which will be analyzed here.\(^1\) We first regressed the aggregate level of strike activity on the set of exogenous variables indicated by our hypotheses developed in Chapter III, and then we regressed the average duration of strikes on a similar set of variables. The general form of these equations are:

A. \( Z_{1t} = f_1(S_1, \ LG, \ T, \ y_{1t}, \ y_{2t}, \ y_{2t-1}, \ldots, y_{2t-6}, \)

\( y_{3t}, \ y_{3t-1}, \ldots, y_{3t-6}, \ y_{4t}, \ y_{4t-1}, \ldots, y_{4t-8}, \)

\( y_{5t-1}, \ y_{6t-1}. \)

B. \( Z_{2t} = f_2(S_1, \ LG, \ y_{1t}, \ y_{2t}, \ y_{2t-1}, \ldots, y_{2t-12}, \)

\( y_{3t}, \ y_{3t-1}, \ldots, y_{3t-12}, \ y_{4t}, \ y_{4t-1}, \ldots, y_{4t-12}, \)

\( y_{5t-1}, \ y_{6t-1}. \)

\(^1\)The third set of equations, with \( \Delta Z_1 \) as the dependent variable, has results not unlike those for \( Z_1 \) and as such will not be listed in this chapter.

IV-1
where

\[ Z_1 = \text{the aggregate level of strike activity} \]
\[ Z_2 = \text{the average duration of strikes} \]
\[ S_i = \text{the seasonal dummy variables} \ (i = 1, 2, 4) \]
\[ LG = \text{the Landrum-Griffin Act dummy variable} \]
\[ T = \text{the time trend dummy variable} \]
\[ y_1 = \text{the unemployment rate} \]
\[ y_2 = \text{the change in labor's compensation} \]
\[ y_3 = \text{the consumer price index} \]
\[ y_4 = \text{the change in corporate profits} \]
\[ y_5 = \text{the change in business inventories} \]
\[ y_6 = \text{personal savings}. \]

Ordinary least squares is utilized with the assistance of the Almon technique for polynomial estimation of distributed lags.\(^2\)

DATA (Quarterly)

With the exception of the dependent variables all data used are seasonalized. The sample used for the equations with \(Z_1\) as dependent variable is 1952 II (second quarter) through 1969 IV and for equations with the duration of strikes as the dependent variable it is 1953 I through

\(^2\)The Almon technique will be discussed more fully later in the chapter.
1969 IV.

1. **Z1, the Aggregate Level of Strike Activity**

Unfortunately, the Bureau of Labor Statistics does not have reliable data compiled for the number of contract expirations involving either 6 or more workers or 1,000 or more workers during our sample period, 1952-1969. Recent years issues of their *Monthly Labor Review* have carried lists of major contract expiration of private industries (1,000 - workers), but these do not extend back far enough to be useful for time-series analysis. As such we use the aggregate level of strike activity as our dependent variable. The data we use are for strikes involving six or more workers in the private nonagricultural sector, gathered from various issues of the *Monthly Labor Review*—the quarterly data we use are simple summations of the three monthly figures (See Table II).³

³As there is no *a priori* reason to believe that the number of contract expirations will vary significantly between years and the seasonal dummy variables we use would remove the seasonal fluctuation from any contract expiration data, we could assume that the number of expirations is the same for the $i$th quarter of each year ($i=1,2,3,4$) and thereby leave $Z1$ as a reasonable proxy for the probability of strikes (the percent of expirations in which strikes materialize). Ashenfelter and Johnson [2] make a similar assertion.
### TABLE II
The Number of Strikers Per Quarter Involving Six or More Workers--Private Nonagricultural Sector

<table>
<thead>
<tr>
<th>Year</th>
<th>QI</th>
<th>QII</th>
<th>QIII</th>
<th>QIV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1952</td>
<td>1279</td>
<td>1482</td>
<td>1454</td>
<td>907</td>
</tr>
<tr>
<td>1953</td>
<td>1125</td>
<td>1723</td>
<td>1438</td>
<td>805</td>
</tr>
<tr>
<td>1954</td>
<td>725</td>
<td>1072</td>
<td>1013</td>
<td>658</td>
</tr>
<tr>
<td>1955</td>
<td>794</td>
<td>1290</td>
<td>1413</td>
<td>823</td>
</tr>
<tr>
<td>1956</td>
<td>794</td>
<td>1232</td>
<td>1111</td>
<td>688</td>
</tr>
<tr>
<td>1957</td>
<td>745</td>
<td>1223</td>
<td>1120</td>
<td>585</td>
</tr>
<tr>
<td>1958</td>
<td>550</td>
<td>975</td>
<td>1050</td>
<td>650</td>
</tr>
<tr>
<td>1959</td>
<td>675</td>
<td>1308</td>
<td>1122</td>
<td>550</td>
</tr>
<tr>
<td>1960</td>
<td>720</td>
<td>1119</td>
<td>951</td>
<td>560</td>
</tr>
<tr>
<td>1961</td>
<td>604</td>
<td>1011</td>
<td>1022</td>
<td>723</td>
</tr>
<tr>
<td>1962</td>
<td>795</td>
<td>1218</td>
<td>1004</td>
<td>624</td>
</tr>
<tr>
<td>1963</td>
<td>624</td>
<td>1048</td>
<td>971</td>
<td>701</td>
</tr>
<tr>
<td>1964</td>
<td>685</td>
<td>1182</td>
<td>1058</td>
<td>730</td>
</tr>
<tr>
<td>1965</td>
<td>781</td>
<td>1265</td>
<td>1149</td>
<td>768</td>
</tr>
<tr>
<td>1966</td>
<td>825</td>
<td>1396</td>
<td>1312</td>
<td>871</td>
</tr>
<tr>
<td>1967</td>
<td>946</td>
<td>1462</td>
<td>1196</td>
<td>991</td>
</tr>
<tr>
<td>1968</td>
<td>1052</td>
<td>1615</td>
<td>1434</td>
<td>944</td>
</tr>
<tr>
<td>1969</td>
<td>1163</td>
<td>1866</td>
<td>1620</td>
<td>1051</td>
</tr>
</tbody>
</table>

Source: *Monthly Labor Review, Various Issues*
2. **Z2, The Average Duration of Strikes**

The data for the average duration of strikes was obtained from an unpublished data-tape from the Bureau of Labor Statistics. To my knowledge this data has not been used for econometric tests. The data-tape contains a multitude of information concerning strikes covering 1,000 or more workers for the period of 1953 through 1969. Each individual strike is listed by case number, followed by both the beginning and ending dates and the duration of the strike in calendar days. The duration for each quarter is simply the total number of calendar days lost on strikes divided by the number of strikes. However, we first extracted all governmental and agricultural strikes. The maximum duration we allowed per strike was 90 days, i.e., those with longer durations would have to be attributed to the period in which they began, whereas that period as well as those following periods were important in establishing the conditions which maintained the strike. As such more than 90 days in the beginning period would bias its average strike

---

4 In addition, for each strike the data-tape gives the occupation code and the union code of the workers, the SIC code of the struck industry, the state and metropolitan area code of the strike, the major issues involved in the negotiations, the number of workers involved in the strike, the monthly man-days idle, the type of settlement, whether or not there was government mediation, and finally if the strike involved violence.
duration upward. The number of workers involved and the man-days idle were given no consideration as it is the decision to begin and end strikes which is important in our analysis, not the size of the strike.

The data for $Z_2$, defined them as the simple arithmetic average of the strikes during the quarter (net of the extracted strikes), is listed in Table 3.

3. $y_1$

$y_1$, is the unemployment rate of private wage and salary workers in nonagricultural industries. The data are quarterly and seasonally adjusted and obtained from various issues of Employment and Earnings.

4. $y_2$

$y_2$ is the quarterly change in compensation (percentage change from previous quarter), private nonagricultural sector, seasonally adjusted, and obtained from the Bureau of Labor Statistics.

5. $y_3$

$y_3$ is the C.P.I., quarterly, seasonally adjusted for
<table>
<thead>
<tr>
<th>Year</th>
<th>QI</th>
<th>QII</th>
<th>QIII</th>
<th>QIV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1953</td>
<td>11.62</td>
<td>18.89</td>
<td>19.02</td>
<td>12.77</td>
</tr>
<tr>
<td>1954</td>
<td>16.64</td>
<td>18.57</td>
<td>18.92</td>
<td>13.80</td>
</tr>
<tr>
<td>1955</td>
<td>12.27</td>
<td>18.19</td>
<td>16.21</td>
<td>15.20</td>
</tr>
<tr>
<td>1957</td>
<td>15.29</td>
<td>18.45</td>
<td>16.14</td>
<td>12.77</td>
</tr>
<tr>
<td>1958</td>
<td>15.13</td>
<td>22.52</td>
<td>15.53</td>
<td>15.86</td>
</tr>
<tr>
<td>1959</td>
<td>22.65</td>
<td>22.00</td>
<td>29.35</td>
<td>23.77</td>
</tr>
<tr>
<td>1960</td>
<td>20.72</td>
<td>15.69</td>
<td>17.36</td>
<td>15.00</td>
</tr>
<tr>
<td>1961</td>
<td>14.30</td>
<td>22.13</td>
<td>22.36</td>
<td>21.72</td>
</tr>
<tr>
<td>1962</td>
<td>18.24</td>
<td>28.09</td>
<td>20.51</td>
<td>17.27</td>
</tr>
<tr>
<td>1963</td>
<td>12.21</td>
<td>19.15</td>
<td>16.46</td>
<td>16.57</td>
</tr>
<tr>
<td>1964</td>
<td>10.69</td>
<td>17.85</td>
<td>19.29</td>
<td>17.85</td>
</tr>
<tr>
<td>1965</td>
<td>14.56</td>
<td>21.94</td>
<td>20.19</td>
<td>18.61</td>
</tr>
<tr>
<td>1966</td>
<td>19.24</td>
<td>17.51</td>
<td>19.98</td>
<td>19.93</td>
</tr>
<tr>
<td>1967</td>
<td>11.85</td>
<td>22.26</td>
<td>20.98</td>
<td>20.61</td>
</tr>
<tr>
<td>1968</td>
<td>18.06</td>
<td>26.60</td>
<td>23.80</td>
<td>19.34</td>
</tr>
<tr>
<td>1969</td>
<td>16.39</td>
<td>23.67</td>
<td>17.35</td>
<td>13.92</td>
</tr>
</tbody>
</table>

Source: Bureau of Labor Statistics Data Tape
the nonagricultural sector—all persons. Obtained from the Bureau of Labor Statistics.

6. \( y_4 \)

\( y_4 \) is the quarterly change in corporate profits after tax, excluding the inventory valuation adjustment, seasonally adjusted. Obtained from the Department of Commerce, Office of Business Economics.

7. \( y_5 \)

\( y_5 \) is the quarterly change in business inventories, seasonally adjusted. Obtained from the Department of Commerce, Office of Business Economics.

8. \( y_6 \)

\( y_6 \) is the personal saving, quarterly, seasonally adjusted. Obtained from the National Income Accounts.

9. LG

LG is the dummy variable for the Landrum Griffin Act of 1959. The quarters preceding Q1, 1960, are given values
of zero and those following it are given values of 1.

METHOD

The method we used to estimate our equations was ordinary least squares with the use of the Almon technique for estimating distributed lags in three of the independent variables. This technique uses a set of Lagrangian interpolation polynomials to estimate the distributed lags (thereby creating moving averages of these independent variables). Lagrange polynomials have the general form:

\[ a_0(X) = \frac{(X-X_1)(X-X_2)(X-X_3)\cdots(X-X_n)}{(X_0-X_1)(X_0-X_2)(X_0-X_3)\cdots(X_0-X_n)} \]

\[ a_1(X) = \frac{(X-X_0)(X-X_2)(X-X_3)\cdots(X-X_n)}{(X_1-X_0)(X_1-X_2)(X_1-X_3)\cdots(X_1-X_n)} \]

\[ \vdots \]

\[ a_n(X) = \frac{(X-X_0)(X-X_1)(X-X_2)\cdots(X-X_{n-1})}{(X_n-X_0)(X_n-X_1)(X_n-X_2)\cdots(X_n-X_{n-1})} \]

where, \( X_0, \ldots, X_n \), are known points, and \( n \) is the degree of the polynomial. Our use of third degree polynomials requires four points, or observations, to fit it.

There are two major advantages in using this technique when the use of multiple lags is required for an
close to unity (actually equal to one when $\lambda = .4$), thus constituting
evidence in support of the expectations hypothesis.\textsuperscript{20} Explicit tests
indicate acceptance of the hypothesis $a^* = 1$ at the 5 percent level of
significance. To reiterate, when $a^* = 1$, an increase in the expected rate
of inflation is fully reflected in the rate of wage change and there is no
(long run) Phillips curve.

Another issue of recent controversy is the impact of the wage
and price guideposts in the 1962-1966 period.\textsuperscript{21} Examination of the resi-
duals of these regressions yields some indirect, and rather fragmentary,
evidence on the effects of the guidepost policy. For example, with $\lambda = .3$
or $.4$, the partial adjustment equation fitted for the entire 1952-1969
period over predicts the percentage change in money wages in the seven
quarters 1962II - 1963IV, in the five quarters 1964IV - 1965IV, and in
1966II, III. Hence, in fourteen of these twenty quarters, or 70 percent
of the time, the equation over predicts. The residuals of the equations
fitted for the more recent 1961-1969 interval display a similar pattern,
although there is slightly less of a tendency toward overprediction.

It is tempting to attribute this behavior to the guideposts,
but such a conclusion might be hasty. To begin with, the evidence is far
from convincing since about ten overpredictions would be anticipated. And
further, the results for the 1961-1969 period may to some extent be colored
by the unpredictable performance of the layoff rate. In any event, a more

\textsuperscript{20} Again, there is very slight difference between the $R^2$s
of the nine equations in Table IX.

\textsuperscript{21} Much of the relevant literature is found in the American
independent variable. First, as we are using quarterly data, it was at times necessary to use as many as thirteen observations on a single variable. Obviously if we were to directly estimate an equation using several such variables a large number of degrees of freedom will be exhausted. As the use of a third degree polynomial (in the Almon technique) requires only four points or observations to fit it, there is a net gain of nine degrees of freedom for such a variable.

Even more important is the reduction of multicollinearity (which is likely to be present if a distributed lag is estimated directly) which the Almon technique involves. If there are multiple period lags of a given variable to be estimated, e.g.,

\[ y_t = a_0 X_t + a_1 X_{t-1} + a_2 X_{t-2} + \ldots + a_n X_{t-n}, \quad (1) \]

then it is not unlikely that the X series is serially correlated such that the equation is multicollinear. By assuming that the shape of the lag weights can be approximated by a polynomial, the Almon technique at once reduces the serial correlation and avoids the type of problems encountered by the estimation of distributed lag structures by the assumption that the lag weights follow a probability distribution form and \( n \) in (1) equals infinity, i.e., it
impressive test of the impact of the guideposts would be to use the equation estimated for the 1952-1960 interval to forecast wage increases from 1961-1966, but this effort has not been undertaken.

1952I-1964IV. This period was examined to shed light on two related issues. The first pertains to the guidepost policy and the impact it may have had on wage changes, particularly in 1962-1964. The 1962-1964 years are generally acknowledged to be the period when the guideposts exerted maximum influence. The Economic Report of the President, released in January 1962, explicitly enunciated guideposts for the first time, and, in April 1962, price increases in the steel industry were rescinded under pressure from President Kennedy. This success probably acted in the short run to restrain price increases in other important, visible industries and hence to stiffen resistance to rapid wage rises. At any rate, estimation over this period provides further evidence on part of the guidepost experience. Secondly, a specific look at the 1952-1964 interval is essential because, while the 1961-1969 span tends to conform rather closely to the expectations model, the 1952-1960 and 1965-1969 years do not. It is possible, however, that arbitrary division of the broad interval into 1952-1960 and 1961-1969 concealed behavior consistent with the expectations hypothesis in the early subperiod. To explore this conjecture, the first interval was extended through 1964.

Table X contains results for the partial adjustment specification of the equation fitted over 1952I-1964IV. There is little apparent effect of extending the sample period through 1964. Compared to Table VII, the coefficient of the unemployment rate has the correct sign but is still
leads to regressions on lagged values of the dependent variable.\textsuperscript{5}

The only assumption about the lag weights which is necessary in the Almon technique is that they follow a form which can be approximated by a polynomial evaluated at the points \(i = 0, 1, 2, \ldots, n\),

\[
\text{from (1), } y_t = \sum_{x=0}^{n} \alpha_i x_{t-n}, \text{ such that } \tag{2}
\]

\[
\alpha_m = \beta_0 + \beta_1 m + \beta_2 m^2 + \beta_3 m^3 + \ldots + \beta_n m^n, \tag{3}
\]

which is not a strong assumption.\textsuperscript{6}

RESULTS OF SPECIFIC EQUATIONS ESTIMATED

I. Z1, THE AGGREGATE LEVEL OF STRIKE ACTIVITY

\[
Z1 = +1708 - 379.S_1 + 113.S_2 - 436.S_4 - 129.y1 - 17.7y2 \tag{226} \tag{26} \tag{24} \tag{26} \tag{8}
+ 2.85y3 - 90.8y4
\]

\textsuperscript{5}See Koich [17] and Solow [30] and Jorgenson [16] for examples of the use of lag weights in a probability distribution form.

\textsuperscript{6}For a more detailed analysis and explanation of this see S. Robinson [25].
$R^2 = .9604$

D.W. = 1.62

Mean of dependent variable = 1016.4

S.E.E. = 69.9

D.O.F. = 56

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Standard errors in parentheses below the coefficients.

... with Almon lags used for $y_2$, $y_3$, and $y_4$--the results being:

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To recall,
\( y_1 = \text{the unemployment rate} \)
\( y_2 = \text{percent change in labor's compensation} \)
\( y_3 = \text{consumer price index} \)
\( y_4 = \text{change in corporate profits} \)
\( S_i = \text{seasonal dummy variables}. \)

(2) Virtually the same equation with the addition of a time variable \((T)\)

\[
Z_1 = 1435 - 375.S_1 + 107.S_2 - 432.S_4 - 13.T
\]
\[
= 121.4 \cdot y_1 - 32.2 \cdot y_2 + 38.8 \cdot y_3 - 31.4 \cdot y_4
\]

\[
R^2 = .9652 \quad \text{S.E.E.} = 66.1
\]
\[
\text{D.W.} = 1.817 \quad \text{D.O.F.} = 55
\]

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Almon lags were used again on \( y_2, y_3, y_4 \)
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(3) \( Z_1 = 1203 - 93y_1 - 614L + 5.0y_3 + 8.0y_8 - 6.0y_{8z} \)
\[ \frac{395}{(8)} \quad \frac{47}{(4.3)} \quad \frac{3.8}{(3.7)} \]
\[ - 373S_1 + 105S_2 - 427S_4 + 7.6y_2 + 4.9y_3 - 126y_4 \]
\[ \frac{31}{(27)} \quad \frac{24}{(24)} \]

\( R^2 = .9636 \)

D.W. = 1.71

S.E.E. = 69.6

\( y_8z = y_8(-1) \)

\( y_{5z} = y_5(-1) \)

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Almon lag variables

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\[(4) \quad Z1 = 1484 - 96.5 \cdot y1 - 15.8 \cdot T + 11.0 \cdot y6 - 5.2 \cdot y6z \\
(785) \quad (17) \quad (3.8) \quad (3.3) \quad (3.2) \]

\[+ 6.1 \cdot y5z - 362 \cdot S_1 + 115 \cdot S_2 - 433 \cdot S_4 - 27.1 \cdot y2 \\
(3.8) \quad (27) \quad (24) \quad (21) \]

\[- 27.1 \cdot y2 + 38.6 \cdot y3 - 46.1 \cdot y4 \]

\[R^2 = 0.9718 \]

D.W. = 2.047

S.E.E. = 61.3

T = Time

D.O.F. = 53

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(5) \[ Z_1 = 1691 - 102.91 + 8.2y_6 - 4.8y_6z + 4.6y_5z + 368S_1 + 108S_2 - 428S_4 - 8.4y_2 - 106y_4 \]
\[ (69) \quad (9.5) \quad (3.4) \quad (3.6) \quad (4.0) \quad (25) \quad (24) \quad (24) \]

\[ R^2 = .9588 \]

\[ \text{D.W.} = 1.5277 \]

\[ \text{S.E.E.} = 70.6 \]

\[ \text{D.O.F.} = 54 \]

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\[(6)\] \( z_1 = 1596 - 95y_1 + 8.0y_6 - 4.2y_6z - 368.5S_1 + 104.S_2 \)  
\((228)\)  \((20)\)  \((2.6)\)  \((3.6)\)  \((31)\)  \((27)\)  
\(- 426.S_4 + 11.0y_2 + 0.2y_3 - 116.8.y_4 \)  
\((24)\)

\( R^2 \) = .9617
\( D.W. \) = 1.6447
\( S.E.E. \) = 70.1
\( D.O.F. \) = 55

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(7) \[ Z1 = 1373 - 100 \cdot y1 - 15 \cdot T + 9.4 \cdot y6 - 4.1 \cdot y6z - 360 \cdot S_1 \]
\[ (794) \quad (18) \quad (3.9) \quad (3.2) \quad (3.2) \quad (28) \]
\[ + 111 \cdot S_2 - 432 \cdot S_4 - 20.5 \cdot y2 + 37.4 \cdot y3 - 33.2 \cdot y4 \]
\[ (24) \quad (21) \]

| \(R^2\) | 0.9704 |
| D.W.    | 2.0006 |
| S.E.E.  | 62.2031 |
| D.O.F.  | 54     |

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The Almon variables being,

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**INTERPRETATION OF THE RESULTS**

In general, the results for the aggregate level of strike activity were quite good. The values of $R^2$ ranged from .9588 to .9718, with Durbin-Watson statistics from 1.5277 to 2.047, indicating little problem with autocorrelation. The standard errors of the estimate were remarkably low, ranging from 61.3 to 60.6 with the mean of the dependent variable equal to 1016.4 strikes per quarter.

1. $S_i$

The results for the seasonal dummies were very good. In every case, the coefficients were those hypothesized as
well as being statistically significant. All $S_i$ coefficients were statistically significant at the .01 level.\footnote{These significance levels, as well as all those we discuss, are for the total area in both the tails of the probability distribution. If using one tail, the significance level .01 for example would become .005.}

In Equation 1 the values, $S_1 = -379$, $S_2 = +113$, $S_4 = -436$, indicate that on the average there will be 379 fewer strikes in the first than the third quarter, 113 strikes more in the second than the third quarter, and 436 strikes less in the fourth than in the third quarter. The $S_i$ coefficients in the remaining equations are quite similar to these.

2. \underline{LG}

The Landrum-Griffin Act had results which were not statistically significant as seen in Equation 3 (other results not shown here were similar).

3. \underline{Y}\footnote{1}

As hypothesized an increase in unemployment was associated with a substantial decrease in strike activity. In equation 1 for example, an increase of one percentage point in the unemployment rate is associated with a decrease
of 129 strikes per quarter (mean strikes per quarter = 1016.4). The results are similar in the remaining equations. In all equations the unemployment rate was statistically significant at the .01 level, with T-statistics ranging from -4.7 to -10.7.

As such our hypothesis that increased unemployment will cause a lower level of aggregate strike activity is corroborated.

4. \( y2 \)

The results for the first Almon variable, the percentage wage change from the previous quarter, were just as predicted. The coefficients of the seven equations are -17.7, -32.2, +7.6, -27.1, -8.4, +11, and -20.5. These results are interesting because those which best agree with the hypothesized negative relation between compensation and the likelihood of strikes are in the equations which include the time trend variable, i.e., equations (2), coefficient = -32.2, (4) \( c = -27.1 \), and (7) \( c = -20.5 \).\(^8\) The removal of the time trend variable biases the results of both \( y2 \) and \( y4 \) (corporate profits). That is, \( y4 \) increases relatively

\(^8\)As anticipated the time trend variable had negative coefficients in each case. In (2) = -13.8, in (4) = -15.8, and in (7) = -15.0. In each case the results are statistically significant at the .01 level.
smoothly over time as does the dependent variable. By having a time trend variable the time trend is taken from Z1, thereby allowing the regression to measure the true effect of changes in y4 on Z1. The case with y2 is just the opposite. Hence by removing the time trend variable, the results will be improved for y4 (to be considered shortly) as the coefficient and statistical significance are both biased upward, whereas the results of the y2 variable are biased downward.

As such the more relevant equations for the Almon variables in testing Z1 are (2), (4), and (7). As stated, in these equations the y2 coefficients are strongly negative in sign. In addition, the lagged periods' -3, -4, and -5 coefficients are statistically significant at the .01 level, while the other lags not significant. In equation (7) we can see that a +4.0 percentage change results in a decrease of 82 strikes per quarter.

In the non-time trend equations the results for y2 are of course worse, being statistically not significant in equations (3) and (6), while significant at the .02 level in (1) and the .05 level in equation (5).

5. \( y^3 \)

The results of the consumer price index variable
indicate money illusion on the part of union members. That is, the nominal wage variable, \( y_2 \), was found to have a significant negative correlation with the aggregate level of strike activity. If real wages are to have a like correlation, the price variable will have a significant positive correlation. However, in all seven equations the \( y_3 \) variable is statistically not significant, indicating the presence of money illusion by the UM.

6. \( y_4 \)

As discussed on page IV-22, when regressing the aggregate level of strike activity on corporate profits, time trend equations are truer indicators. In these equations the coefficients are (2) \( c = -3.14 \), (4) \( c = -4.61 \), and (7) \( c = -33.2 \), with the coefficients for one, two, and three period lags being statistically significant at the .01 level (to demonstrate the upward bias in the remaining equations, they have negative \( y_4 \) coefficients approximately three times larger, with statistical significance at the 0.1 level in all lags of -1 through -7). As such, an increase of $2 billion in corporate profits is associated with a decrease of 66.4 strikes per quarter in equation (7).
7. \( y_5 \)

The results for the change in business inventories are, we believe, the product of offsetting forces. In equations (3), (4), and (5) the coefficients for \( y_5 \) were not statistically significant. Our hypotheses in Chapter III said they should be and that the coefficients would be negative. However, one factor which we did not take into account was the seeming inevitability of certain strikes and the natural reaction of firms to stockpile inventories for that reason. In such cases the flow of the relationship is reversed and the \( y_5 \) variable becomes a function of the likelihood of strikes. We will naturally see a positive relation in these situations. The net effect of these two forces, if we are correct in our assertions, is to disguise the interrelation between the likelihood of strikes and \( y_5 \).

8. \( y_6 \)

The personal savings variable was entered in equations (3), (4), (5), (6), and (7). With a zero lag the coefficients were positive; +8.0, +11.0, +8.2, +8.0, +9.4 respectively, and statistically significant at the .05, .01, .02, .05, .01 levels respectively, such that with this lag
the hypotheses of an increased likelihood of strikes due to the higher personal savings is substantiated.

Given this, in equation (3), the increase in personal savings from $33.3 billion in 1969 II to $42.0 in 1969 III is associated with an increase of 70 strikes for the third quarter of 1969.

II. Z2, THE AVERAGE DURATION OF STRIKES

\[ Z2 = 82.2 + 7.0LG - 1.23 y1 + 0.4 y6z - 0.3 y5z \]
\[ (30.4) (29) \]
\[ (1.20) \]
\[ (0.1) \]
\[ (1.7) \]
\[ - 3.2 S1 + 1.9 S2 - 3.1 S4 - 3.0 y2 - 0.57 y3 + 3.7 y4 \]
\[ (1.0) \]
\[ (1.0) \]
\[ (1.0) \]

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\[ R^2 = .7930 \]
\[ D.W. = 2.0783 \]
\[ S.E.E. = 2.851 \]

Mean of the dependent variable = 17.3198 days

\[ y8z = y8(-1) \]
\[ y5z = y5A(-1) \]
The Almon variables being,

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(2) \[ Z_2 = 79.2 + 7.2 \text{ LG} - 1.2 y_1 + 0.1 y_6 + 0.33 y_6 z \]

\[ (30) \quad (2.9) \quad (1.1) \quad (0.2) \quad (0.15) \]

\[ - 0.25 y_5 z - 2.84 S_1 + 1.97 S_2 - 3.05 S_4 - w.78 y_2 \]

\[ (0.17) \quad (1.0) \quad (1.0) \quad (1.0) \]

\[ - 0.55 y_3 + 1.70 y_4 \]

\[ R^2 = .7932 \]

\[ \text{D.W.} = 1.9799 \]

\[ \text{S.E.E.} = 2.878 \]

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(3)' \[ Z2 = 94.3 + 7.8 \text{LG} - 0.93 y1 + 0.27 y6 + 0.21 y6z \]
\[ (33) \quad (3.1) \quad (1.2) \quad (0.17) \quad (0.15) \]
\[ - 3.1 S_1 + 2.0 S_2 - 3.2 S_4 - 3.1 y2 - 0.7 y3 + 2.4 y4 \]
\[ (1.0)^1 \quad (1.0)^2 \quad (1.0)^3 \]

\[ R^2 = 0.7903 \]
\[ \text{D.W.} = 2.113 \]
\[ \text{S.E.E.} = 2.86955 \]

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\[
(4)' \quad Z2 = 78.8 + 6.8 \, \text{LG} - 0.65 \, y1 + 0.27 \, y6z + 0.22 \, y6zz \\
- 0.23 \, y5z - 33 \, S_1 + 1.57 \, S_2 - 3.13 \, S_4 - 2.6 \, y2 \\
- 0.6 \, y3 + 3.4 \, y4
\]

\[ R^2 = .8011 \]
\[ \text{D.W.} = 2.0417 \]
\[ \text{S.E.E.} = 2.822 \]
\[ y8zz = y8(-2) \]

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<td>-2.54</td>
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<td>-0.19</td>
<td>-0.97</td>
<td>0.23</td>
<td>1.17</td>
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<td>0.34</td>
<td>2.16</td>
<td>0.24</td>
<td>1.20</td>
</tr>
<tr>
<td>-8</td>
<td>0.24</td>
<td>-2.97</td>
<td>0.74</td>
<td>3.93</td>
<td>0.26</td>
<td>1.23</td>
</tr>
<tr>
<td>-9</td>
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<td>-2.75</td>
<td>0.88</td>
<td>4.20</td>
<td>0.27</td>
<td>1.31</td>
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<td>1.51</td>
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<tr>
<td>-11</td>
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<td>-0.24</td>
<td>-1.66</td>
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<td>0.06</td>
<td>0.76</td>
<td>-1.78</td>
<td>-3.73</td>
<td>0.28</td>
<td>1.37</td>
</tr>
</tbody>
</table>

INTERPRETATION OF THE RESULTS

In the equations testing the duration of the strike, the $R^2$ values varied from .7903 to .8011, the Durbin-Watson statistics from 1.9799 to 2.1131 and the standard errors of the estimate from 2.822 to 2.878, with the mean of the dependent variable being 17.320.\(^9\)

1. \( \bar{S}_1 \)

In equation 1' we see that $S_1 = 3.2$, $S_2 = +1.9$, and

\(^9\)If one accepts our theoretical analysis, then $R^2$ values of near .80 are quite reasonable to expect for $X_2$. That is, unless the contract curve in our analysis is vertical, the model will yield only the range of feasible solutions for the duration of the strike, i.e., the solutions are not unique. Hence the variation in the point of settlement on the contract curve will remove the model's ability to predict the average duration of strikes with precision.
advances outstrip price and labor productivity gains, unemployment will rise, ceteris paribus. The coefficient on the expected rate of inflation variable was positive but not significantly different from zero. At face value, this means that on the labor supply side the income and substitution effects of an increase in the anticipated rate of price change about cancel each other out. Whether this interpretation is correct or not does not appear to be crucial to the major thrust of this research.

As a second test of the relation between productivity and wages, the following equation was fitted for the usual 1952I-1969IV period:

\[
U_t = -0.19 + 0.16\star \frac{[W/W]_{t}}{[W/W]_{t}} - 0.05 (P/P)_{t} (-0.5) \\
- 0.06 (P/P)^\star_{t} + 0.87\star U_{t-1} (-0.4) \\
\]

\[
R^2 = 0.7199, R^2 = 0.7032 \\
SE = 0.6417 \\
DW = 0.76
\]

*Coefficients significant at 5 percent level.

Of major interest here is the coefficient of the term representing the difference between the growth of wages and productivity. Its coefficient is positive and significant, as expected, indicating that when the rate of increase of money wages exceeds that of productivity, unemployment rises. Overall, with regard to the relationship between unemployment and wages, prices, and productivity, the weight of the results of equations (4) and (5) corroborates the neoclassical view that unemployment rises when the rate of wage increase exceeds the advance of prices and productivity. Furthermore, this finding is consistent with the dynamic adjustment path described in the expectations-Phillips curve context of Chapter IV.
$S_4 = 3.1$, such that the average duration of strikes will be 3.2 and 3.1 days shorter in the first and fourth quarters respectively than in the third quarter, and they will be 1.9 days longer in the second quarter than in the third quarter. As such, our hypotheses concerning the seasonal nature of the duration and the aggregate level of strike activity, as well as the timing of contract expirations, are borne out very well by the results of our tests.

2. **LG**

The LG dummy variable had strong positive coefficients for the average duration of strikes. For example, the $+7.0$ LG in Equation (1') means that there was an increase of 7 days in the average duration of strikes occurring after the 1959 passage of this Act. The LG coefficients for the remaining equations are $7.2$, $7.8$, and $6.8$ days. All of these are statistically significant at the .02 level. As such, our hypotheses that the LG Act caused an increase in the average duration of strikes is strongly supported by the evidence.

3. **yi**

In the Z2 tests the unemployment variable had the
In (5), as in equation (4), the coefficient of \((P/P)_t^*\) is insignificant, while the coefficient of the actual percentage change in prices possesses the anticipated sign but is also insignificant. Finally, the coefficient of the lagged dependent variable provides impressive evidence of the partial adjustment process.

II

One objection to the general form of the preceding unemployment adjustment equations is that they were based on a very simple representation of the demand for labor. Since econometric evidence\(^7\) has indicated that certain categories of investment spending are quite sensitive to interest rates (and hence presumably to monetary policy), a more fully specified formulation of the demand for labor would attempt to include the effects of an increase in spending resulting from stimulative or "easy" monetary policy. In this view, unemployment adjustment equations should include variables which capture the impact on unemployment of changes in the demand for labor in particular sectors of the economy; that is, when residential construction, new plant and equipment spending, or business inventories are growing rapidly, there should be a concomitant reduction in unemployment.

As a step toward testing the preceding presumptions, a round of unemployment adjustment relations of the following general form were estimated:

---

hypothesized negative coefficient, but was not statistically significant as the T-statistics were for the most part near -1.0.

4. $y_2$

The results for the first Almon variable, the percentage wage change from the previous quarter, were just as the model predicted. The sum of the lagged coefficients for the four equations are -3.0, -2.78, -3.1, and -2.6, with the large majority of these coefficients being statistically significant at the .01 level. The average coefficient is approximately -0.30, such that a positive percentage wage change of, say, 4.0 in a given quarter will be accompanied by a 1.2 day decrease in the average duration of strikes.

5. $y_3$

The results for $y_3$ are mixed and noncommittal. For each of the four equations, of the thirteen lagged periods tested, seven have negative coefficients and six have positive coefficients, in somewhat random order. There is no definite pattern and we are forced to conclude that the money illusion indicated above exists here as well. The
absence of money illusion would be indicated by a definite set of positive coefficients for all lagged periods to offset the sets of negative coefficients observed for the thirteen lagged periods of the wage change variable, y2.

6. \( y_4 \)

The coefficients of \( y_4 \) are (1)' \( c = +.3.7 \), (2)' \( c = +1.7 \), (3)' \( c = +2.4 \), and (4)' \( c = +3.4 \). All are positive as the analysis predicted. This means that for an increase in corporate profits of $2 billion in a given quarter, the average duration of strikes will increase 7.4 days, 3.4 days, 4.8 days, and 6.8 days per quarter in the respective equations. The T-statistics are not as good as hoped for. In equation (1)', 10 of the 13 lagged coefficients are statistically significant at the .20 level and 2 of them at the .10 level; in equation (2)' only two lagged coefficients are significant at the .20 level, in equation (3)' three coefficients are significant at the .20 level and two at the .10 level; and in equation (4)' seven coefficients are significant at the .20 level.\(^{10}\)

---

\(^{10}\)While realizing that a .20 significance level, even for both tails of the probability distribution, is in effect not statistically significant, we shall continue to report them.
7. $y_5$

The results show that we were correct in predicting a negative relation between the average duration of strikes and the change in business inventories. The coefficients for business inventories are $-0.3$, $-0.25$, and $-0.23$ for equations (1)', (2)' and (4)' respectively. However, their statistical significance levels were only at the .10, .20 and .20 levels. This says for example that the increase in business inventories of $\$11.3$ billion in 1969 III gives rise to a decrease in the average duration of strikes of $3.39$ in the third quarter of 1969, according to equation (1)'.

8. $y_6$

The results for personal savings in general corroborate the hypothesis. For the average duration of strikes the personal saving coefficients for the four equations are $+0.4$, $+0.33$, $+0.21$, and $+0.27$, with these coefficients being statistically significant at the .01, 0.5, .20, and .20 levels respectively.\textsuperscript{11} This means, for

\textsuperscript{11}These refer to personal saving lagged one quarter. In equation (4)' we lagged personal saving two quarters and the coefficient was $+0.22$, statistically significant at the .20 level. Personal savings with zero lag was tested in equations (2)' and (3)', with the results being not statistically significant.
example, that in equation (2)' with the coefficient of +0.33, the increase in personal savings from $33.3 billion in 1969 II to $42.0 in 1969 III would be associated with a 2.87 day increase in the average length of strikes for the third quarter, 1969.

SUMMARY OF RESULTS

Overall the empirical results have given solid corroborated to our hypotheses and therefore to our model. While empirical work can never "prove" a theory, it can determine whether or not the theory can be rejected—on the basis of the foregoing empirical tests we believe that we can state that our model has not been rejected.

Of the twenty-one hypotheses tested, only two can be rejected outright by the results. These are that the Landrum-Griffin Act would cause an increase in the aggregate level of strike activity and that increases in the unemployment rate would cause a shorter average duration of strikes. The coefficients for both of these variables were not statistically significant. A third variable, the change in business inventories, was found to be statistically not significant with respect to the aggregate level of strike activity, but a very feasible explanation for this
(in the form of offsetting affects) was offered. In addition, both dependent variables were found to have an insignificant correlation with the consumer price index variable; however, this is quite likely an indication of money illusion on the part of union members vis-à-vis evidence to reject an hypothesis.

\footnote{These offsetting effects are, to recall, due to confusion over the direction of the casual relation between the aggregate level of strike activity and the change in business inventories. As such, the y5 results are an indication of misspecification of a given variable in the 21 equations, not evidence to reject the original hypothesis.}
The overall results are summarized in Table IV.

### TABLE IV

<table>
<thead>
<tr>
<th>Given an Increase in</th>
<th>The Level of Aggregate Strike Activity Will</th>
<th>The Average Duration of Strikes Will</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The unemployment rate</td>
<td>Decrease H*Accepted</td>
<td>Decrease H Rejected</td>
</tr>
<tr>
<td>2. Percentage wage change</td>
<td>Decrease H Accepted</td>
<td>Decrease H Accepted</td>
</tr>
<tr>
<td>3. Consumer price index</td>
<td>Increase Money Illusion</td>
<td>Increase H Money Illusion</td>
</tr>
<tr>
<td>4. Corporate profits</td>
<td>Decrease H Accepted</td>
<td>Increase H Accepted</td>
</tr>
<tr>
<td>5. Change in business inventories</td>
<td>Decrease Offsetting Effects</td>
<td>Decrease H Accepted</td>
</tr>
<tr>
<td>6. Personal savings</td>
<td>Increase H Accepted</td>
<td>Increase H Accepted</td>
</tr>
<tr>
<td>7. The Landrum-Griffin Act</td>
<td>Increase H Rejected</td>
<td>Increase H Accepted</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DUMMY VARIABLE</th>
<th>Coefficient When the Dependent Variable is the Level of Aggregate Strike Activity</th>
<th>Coefficient When the Dependent Variable is the Average Duration of Strikes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. QI dummy variable</td>
<td>Negative H Accepted</td>
<td>Negative H Accepted</td>
</tr>
<tr>
<td>2. QII dummy variable</td>
<td>Positive H Accepted</td>
<td>Positive H Accepted</td>
</tr>
<tr>
<td>3. QIV dummy variable</td>
<td>Negative H Accepted</td>
<td>Negative H Accepted</td>
</tr>
<tr>
<td>4. Time trend dummy variable</td>
<td>Negative H Accepted</td>
<td>Not Applicable</td>
</tr>
</tbody>
</table>

*H = Hypothesis
CHAPTER V

I. SUMMARY OF FINDINGS

From our theoretical model and our empirical results, the following tentative conclusions can be made.

1. Strikes may indeed be and often are "rational" from the viewpoint of the bargaining parties. In determining the rationality of a strike, it is the utility functions of the bargaining participants which are relevant as they are the decision makers.

2. Closely related to (1) is our refutation of Hick's [15] statement that "Under a system of collective bargaining some strikes are more or less inevitable...; but nevertheless the majority of actual strikes are doubtless the result of faulty negotiations." The only fault that will make this statement read true with respect to the model developed, is to fault union members and stockholders for not possessing perfect knowledge. Given UM and SG perfect knowledge, the learning function of strikes would not be necessary nor would there be a distinction between union members and union leaders as
any attempt by the UL not to maximize UM utility would result in their removal from office, but unfortunately this is a hypothetical situation—many faultless negotiations by the union leaders and management lead to equitable pareto efficient solutions which entail strikes.

3. The higher the time preference of each bargainer, i.e., the higher their discount rates \( r_1 \) and \( r_2 \), the faster a stable solution will be found and thus the shorter any given strike will be.

4. The greater the weight that the UL give to their own political ambitions within the union, vis-à-vis the best interests of the UM, the greater the likelihood of a strike as well as a longer duration of the strike if it does occur.

5. The greater the initial disparity between UME and the minimal acceptable wage (regardless of the length of the strike), i.e., the more highly inflated the wage expectations of the UM, the greater the likelihood of a strike and the greater the average duration of those strikes which do occur.

6. Fifth party (government) intervention in collective bargaining, in the form of moral suasion, is very
unlikely to accomplish any restraining of industrial conflicts if applied to the union side of the UL-M coalition. The firm is somewhat more susceptible however and at times moral suasion could conceivably be quite effective when applied to management.

7. There is money illusion in collective bargaining on the part of the rank and file union members. This result is contrary to that of Ashenfelter and Johnson [2] whose results found that nominal wage and price changes "mirror" each other with respect to collective bargaining.

8. There has been a secular decline in strike activity in the past twenty years (as witnessed by the highly significant negative coefficient on our time trend variable) due to the trend toward multi-employer bargaining and the decline in institutional strikes.

9. The level of strike activity and contract expirations are very seasonal in nature, both being smaller in the first and fourth quarters than in the second and third quarters of the year.

10. The average duration of strikes is also seasonal in nature, although somewhat less so than the level
of strike activity, with strikes being longer in the second and third quarters than the first and fourth quarters of the year.

11. The passage of the Landrum-Griffin Act has increased the average duration of strikes due to the increased sensitivity which it caused the union leaders to have for the wishes of their constituents. However, it has had no apparent effect on the level of aggregate strike activity.

12. Lagged changes in corporate profits are negatively correlated with the level of aggregate strike activity, but are positively correlated with the average duration of those strikes which do occur.

13. Lagged wage increases cause both a lower aggregate level strike activity and a shorter average duration of strikes.

14. Increases in unemployment cause a lower aggregate level of strike activity, but have no significant effect on the average duration of strikes.

15. Increases in personal savings are associated with increases in both the aggregate level of strike activity and the average duration of strikes.

16. Finally, increases in business inventories cause a shorter average duration of strikes.
II. POSSIBLE EXTENSIONS OF THE ANALYSIS

An obvious extension of the analysis would be a utilization of the model to lend theoretical explanation to the maze of empirical studies concerning interindustry wage differentials and the role that unions play in their determination. This would involve analyzing the varying conditions between industries as they manifest themselves in shifting the various functions of our model and determining the net interaction of these changes for each type of industry.

In addition, as data becomes available it would be useful to extend the present empirical tests to include such variables as foodstamps and unemployment compensation available to strikers. It would be interesting to know what the total cost of these practices are to society; i.e., if they in fact result in more and longer strikes in addition to the size of the foodstamp subsidy and unemployment compensation payments.

Finally, we believe that the model could be useful in giving a theoretical explanation to the empirical findings of Rees [24], O'Brien [21], Weintraub [33], Scully [27], and others concerning the observed relation between the aggregate level of strike activity and the business cycle. We
believe our analysis could be of use in explaining the observed lag of strike activity at the trough of the cycle and the lead of strike activity at the peak of the cycle. This pattern, repeatedly observed over the past few decades, has yet to receive an acceptable theoretical explanation.
REFERENCES


