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UNION WAGES AND THE MINIMUM WAGE*

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ABSTRACT

Union Wages and the Minimum Wage

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It is argued that a change in the minimum wage may affect the outcomes of collective bargaining through its effect on a hypothetical "reference wage" which the union rank-and-file use as a basis of comparison in formulating their wage demand. It is further argued that the importance of the minimum wage in the reference wage is stronger for collective bargaining relationships which have base wage rates relatively close to the minimum wage.

In order to investigate these hypotheses empirically and to measure the effect of changes in the minimum wage on the wage and strike outcomes of collective bargaining, a sample of 209 contracts representing nineteen collective bargaining relationships over the period from 1957 through 1979 was formulated. The results of the empirical analysis suggest that changes in the minimum wage have an effect on negotiated wage changes which is quite small and, given the precision with which it is estimated, which is unlikely to be of substantial magnitude. Even for relationships with base wage rates only 10 percent above the minimum wage the elasticity of union wages with respect to a change in the minimum is less than .05. This small effect declines further as the base wage increases relative to the minimum. No systematic relationship could be found between changes in the minimum wage and the likelihood or duration of

strikes. However, these results were rather poorly determined, and further theoretical and empirical analysis of the determinants of strike activity in general is needed before conclusions can be drawn with confidence.

In order to investigate a potential mechanism through which changes in the minimum wage might affect the outcomes of collective bargaining, an Ashenfelter-Johnson type model of outcomes was developed and implemented. However, data constraints forced the elimination of the four lowest wage relationships from the sample which reduced its usefulness in an investigation of the effects of changes in the minimum wage. Nonetheless, two interesting tentative results relating to the minimum wage were found. First, no systematic relationship could be found between changes in the minimum wage and union wage demands while changes in a manufacturing average hourly earnings measure were found to have a substantial impact on union wage demands. Second, it was found in the context of the model that the level of the minimum wage relative to the base wage is an important determinant of the alternative wage available to workers. Since this quantity governs the ultimate concessions the union will make, it can have an important effect on outcomes. More specifically, it is likely that a change in the minimum wage increases wage settlements somewhat as the base wage rises to reassert partially the old union-minimum wage differential. There may also be a reduction in strike activity.

I. Introduction

While most research by economists on the minimum wage addresses its potential employment effects, an important (and relatively neglected) issue concerns the effect of changes in the minimum wage on other wages in general and on the wage negotiated by unions in particular. Gramlich (1976) found that average hourly earnings in the private sector had an impact elasticity of .027 with respect to a change in the minimum wage. In a recent study Grossman (1980) found a somewhat more substantial effect of changes in the minimum wage on the earnings of workers who earned close to the minimum wage. However, neither of these studies address the issue of how changes in the minimum wage affect wages in the union sector through the collective bargaining process. It is this problem which serves as the focus of this study.

There are at least two plausible explanations which can be developed for an effect of changes in the minimum wage on wage changes negotiated by labor unions. The first is termed here the reference wage theory. This theory posits that unions are concerned not only about the real wages of their members but also about the wages of their members <u>relative</u> to the earnings of some reference group. This concept is argued for persuasively by Ross (1948). More recently Mitchell (1980) has discussed what he terms "wage imitation" particularly within the union sector between various collective bargaining relationships.

A particular wage (or more plausibly, combination of wages) may become the reference wage for a particular collective bargaining relationship for any of a number of reasons. For example, the union workers may consider workers who earn the reference wage (or wages) to be comparable in some dimension (e.g., skill level or residential neighborhood) and demand parity through some sort of equity argument. More generally union workers may perceive that a fixed relationship with workers who earn the reference wage (or wages) is equitable and demand that this fixed relationship be maintained. The reference wage concept may also be rooted in union workers' perceptions of the wages associated with their alternative employment opportunities. The reference wage for a particular group may not be the wage earned by a particular worker, but it may be an average of the wages earned by a relevant reference group.

Changes in the minimum wage can affect union wages to the extent that the minimum wage is represented in the reference wage. It is clear that the reference wage in relatively low wage collective bargaining relationships ought to be more dependent on the minimum wage than the reference wage in higher wage collective bargaining relationships. Thus, an important empirical implication of the model is that any effect of changes in the minimum wage on negotiated wage rates will diminish as one progresses upward through the wage structure.

The second explanation which can be developed for an effect of changes in the minimum wage on wage changes negotiated by labor unions is that the minimum wage can serve as a wage floor for potential nonunion competition. Given the higher wages negotiated by unions this will limit the amount by which nonunion firms can undercut the costs of union firms. The result will be that the long run employment effect of any union wage demand is smaller in an environment which includes a minimum wage, and unions may then be free to negotiate higher wages.[1] This "wage floor" theory has the implication that the importance of the minimum wage as a wage floor in the context of a particular collective bargaining relationship is higher in those situations where the workers are earning close to the minimum wage. Thus, as with the reference wage theory, the wage floor theory has the empirical implication that any effect of the minimum wage on negotiated wage rates will diminish as one progresses upward through the wage structure.

In the remainder of this study the reference wage concept will be used as the basis for the analysis. However, in light of the above discussion it is clear that both the reference wage theory and the wage floor theory have similar empirical implications regarding the effect of the minimum wage on union wages and that the expositional choice made here is somewhat arbitrary.

The appropriate data for analysis of the effect of changes in minimum wages on union wages are data on the outcomes of collective bargaining disaggregated to the level at which negotiations take place. To this end the empirical analysis presented below relies on information on nineteen collective bargaining relationships from 1954 through 1979. The particular relationships selected represent a broad spectrum of the wage structure from relatively low paid textile workers to more highly paid automobile workers. The data set is described in detail in the next section along with the development of an empirical representation of the reference wage concept.

Section III contains the development of a microeconomic empirical relationship which relates the wage changes negotiated in a collective bargaining relationship to such things as the unemployment rate and expectations regarding inflation as well as to changes in the reference wage. The empirical results presented in that section suggest that even in relatively low wage situations changes in the minimum wage have only a small effect on the negotiated wage changes and that this small effect diminishes in higher wage situations.

In Section IV a link is drawn between the wage demand of a union and the potential for an employer to dissipate some of the wage demand by withstanding a strike. A reduced form tobit model of the occurrence of strikes is formulated and estimated. In general, the model exhibits little explanatory power and no significant relationship is found between changes in the minimum wage and the probability or duration of a strike.

Section V contains the development and implementation of a structural model of the outcome of industrial disputes which is based on the work of Ashenfelter and Johnson (1969). The simultaneous determination of wage and strike outcomes of collective bargaining is the focus of the theoretical and empirical analysis in this section. Unfortunately, the data requirements of this model forced the elimination from the sample of four of the low wage firms so that the results in this section are less useful than one would like in determining the potential effects of changes in the minimum wage on wage demands and strike activity. However, it is tentatively concluded in the context of the model that, while changes in the minimum wage have little discernable impact on the level of union wage demands, the level of the minimum wage relative to the union wage has a substantial effect on the wage alternatives available to union workers. This implies that it is through this route that a change in the minimum wage can affect the wage and strike outcomes of collective bargaining.

In the final section the results of the study are summarized. It is concluded on the basis of the empirical analysis that, while changes in the minimum wage have only a small effect on union wages, the latter are substantially influenced by changes in average earnings in manufacturing. In addition, to the extent that changes in the minimum wage are the result of changes in average earnings in manufacturing, even the small direct effect of changes in minimum wage on union wages which was found in Section III may actually be an indirect effect of changes in average earnings.

II. The Data

The nineteen collective bargaining relationships listed in table 1 were selected in order to represent a wide range of base wage rates varying from near the minimum wage to over twice the minimum wage.[2] Data availability was a major factor in determining the pool from which the relationships were selected. The majority of the nineteen relationships were the subjects of

Wage Chronologies published by the U.S. Bureau of Labor Statistics (BLS). The natural unit of observation is a contract rather than an arbitrary time unit such as a year, and the sample consists of 209 contracts covering the nineteen relationships over the period from 1954 to 1979. Eighteen of the nineteen relationships in the sample are in the manufacturing sector, and they are broadly representative of the unionized portion of that sector. Thus, while any results derived from this sample can be generalized to the unionized manufacturing sector as a whole, caution must be exercised in extrapolating any results to other sectors such as the service or construction sectors. This limitation is particularly important in light of the unique nature of the collective bargaining process in industries such as construction.

Given the range of wage rates specified in any collective bargaining agreement it is necessary to select a single wage rate which can serve as a basis for comparison both over time and between firms insofar as possible. The janitor's wage was selected because of its availability for a large number of the firms. Any other occupational wage has the drawback that the occupation is not likely to be common to very many industries. Where the janitor's wage was not available the plant minimum regular wage rate was selected.[3] The particular wage rate selected will be referred to as the base wage.

In order to illustrate the broad spectrum of wage rates represented in the sample table 2 contains for each relationship over the 1954-1979 period the average of the differential between the base wage and the minimum wage existing prior to negotiation of each contract.[4] The base wage in four of the firms is less than twenty percent above the minimum on average over the sample period while in five of the firms the base wage is over twice the minimum wage on average. In the remaining ten firms the base wage rate is between twenty and onehundred percent above the minimum wage on average. Note that use of the base wage, which is at the bottom of the intra-firm wage structure, for this calculation results in a systematic understatement of the differential between the average wage in the firm and the minimum wage. Nontheless, the differential between the base wage and the minimum is a good indicator of the relative positions of the various intra-firm wage structures vis a vis the minimum wage.

The wage change measure which is used to represent the wage outcome of collective bargaining in this study is the average annual proportional change in the base wage negotiated at the time of contract expiration excluding any cost-of-living escalator adjustments. In other words this is the noncontingent (on prices) rate of wage increase. More formally, this measure is calculated as

$$\dot{W}_n = \left[\frac{W_n - W}{W}\right] \frac{12}{DUR} \qquad (1)$$

where $\dot{W}_n$ represents the average annual rate of change of the base wage which is negotiated, W_n represents the base wage rate which will prevail at expiration of the new contract (excluding any cost-of-living adjustments), W represents the base wage rate which prevails at expiration of the old contract, and DUR represents the duration of the new contract in months. The quantity $\dot{W}_n$ is used as a proxy for negotiated changes in the general intra-firm level of wages, and it will be an accurate proxy to the extent that the intra-firm wage structures are stable over time. It is recognized that some compression of these wage structures has taken place due to the use of "across the board" absolute cents per hour wage increases. However, this tendency is offset in many instances through the negotiation periodically of special increases for the more highly skilled groups. On balance, given the limitations of the data it is argued that $\dot{W}_n$ accurately reflects the negotiated noncontingent general rate of wage increase.

An important component of the empirical analysis is a variable representing expectations about the rate of price inflation over the new contract. The relevant price index to form expectations on is the consumer price index (CPI) because the parties (particularly the workers) are exposed to its well publicized movements and because most escalator clauses are linked to the CPI. The expectations series was formulated using a straightforward autoregression on annual rates of change in the CPI in the postwar period. More specifically, for a contract being negotiated in month j of year t, the j to j annual rate of change in the CPI from 1947 to t was regressed on lagged j to j changes in the CPI and a constant.[5] The length of the lag depended on t. From 1954 through 1957 only one lag was included, from 1958 through 1965 two lags were included, and from 1966 through 1979 three lags were included. This procedure is somewhat arbitrary, but the results are not very sensitive to variations in the lag structure.[6]

The resulting set of forecasting equations was then used to form expectations about the rate of inflation. To forecast the rate of inflation over the life of the new contract, sequential annual forecasts were made. First, using actual data available at the time of negotiation, the appropriate autoregression was used to formulate an expected rate of inflation over the next year ($\dot{p}_e^1$). If the contract was longer than one year, $\dot{p}_e^1$ was used as a datum in the same autoregression to compute an expected rate of inflation over the second year ($\dot{p}_e^2$). For longer contracts this process was continued until enough yearly expected rates of inflation had been computed. Finally, these expectations were converted to an average annual expected rate of change over the new contract ($\dot{p}_e$) by computing $\dot{p}_e = \frac{1}{D} \sum_{i=1}^{D} (1 + \dot{p}_e^i) - 1$ where D represents the duration of the new contract in years. For contracts which are not of year multiple duration, $\dot{p}_e$ was computed for the two years bracketing the actual duration and the correct $\dot{p}_e$ was computed by linear interpolating between these values.

The central empirical construct for the analysis of the effect of changes in the minimum wage on union negotiated base wage rates is the reference wage (W_R). It is assumed here that the reference wage for a bargaining relationship is a weighted geometric average of the minimum wage and average hourly earnings in durable goods manufacturing. The latter was chosen to be representative of the earnings of workers at the high end of the blue collar wage spectrum.[7] The logarithm of the reference wage is represented formally as

$$\ell n\ W_R = \alpha\ \ell n\ W_m + (1-\alpha)\ \ell n\ W_H \qquad (2)$$

where W_m represents the minimum wage, W_H represents average hourly earnings in durable goods manufacturing, and α is the weight put on the minimum wage. It was argued that this weight is an inverse function of the differential between the minimum wage and base wage of workers at the time of negotiations (W). Let

$$\alpha = \alpha_1 + \alpha_2\ \Delta \qquad (3)$$

where $\Delta = \frac{W - W_m}{W_m}$ and is the differential between the base wage and the minimum wage. The hypothesis that the effect of the minimum wage on the reference wage diminishes as the base wage of the workers become large relative to W_m is embodied in the empirical specification as the hypothesis that $\alpha_2 < 0$.

The proportional change in the reference wage over a span of time can be approximated by taking the total differential of equation (2). Neglecting any change in α this is

$$d\ell n\ W_R = \alpha\ d\ell n\ W_m + (1-\alpha)\ d\ell n\ W_H. \qquad (4)$$

In the next section it will become clear that in determining the rate of wage increase negotiated at a point in time a relevant variable is the rate of change in the reference wage over the previous contract. This variable is called $\dot{W}_R$ and can be represented as

$$\dot{W}_R = \alpha \dot{W}_m + (1-\alpha) \dot{W}_H \quad (5)$$

where $\dot{W}_m$ represents the average annual rate of change in W_m over the previous contract and $\dot{W}_H$ represents the average annual rate of change in W_H over the previous contract. Rearrangement of terms in equation (5) and substitution for α from equation (3) yields

$$\dot{W}_R = \dot{W}_H + \alpha_1(\dot{W}_m - \dot{W}_H) + \alpha_2(\dot{W}_m - \dot{W}_H)\Delta. \quad (6)$$

This empirical representation is used in the analysis in the succeeding sections.

Table 3 contains the means and standard deviations of the variables used in this study for the sample of 209 contracts described above. Strikes occurred during the negotiation of 34 of the 209 contracts, and the average duration of a strike where one occurred was .118 years (43 days). Cost-of-living adjustment clauses were included in 46 of the 209 contracts.

III. Changes in the Minimum Wage and Negotiated Wage Changes

The observed wage and strike outcomes of collective bargaining can be considered to be the result of a process by which union wage demands are translated through the bargaining process into these outcomes. A version of this model is developed formally in Section V. In this section the observed wage outcomes are modelled as a reduced form relationship between $\dot{W}_n$ and exogenous variables which affect the wage demands of the union. Some of these variables also reflect the willingness of employers to accede to such demands. The resulting reduced form looks very much like a microeconomic analogue of an aggregate Phillips Curve relationship, but it must be remembered that the theoretical justification and the interpretation of this microeconomic relationship is somewhat different.

Before consideration of the reference wage hypotheses, a plausible specification is

$$\dot{W}_n = \beta_0 + \beta_1 UR + \beta_2 RWCH + \beta_3 (NES)\dot{p}_e + \beta_4 (ES)\dot{p}_e + Z\gamma + \varepsilon \quad (7)$$

where ε is a random component, $Z\gamma$ is a linear combination of dichotomous variables for periods with incomes policies (G, PH1, PH3), and the rest of the variables are defined in Table 3. Intuitively, the unemployment rate is an indicator of general labor market conditions which may be important to the union's ability to negotiate a higher wage. For instance, if the unemployment rate is low then union workers may have better job alternatives, they may be able to locate temporary work more easily during a strike, and employers may have difficulty finding alternative workers. The rate of change of real wages over the previous contract (RWCH) is a "catchup" variable which reflects a union's desire to make up for a decline in real wages which occurred over the previous contract. Similarly, if real wages have been rising rapidly then union wage demands may be moderated. It is expected that the coefficient on RWCH will be negative.

Separate coefficients are estimated on the expected inflation variable for indexed and nonindexed contracts. This is necessary because the dependent variable is the noncontingent (on prices) negotiated rate of wage increase rather than the total realized ex post rate of wage increase. Clearly, the parties must be more concerned about the expected rate of inflation if the contract is not indexed than they must be if the contract is indexed. For indexed contracts the rate of inflation affects the wage independently of the negotiated rate of wage increase. Hence, it is expected that the coefficient of $\dot{p}_e$ for indexed contracts (β_4) will be smaller than the coefficient of $\dot{p}_e$ for nonindexed contracts (β_3) and that the difference ($\beta_3 - \beta_4$) will reflect the average perceived degree of wage indexation in indexed contracts as it affects wage outcomes.

The first column of Table 4 contains the results of an ordinary least squares (OLS) regression of equation (7) over the sample of 209 contracts. With the exception of the positive coefficient on the unemployment rate, the results accord with expectations. In particular, the effect of the expected rate of inflation on the negotiated proportional wage increase is positive but smaller in indexed contracts than in nonindexed contracts. The difference between the coefficients which represents the degree to which indexation obviates the necessity for the union to consider the expected rate of inflation in negotiating a wage change is estimated to be .649 - .250 = .399 with a standard error of .0836. The hypothesis that these coefficients are identical can be rejected at any reasonable level of significance. The coefficient of RWCH is estimated to be negative as expected, and the hypothesis that it is equal to zero can be rejected at the 10 percent level of significance. The Kennedy-Johnson guidelines variable (G) has a negative coefficient which is significantly less than zero at the 5 percent level. Its magnitude suggests that, on average, negotiated wage changes were 1.2 percent lower than they would otherwise have been. The Nixon-Ford controls variables (PH1, PH3) are of unconsequential magnitude with small standard errors.

The coefficient on the unemployment rate is positive and significantly different from zero at the 5 percent level. This is the opposite of the expected result, and it suggests that wage changes in the union sector, more than being less susceptible than nonunion wage changes to moderation by a loose labor market, are actually higher when the labor market is slack. As to the practical significance of this positive effect, it is actually quite small. The point estimate of .09 suggests that if the unemployment rate doubles from 4 percent to 8 percent union negotiated wage changes will increase by only .36 percentage points.

The well known instability of the aggregate Phillips Curve relationship after approximately 1970 suggests that the perverse relationship between union negotiated wage changes and the unemployment rate may be a result of some structural shift which took place after 1970. In order to investigate this conjecture equation (7) was re-estimated using only the 150 contracts negotiated prior to 1971. The results of this estimation are contained in the second column of Table 4. The results are remarkably similar to those computed from the entire sample of 209 contracts, and the positive relationship between $\dot{W}_n$ and the unemployment rate clearly existed prior to the 1970's. In order to perform an F-test of the hypothesis that the structure did not shift in the 1970's, equation (7) was also re-estimated over the post-1970 period. These results were not terribly well determined due to the relatively small number of observations (59), and the hypothesis of structural stability could be rejected at the 5 percent level of significance.[8] However, it is clear from the relationship estimated over the contracts negotiated prior to 1971 that this structural instability cannot account for the positive relationship between the unemployment rate and $\dot{W}_n$.

A second potential explanation for the positive coefficient on the unemployment rate is that the demographic composition of the labor force shifted toward groups with relatively higher unemployment rates over the sample period. Given that the negotiated rates of wage increase were increasing secularly over the sample period and if the aggregate unemployment rate is not the appropriate measure of "slack" in the labor market, the estimated coefficient may be an upward biased indicator of the effect of the state of the labor market on negotiated wage outcomes.[9] In particular, if the appropriate measure of the state of the labor market is the unemployment rate of a particular demographic group (e.g., prime age males) then use of the aggregate unemployment rate will be misleading because the latter is drifting steadily upward over time relative to the unemployment rate of the subgroup.

In order to evaluate this explanation empirically equation (7) was re-estimated using the unemployment rate for prime age males in place of the aggregate unemployment rate. The results, presented in the third column of table 4, suggest that this explanation has some validity. The estimated coefficient on the prime age male unemployment rate is significantly less than zero at the 1 percent level. The estimated coefficients of the other variables are virtually unchanged from those contained in the first column of table 4. Column (4) of table 4 contains estimates of equation (7) where both unemployment rates are included. It is interesting to note that both unemployment rates have coefficients which are significantly different from zero but with opposite signs. The aggregate unemployment rate has a positive coefficient while the prime-age male unemployment rate has a negative coefficient. Again, the estimated coefficients of the other variables are virtually unchanged from those contained in the first column of table 4.

Given the lack of a clear theoretical guide concerning the appropriate measure of slack in the labor market, the analysis proceeds using the aggregate unemployment rate. However, because of this ambiguity all of the relationships estimated in the remainder of this study were also estimated using the prime age male unemployment rate. Apart from the opposing signs of the two unemployment rate variables none of the other estimated coefficients in any of the models considered below was changed to any meaningful degree by the specification of the unemployment rate variable, and for this reason only the estimates using aggregate unemployment rate are presented in the succeeding work.

In order to consider the reference wage hypothesis equation (7) is modified to include $\dot{W}_R$ as a regressor. This is

$$\dot{W}_n = \beta_0 + \beta_1 UR + \beta_2 RWCH + \beta_3 (NES)\dot{p}_e + \beta_4 (ES)\dot{p}_e + \beta_5 \dot{W}_R + Z\gamma + \varepsilon. \qquad (8)$$

However, $\dot{W}_R$ is not observable so that it is necessary to use the empirical representation of $\dot{W}_R$ defined in equation (6). The resulting estimating equation is

$$\dot{W}_n = \beta_0 + \beta_1 UR + \beta_2 RWCH + \beta_3 (NES)\dot{p}_e + \beta_4 (ES)\dot{p}_e + \beta_5 \dot{W}_H + \beta_6 (\dot{W}_m - \dot{W}_H) + \beta_7 (\dot{W}_m - \dot{W}_H)\Delta + Z\gamma + \varepsilon \qquad (9)$$

where the variables are defined in Table 3. From equation (6) it is clear that the coefficient β_5 represents the elasticity of the union negotiated wage with respect to a change in the reference wage. The ratio $\frac{\beta_6}{\beta_5}$ represents the coefficient α_1 which is the weight, defined in equation (3), of the minimum wage in the reference wage where the union wage is equal to the minimum wage ($\Delta = 0$). The ratio $\frac{\beta_7}{\beta_5}$ represents the coefficient α_2 which measures the decline in the weight of the minimum wage in the reference wage as the union wage increases relative to the minimum wage.

The first column of Table 5 contains OLS estimates of equation (9). Setting aside the reference wage variables for the moment, the estimated coefficients are similar to those contained in Table 4. The unemployment rate again is estimated to have a positive coefficient of approximately .1 which is significantly different from zero at the 5 percent level. It is interesting that, while the estimated coefficients on the inflation expectations variables are substantially smaller than those contained in Table 4, the difference between them ($\beta_3 - \beta_4$) is estimated to be approximately the same. This difference is .194 - (-.210) = .404 with a standard error of .0784. Again, the hypothesis that the coefficients are identical ($\beta_3 = \beta_4$) can be rejected at any reasonable level of significance.

The hypothesis that the reference wage variables ($\dot{W}_H$, $\dot{W}_m - \dot{W}_H$, $(\dot{W}_m - \dot{W}_H)\Delta$) all have coefficients of zero can be rejected at any reasonable level of significance using an F-test.[10] However, it is clear from the coefficients and their standard errors that the majority of the explanatory power is coming from the rate of change of average hourly earnings in durable goods manufacturing ($\dot{W}_H$) rather than from the rate of change of the minimum wage ($\dot{W}_m$).

The elasticity of the union negotiated wage with respect to a change in W_H is $\beta_5 - \beta_6 - \beta_7\Delta$. This is .704 with a standard error of .146 where the base wage is ten percent above the minimum wage (Δ =.1). Table 6 contains the value of $\frac{d\dot{W}_n}{d\dot{W}_H}$ with its associated standard error for various values of the differential of the base wage from the minimum wage (Δ). The large and well determined coefficient on $\dot{W}_H$ suggests that changes in W_H over the previous contract (and indirectly changes in the reference wage) are important determinants of union negotiated wage changes.

Table 6 also contains estimates of the effect of changes in the minimum wage on union negotiated wage changes ($\frac{d\dot{W}_n}{d\dot{W}_m}$) using the coefficient estimates contained in the first column of Table 5. As expected the effect is positive for contracts with base wage rates near the minimum and it declines as the base wage is farther from the minimum ($\beta_7 < 0$). For contracts with base wage rates within approximately twenty percent of the minimum ($\Delta < .2$), the effect ($\frac{d\dot{W}_n}{d\dot{W}_m} = \beta_6 + \beta_7\Delta$) is statistically significantly greater than zero at the ten percent level.

While the estimated elasticity of the negotiated wage with respect to changes in the minimum wage is of the appropriate sign, its magnitude is small relative to $\frac{d\dot{W}_n}{d\dot{W}_H}$. The elasticity is .044 with a standard error of .034 where the base wage is ten percent above the minimum ($\Delta = .1$) and it decreases to -.002 with a standard error of .029 where the base wage is twice the minimum ($\Delta = 1$). These estimates are so small as to make the effect of charges in the minimum wage on union negotiated wages of little practical importance. To illustrate this note that the largest proportional increase in the minimum wage over the sample period (1954 - 1979) was less than 35 percent. Even where the base wage is only ten percent above the minimum, an increase in the minimum wage of 35 percent would increase the union negotiated wage by only 1.5 percent.

It is important to note that the estimated elasticities are not only small but also are estimated quite precisely. It is unlikely that the effect of changes in the minimum wage on union negotiated wage changes is substantial. The upper limits of a 95 percent confidence interval on $\frac{d\dot{W}_n}{d\dot{W}_m}$ is .111 where $\Delta = .1$ which implies that at that wage level an increase in W_m of 35 percent would increase the union wage by 3.9 percent. For a base wage of twice the minimum ($\Delta = 1$), the upper limit of a 95% confidence interval on $\frac{d\dot{W}_n}{d\dot{W}_m}$ is .054 which implies that at that wage level an increase in W_m of 35 percent would increase the union wage by 1.9 percent.

In the context of the reference wage theory, it can be inferred from the coefficient estimates both that changes in the reference wage are important determinants of union negotiated wage changes and that the reference wage is heavily weighted toward the AHE measure rather than toward the minimum wage even for relatively low wage contracts. The first point is supported by the evidence that the coefficient of $\dot{W}_H$ (β_5) in the regression of $\dot{W}_n$ is interpreted as the elasticity of W_n with respect to changes in the reference wage (W_R). The estimates contained in the first column of Table 5 suggest that this elasticity is .748 with a standard error of .140. The hypothesis that $\beta_5 = 0$ can be rejected at any reasonable level of significance.

The second point, that changes in the reference wage are relatively unaffected by changes in the minimum wage, can be illustrated by computing the weight (α) on the minimum wage in the reference wage equation. The third column of Table 6 contains the values of α computed for various values of Δ. This weight is .059 for contracts with a base wage ten percent above the minimum, and it falls to zero for contracts with a base wage of twice the minimum. Correspondingly, the weight on W_H in the reference wage equation ($1-\alpha$) is .941 for contracts with a base wage ten percent above the minimum, and this rises to one for contracts with a base wage of twice the minimum.

A caveat to the conclusion that union wage changes are not greatly affected by changes in the minimum wage is that almost by definition it cannot be true for union workers who earn approximately the minimum wage ($\Delta \approx 0$). The wages of these workers must rise essentially one for one with increases in the minimum wage. This is true for legal reasons for workers who are covered by the minimum wage, and it is true for organizational-political reasons for all union workers. Clearly, a union will have trouble justifying its continued existence if it cannot guarantee its workers some premium (however small) above the government mandated wage floor. The practical importance of this issue is limited by the fact that few union workers (particularly in manufacturing) earn very close to the minimum wage. In the sample considered here there was no relationship with an average differential between the base wage and the minimum wage of less than .1. Nonetheless, when considering unions in relatively low paid service industries and particularly newly organized unions these considerations may be of some importance.

While the conclusion that union wage changes are not substantially affected by changes in the minimum wage can be tentatively drawn from the empirical results derived above, there are a number of alternative formulations which must be investigated before this result can be accepted with some degree of assurance. The first problem is that, as mentioned above, the structure may have shifted after 1970 causing the results to be distorted. In order to investigate this issue the model was re-estimated using only the 150 contracts negotiated prior to 1971. These estimates are contained in the second column of Table 5, and, unlike in the estimation of equation (7), the hypothesis that the structure did not shift cannot be rejected at the 5 percent level of significance.[11] The estimates obtained from the earlier part of the sample for the effect of changes in the minimum wage on $\dot{W}_n$ are qualitatively similar to those obtained for the entire sample. The point estimates suggest that $\frac{d\dot{W}_n}{d\dot{W}_m}$ was somewhat larger prior to 1970, but it was relatively small in magnitude even then. For contracts with base wages ten percent above the minimum, prior to 1970 the estimated elasticity of W_n with respect to changes in W_m was .076. If the minimum wage were to increase by 35 percent this suggests that at $\Delta = 1$ the union wage would increase by 2.7 percent. These estimates also imply that at $\Delta = .1$ the weight (α) on W_m in the reference wage equation is $\frac{.076}{.602} = .126$.

The second potential problem is that, given the pooled nature of the data set, it may be true that there are unmeasured influences which are systematic within firms and persist over time which if not accounted for can distort the results. In order to investigate this the model was re-estimated using a fixed-effect framework. Computationally a separate intercept term was estimated for each firm, and the results of this estimation are contained in the third column of Table 5. The results are virtually identical to those obtained for the basic model and contained in the first clumn of Table 5. Using an F-test, the hypothesis that the intercept terms are identical across all nineteen firms cannot be rejected at any reasonable level of significance.[12] Thus, it can be concluded that fixed effects are not an important factor in the determination of negotiated wage changes and that their inclusion does not alter the relationship described above between $\dot{W}_m$ and $\dot{W}_n$.

The final potential problem considered here concerns the fact that certain future changes in the minimum wage are known in advance because the legislature often passes an amendment to the Fair Labor Standards Act which specifies that the minimum wage will increase in a series of steps over the next few years. These programmed changes may affect the reference wage and hence union negotiated wage changes even before they become effective. In order to investigate this issue the model was re-estimated using a modified minimum wage change variable. This modified $\dot{W}_m$ is defined as the average annual rate of change of the expected minimum wage where expectations concerning the minimum wage are confined to previously legislated programmed changes. In other words, in computing $\dot{W}_m$ the parties are assumed to look at what the minimum wage is programmed to be as of the expiration date of the contract, and they compare this to what the minimum wage was programmed (as of the date of negotiation of the last contract) to be at the expiration of the last contract. The results of the estimation with this expected $\dot{W}_m$ measure are contained in the last column of Table 5, and they are once again qualitatively similar to those obtained for the basic model. The regression with the expected $\dot{W}_m$ measure implies an even smaller estimated effect of changes in W_m on negotiated wage changes than the basic model, and the results provide little support for the position that $\dot{W}_m$

computed from programmed changes is the relevant measure.

Overall, the results presented in this section concerning the effect of changes in the minimum wage on union negotiated wage changes are rather clearcut. The point estimate of the effect is small (an elasticity of approximately .05) even for a base wage which is fairly close to the minimum and the effect declines to zero as the base wage grows relative to the minimum. In addition, the effect is tightly estimated in the sense that there is a negligible probability that the elasticity of the union wage with respect to changes in the minimum wage exceeds .15 even for contracts with a base wage relatively near the minimum. The results also suggest that changes in average hourly earnings are much more important at all base wage levels in the determination of the reference wage and union negotiated wage changes than are changes in the minimum wage. To the degree that legislated changes in the minimum wage are the result of changes in AHE, the latter variable assumes even greater importance in union wage determination.

IV. Changes in the Minimum Wage and the Occurrence of Strikes

To the extent that changes in the minimum wage increase the reference wage and to the extent that the union rank-and-file are concerned about their wage relative to the reference wage, it will be true that changes in the minimum wage affect union wage demands. Union wage demands are defined here as that wage increase which the employer must yield in order to avert a strike.

If the employer believes that union wage demands can be moderated by withstanding a strike then the employer, in deciding whether or not to grant the union wage demand without a strike, faces a tradeoff between the lost profits incurred during a strike and the reduction in the present value of future labor costs resulting from the moderation of union wage demands. Depending on the nature of this tradeoff an increase in union wage demands (perhaps caused by an increase in the minimum wage) may increase the likelihood of a strike.

This hypothesized relationship between union wage demands and the likelihood of a strike is clearly an oversimplification. While it is true that the employer faces the sort of tradeoff described above the key variable is not the level of union wage demands but it is the rate at which the union can be expected to moderate those demands during a strike. Intuitively, if the union doubles its wage demand but is resolved to hold firmly to this new demand during a strike there will be a negligible benefit to the employer from withstanding a strike. Conversely, if the union is seen to lose its "resolve" so that the employer foresees a rapid moderation of union wage demands during a strike then there will be a substantial benefit to the employer from withstanding a strike. A strike will be more likely in the latter case.[13] On the other hand the level of wage demands may affect the absolute size of any concession, and to the extent that this is true, an increase in union demands can increase the likelihood of a strike.[14]

In the next section a formal structural model of this process is developed and estimated. In this section an empirical model relating the set of variables that in the last section was hypothesized to affect wage outcomes to the length of strike which occurred in a particular negotiation is developed and estimated. Both this model and the wage change model estimated in the last section can be considered reduced form versions of a structural model which mediates union wage demands through the bargaining process to yield wage and strike outcomes.

Before proceeding it must be pointed out that strikes, being costly, are not Pareto efficient, ex post, in the sense that both parties would have been better off to have settled before any strike on the same terms. In this context, Hicks (1963) suggests that strikes are the result of divergent expectations as to the disagreement outcome. Intuitively, if each party expects the settlement after a strike to be relatively favorable to its respective position then neither party may be willing to concede enough to yield a peaceful settlement. A clear implication of this interpretation of strikes is that, in the absence of a real understanding of expectations formation, the likelihood of occurrence of strikes ought not to be systematically related to the sorts of variables which were found to affect wage outcomes. In addition, by this interpretation the reduced form estimation performed below ought not have much explanatory power.

Strikes occured in negotiating 34 of the 209 contracts in the sample. The average duration of a strike where one occurred was .118 years. Given the large number of cases where no strike occurred it is necessary to utilize an econometric framework which explicitly recognizes the truncated nature of the strike distribution. Suppose that there is a variable, S*, which represents the "notional" strike length which is defined as

$$S^* = X\beta + \varepsilon \, . \qquad (10)$$

where $X\beta$ is a linear combination of exogenous variables (X) with a parameter vector (β) and ε represents unmeasured determinants of S*. The observed length of strike (S) is defined as

$$S = S^* \quad \text{if} \quad S^* > 0$$

and (11)

$$S = 0 \quad \text{if} \quad S^* \leq 0.$$

Assume that ε is a random variable distributed normally with mean 0 and variance σ^2. This, together with the definiton of S* in equation (10), implies that the probability of observing a strike of positive length S is $\frac{1}{\sigma}\phi\left(\frac{S - X\beta}{\sigma}\right)$ where $\phi(\cdot)$ represents the standard normal probability density function. Additionally, the probability of observing no strike is $\Phi\left(\frac{-X\beta}{\sigma}\right)$ where $\Phi(\cdot)$ represents the standard normal cumulative distribution function. The log-likelihood function (L) associated with this Tobit model for the sample is

$$L = -\frac{n_1}{2} \ln \sigma^2 + \sum_{i=1}^{n_1} \ln\left(\phi\left(\frac{S - X_i\beta}{\sigma}\right)\right) + \sum_{i=n_1+1}^{n} \ln\left(\Phi\left(\frac{-X_i\beta}{\sigma}\right)\right) \qquad (12)$$

where i indexes observations, strikes occurred in the first n_1 observations and strikes did not occur in the last $n-n_1$ observations. This specification correctly accounts for the fact that a strike of negative duration is not conceptually meaningful and that the observations on S are truncated at zero. In terms of the distribution of ε this is accounted for by noting that the observed values of ε are truncated from below at $-X\beta$.

In order to obtain estimates of the parameters of the model (β and σ^2) the log-likelihood function specified in equation (12) was maximized using an algorithm described in Berndt, Hall, Hall, and Hausman (1974). The first column of Table 7 contains estimates of the parameters where the β vector includes a constant, UR, RWCH, (NES) $\dot{p}_e$, (ES) $\dot{p}_e$, and CON. The latter variable was not used before, and it is a dichotomous variable which equals one if the contract was negotiated during the Kennedy-Johnson guidelines program or during the Nixon-Ford controls programs and is zero otherwise.[15] The model does not seem to have much explanatory power in the sense that a likelihood ratio test of the hypothesis that all of the elements of the β vector are zero except for the constant cannot be rejected at the ten percent level of significance.[16]

Only two coefficients are significantly different from zero at conventional levels. The coefficient of RWCH is significantly less than zero at the ten percent level. This suggests that strikes are both less likely to occur and to be of shorter duration where they do occur when real wages have been rising rapidly over the last contract. This result is intuitively appealing in that one might expect lower demands and less industrial conflict where the workers have been experiencing a recent increase in real income.

The coefficient of (NES)$\dot{p}_e$ is significantly less than zero at the five percent level. This suggests that strikes will occur less frequently and be of shorter duration where contracts are not indexed and inflation expectations are high. It is also true that the negative effect of $\dot{p}_e$ on strike activity is significantly larger (in absolute value) at the five percent level where contracts are not indexed than where they are indexed. The difference between the relevant coefficients is (-3.41 - (-1.14)) = - 2.27 with an asymptotic standard error of 1.37. These results do not accord with intuition, and no explanation is offered in their defense.

The second column of Table 7 contains estimates of the strike model where the vector of independent variables includes the additional variables which determine changes in the reference wage. These are $\dot{W}_H$, $(\dot{W}_m - \dot{W}_H)$, and $(\dot{W}_m - \dot{W}_H)\Delta$. Once again, it is not possible to reject the hypothesis at conventional levels of significance that all of the elements of β are zero except for the constant using a likelihood ratio test.[17] In addition, it is not possible to reject the hypothesis that the three coefficients on $\dot{W}_H$, $(\dot{W}_m - \dot{W}_H)$, and $(\dot{W}_m - \dot{W}_H)\Delta$ are zero using a likelihood ratio test at conventional levels of significance.[18] As above, the coefficient on RWCH is significantly less than zero, this time at the 5 percent level. The nonintuitive result found above that the coefficient on $(NES)\dot{p}_e$ is significantly less than zero (and significantly greater in absolute terms than the coefficient of $(ES)\dot{p}_e$) does not hold for the model augmented by the $\dot{W}_R$ variables.

The effect of the rate of change of AHE in durable goods manufacturing ($\dot{W}_H$) on strike activity is not significantly different from zero at the ten percent level where $\Delta = 0$. The estimated effect is -2.77 with an asymptotic standard error of 2.28. In addition, its sign is the opposite of what would be expected if increases in the reference wage increase union wage demands which in turn increase the likelihood and duration of strikes.

The estimated effect of changes in the minimum wage on strike activity is not significantly different from zero at any reasonable level for any value of Δ. While little importance can be attached to the sign of the estimated effect due to the size of its standard error, the size of the effect of $\dot{W}_m$ on strike activity is the opposite of what the union wage demand theory of strikes would predict. Given the imprecision with which the parameters are estimated, it is not possible to draw any conclusions concerning the effect of changes in the minimum wage on the likelihood or duration of strikes.

It is clear from the results of this analysis that very little was found in the way of systematic relationships between the exogenous variables and the level of strike activity. This suggests that the reduced form "union wage demand" model of strikes is inadequate, and that a different approach is required.

One approach would be to build a "Hicks" type model of strike based on the divergence of expectations, but it is difficult to see just what (if any) role changes in the minimum wage would play in such a model. The approach taken here is to gain some efficiency in estimating the effects of changes in the minimum wage on the outcomes of collective bargaining by estimating a carefully specified structural version of the "union wage demand" model. This is the subject of analysis in the next section.

V. Structural Model of Wage and Strike Outcomes

The model of the outcomes of collective bargaining described here was originally developed by Ashenfelter and Johnson (1969) and has been applied to microeconomic data by Farber (1977, 1978). The foundation of this model is that in any negotiation the union has a downward sloping concession schedule which relates the smallest wage increase acceptable to the union to the length of strike. This schedule presents the employer with a tradeoff between increased future labor costs (wage increases) and foregone current profits (strike). The employer selects the wage-strike combination which maximizes the firm's present value.

More formally, let the proportional wage increase negotiated by the union be represented by $\dot{W}$. The union has a concession schedule which determines the smallest $\dot{W}$ acceptable to the union at any length of strike (S). A convenient parameterization for this schedule is

$$\dot{W}(S) = \dot{W}_* + (\dot{W}_0 - \dot{W}_*)e^{-\delta S} \qquad (13)$$

where $\dot{W}_* = \dot{W}(\infty)$ which is the minimum wage change the union will accept even after a very long strike. The quantity $\dot{W}_0 = \dot{W}(0)$ which is the minimum wage change necessary to avert a strike. This is what is referred to above as the union wage demand. The parameter δ governs the rate of concession of the union. If $\dot{W}_0 - \dot{W}_*$ is considered to be the maximum possible concession that the union will make after a very long strike then the quantity $\frac{\ell n(2)}{\delta}$ represents the "halflife" of the concession. In other words this is the length of strike necessary to reduce the remaining concession $(\dot{W}(S) - \dot{W}_*)$ by one half. Clearly, the higher is δ the shorter is the halflife and the union is conceding faster. The curve in Figure 1 which is convex to the origin represents a typical concession schedule of the type parameterized in equation (13).

The quantities $\dot{W}_0$, $\dot{W}_*$, and δ are the major parameters of the model, and they are specified below as functions of the exogenous variables. The parameter $\dot{W}_0$ is particularly important in the investigation of the effect of changes in the minimum wage on collective bargaining outcomes because it represents the initial wage demand of the union in the sense that a wage change of at least $\dot{W}_0$ is necessary in order to avert a strike. The empirical specifications for $\dot{W}_0$, $\dot{W}_*$, and δ are discussed below.

In order to derive the optimal wage strike combination for the firm to select, it is assumed that the firm has a present value function which can be written as

$$V = \int_{S}^{\infty} \{R - WL[1 + \dot{W}(S))\}e^{-rt}dt \qquad (14)$$

where R represents the revenues of the firm, WL represents the wage bill of the firm prior to the negotiation in question, and r is the discount rate of the firm. The employer can select the strike length which maximizes V subject to the constraint provided by the concession schedule in equation (13). Integration of equation (14) yields

$$V = \frac{1}{r}\{R - WL[1 + \dot{W}(S)]\}e^{-rS} \qquad (15)$$

which is differentiated with respect to S after substituting for $\dot{W}(S)$ from equation (13). Setting the result equal to zero and solving for S yields an optimal strike length of

$$S = -\frac{1}{\delta}\, \ell n \left\{\frac{\frac{1}{H} - [1 + \dot{W}_*]}{[1 + \frac{\delta}{r}][\dot{W}_0 - \dot{W}_*]}\right\} + \varepsilon_1 \qquad (16)$$

where $H = \frac{WL}{PQ}$ which is labor's share of revenues. The ε_1 is a random component which captures unmeasured aspects of the process.

Figure 1 contains a graphical representation of the wage-strike outcomes under this model. The curve which is convex to the origin is the union's concession schedule, and the family of concave curves are iso-present value curves for the firm. The firm attempts to reach the iso-present value curve closest to the origin, but it is constrained by the fact that it must be on the concession schedule (be acceptable to the union). Thus, the solution is the point of tangency between the concession schedule and an iso-present value curve. If the concession schedule is steeper than the iso-present value curves everywhere in the first quadrant then there will be no strike. This is the case where the union does not concede fast enough, even initially, for a strike to be worthwhile to the firm.

Algebraically, if there is no strike then the relationship defining the optimal strike length in equation (16) do not hold exactly. Specifically, there is no strike if

$$S = 0 > -\frac{1}{\delta}\ \ell n\left\{\frac{\frac{1}{H} - [1 + \dot{W}_*]}{[1 + \frac{\delta}{r}][\dot{W}_0 - \dot{W}_*]}\right\} + \varepsilon_1 . \qquad (17)$$

Suppose that equation (13) also contains a random component (unknown to the firm) so that it can be written as

$$\dot{W}(S) = \dot{W}_* + (\dot{W}_0 - \dot{W}_*)e^{-\delta S} + \varepsilon_2 . \qquad (18)$$

If there is no strike the firm will grant the minimum wage change necessary to avert a strike. This is $\dot{W}(0) = \dot{W}_0 + \varepsilon_2$ which is, aside from the random component, the union wage demand.

In order to derive a likelihood function appropriate to this model it is assumed that ε_1 and ε_2 have a joint normal distribution with mean vector zero, and a covariance matrix of $\begin{pmatrix} \sigma_1^2 & \rho\sigma_1\sigma_2 \\ \rho\sigma_1\sigma_2 & \sigma_2^2 \end{pmatrix}$ where σ_1^2 and σ_2^2 represent the variances of ε_1 and ε_2 respectively and ρ represents the correlation between ε_1 and ε_2. From equations (16) and (18) the contribution to the likelihood function (L_i) where a strike occurs is simply the appropriate bivariate normal probability density function ($f(\cdot, \cdot)$) evaluated at $\varepsilon_1 = S - Z_1$ and $\varepsilon_2 = \dot{W} - Z_2$ where

$$Z_1 = -\frac{1}{\delta}\ln\left\{\frac{\frac{1}{H} - [1 + \dot{W}_*]}{[1 + \frac{\delta}{r}][\dot{W}_0 - \dot{W}_*]}\right\} \tag{19}$$

and

$$Z_2 = \dot{W}_* + (\dot{W}_0 - \dot{W}_*)e^{-\delta S}. \tag{20}$$

This contribution is

$$L_i = f(S_i - Z_{1i}, \dot{W}_i - Z_{2i}) \tag{21}$$

where i indexes observations.

Where a strike does not occur the contribution to the likelihood function is a bivariate normal expression which is truncated in one dimension. From equations (17) and (18) this is

$$L_i = \int_{-\infty}^{-Z_{1i}} f(\varepsilon_1, \dot{W}_i - Z_{2i}) d\varepsilon_1. \qquad (22)$$

which is the joint probability density that $\varepsilon_1 < - Z_{1i}$ and $\varepsilon_2 = \dot{W}_i - Z_{2i}$.

The log-likelihood function for the model derived here is

$$\log L = \sum_{i=1}^{n_1} \ell n[f(S_i - Z_{1i}, W_i - Z_{2i})]$$

$$+ \sum_{i=n_1+1}^{n} \ell n[\int_{-\infty}^{-Z_{1i}} f(\varepsilon_1, W_i - Z_{2i}) d\varepsilon_1] \qquad (23)$$

where strikes occurred in the first n_1 observations and did not occur in the last $n-n_1$ observations.

Note that implementation of this model requires data on labor's share of total costs (H) which is a central element of Z_2. Unfortunately, these data were available only for the first fifteen firms listed in Table 2. The four firms for which these data were not available are those with base wage rates which are closest to the minimum wage. None of the remaining fifteen firms has a base wage which is within even 25 percent of the minimum on average over the sample period. Given the results in Section II which suggest that the effect of changes in the minimum wage on wage outcomes is small even for low wage relationships and that this effect falls as the wage increases, analysis of the data from the remaining fifteen relatively high wage relationships concerning the role of $\dot{W}_m$ in the collective bargaining process may prove difficult. Any conclusions drawn from this analysis must be considered tentative. Nonetheless, the model is estimated over the 159 observations of the first fifteen relationships.

In order to complete the specification of the model, empirical constructs for the unobservable quantities $\dot{W}_0$, $\dot{W}_*$, and δ must be developed. While this is done in a somewhat arbitary manner, attention is paid to reasonable interpretations of the roles of these parameters in the model. The quantity $\dot{W}_0$ represents union wage demands. It is specified to be a linear function of the observable characteristics that were hypothesized to affect union wage demands in section III. This function is $\dot{W}$ = XB where B is a vector of unknown parameters and the X vector includes a constant, UR, RWCH, (NES)$\dot{p}_e$, (ES)$\dot{p}_e$, $\dot{W}_H$, $(\dot{W}_m - \dot{W}_H)$, $(\dot{W}_m - \dot{W}_H)\Delta$, G, PH1, PH3, and NRET. With the exception of NRET, all of these variables were included in the earlier OLS analysis of wage outcomes. The variable NRET is included to reflect the possibility that union wage demands may be higher where the profit rate of the firm is high. Once again, the variables $\dot{W}_H$, $(\dot{W}_m - \dot{W}_H)$, and $(\dot{W}_m - \dot{W}_H)\Delta$ are included in order to measure the effect of changes in the reference wage on union wage demands. It is the coefficients of these three variables which will play a central role in the evaluation of the effect of changes in the minimum wage on bargaining outcomes.

The empirical analogue of $\dot{W}_*$ is somewhat more complicated. This quantity is interpreted as the minimum proportional wage change that the workers will accept in order to return to work even after a very long strike. More formally, it is the horizontal asymptote of the union concession schedule. For the purpose of this analysis $\dot{W}_*$ is interpreted here as the wage change which would make a worker indifferent between staying on his current union job and taking his best alternative job. In terms of wage rates this implies that $(1 + \dot{W}_*)W = W_A$ where W represents the current wage of the worker and W_A represents his certainty equivalent alternative wage. With other job characteristics held constant a worker would quit his job and take a job at W_A rather than accept a wage change of less than $\dot{W}_*$. Solving the above relationship for $\dot{W}_*$ yields $\dot{W}_* = \frac{W_A}{W} - 1$, and it remains to specify the determinants of the alternative wage. In a manner analogous to the specification of the reference wage it is assumed that the alternative wage is proportional to a weighted average of the minimum wage (W_m) and average hourly earnings in durable goods manufacturing (W_H). This is

$$W_A = K[\gamma W_m + (1-\gamma)W_H] \qquad (24)$$

where K is an arbitrary positive constant and γ is the weight attached to the minimum wage and is a declining function of the differential (Δ) between the base wage (W) and the minimum wage. Let

$$\gamma = \gamma_1 + \gamma_2 \Delta, \qquad (25)$$

where $\gamma_2 < 0$. Substitution for γ in equation (24) and rearrangement of terms yields the result that

$$W_A = K[W_H + \gamma_1(W_m - W_H) + \gamma_2(W_m - W_H)\Delta]. \qquad (26)$$

Using the definition of $\dot{W}_* = \frac{W_A}{W} - 1$ yields an empirical specification of

$$\dot{W}_* = A_0 + A_1 \frac{W_H}{W} + A_2(\frac{W_m - W_H}{W}) + A_3(\frac{W_m - W_H}{W})\Delta. \quad (28)$$

The parameters A_0, A_1, A_2, and A_3 will be estimated.

Intuitively, this specification suggests that an increase in the minimum wage will give union workers the opportunity of taking higher wage alternative jobs. This reduces the total amount which will be conceded during a strike of a given length and it both reduces the likelihood of strikes and reduces the optimal duration of strikes that do occur.[19] In addition, wage outcomes will be higher where strikes would have occured due to the negative slope of the concession schedule. To the extent that higher wage workers have alternatives which are less closely linked to the minimum wage ($\gamma_2 < 0$, $A_3 < 0$) these effects of changing the minimum wage will be smaller for higher wage workers.

It is interesting to note at this point that while a change in the minimum may have a positive effect on wage changes and strike activity through its effect on union wage demands, the above discussion suggests that some wage outcomes will be higher and the likelihood of a strike will be lower if the minimum wage rises due to the positive effect of a change in W_m on the alternative wage available to workers. Thus, according to this model the effect of an increase in the minimum wage on wage outcomes is unambiguously positive, but the effect of an increse in W_m on strike activity is indeterminate.

The final empirical construct needed in order to estimate the model is the parameter δ governing the rate of concession of the workers. This is hypothesized to be

$$\delta = C_0 + C_1 H \qquad (29)$$

where labor's share of total cost (H) has a negative effect on the rate of concession ($C_1 < 0$). It is argued that where labor is important in production (proxied by a large H) a strike will be more likely to be successful in closing down an employer's operation, and where a strike is effective the workers will recognize this and hold back concessions. Where a strike is relatively ineffective workers may become discouraged and concede more quickly.[20]

Rather than estimate employer discount rates, which are likely to vary over the sample period, Moody's averge yield on corporate bonds for the year of negotiation was selected as an empirical proxy. This completes the specification of the model and we turn now to its estimation.

The log-likelihood function defined in equation (23) was maximized over the sample of 150 observations using the algorithm described in Berndt, Hall, Hall, and Hausman (1974). Twentynine of the negotiations represented in the sample ended in a strike. The mean duration of a strike where one occurred was .126 years. The parameters estimated include the vectors B, A, and C which are the coefficients of the empirical constructs for $\dot{W}_0$, $\dot{W}_*$, and δ respectively as well as the elements of the covariance matrix of the errors (σ_1^2, σ_2^2, ρ). The results are contained in Table 8.

The estimates of the parameter vector B which determines the union wage demand is, with two exceptions, similar to the relationship which determines the wage outcomes ($\dot{W}_n$) contained in the first column of Table 5. The first difference is that the rate of change of real wages over the last contract (RWCH) has a much stronger negative effect on wage demands than on wage outcomes. The coefficient on RWCH in the $\dot{W}_0$ equation is significantly less than zero at the .001 level.

The second difference between the determinants of $\dot{W}_0$ and the determinants of $\dot{W}_n$ concerns the effect of changes in the minimum wage. The estimates of the effect of $\dot{W}_m$ on union wage demands do not support even the relatively small effect, found in Table 5, of $\dot{W}_m$ on wage outcomes. One potential explanation for this is that the sample in this section does not include the four relatively low wage relationships which might be expected to be most affected by changes in the minimum wage. However, this explanation is weakened by the fact that in the OLS regression of $\dot{W}_n$ contained in the first column of table 5 the coefficient (standard error) on ($\dot{W}_m - \dot{W}_H$) is $\underset{(.0380)}{.0492}$ for the full sample while the identical equation estimated over the fifteen firm sample yields a qualitatively similar coefficient on ($\dot{W}_m - \dot{W}_H$) of $\underset{(.0628)}{.0673}$. Likewise, the coefficient on ($\dot{W}_m - \dot{W}_H$)Δ is $\underset{(.0497)}{-.0515}$ for the full sample and $\underset{(.0731)}{-.0758}$ for the fifteen firm sample. The other OLS coefficients also do not differ substantially between the fifteen and nineteen firm samples.

Another potential explanation is that, while changes in the minimum wage affect wage outcomes, the mechanism through which this occurs is not via wage demands but through some other route. Indeed, an examination of the estimates contained in Table 8 of the determinants of the ultimate minimum acceptable wage change ($\dot{W}_*$) suggests that the level of the minimum wage relative to the base wage plays a significant role in the determination of $\dot{W}_*$. The first column of Table 9 contains estimates of the effect of changes in $\frac{W_m}{W}$ on $\dot{W}_*$.[21] These results show that the effect of changes in $\frac{W_m}{W}$ on $\dot{W}_*$ is significantly positive at the ten percent level for all values of $\Delta < 1$. As expected the magnitude of the effect is significantly larger in relatively low wage relationships which reflects the notion that minimum wage jobs are more important alternatives for workers in low wage jobs than they are for workers in high wage jobs.

This effect of the minimum wage is due to the level of the minimum wage relative to the base wage rather than to changes in that level. Thus, when the minimum wage increases the ratio $\frac{W_m}{W}$ increases. This will result in an increase in $\dot{W}_*$ which will yield somewhat higher wage settlements and perhaps fewer strikes. At the same time the higher wage increase will reduce the ratio $\frac{W_m}{W}$ which will offset the original change in $\dot{W}_*$. Thus, the effect of a change in W_m on the negotiated rate of change of wages will be temporary although the level of wages will be permanently increased.

It is interesting that the level of W_H is not nearly as important a determinant of $\dot{W}_*$ as is the level of W_m. The second column of Table 9 contains estimates of $\frac{d\dot{W}_*}{d(\frac{W_H}{W})}$ computed for various values of Δ. The results suggest that $\frac{W_H}{W}$ has a substantial effect on $\dot{W}_*$ only in relatively high wage relationships. This is in contrast to the importance of changes in W_H in the determination of union wage demands.

It must be noted that a strict interpretation of the specification of $\dot{W}_*$ as $\dot{W}_* = \frac{W_A}{W} - 1$ where W_A is defined in equation (26) is not supported by the results. This model has the clear implication that the constant (A_0) in the $\dot{W}_*$ equation ought to be -1. However, the point estimate of A_0 contained in table 8 is -.189 with an asymptote standard error of .0999, and the hypothesis that $A_0 = -1$ can be rejected at any reasonable level of significance. This suggests that there are substantial nonwage benefits to staying in a current job which are not proportional to the wage rate. Nonetheless, the results are supportive of the general notion that alternative wages are affected by the levels of the minimum wage and of W_H relative to the base wage.

Overall, the results contained in this section suggest that changes in the minimum wage do not have an important effect on union wage demands. However, the evidence suggests tentatively that the minimum wage may be an important determinant of the wage on alternative jobs available to the workers. This has important implications for the outcome of collective bargaining in the context of the model developed here. An increase in the minimum wage relative to the base wage reduces the amount by which the union will ultimately concede. This will translate into higher wage increases in cases where strikes would have occurred had W_m not changed and perhaps into less strike activity. Given the complex nature of the model it is difficult to quantify these effects, but the analysis contained in previous sections found a small and statistically significant effect of $\dot{W}_m$ on negotiated wage changes in relatively low wage firms. No relationship could be found between changes in the minimum wage and the level of strike activity. The analysis contained in this section does not require that these conclusions be modified.

VI. Summary and Conclusions

The major empirical finding of this study is that changes in the minimum wage have an effect on negotiated wage changes which is quite small and, given the precision with which it is estimated, which is unlikely to be of substantial magnitude. Even for relationships with base wage rates only 10 percent above the minimum wage the elasticity of union wages with respect to a change in the minimum is less than .05. This small effect declines further as the base wage increases relative to the minimum.

No systematic relationship could be found between changes in the minimum wage and the likelihood or duration of strikes. However, the results were rather poorly determined, and further theoretical and empirical analysis of the determinants of strike activity in general is needed before conclusions can be drawn with confidence.

In order to investigate a potential mechanism through which changes in the minimum wage might affect the outcomes of collective bargaining, an Ashenfelter-Johnson type model of outcomes was developed and implemented. However, data constraints forced the elimination of the four lowest wage relationships from the sample which reduced its usefulness in an investigation of the effects of $\dot{W}_m$. Nonetheless, two interesting tentative results relating to the minimum wage were found. First, no systematic relationship could be found between changes in the minimum wage and union wage demands while changes in the AHE measure was found to have a substantial impact on union wage demands.

The second result relating to the minimum wage has broader implications. It was found <u>in the context of the model</u> that the level of the minimum wage relative to the base wage is an important determinant of the alternative wage available to workers. Since this quantity governs the ultimate concessions the union will make, it can have an important effect on outcomes. More specifically, it is likely that a change in the minimum wage increases wage settlements somewhat in situations where strikes would have occurred until the base wage rises to reassert partially the old union-minimum wage differential. There may also be a reduction in strike activity. The broader implication comes from the fact that this effect of the minimum wage on wage alternatives is largely a function of the level of the minimum relative to the base wage rather than changes in that level. This suggests that, while changes in the minimum wage may have a temporary and relatively minor effect on negotiated wage changes, the existence of a minimum wage which is set substantially above the "market" wage may fundamentally alter the distribution of alternative wages available to union workers. The result will be a higher union wage structure than would exist in the absence of a minimum wage. This study has focused on marginal changes in the minimum wage, and, while the effects of such changes on union wage changes seem small, the discrete change implied by the existence of the minimum wage may have had a somewhat larger effect.

Overall, given the relatively small effect of changes in the minimum wage and the relatively large effect of changes in average hourly earnings on union negotiated wage changes, it is likely that changes in AHE are dominant in the determination of both changes in the reference wage and the changes in the union negotiated wage rate. In addition, it can be argued that legislated changes in the minimum wage are a result of changes in average hourly earnings as well.[22] Thus, even the small and seemingly independent effect of $\dot{W}_m$ on union negotiated wage changes may be indirectly a result of changes in average hourly earnings.

FOOTNOTES

[1]Cox and Oaxaca (1980) develop a general equilibrium model of wages and employment where unions and a minimum wage are present which they use to analyze this issue.

[2]The particular wage rate selected is that for janitors, or, if that was not available, the plant minimum regular wage.

[3]The plant minimum regular wage is the minimum non-starting wage paid to workers in the plant.

[4]This differential is $\Delta = \frac{W - W_m}{W_m}$ where W represents the base wage and W_m represents the minimum wage.

[5]Note that twelve autoregressions for each year from 1954 through 1979 had to be estimated for a total of 312 estimating equations.

[6]Various ARIMA models were also estimated, but the moving average seemed to be of little consequence.

[7]All of the analyses reported below were also carried out using average hourly earnings in manufacturing as a whole and in all cases the results were virtually identical to those obtained using average hourly earnings in durable goods manufacturing.

[8]The unconstrained SSE is .0989 while the constrained SSE is .112. The number of constraints is 5, and the appropriate test statistic is $(\frac{.112 - .0989}{.0989} \cdot \frac{196}{5}) = 5.23$ which distributed as $F(5,196)$. The critical value of the $F(5, 196)$ distribution at the 5 percent level is approximately 2.25.

[9]This explanation was suggested by Robert Gordon.

[10]The unconstrained SSE is .097 while the constrained SSE is .112.

The number of constraints is 5, and the appropriate test statistic is $(\frac{.112 - .097}{.097} \cdot \frac{198}{3}) = 9.9$ which is distributed as F(3, 198). The critical value of the F(3, 198) distribution at the 1 percent level is approximately 3.8.

[11]The constrained SSE is .090 while the constrained SSE is .097. The number of constraints is 8, and the appropriate test statistic is $(\frac{.097 - .090}{.090})(\frac{189}{8}) = 1.81$ which is distributed as F(8, 189). The critical value of the F(8, 189) distribution at the 5 percent level is 2.0.

[12]The unconstrained SSE is .091 while the constrained SSE is .097. The number of constraints is 18, and the appropriate test statistic is $(\frac{.097 - .091}{.091})(\frac{180}{18}) = .649$ which is distributed as F(18, 180). The critical value of the F(18, 180) distribution as the 5 percent level is approximately 1.65.

[13]See Ashenfelter and Johnson (1969) and Farber (1978) for more detailed developments of this model.

[14]This will be true if the concession rule for the union relates to some proportion of the total demand.

[15]The separate variables used before for the Kennedy-Johnson guidelines and the Nixon-Ford guidelines were computationally infeasible in the strike model because no strikes took place during one of the Nixon-Ford subperiods. This resulted in the parameter associated with that variable being unbounded.

[16]The log-likelihood value of the constrained model is -53.9 which compares with the unconstrained log-likelihood of -49.5. The number of constraints is 5 and the quantity -2(-53.9 - (49.5)) =

8.8 is distributed as $\chi^2(5)$. The critical value of the $\chi^2(5)$ distribution at the .1 level of significance is 9.24.

[17]The log-likelihood value of the constrained model is -53.9 which compares with the unconstrained log-likelihood of -47.9. The number of constraints is 8 and the quantity -2(-53.9 - (-47.9)) = 12. is distributed as $\chi^2(8)$. The critical value of the $\chi^2(8)$ distribution at the .1 level of significance is 13.4.

[18]The log-likelihood of the constrained model is -49.5 which compares to an unconstrained log-likelihood of -47.9. The number of constraints is 3 and the quantity -2(-49.5 - (-47.9)) = 3.2 is distributed as $\chi^2(3)$. The critical value of the $\chi^2(3)$ distribution at the .25 level is 4.11.

[19]In formal terms this can be demonstrated by differentiating equation (16), which defines the strike length and governs the likelihood of a strike, with respect to $\dot{W}_*$. The result is

$$\frac{ds}{dy_*} = \frac{\frac{1}{H} - (1 + \dot{W}_0)}{(\frac{1}{H} - (1 + \dot{W}_*))(\dot{W}_0 - \dot{W}_*)} > 0.$$

This expression is positive because $\dot{W}_0 > \dot{W}_*$ and because it must be true that $\frac{1}{H} > (1 + \dot{W}_0)$ for the union wage demand to not absorb more than total revenues.

[20]It is interesting to contrast this to the role of labor's share that is built in to the model through the employer's objective function. In that context a large share for labor suggests that the costs of any concession will be larger and that foregone profits during a strike will be relatively smaller. These two roles for labor's share are analogous to two of Marshall's four

conditions for a low elasticity of derived demand for labor. First, it is "important to be unimportant" in the sense that a small share of costs makes the elasticity of derived demand for labor smaller. Second, it is "important to be indispensible" in the sense that substitute factors of production may not be readily available. See Rees (1962).

[21]The computations do not consider the effect of changes on $\frac{W_m}{W}$ on Δ. While strictly speaking this is not correct because $\Delta = \frac{W - W_m}{W_m}$, it is appropriate for this analysis. This is because Δ is included to represent the mix of alternative jobs available to the individual, and the goal of the analysis is to determine how a change in W_m affects the wages paid for a fixed set of alternative jobs. The change in the minimum wage should have only a second order effect on the mix of actual jobs available.

[22]A rudimentary probit model of the probability of a legislated change in the minimum wage occuring during a particular year yields the tentative result that the legislature amends the Fair Labor Standards Act to raise W_m in response to a deterioration of the minimum wage relative to average hourly earnings in manufacturing ($\overline{W}$). The model is specified as

$$Pr(L = 1) = Pr(\beta_0 + \beta_1 \frac{\overline{W}}{W_m} + \varepsilon_1 > 0)$$

where L = 1 if the legislature raises the minimum wage and ε_1 has a standard normal distribution. The model is estimated over the

26 year period from 1954-1979, and years with programmed changes are included as years with no legislative action (L = 0) at the new programmed minimum wage. Legislated changes took place in five of the twentysix years. The maximum likelihood estimates of the parameters are $\beta_0 = \underset{(2.03)}{-11.1}$ and $\beta_1 = \underset{(2.34)}{4.46}$ where the numbers in parentheses are asymptotic standard errors, and log L = -8.98. Care must be taken in interpreting the results due to the small sample size and overly simplistic analysis. The results suggest that indeed the probability of a legislated increase in the minimum wage is higher where $\frac{\overline{W}}{W_m}$ is higher. Certainly a more careful analysis of this problem would be useful.

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Table 1: The Sample

Number	Firm	Union
1	American Cyanamid	International Chemical Workers Union
2	Armour	Amalgamated Meatcutters and Butcher Workmen of North America
3	Atlantic Richfield	Oil, Chemical, and Atomic Workers International Union
4	Boeing	International Association of Machinists
5	Firestone	United Rubber, Cork, Linoleum, and Plastic Workers of America
6	FMC	Textile Workers Union of America
7	General Electric	International Union of Electrical, Radio, and Machine Workers
8	General Motors	United Automobile, Aircraft, and Agricultural Implement Workers of America (UAW)
9	International Paper	United Paperworkers International Union
10	Interco (International Shoe)	International Boot and Shoe Workers
11	PPG	United Glass and Ceramic Workers
12	Rockwell International	UAW
13	Simmons	Union of International Upholsterers
14	U.S. Steel	United Steel Workers of America
15	Weyerhauser	International Woodworkers of America
16	Berkshire-Hathaway	Textile Workers Union of America
17	Dan River-Mills	United Textile Workers of America
18	Massachusetts Shoe Manufacturing (Association)	United Shoe Workers of America
19	New York City Laundries (Association)	Amalgamated Clothing Workers of America

Table 2: Average Differentials Between the Base Wage and the Minimum Wage Prior to Negotiation of Each Contract over the 1954-1979 Period

	Firm	Number of Contracts	Average Differential*
1	American Cyanamid	16	.45
2	Armour	10	1.17
3	Atlantic Richfield	15	1.07
4	Boeing	10	.99
5	Firestone	14	1.28
6	FMC	9	.65
7	General Electric	7	.29
8	General Motors	8	1.32
9	International Paper	14	.83
10	International Shoe	11	.31
11	PPG	9	.95
12	Rockwell	9	.94
13	Simmons	8	.39
14	U.S. Steel	8	.95
15	Weyerhauser	11	1.02
16	Berkshire-Hathaway	11	.16
17	Dan River Mills	20	.12
18	Massachusetts Shoe	11	.13
19	NYC Laundries	8	.10
Total		209	.68

*The differential is $\frac{W - W_m}{W_m}$ where W is the base wage and W_m is the minimum wage.

Table 3: Means and Standard Deviations of Data

Variable	Definition	Mean	S.D.
$\hat{W}_n$	Negotiated annual rate of wage change	.0551	.0294
W	Base wage on expiration of old contract	2.32	1.13
W_m	Minimum wage prevailing at negotiation	1.38	.472
W_{me}	Minimum wage expected to prevail at end of contract (W_m + programmed changes)	1.44	.504
W_H	Average hourly earnings in durable goods manufacturing	3.25	1.23
$\hat{P}_e$	Expected annual rate of inflation	.0351	.0254
UR	Civilian unemployment rate	.0558	.0372
UR_{male}	Prime-age male unemployment rate	.0351	.0122
$\hat{P}_L$	Annual rate of inflation over last contract	.0345	.0296
$\hat{W}_L$	Annual rate of change of base wage over last contract (including cost of living escalator)	.0570	.0304
RWCH	Annual rate of change of real wages over last contract ($\hat{W}_L - \hat{P}_L$)	.0225	.0263
Δ	Differential between W and W_m $(\frac{W - W_m}{W_m})$	.680	.458
$\hat{W}_H$	Average annual rate of change of W_H over last contract	.0516	.0221
$\hat{W}_m{}^a$	Average annual rate of change of W_m over last contract	.0573	.0775
$\hat{W}_m\Delta$	$\hat{W}_m * \Delta$	.0337	.0619
$\hat{W}_H\Delta$	$\hat{W}_H * \Delta$	.0364	.0348
ES	ES = 1 if contract does not contain cost-of-living escalator, NES = 0 otherwise	.220	——

Table 3: (continued) Means and Standard Deviations of Data

Variable	Definition	Mean	S.D.
NES	NES = 1 if contract does not contain cost-of-living escalator, NES = 0 otherwise	.220	——
G	G = 1 if contract negotiated during Kennedy-Johnson guidelines, G = 0 otherwise	.206	——
PH1	PH1 = 1 if contract negotiated during Phases I or II of Nixon-Ford controls, PH1 = 0 otherwise	.0381	——
PH3	PH3 = 1 if contract negotiated during Phases III or IV of Nixon-Ford controls, PH3 = 0 otherwise	.0526	——
CON	CON = 1 if G = 1 or PH1 = 1 or PH3 = 1, CON = 0 otherwise	.297	——
H[b]	Labor's Share of Total Costs	.292	.0932
NRET[b]	Net Rate of Return on Firm's Assets of time of negotiation	.122	.0584
r[b]	Moody's Average Yield on Corporate Bonds	.0580	.0204

n = 209

[a]Uses duration of new contract to compute rate

[b]Over the 159 observations of Relationships 1-15.

Table 4: OLS Regression of $\hat{W}_n$ (Equation 7)

Coefficient of:	(1) 1954-1979	(2) 1954-1970	(3) 1954-1979	(4) 1954-1979
Constant	.0353 (.00443)	.0316 (.00759)	.0561 (.00592)	.0541 (.00579)
UR	.0906 (.0448)	.0827 (.0404)	——	.154 (.0446)
UR_{male}	——	——	-.535 (.142)	-.685 (.145)
RWCH	-.0873 (.0654)	-.181 (.0807)	-.0663 (.0641)	-.0634 (.0624)
(NES) $\hat{P}_e$	.649 (.0814)	.855 (.297)	.754 (.0810)	.728 (.0792)
(ES) $\hat{P}_e$	.250 (.0833)	.428 (.311)	.320 (.0816)	.297 (.0798)
G	-.0127 (.00432)	-.0108 (.00394)	-.0136 (.00422)	-.0159 (.00417)
PH1	-.00586 (.00859)	——	-.00988 (.00845)	-.0110 (.00824)
PH3	.00913 (.00746)	——	.000613 (.00754)	.0000786 (.00735)
R^2	.381	.163	.411	.444
SEE	.0236	.0211	.0231	.0224
N	209	150	209	209

(The numbers in parentheses are standard errors)

Table 5: OLS Regression on $\hat{W}_n$ (Equation 9)

Coefficient of:	Basic Model (1)	< 1970 (2)	Firm Fixed Effects (3)	Programmed Changes in W_m (4)
Constant	.00931 (.00632)	.00621 (.00924)	——	.00909 (.00634)
UR	.103 (.0420)	.101 (.0386)	.0986 (.0448)	.102 (.0421)
RWCH	-.0528 (.0632)	-.110 (.0785)	-.0637 (.0655)	-.0444 (.0634)
(NES) $\hat{P}_e$	.194 (.115)	.634 (.294)	.177 (.123)	.177 (.115)
(ES) $\hat{P}_e$	-.210 (.117)	.189 (.310)	-.123 (.127)	-.227 (.117)
$\hat{W}_H$	.748 (.140)	.602 (.163)	.700 (.146)	.765 (.141)
$\hat{W}_m - \hat{W}_H$	.0492 (.0380)	.0854 (.0425)	.0509 (.0389)	.0255 (.0324)
$(\hat{W}_m - \hat{W}_H)\Delta$	-.0515 (.0497)	-.0933 (.0612)	-.0547 (.0509)	-.00755 (.0371)
G	-.00152 (.00454)	-.00202 (.00431)	-.00193 (.00472)	-.00146 (.00455)
PH1	-.0150 (.00858)	——	-.0131 (.00902)	-.0155 (.00851)
PH3	.00193 (.00742)	——	.00325 (.00776)	.00301 (.00737)
FIRM FIXED EFFECTS	NO	NO	YES	NO
R^2	.464	.267	.497	.463
SEE	.0221	.0199	.0225	.0222
N	209	150	209	209

(The numbers in parentheses are standard errors)

Table 6: $\frac{d\hat{W}_n}{d\hat{W}_m}$, $\frac{d\hat{W}_n}{d\hat{W}_H}$, and α

at various wage levels relative to the minimum wage (Δ)

Δ	$\frac{d\hat{W}_n}{d\hat{W}_m}$ [a]	$\frac{d\hat{W}_n}{d\hat{W}_H}$ [b]	α [c]
0	.049 (.038)	.699 (.147)	.066
.1	.044 (.034)	.704 (.146)	.059
.2	.039 (.031)	.709 (.145)	.052
.4	.029 (.025)	.719 (.143)	.038
.6	.018 (.022)	.729 (.142)	.024
.8	.008 (.024)	.740 (.142)	.011
1.	-.002 (.049)	.750 (.143)	-.003
1.5	-.028 (.049)	.776 (.147)	-.038

Note: The numbers in parentheses are standard errors. These numbers are derived from the estimates in the first column of table 5.

a) $B_6 + B_7\Delta$

b) $B_5 - B_6 - B_7\Delta$

c) $\frac{B_6}{B_5} + \frac{B_7}{B_5}\Delta$

Table 7: Maximum Likelihood Estimates of Tobit Model of Strike Length (Equation 12)

Coefficient of:	(1)	(2)
Constant	-.0715 (.0950)	.0339 (.114)
UR	-.0253 (.126)	-.140 (1.52)
RWCH	-1.58 (1.15)	-1.89 (1.12)
(NES) $\hat{P}_e$	-3.41 (1.59)	-1.31 (2.51)
(ES) $\hat{P}_e$	-1.14 (1.59)	.999 (2.47)
CON	-.0443 (.0564)	-.0725 (.0580)
$\hat{W}_H$	——	-3.00 (2.22)
$(\hat{W}_m - \hat{W}_H)$	——	-.227 (.786)
$(\hat{W}_m - \hat{W}_H)\Delta$	——	-.0411 (1.06)
σ^2	.0451 (.0173)	.0430 (.0169)
Log L	-49.5	-47.9
N	209	209

(The Numbers in parentheses are asymptotic standard errors)

Table 8: Maximum Likelihood Estimates of Two Equation Structural Model.

$\hat{W}_0$ Coefficient of:		$\hat{W}_*$ Coefficient of:		δ Coefficient of:	
Constant	.0190	Constant	-.189	Constant	2.56
	(.00938)		(.0999)		(.518)
UR	.106	$\frac{W_H}{W}$	.283	H	-3.27
	(.0776)		(1.63)		(.936)
RWCH	-.183	$\frac{W_m - W_H}{W}$	.344		
	(.0588)		(.215)		
(NES) $\hat{P}_e$	.255	$\frac{W_m - W_H}{W}\Delta$	-.135		
	(.115)		(.0725)		
(ES) $\hat{P}_e$	-.133				
	(.100)				
$\hat{W}_H$	.703	σ_1^2	.125		
	(.154)		(.0598)		
$(\hat{W}_m - \hat{W}_H)$	-.00485	σ_2^2	.000477		
	(.0662)		(.0000528)		
$(\hat{W}_m - \hat{W}_H)\Delta$	-.0153	ρ	.317		
	(.0799)		(.144)		
G	-.00285				
	(.00569)				
PH1	-.0160				
	(.0244)				
PH3	-.00311				
	(.0109)				
NRET	-.0270				
	(.0388)				

(The numbers in parentheses are asymptotic standard errors.)

$n = 159$

$L = 331.3$

Table 9: $\frac{d\hat{W}_*}{d(\frac{W_m}{W})}$ and $\frac{d\hat{W}_*}{d(\frac{W_H}{W})}$ at various wage levels relative to the minimum wage (Δ).

Δ	$\frac{d\hat{W}_*}{d(\frac{W_m}{W})}$ a)	$\frac{d\hat{W}_*}{d(\frac{W_H}{W})}$ b)
0	.344 (.215)	-.0617 (.0554)
.1	.331 (.209)	-.0482 (.0497)
.2	.317 (.202)	-.0347 (.0445)
.4	.290 (.188)	-.0077 (.0362)
.6	.263 (.175)	.0193 (.0325)
.8	.236 (.162)	.0463 (.0351)
1.	.209 (.149)	.0733 (.0427)
1.5	.142 (.119)	.141 (.0717)

Note: The numbers in parentheses are asymptotic standard errors. These numbers are derived from the estimates in table 8 ignoring changes in Δ.

a) $A_2 + A_3\Delta$ b) $A_1 + A_2 - A_3\Delta$

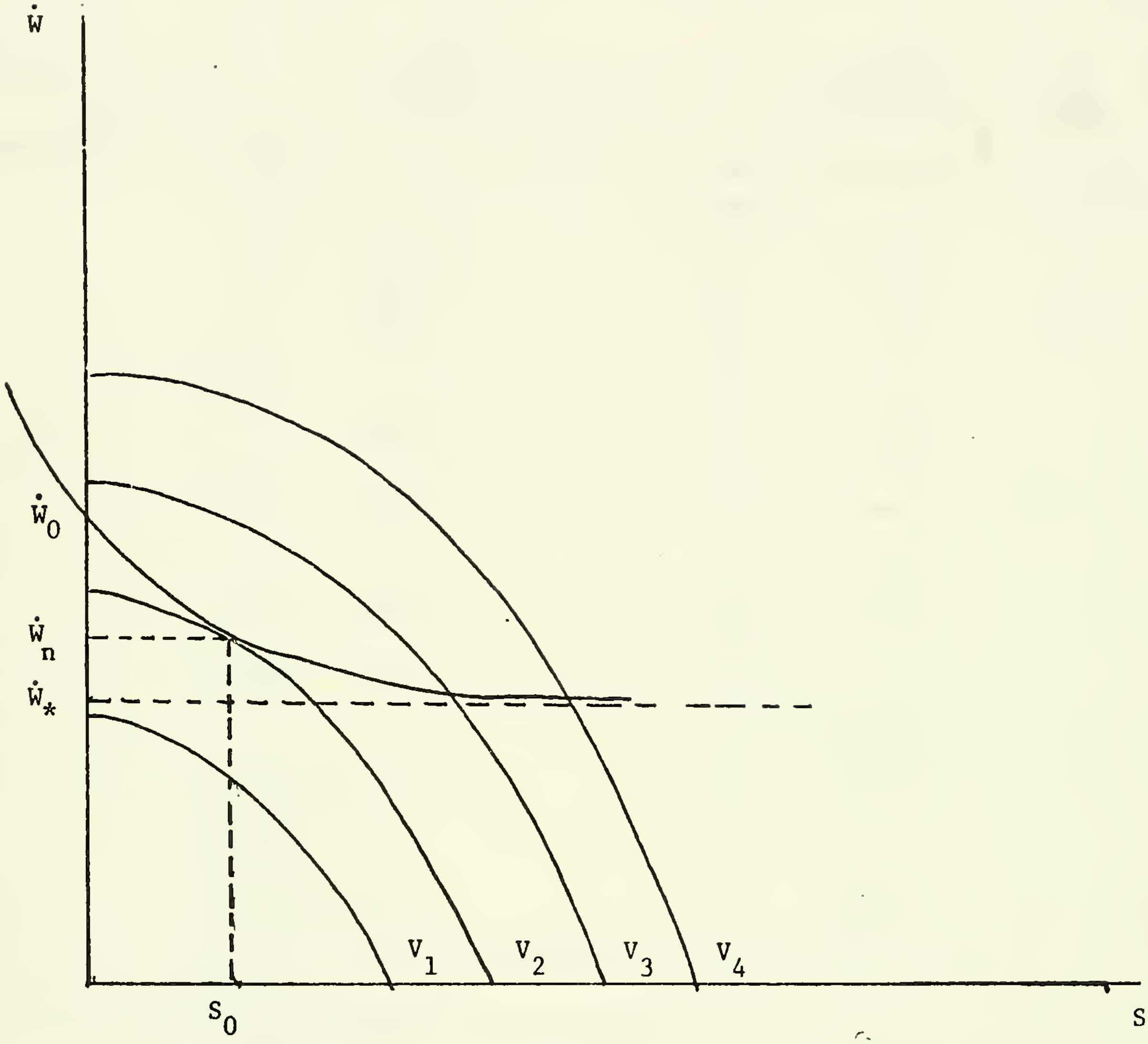

FIGURE 1