CONCENTRATION, UNIONISM, AND LABOR EARNINGS:
A SAMPLE SELECTION APPROACH

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Abstract—Using a simultaneous equations model of wages and union membership, the elasticity of the wage with respect to market concentration is estimated to be approximately 0.2. The estimate uses a large data set and extensive controls to measure concentration's direct effect on the wage, an indirect effect through unionization, and a feedback effect. The indirect effect represents the majority of concentration's effect.

The effect of market concentration on wages has been a matter of disagreement among economists since the rise of trusts at the end of the last century. Writers including Dunlop, Galbraith, Segal, and Levinson have argued that more concentrated industries will pay higher wages than less concentrated industries. Others, notably Rees, have suggested that higher concentration could reduce wages. The issue retains interest both because concentration may play an important role in the determination of wages and because a positive relation between concentration and the industry wage bill would indicate the social costs of concentration have been systematically underestimated.

Thirty-five years of empirical research have done little to resolve these questions. Estimates of concentration's effect on wages have varied between positive and significant to statistically insignificant depending on the universe of the study, the level of aggregation of the data, the specification of the control variables, and the form of the concentration variable. Although simultaneous equation research has indicated the need for a more sophisticated approach to understanding concentration's effect on wages, no previous study has provided an adequate measure of this effect.

This paper reports new results on the wage effect of concentration. Using a contemporary simultaneous equations model of wages and union membership with a large data set and extensive controls for personal, geographic, and industry characteristics, it is shown that the elasticity of the wage with respect to market concentration is approximately 0.20. Further, much of concentration's effect is mediated through unionization.

Previous Research

Concentration may affect wages directly or indirectly. A direct effect exists if there is an immediate relation between concentration and the wage. There is an indirect effect if the relation is mediated through another factor, notably unionization. Commonly cited arguments for a direct relation are that the inelasticity of the demand curves of firms in concentrated industries reduces their incentive to resist high wages, that unions can better coordinate wage policies where there are few firms, that threat effects are also stronger where there are few firms, that firms in concentrated industries court public approval by paying higher wages, and that unmeasured labor productivity is higher in concentrated industries.

An indirect effect through unionization will occur if increased concentration leads to higher levels of unionization which, in turn, make the union better able to extract concessions from firms. The arguments for a positive relation between union strength and the wage are well known. Many go on to claim that unions are attracted to industries where there are monopoly rents, that the characteristics of concentrated industries increase the likelihood of union success in organizing, that unions are easier to maintain in concentrated markets, or that large firms fear the adverse publicity attendant on open resistance to unions.1

Rees (1977) rejects these arguments, pointing out that monopolized industries operate in a more elastic portion of the industry demand curve than competitive industries. Facing a less favorable tradeoff between employment and the wage, unions in monopoly industries may bargain lower wages than under competitive conditions. Levinson (1967) argues that the resources available to

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1 For more on these arguments see Weiss (1966) and Segal (1964).
firms in concentrated industries better equips them to resist union wage demands. Lewis (1959) suggests that under "competitive unionism," competitive industries are more readily unionized than monopoly industries.

The bulk of empirical research has considered only direct effects. With the exception of Lewis (1963), studies using data aggregated by industry have not found a statistically significant relation between concentration and the wage. Studies using individuals or collective bargaining agreements as observations generally find a positive relation. Virtually all studies of the direct effect find a positive relation between union penetration and the wage, a result consistent with the existence of an indirect effect.

Research on indirect effects, universally derived from simultaneous equations models of wages and union membership, has been less common. Using data aggregated by industry, Ashenfelter and Johnson (1972) found that, despite a positive and significant relation between concentration and union penetration, there was no direct or indirect effect. Kahn (1977) obtained similar results using less aggregate industry data. Although models using individuals as observations have not been intended to measure concentration's effect on the wage, their results provide some evidence for the existence of indirect effects. Lee's (1978) work shows an indirect effect for union members and a direct effect for non-members. Hirsch and Berger (1985) report a positive relation between market concentration and union membership.

Current Research

Lee's (1978) simultaneous equations model of union membership and wages offers several advantages for measuring concentration's effect on the wage. It permits a sophisticated approach to measurement of indirect effects, can be used with the large data sets common to research in labor economics, provides results reflecting the relative employment of industries, and can incorporate controls for industry and individual characteristics. The model has three equations. The first determines the union status of the individual. The second and third equations are the individual's union and non-union wage equations, respectively.

\[ I^* = a_0 + a_1 (\ln W_{ui} - \ln W_{ni}) + a_2 ACR + a_3 X + e_i \]  \hspace{1cm} (1)

\[ \ln W_{ui} = b_{u0} + b_{u1} ACR + b_{u2} UHAT + b_{u3} Z + e_{ui} \]  \hspace{1cm} (2)

\[ \ln W_{ni} = b_{n0} + b_{n1} ACR + b_{n2} UHAT + b_{n3} Z + e_{ni} \]  \hspace{1cm} (3)

\( I^* \) is a latent variable indicating net pecuniary and non-pecuniary gains from union membership. Employees become union members if \( I^* \) is greater than zero. \( ACR \) is a measure of market concentration. \( UHAT \) is an estimate of union penetration, the proportion of industry employees belonging to labor organizations. \( X \) and \( Z \) are vectors of explanatory variables while \( e_i, e_{ui}, \) and \( e_{ni} \) are error terms in the status and wage equations.

In this system, the direct effect is measured by the coefficients on concentration in the two wage equations, \( b_{u1} \) and \( b_{n1} \). These coefficients must be positive to support the direct effect hypothesis. The indirect effect has two stages: concentration's effect on union status and status's effect on the wage. The first stage requires that coefficient \( a_2 \) in the status equation is positive. The second stage may operate through two distinct channels, union penetration and individual membership. The indirect effect of penetration is captured in the coefficients on \( UHAT, b_{u2} \) and \( b_{n2} \). The indirect effect of individual membership is reflected in the difference between the mean union and non-union wage. The conditions on the first stage and at least one of the second stage channels must be met for there to be an indirect effect.

Because the equations in this system are fully simultaneous, concentration may influence the wage through feedback. The requirement for a positive feedback effect is that the net direct and indirect effect is positive and that the wage difference coefficient in the status equation, \( a_1 \), is positive. The total effect of concentration on the wage is

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3 While Weiss (1966) concluded that concentration did not influence the wage, Hendricks (1975), Dalton and Ford (1978), Kwoka (1983), and Heywood (1986) have found such an influence.

4 See Lee (1978) or Lee (1979) for details. Because the wage equations are separated on union status, an endogenous variable, status and wages are fully simultaneous. The system must be estimated using two-stage probit or maximum likelihood.
is the sum of the direct, indirect, and feedback effects.

**Measuring the Effect of Concentration on the Wage**

Our strategy is to find measures of the direct, the two indirect, and the feedback effects and combine them into a single summary measure. Measures of the three effects can be obtained from restricted reduced form coefficients, reduced form coefficients which are computed from estimates of the structural coefficients.

We first linearize the status equation (equation (1)) by substituting the derivatives of the likelihood function for their estimated coefficients. The restricted reduced form for this equation is then calculated by substituting the structural wage equations (equations (2) and (3)) into the wage difference term \( (\ln W_u - \ln W_n) \) of the linearized structural status equation (equation (4)).

\[
I = (a_0 + a_1(b_u0 - b_n0)) \\
+ (a_2 + a_1(b_u1 - b_n1))ACR \\
+ a_1(b_u2 - b_n2)UHAT
\]

where \(* = \) subscript designating a derivative of the likelihood function.

In this form, the coefficient on \( ACR \) does not capture the full effect of concentration on status. Status is a function of both concentration and estimated union penetration. Penetration is a function of industry characteristics including concentration. A complete measure of concentration’s effect on status must include this effect through penetration. In large samples, union penetration will equal the mean probability of observing a union member in an industry. In the region of the means of the independent variable, \( I = U \). Thus, the restricted reduced form status equation simplifies to

\[
I = \left[ \frac{1}{1 - a_1(b_u2 - b_n2)} \right] \\
\times \left[ (a_0 + a_1(b_u0 - b_n0)) \\
+ (a_2 + a_1(b_u1 - b_n1))ACR \right],
\]

or

\[
I = G_0 + G_sACR,
\]

where \( G_s \) measures the direct, indirect, and feedback effects of concentration on union status.\(^6\)

The restricted reduced form of the wage equations is obtained by substituting the restricted reduced form of the status equation into the wage equations. The reduced form union wage equation is

\[
\ln W_u = (b_u0 + b_u2G_0) + (b_u1 + b_u2G_s)ACR,
\]

or

\[
\ln W_u = G_u0 + G_uACR.
\]

The coefficient on concentration, \( G_u \) in the union equation, measures the direct effect, indirect effect through penetration, and associated feedback for union members. The restricted reduced form coefficient for the non-member wage equation, \( G_n \), is calculated in the same manner and summarizes the same effects for non-members.

Finally, the restricted reduced form coefficients may be combined to provide an estimate of concentration’s total wage effect:

\[
\text{Total Effect} = p_uG_u + (1 - p_u)G_n \\
+ G_s(WageDiff),
\]

where

\[
p_u = \text{proportion of employees belonging to a union} \\
G_u = \text{restricted reduced form coefficient for the union wage equation} \\
G_n = \text{restricted reduced form coefficient for the non-union wage equation} \\
G_s = \text{restricted reduced form coefficient for the status equation} \\
WageDiff = \text{the difference between the mean estimated union and non-union log wage.}
\]

The first two terms are the reduced form coefficients from the wage equations weighted by the proportion of the sample in each sector. The sum of these terms measures the net direct effect, indirect effect through penetration, and associated

\(^6\) The coefficient on concentration in the membership equation is used as the measure of both the relation between concentration and individual union membership and relation between concentration and union penetration because of the instability of coefficient estimates in the equation used to predict \( UHAT \).
feedback from a one unit change in concentration. The last term measures the indirect effect through membership and associated feedback. It is the estimated difference between the mean individual’s union and non-union wage multiplied by the total change in membership caused by a one unit change in concentration. The sum of these three terms is the measure of concentration’s total effect. 7

An Empirical Model

Our empirical model uses 2,005 male and female blue collar manufacturing employees drawn from the May 1978 Current Population Survey. The study includes conventional controls for personal, occupational, and geographical characteristics. In the wage equations we control for human capital, job market attachment, race and gender discrimination, differences in the cost of living and labor market conditions between regions, and shift differentials. In the status equation we control for differences in the benefits of union membership, costs of union membership, and tastes for unionization. Controls for race, gender, marital status, education, occupation, region, urban location, and shift were arranged as dummy variables. Where applicable, variable definitions follow Lee (1978).

The inclusion of industry variables in the system is less conventional. In the wage equation we control for factors regulating the elasticity of labor demand. In the status equation, we include factors regulating firm resistance to unions and worker benefits from collective action. 8 Definitions are provided in table 1. 9

The measure of concentration, the adjusted concentration ratio (ACR), is the four firm concentration ratio published in the 1977 Census of Manufactures adjusted for geographically fragmented markets, product markets which are too narrowly or broadly defined by Census, and import competition. The union penetration variable, UHAT, is an estimate obtained from a log-odds model. It is used in place of observed penetration

8 Inclusion of a number of industry variables reduces specification bias in the wage coefficients of concentration and union penetration. Firms in concentrated or highly organized industries employ sophisticated procedures for screening personnel which permit selection of more productive personnel by traits unobserved by the researcher. The correlation of these traits with concentration and penetration causes an upward bias in the wage coefficients of these variables. Because industry characteristics such as plant size and firm specialization are also associated with the use of sophisticated personnel practices, their inclusion should reduce this bias (see Foulkes (1982)). In addition, the sample selection term eliminates bias caused by omitted variables which are correlated with union membership. If union firms are more likely to use sophisticated personnel practices, this would affect the selection coefficient rather than the coefficients of explanatory variables.


Note: Definitions for other variables are available from the author on request.
to eliminate simultaneity with the wage. Union status is a dichotomous variable indicating whether an individual is a union member. Status is the dependent variable in the membership equation and is used to separate the observations for the wage equations. The dependent variable in the wage equation is the natural log of the hourly wage in cents per hour.

### Results

As illustrated in Table 2, controls for personal, occupational, and geographic factors in the wage equations are conventional in sign and significance. Results for the industry variables are mixed, many are not statistically significant. The coefficients in the union and non-union wage equations

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**Table 2.—Status and Wage Equations**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Status Equation</th>
<th>Wage Equations</th>
<th>Union</th>
<th>Non-Union</th>
</tr>
</thead>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Union</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Non-Union</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ACR</td>
<td>1.9138a</td>
<td>−.0723</td>
<td>3.619a</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.3430)</td>
<td>(.068)</td>
<td>(.1128)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[.7623]</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>UHAT</td>
<td>.4955a</td>
<td>−.2097</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.1243)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WAGEDIFF</td>
<td>2.898a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.4187)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[1.1542]</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Personal, Location, and Industry Controls

- **CONSTANT**
  - −1.667a
  - (.5841)

- **WHITE**
  - −.2473a
  - (.0972)

- **MALE**
  - .0397
  - (.0812)

- **MARRIED**
  - .3537a
  - (.0728)

- **EDUCATION2**
  - .2404
  - (.2435)

- **EDUCATION3**
  - .3711
  - (.2175)

- **EDUCATION4**
  - .6439
  - (.2201)

- **EDUCATION5**
  - .4258
  - (.2340)

- **EXPERIENCE**
  - .0051a
  - (.0025)

- **EXPERIENCE2**
  - −.00022a
  - (.00006)

- **CRAFT**
  - .0359
  - (.1125)

- **OPERATIVE**
  - −.1301a
  - (.1033)

- **CITY**
  - −.0390
  - (.0698)

- **FARM**
  - −.0478
  - (.0993)

- **SOUTH**
  - −.2450a
  - (.0993)

- **NORTHEAST**
  - −.1482
  - (.1090)

- **NORTH-CENTRAL**
  - .1123
  - (.0979)

- **DURABLE**
  - .0667a
  - (.0231)

- **NOON**
  - .0149
  - (.0194)

- **SOUTH**
  - −.1801a
  - (.0993)

- **NORTHEAST**
  - −.1634a
  - (.1090)

- **NORTH-CENTRAL**
  - .0759a
  - (.0281)

- **DURABLE**
  - .0579
  - (.0149)

- **NOON**
  - .0613
  - (.0289)
are considerably different, indicating differences in the wage determination process in the two sectors. The industry variables perform better in the status equation. Contrary to the expectations of most researchers, personal characteristics are weak predictors of union membership. The estimated differential between union and non-union wages is 16%, a conventional result which is close to Lee's original estimate.

The results show that concentration affects the wages of union members and non-members through different mechanisms. Although the coefficient of ACR, the measure of the direct effect, is small and not statistically significant in the union wage equation, it is large, positive, and statistically significant in the non-union equation. A ten point increase in concentration would be associated with a 3.6% increase in the non-union wage. In contrast, only union members' wages are influenced by the indirect effect. The coefficient of ACR in the status equation is large and positive. The elasticity of status with respect to concentration is 0.51; the derivative of ACR at the mean of the independent variables, the analog of a linear coefficient, is 0.76. A ten point rise in market concentration would cause mean union membership to rise from 45% to 53% of the sample. The second stage of the indirect effect operates through union penetration and individual membership. The coefficient on UHAT is positive in the union equation, indicating an indirect effect for union members. A ten point increase in concentration would cause the union wage to rise by 3.8%. The coefficient in the non-union equation is not statistically significant. There is also a positive indirect effect through individual membership.

The two-stage probit does not provide estimates of covariance between the two wage equations, making comparison of coefficients possible only under restrictive assumptions.

Ceteris paribus, the direct effect narrows the difference between the wages of members and non-members. This is consistent with the negative coefficient on the interaction of union density and concentration found by Lewis (1963) and Weiss (1966).
A ten point increase in market concentration would cause an additional 7.6% of the sample to receive the 16% higher union wage. Industry wages would rise by 1.2%.\(^\text{13}\)

Estimates of \(G_r\), \(G_{ru}\), and \(G_w\) are 1.4036, 0.6233, and 0.0675, respectively. A ten point increase in concentration would cause a 6.2% increase in the union wage. A similar increase in concentration would cause the non-union wage to increase by an economically insignificant 0.7%. The weighted average increase in the wage, the sum of the direct effect, the indirect effect through penetration, and feedback through penetration, would be 3.4%. With a union wage differential of 16%, the indirect effect through individual membership caused by a ten point increase in concentration would be 2.2%. The total effect of a ten point increase in concentration would be a 5.6% increase in wages. The elasticity of the wage with respect to concentration is 0.195.

**Conclusion**

This study provides empirical evidence that increases in industrial concentration are associated with substantial increases in industry wages. While part of the increase in wages is directly related to concentration, much of concentration's wage effect is mediated by union membership and penetration. Failure to allow for this indirect effect may be a source of the contradictory results obtained in earlier studies. Concentration's effect on the wage is not trivial. Based on our estimate of the total elasticity of the wage bill with respect to concentration, the highest concentration industry observed in this study, photographic equipment with a concentration ratio of 84%, would have a 41% higher wage than the lowest concentration industry, screw machine products, with a concentration ratio of 10%.

An implication of this result is that firms in concentrated industries are apparently subject to X-efficiency problems with respect to labor costs. Increases in labor costs will cause deviations in output above and beyond that caused by a firm's exercise of monopoly power. A complete measure of the social inefficiency of concentrated markets must account for this X-efficiency loss.

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\(^{13}\) The calculations in this paragraph measure the direct and indirect effects without feedback.
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