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INTERINDUSTRY WAGE DIFFERENCES AND INDUSTRY CHARACTERISTICS

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ABSTRACT

This paper examines the extent of interindustry wage differences for nonunion workers and finds that even after controlling for a wide range of individual characteristics and geographic location a substantial amount of individual wage variation can be accounted for by industry differences. In the aggrergate industry effects explain at least 6.7% of inter-personal wage variation. At most they explain 30%.

While the importance of industry differences is clear, the reasons for the differences are more difficult to establish. Independent of the problems of interpreting the correlates of industry differences, even the sign of the relation of many variables with wages is difficult to establish when other variables are included as controls. This conclusion is suggested by a literature review and confirmed by an analysis of a large number of alternative specifications of an industry wage equation using individual wage data from the CPS and industry characteristics from a number of recent sources. Only industry average education and industry profitability have the same (positive) sign in every specification and in all the studies reviewed. Of these two only average education was nearly always significantly related to wages. Average establishment size had a nearly consistent positive relation.

What does emerge from the analysis is a pattern of correlations. There appears to be one major dimension (and perhaps other less important dimensions) along which industries differ. A principal components analysis of an industry characteristics data set is used to demonstrate this. High wage industries have lower quit rates, higher labor productivity, fewer women, more educated workers, longer work weeks, a higher ratio of nonwage to wage compensation, higher unionization rates, larger establishments and firms, higher concentration ratios and are more profitable. An analysis of a limited number of industry characteristics in 1939 yields a similar pattern.

The implications of these results for alternative theories of wage determination are considered.

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I. Introduction

It has long been noted that there are large differences in wages across industries for workers with similar characteristics doing apparently similar jobs. Area wage surveys invariably indicate a great deal of wage dispersion for a defined job classification, such as key punch operator or order filer, within a locality. Slichter (1950) observes that hiring rates paid for common labor by 85 plants in Cleveland in February 1947 ranged from $.50 to $1.09 an hour. A more recent wage survey reveals that wages for the job classification key entry operator I ranged from $160 to $480 a week in Cleveland in September 1985 (U.S. Bureau of Labor Statistics, 1985). Dunlop (1985) notes that consideration of differences in fringe benefits tends to expand rather than offset the wage differences observed across industries in area wage comparisons. Substantial industry wage differentials remain even after controlling for union status and observed worker and job characteristics.

A textbook competitive labor market model offers several explanations for interindustry wage differentials. They can arise from systematic differences in worker ability that are correlated with industry status or from compensating differentials for non-pecuniary aspects of work that directly affect worker utility. Alternatively, industry wage premiums may reflect transitory differentials related to shifts in labor demand or supply across sectors and imperfect short-run labor mobility.

In recent years, a number of alternative theories of wage determination; such as the efficiency wage theories surveyed by Stiglitz (1984), Yellen (1984), and Katz (1986) and the union threat model of Dickens (1986); have been proposed as possible explanations for industry wage differentials, equilibrium involuntary unemployment, and a wide variety of other labor market phenomena. These alternative explanations focus on potential reasons why firms may find it profitable

to pay above market clearing wages and why the importance of these factors may differ among establishments both within and across industries.

Efficiency wage models suggest that the potential benefits to a firm of higher wages include increased effort and reduced shirking by employees, lower turnover costs, a higher quality workforce, and improved worker morale and better group work norms. A basic implication of efficiency wage models is that if the conditions necessitating efficiency wage payments differ across industries, then the optimal wage will differ among industries. This means that workers with identical productive characteristics are paid differently depending on their industry affiliation. These wage differences for similar workers may reflect industry characteristics that do not directly affect the utility of workers and thus would not require compensating differentials in a standard competitive labor market.

The payment of non-competitive wage premiums may also be related to the presence of unions or threat of collective action by workers. Firms may find it profitable to pay greater than competitive wages to unionized workers to prevent strikes and maintain industrial peace.[1]

Determining the empirical relevance of these alternative models of wage determination is quite important since the non-competitive models generate positive and normative implications with respect to issues such as trade, industrial policy and unemployment insurance that can be quite different from textbook competitive labor market models or implicit contract models.[2] An understanding of the nature of interindustry wage differentials could prove quite useful in determining the relevance of alternative models of wage determination. Dickens and Katz (1986), Krueger and Summers (1986), and Murphy and Topel (1986) have shown that industry wage differentials are quite persistent over long time periods. This persistence of the wage premiums appears to rule out transitory skill premiums as a major factor in explaining industry wage differences. The studies by Dickens and Katz

and by Krueger and Summers also indicate that industry wage differentials are quite similar across countries, across occupational groups, and for both the union and nonunion sectors. In this paper, we analyze the industry characteristics associated with wage premiums.

Simple competitive labor market models suggest that industry characteristics should only generate persistent wage differences if they affect skill requirements and working conditions. Product market factors should not matter after controlling for relevant worker and job characteristics. It is widely believed that collectively bargained wages are set in a manner different from others, and, in particular, that they may be related to a firm's "ability to pay." We are primarily interested in this paper in the relevance of different theories of wage determination in the absence of explicit collective bargaining. The union threat model predicts that the bargaining power of insider nonunion workers should enable them to capture a part of product market rents. Efficiency wage models suggest establishment and firm size variables may affect wages by affecting the ability to monitor worker performance. Normative efficiency wage models (Akerlof, 1984) postulate that ability-to-pay may affect a firm's optimal wage structure.

The plan of this paper is as follows. The importance of industry affiliation in explaining cross-sectional wage variation for the nonunion sector as a whole, the union sector as a whole, and for individual occupational groups is analyzed in section II. Previous studies of the impact of industry characteristics on wages are reviewed in section III. The sensitivity of results in these studies to the exact specifications chosen and the failure to adequately assess the distinct impacts of industry attributes on union wages and on wages set in the absence of collective bargaining within the existing literature motivates our detailed analysis of the correlates of industry wage differences for both union and nonunion workers. This empirical analysis is presented in section IV. The

implications of the observed relationships among industry characteristics and wages for alternative wage determination theories is discussed in section V.

II. The Importance of Industry Affiliation in Wage Variation

To determine the importance of industry affiliation we use analysis of covariance.[3] We begin by postulating an earnings function in which wages depend on human capital factors, personal characteristics, location, occupation, and industry:

$$(1) \qquad \log W_{ij} = \mu + X_i\beta + Z_j\alpha + \varepsilon_{ij}$$

where W_{ij} = hourly wage of individual i in industry j,

X_i = vector of individual characteristics and locational variables for individual i,

Z_j = vector of mutually exclusive dummy variables indicating industry affiliation,

ε_{ij} = random disturbance term,

μ is the intercept, and β and α are parameter vectors. The total proportion of wage variation (share of total sum of squares) explained by the covariates (the variables in X) and industry affiliation is given by the R^2 of equation (1).

If the covariates and industry dummy variables were orthogonal to each other, regressions of log earnings on the covariates alone and on the industry dummies alone would give a unique decomposition of the contribution of each set of variables to the total explained variation. The realistic case of multicollinearity between the covariates and industry affiliation implies there is no unique variance decomposition. A conservative approach to evaluating the importance of industry effects is to credit the industry effects only with the increase in explanatory power arising from adding industry dummies to a log wage regression

already including the covariates. This approach attributes all common impacts on wages of the industry fixed effects and the covariates to the covariates. An alternative upper bound on the importance of the industry effects is given by the R^2 of a log wage regression including only the industry dummies.

The analysis requires a large micro data set with information on personal characteristics, occupation, industry, and union status. All twelve monthly Current Population Surveys (CPSs) from 1983 were combined to generate a sample of individuals with these properties large enough to accurately estimate industry effects for detailed industry categories. The sample consists of private sector, nonagricultural employees, 16 years of age or older with complete data on industry and occupation and on either hourly wages or normal weekly earnings and normal hours of work per week. Average earnings per hour were computed for each individual with complete earnings data. Observations with reported wages of less than $1.00 per hour or more than $250 an hour were assumed to be coding errors and were deleted from the data set. Although the CPS is partially a panel data set, only those individuals in outgoing rotation groups are asked about earnings and people exit the sample only once a year. Thus, we can be sure that all observations represent unique individuals. This procedure left us with a sample of 109,735 nonunion workers and 25,193 union workers.[4]

The basic decomposition of the sources of wage variation for the nonunion and union samples are presented in Table 1. The covariates include detailed controls for individual characteristics, state dummy variables, an SMSA status dummy variable, and dummy variables for broad occupational groups. The industry factor measures the explanatory power of a set of three digit 1980 Census of Population code industry dummy variables (fixed effects).[5] These industry effects account for 7 to 30 percent of the nonunion wage variation and 10 to 29 percent of the union wage variation.[6] The broad ranges arise from the large degree of

multicollinearity between the industry effects and the covariates. The F-statistics for the hypothesis that the industry effects are all zero once the covariates are present in the earnings equations are 81.45 for the nonunion sample and 23.17 for the union sample. Thus, the hypothesis that the industry effects do not matter can be rejected at any conventional significance level.

Industry differentials appear to have a substantial impact on earnings even when allocating the joint contribution of industry and the covariates entirely to the covariates. An approximate measure of the impact of the portion of the industry effects orthogonal to the covariates on earnings can be derived by multiplying the proportion of sum of squares attributable to industry alone by the variance of log earnings in the sample, and then taking the square root of this quantity. This yields a conservative estimate of the standard deviation in earnings generated by industry differentials after accounting for other observables.[7] This procedure yields a standard deviation in log wages attributable to industry of .141 for the nonunion sample and .140 for the union sample.

A further issue relevant to assessing the importance of alternative theories of wage determination is the extent to which the impact of industry affiliation on wages differs across occupations. Working conditions, skill requirements, efficiency wage considerations, and union threat effects that may give rise to industry wage effects for particular groups of workers are likely to differ substantially across occupational groups. We performed separate analyses of the sources of wage variation for each of twelve occupational groups for the nonunion sample.[8] The twelve occupational groups are managers, professionals, technicians, supervisors, sales, clericals, service workers, craft workers, operators, transport and equipment operators, semiskilled workers, and laborers. The decompositions are based on on a separate set of earnings equations for each occupational group. The industry effects are strongly statistically significant and contribute

substantially to the explained variation in earnings for each group. The minimum proportion of the variation in wages explained by industry effects ranges from 7.6 percent for clericals to 18.9 percent for professionals, while the maximum proportion explained ranges from 13.2 percent for clericals to 46.1 percent for sales workers.

III. Previous Studies of Industry Characteristics and Wages

The evidence presented in the previous section indicates that industry wage differentials account for a substantial share of individual wage differences. Furthermore, Dickens and Katz (1986) find that industry wage differentials are strongly correlated across occupations. There appears to be a pattern of wage differentials in which all workers in some industries are highly paid relative to similar workers in other industries. The pattern of which industries pay high wages has been very stable over time and across countries with widely varying methods of determining labor compensation.

What are the attributes of high paying and of low paying industries? In this section, we present a partial survey of the large empirical literature that has attempted to answer this question by relating workers' wages to industry characteristics. Previous studies fall into two broad categories. The first group consists of studies attempting to relate industry attributes and average worker characteristics to a measure of industry average wages. Selected industry-level (or macro) studies are summarized in table 2. The aggregate nature of the data typically leads to difficulties in adequately controlling for worker characteristics. A major conceptual problem arises in the interpretation of these macro estimates. For example, if an individual's wage depends on his or her own union status as well as the extent of unionization in his or her industry of employment, the macro estimates of the impact of union density on industry average wages in-

volve a combination of the two effects.[9] The industry level studies, with the exception of Moore, Newman and Cunningham (1985), also do not allow one to determine the potential differences in impact of industry characteristics on union and nonunion wages.

The second group of studies add industry level variables to individual level data sets which include individual worker characteristics. Selected studies of this type are summarized in table 3. The large micro data sets utilized in these studies permit detailed controls for worker characteristics. Individual level data with information on the union status of workers potentially allows the investigator to estimate separate effects of industry attributes on collectively bargained wages and on nonunion wages. The merging of data on individuals with industry data also permits one to include both micro and macro features of other variables that may affect earnings. In particular, an individual's earnings may depend on his or her own attributes and the characteristics of his or her establishment as well as on the attributes of the industry.

The existing micro studies suffer from several conceptual and econometric difficulties. A particular problem involves the use of variables from an incorrect level of aggregation, such as industry average plant size rather than the size of the plant in which each individual is employed and a concentration ratio measure at an aggregation level not closely related to the relevant product markets. This type of aggregation problem is likely to bias the estimates and lead to incorrect standard errors (Dickens and Ross, 1984). The inclusion of aggregate (or grouped) data in a micro specification even if it is at the correct level of aggregation typically means that the OLS standard errors are incorrect and exaggerate the significance of the included aggregate variables (Moulton, 1985). This is because there are typicaly common group error components. None of the existing studies have used GLS to obtain correct standard errors. We shall discuss the

statistical significance of the findings in these studies based on the standard errors presented by the authors of the studies. The caveats noted here indicate that the results for the industry level variables in these equations are probably less precise than indicated by the standard errors reported by the authors.

A. Extent of Unionization: The extent of union organization of an industry is likely to affect the wages of both union and nonunion workers employed in the industry. An increase in the extent of unionization in a product market is likely to reduce the ability of purchasers to substitute nonunion for union products and thereby tends to lower the elasticity of demand for organized workers.[10] The improved trade-off between wages and membership employment for the union suggests, all else equal, a positive relationship between union wages and the extent of industry organization.[11]

The direction of the impact of the extent of unionization on nonunion wages is unclear a priori. Increased union wages may increase the threat of organization for nonunion firms and lead to the payment of higher nonunion wages to help prevent unionization. Increased costs of union firms may lead to shifts of demand toward nonunion products raising the demand for nonunion workers. On the other hand, reduced employment in the union sector may increase the supply of labor to nonunion firms in an industry. These changes in demand and supply for nonunion workers should not have permanent effects on nonunion wages in the industry relative to the wages of nonunion workers in other industries given worker mobility across industries. The typical finding of the studies summarized in table 2 with respect to the relation between union density and industry wages is that they are positively related in the presence of limited controls for worker quality and other industry characteristics. But, there are the problems of interpretation discussed above.

A number of the studies utilizing micro data on earnings have controlled both for individual union status and for industry union density. Freeman and Medoff (1981) estimate separate union and nonunion earnings including an industry extent of unionization measure as well as controls for other individual and industry characteristics using pooled CPS data for production workers in manufacturing. They find that union density has a large positive effect on union wages and little impact on nonunion wages. In contrast, Podgursky's (1986) results with a similar sample indicate a large positive effect on industry unionization on the wages of nonunion workers in both manufacturing and nonmanufacturing. The Podgursky and the Freeman and Medoff studies differ in the controls for other industry characteristics included in the wage equations.

Moore, Newman, and Cunningham (1985) separately aggregate CPS data for union and nonunion workers into fairly broad industry-occupation-region cells. They also find a positive effect of union density on nonunion wages. Their use of unweighted regressions with data separately aggregated into union and nonunion groups is likely to avoid some of the problems in inference from combining data of different levels of aggregation.

Existing studies generally find that industry union density is positively related to the earnings of union and nonunion workers. The positive effect on nonunion wages is consistent with union threats acting to keep nonunion wages in heavily unionized industries high. The estimates appear quite sensitive to the particular data set utilized and to the other industry attributes included as regressors. The studies surveyed which allow differential impacts of extent of unionism on union and nonunion wages yield coefficient estimates on the industry percent unionized variables in log wage equations ranging from .045 to .460 for union workers and from -.013 to .421 for nonunion wages.

B. Concentration and other Product Market Power Measures: Alternative models of the labor market provide many rationales for an observed relationship between measures of product market power and wages. A potential competitive labor market explanation for a positive relationship between product market power and wages even after controlling for observed worker characteristics is complimentarity between capital and unobserved skills. This link relies on a view that capital-intensive industries are likely to be more concentrated and typically more likely to generate monopoly rents for incumbent firms. The union threat model and some other models in which insider workers have bargaining power imply that workers should share in product market rents in the form of higher wages. The same relationship arises from efficiency wage models in which workers notion of fairness are related to the firm's ability to pay.[12] Additionally, one attribute of expense-preference behavior by managers in noncompetitive product markets may be the paying of higher wages to reduce managerial effort required for monitoring workers or for dealing with turnover. This type of behavior may not be very costly to a firm in a market where efficiency wage considerations are important.[13]

Weiss (1966) and Masters (1969) both find that concentration has a strong positive relationship to earnings when no labor quality variables are included as controls. Weiss also finds that the effect of concentration on earnings is greatly reduced once detailed personal characteristics are included as controls in a micro earnings equation. Weiss concludes that employers in more concentrated industries appear to pay their employees more, but that they get higher "quality" labor in exchange. On the other hand, Kwoka (1983), Long and Link (1983), Mellow (1982), and Heywood (1986) find a large positive and and significant effect of industry concentration on wages utilizing individual level data on earnings and worker characteristics combined with other industry level variables. The studies presented in tables 2 and 3 indicate that the relationship between concentration

and wages is quite ambiguous when detailed labor quality controls are utilized. Furthermore, concentration has been sharply criticized as a measure of product market power and monopoly rents (Phillips, 1976).

Pugel (1980) and others have argued that economic profitability is a better measure of product market power across industries than concentration. The major problem that arises is getting an empirical measure of of economic profitability given the lack of a tight relationship between available measures of accounting profits and the theoretical construct of economic profitability.[14] Pugel (1980) and Hodson and England (1986) find strong positive effects of industry profitability measures on average industry wages even with controls for average worker characteristics, union density, and other industry variables including the rate of employment growth. Both these studies find that wages are much more strongly related to direct measures of profits than to concentration. This positive relationship between wages and profitability is apparent even though the direct effect of higher wages is to lower profits. Alternatively, Kumar (1972) finds a much larger impact, on wages of unskilled workers, for concentration than for a measure of profits in a small sample of Canadian industries. None of these studies permit one to determine if product market power has differential impacts on the wages of union and nonunion workers. Kalachek and Raines (1976) add an industry rate of return variable to a micro earnings equation and find a significant positive effect on union wages and little impact on nonunion wages.

Industry wage differences appear to be related to ability-to-pay although measurement problems in variables such as concentration and accounting profits mean these conclusions should be be viewed as tentative. Several studies (Heywood, 1986; Weiss, 1966; Mellow, 1982; and Jenny, 1978) indicate that interaction effects between concentration, extent of unionization, and individual un-

ion status might be important for sorting out the effects of concentration on earnings.

C. Plant and Firm Size: Large employers typically pay more than small employers within a given industry.[15] Masters (1969) reports a positive simple correlation between industry average wages and the industry proportion of workers in large plants. Most models of wage determination can be made consistent with this positive relationship between wages and employer size. Oi (1983) argues that large employers hire higher quality employees to conserve on managements time since better workers are easier to monitor. Alternatively, some have argued that the shirking version of the efficiency wage model implies that higher wages are paid by large firms, holding worker quality constant, to conserve on monitoring costs and create incentives against poor performance. It is argued that this relation holds because monitoring is likely to be quite costly in large organizations and because large plants often have integrated production processes utilizing expensive equipment. Masters (1969) further suggests that large plants need to pay compensating differentials for the regimentation of work typically found in these settings. Additionally, large nonunion establishments may be potential union organizing targets and pay high wages to avoid unionization.

The proportion of workers in an industry in large plants and the average establishment size have typically been found to be positively related to industry wage levels even in the presence of detailed control variables (Kwoka, 1983; Long and Link, 1983; Pugel, 1980 and many others). Although establishment size and firm size appear to have quite important effects on wages within industries, they cannot explain much of inter-industry wage differentials. The May 1979 CPS contains a special survey including questions on establishment and firms size. Krueger and Summers (1986) find in analyzing this data set that the inclusion of

plant size and firm size controls barely affects the estimates of industry wage differentials. They find the employment weighted standard deviation of two-digit industry log wage differentials falls only from .104 to .099 when plant and firm size controls are added to a log earnings equation with controls for occupation, region, union status and individual characteristics. The raw correlation of the estimated industry differentials with and without employer size controls is .96. Katz (1986) finds that estimated industry differentials are only slightly affected by the inclusion of plant size and firm size dummies when nonunion workers are analyzed alone.

Brown and Medoff (1985) present the most detailed analysis of the relationships among plant size, firm size and wages. Brown and Medoff find that plant size and firm size have distinct positive effects on wages for both union and nonunion employees. They conclude that most of the employer size effect on wages occurs within detailed industries and that a large employer size effect persists even after controlling in detail for worker quality and working conditions in several data sets. Employer size appears to be an important factor in explaining intra-industry wage differentials, but not very important in explaining differences in wage levels across industries.

D. Other Industry Characteristics: The differences in results for a variety of variables across studies are highlighted for micro and macro industry wage studies in tables 4 and 5 respectively. Capital-intensity is one variable that efficiency wage models and insider bargaining models indicate is likely to be positively related to worker bargaining power and wages (Dickens, 1986). Haworth and Rasmussen (1971), Hodson and England (1986), and Lawrence and Lawrence (1986) all find that the capital-to-labor ratio has a strong positive relationship with industry average wages. A basic simultaneity problem makes it difficult to deter-

mine whether these findings mean that capital intensive industries need to pay high wages or that high wages generated for other reasons lead to the substitution of capital for labor.

The studies reviewed in this section indicate that conclusions concerning the industry characteristics that affect wages are quite sensitive to the specification (e.g. other control variables included) and to the particular sample analyzed (e.g. time period and group of industries included). These findings suggest the effects are not uniform across industries and that multicollinearity makes it quite difficult to sort out the effects of individual industry attributes. These problems are studied in detail in the next section.

IV. Correlates of Industry Wages.

As the last section makes clear, there are a number of problems with sole reliance on the results of previous studies for the purposes of our analysis. First, only a few of the previous studies have distinguished between wages of union and nonunion workers. Most economists would expect the wages of union workers to be set in a noncompetitive manner, but how wages are set for nonunion workers is an open question. Below we analyze union and nonunion wages separately. Second, many results reported above are sensitive to the specification of the wage regression. What we can not tell from the literature survey is whether the results presented in each study are representative of a wide range of specifications or idiosyncratic to the particular specification chosen. If a result is idiosyncratic -- unique to a particular sample or some unusual set of control variables -- we may wish to ignore it as not representative of the behavior across most industries or as being due to the inclusion of theoretically inappropriate controls. Below we analyze a large number of specifications to determine which results are representative and which are idiosyncratic. Finally, the discussion

above pointed out several econometric problems with past studies which are remedied in the analysis presented below. To avoid confounding the effects of individual and industry characteristics, we use micro data. One approach would be to include the industry variables in with the micro data and to use a GLS estimator to deal with the industry error components. This approach would be expensive and unwieldy given the number of different specifications we wish to examine. In addition, the level of aggregation problems discussed in section III can lead to biased coefficient estimates. Since we are only concerned with the coefficients of the industry characteristics, we take a second approach.

We have estimated wage equations in two steps. In the first step, we regress wages on a number of individual characteristics, geographic dummy variables and three-digit 1980 Census of Population code dummy variables. In the second step, the coefficients on the three-digit industry dummies are regressed on industry characteristics. Dickens and Ross (1984) suggest this approach as a possible solution to the aggregation problem which results from the correlations between the characteristics of individual workers and the deviations of the attributes of their firms' characteristics from industry averages. For large numbers of people in each industry, this method produces reliable parameter estimates even in the presence of such correlations. The results in Dickens (1985) suggest that the standard errors from an OLS wage equation of this sort may differ insubstantially from those of the ideal GLS estimator where the variances of the individual and group error components are assumed known. For several specifications we estimated standard errors with unweighted data, with data weighted by the square root of group size and using White's technique. All three methods gave qualitatively similar results so we have used and reported unweighted OLS standard errors.

A. Regression Specifications: The first stage regressions are run using the 1983 CPS data set described in section II. The specification is the same as that described above including three-digit industry dummies and occupational dummy variables. All the other covariates were also included. The industry characteristics used as independent variables in the second stage are described briefly below and in detail in appendix 1. There is a problem in that the variables we use are characteristics of the entire industry -- both union and nonunion workers and firms -- while we are estimating equations for the union and nonunion wages separately. Further, we know from previous studies that at least some of these characteristics differ between union and nonunion workers within three digit industries (for example the injury rate). If at least the ordering of the observations on each variable are correct, we can interpret these variables as indexes for the factors they are supposed to represent.

A problem in analyzing the correlates of industry wages is that many industry characteristics are available only for a subset of the industries we wish to examine. The existence of many different systems for coding industry data aggravates this problem since it is often impossible to impute the values for some industries using one coding system from the values using another. Since we are using census (CPS) data on individuals, we use 1980 Census industry codes. We have two different ways of dealing with missing values. In one set of specifications, we eliminated all industries for which information on any variable included in a regression was missing. In the other group, we set missing values to zero and included a dummy variable for each variable with missing values. Each dummy variable of this type was set equal to 1 when data were missing for the relevant variable and zero when data were present. The first method is unbiased as long as data are randomly missing. The second is unbiased only if the variables

with missing data are orthogonal to all other variables. When these orthogonality conditions hold, the second method yields unbiased estimates even if data are non-randomly missing and it also makes more efficient use of available data. Since the right-hand-side variables used here are not in general orthogonal, the use of this method involves a compromise between efficient use of available data and different sources of bias.

The industry characteristics included in our analysis can be thought of as falling into five groups. The classification presented below is to some extent arbitrary since some variables could be thought of as falling into several of the categories.

Human Capital Variables: Although we have already controlled for the standard human capital variables at the individual level, it is possible that average levels of observable human capital at the industry level may still be correlated with wages. Workers in industries where other workers are highly educated, more experienced and/or have had longer job tenures than themselves may be exceptional workers. Alternatively, better workers may be attracted to firms paying higher wages even though those higher wages are not set explicitly to compensate them for their human capital as in the noncompetitive wage models discussed in the introduction. The three human capital characteristics we consider are average years of education in the industry, average years of job tenure with current employer, and average years of labor market experience.

Discrimination or Unobserved Labor or Job Quality: It has been argued (Bergmann, 1971) that women and blacks may be "crowded" into certain jobs and that that crowding may reduce their wages. The crowding would also reduce the wages of any other workers in that job. For this reason the percent of an industries work force which is female or black may be related to the average wage in the industry. It might also be related if skill requirements or unobservable aspects

of job quality differ across industries with different racial and sex compositions. We include the percent of each industry's workers who are female and the percent who are black as independent variables in our second stage regressions.

Compensating Differentials: Several variables are included in the analysis because they represent characteristics of employment in an industry for which workers might receive a compensating wage premium. These variables are the layoff rate, the injury rate, the number of hours in the work week, the number of hours of overtime worked, and the ratio of total compensation to wage compensation.

Labor Market Characteristics: Two attributes of industries labor markets are included -- the industry unemployment rate and union density. Firms in industries with high unemployment rates may have to pay workers more to compensate them for the prospect or frequent or long spells of unemployment.[16] Alternatively, if wages are determined by noncompetitive mechanisms, a high unemployment rate may indicate the existence of a queue for high wage jobs. Union density in an industry may effect the wages of both union and nonunion workers via a number of routes as discussed in section III.

Technology and Product Markets: Ten variables related to the structure of each industry's product market or the technology of production were included in the analysis: two measures of firm size (the number of employees per firm and the dollar value of sales per firm), the four firm concentration ratio, the capital-to-labor ratio, the ratio of R&D spending to the dollar value of sales, the average number of employees per establishment, the fraction of production workers in each industry's workforce, and three measures of profitability (net income as a percent of sales, the rate of return on capital and net income per employee) were also included.

Altogether 432 specifications were tried -- 216 for the union sector and 216 for the nonunion sector. All specifications included the average tenure of

workers in the industry, their average education and job experience, union density, and the percent of workers who are female, black and the percent who are production workers. Half the specifications also included the average number of employees per firm, the average dollar value of sales per firm, the average number of employees per establishment, the average number of hours worked each week and the number of injuries per 10,000 workers resulting in a lost work day. All of these variables were available for a wide range of industries.

For each of these two basic specifications, four other specifications were created. Each of the three profit measures was included individually with each of the basic specifications. Two other specifications were added in which all three profit measures were included with each of the basic specifications. These eight specifications were repeated including the capital-to-labor ratio and the industry unemployment rate. These two variables were also included with the two basic specifications without profit variables for a total of ten new specifications or eighteen specifications altogether. Each of these specifications was estimated with and without eighteen dummy variables for one and two digit industries. (See table 7 for a list of the dummies). The inclusion of these dummies allows us to consider the effects within relatively comparable groups of industries rather than across very different industries. This gives us thirty-six specifications. Each of the thirty-six specifications was repeated again including a number of variables only available for manufacturing industries: the four-firm concentration ratio, the ratio of R&D spending to sales, the ratio of total compensation to wages and salaries, average hours of overtime per week and the layoff rate. This gives us seventy-two specifications.

This hierarchical construction of the specifications was developed in part because of the different industries for which the data on each groups of variables were available and in part as an attempt to discover patterns with respect to

which variables were significant or insignificant in conjunction with what other variables. We were mostly unsuccessful in this second regard.

Each of these seventy-two specifications was run on three different samples. In the first, all observations with missing values for any of the variables were deleted. In the second, only manufacturing industries were included. Missing data were handled by setting missing elements to zero and including missing value dummies for each variable. In the third, all industries were included and again missing data were handled using the dummy variable technique. Each of these 216 specifications was run with the union fixed effects as the dependent variable and with the industry fixed-effects from the nonunion regression as the dependent variable.

B. Regression Results: Table 6 presents the raw correlations of all the variables in the industry data set. Table 7 presents the results of some representative regressions from the 432 we estimated. The results with respect to nearly all the variables proved sensitive to the specification. Average years of education in the industry was the exception. It was one of only two variables with the same sign in every specification in the nonunion sector. It was the only variable that was positive and statistically significant in every specification tried. Coefficient values ranged from .04 to .15 with most falling in the middle of the range.

The results with respect to the other two human capital variables were far less robust. Minor changes in the specification produced sign changes for both variables. For example, tenure generally had a positive sign and was sometimes significant when missing values were deleted; but when dummies were used to deal with missing values in the full sample, the sign was negative more often than not and sometimes significant.

The percent of an industry's workforce which is female was nearly always significantly negatively related to wage. In a half-dozen specifications the coefficient was positive -- though never positive and significant. Nothing clearly distinguished these six specifications. The coefficients on the percent of an industry's workforce which is black were less uniform. In general, it was positive and occasionally significant though it was often negative when the sample was restricted to the manufacturing sector or when dummy variables were used to deal with missing data in the full sample.

The results with respect to the variables included to take account of compensating differences were mixed. The layoff rate entered most often with a positive coefficient which was occasionally significant in the nonunion sector, but it was mostly negative for union workers. In the nonunion sector, the injury rate was positive and insignificant in all but eight specifications. It was negative in five of those and significantly positive in three. In the union sector, there were many more negative coefficients. The coefficient on hours of work was always positive and often significant in the nonunion sector except when the sample was restricted to the manufacturing sector. More often than not the coefficient was significant. Negative coefficients were far more common for union workers. On the other hand, the overtime variable almost always had a negative coefficient which was often significant. Finally the ratio of total compensation to wage and salary compensation almost always had a negative coefficient, but the size of the coefficient was always less than the -1 that would be expected if workers valued a dollar of benefits the same as a dollar of pay.

The relation between the wage and the industry unemployment rate varied considerably with small changes in the specification. The sign on the coefficient was as often negative as positive. There were a few specifications where it was

positive and significant in the nonunion sector and some where it was significantly negative in the union sector.

The extent of union coverage also appears to have a somewhat ambiguous relationship to wages. When the full sample was considered for nonunion workers and missing observations were deleted, this variable was almost always positive though only significant when the industry dummies were not included. When dummies were used to deal with missing data, union coverage was nearly always significantly positive. When the sample was restricted to manufacturing industries, the coefficient was often insignificantly negative. The coefficient on industry union density was always positive and significant ranging from about .3 to .7 for union workers.

The sign on the coefficient on the number of employees per firm was sensitive to the sample. In the full nonunion sample it was always negative and insignificant, but in the manufacturing only sample it was always positive and often significant. In the union sample these results were reversed. The results for the sales-per-firm variable were somewhat more consistent. The coefficient was nearly always positive and sometimes significant. The exceptions were some specifications in which only manufacturing industries were included. The results for the establishment size variable were even more consistent, at least for nonunion workers. In every specification the coefficient was positive and was often significant. Only for union workers was the coefficient ever negative. The ratio of research and development expenditures to sales was also fairly consistently positively related to wages in the nonunion sector and was statistically significantly positive in about half the specifications. This result was reversed for union workers with most of the specifications having a negative coefficient which was sometimes significant. The coefficient on the percent of production workers in the industry's workforce varied considerably depending on the sample. For the

full sample for nonunion workers the coefficient was generally negative and significant. For manufacturing it was generally positive and often significant. For union workers the coefficient was generally negative.

The capital-to-labor ratio was nearly always positively and often significantly related to wages. In the manufacturing sample the coefficient was always positive. The concentration ratio variable had an inconsistent relation to the wage with both positive and negative coefficient values following no easily discernible pattern. There was only a small difference between the results for union as opposed to nonunion workers with the coefficients for the union sector being negative more often than for the nonunion sector.

Finally, the profitability variables performed fairly uniformly for nonunion workers. The ratio of net income to sales and the average return on capital were both positively related to wages in all specifications tried and were often significantly related when entered by themselves. Profits per employee was nearly always positively related and often significantly positively related when entered by itself. Given the point estimates, the wage difference between an industry with an average net-income/sales ratio two standard deviations above the mean and one two standard deviations below the mean would range from 5% in the specification with the smallest coefficient to 12% in the specification with the largest. Most estimates were towards the middle of that range. The same range for the average rate-of-return on capital was from 2.5% to 15.4% and for net-income per worker the range was from negative values to 17.6%. When all three profitability variables were included, one or two of the variables might have a negative coefficient while the other one or two would be positive. Results were less strong for unionized workers. In those specifications the coefficients on the profit variables were often negative.

An exercise similar to this can be performed for manufacturing industries in a much earlier year.[17] This is a useful comparison given the long-term stability in industry wage levels reported in previous studies (Slichter, 1950; Dickens and Katz, 1986; Krueger and Summers, 1986). Although the micro data are not available and far fewer of the industry characteristics can be identified, table 9 presents the results of regressing average industry wages on a number of characteristics of manufacturing industries using 1939 data (see appendix 2 for a description of the data) and table 8 presents the correlation matrix for these data. The results are consistent with those reviewed above with one interesting exception. The average hours worked a week was consistently positive and often significantly related to wages in the modern data. In table 8 the correlation is negative and the regressions yield an insignificant positive coefficient.

C. Principal Component Analysis: The correlation matrices presented in tables 6 and 8 suggest why the results are as unstable as they are. Industry characteristics are fairly highly correlated with each other. Further, there is a pattern to the correlation suggesting that there is one or a few underlying factors which explain the distribution of industry characteristics. This has been the conclusion of people studying industry characteristics from the "dual-economy" perspective. Several authors[18] have factor analyzed industry data and have found one dominant factor corresponding to the view that there is a single dimension along which industries vary. At one end of this spectrum are industries which pay high wages, have substantial market power, tend to be made up of large firms with large establishments, have a higher union density, have high capital-to-labor ratios and employ fewer women. At the other end are those with the opposite characteristics.

We have repeated this exercise for both our modern data and the 1939 data using principal components analyses. For the more recent data we ran two analysis -- one for manufacturing industries and one for the full sample of industries. In both of these analyses and in the analysis of the 1939 data, we find that the first component extracted fits the dual economy description and accounts for over a third of the standardized variance of the industry variables.

Table 10 presents the results for an analysis of the modern manufacturing data. In these data and in the analysis of the full modern sample and the 1939 data the first component accounts for over a third of the variance in the data set. An examination of the first eigenvector in each analysis, which can be interpreted as the correlation between each of the variables and the respective component, shows the pattern predicted by the dual economy theory.

The second components of both of the analyses of the modern data are positively correlated with the average experience and tenure of the the workforce, union coverage, the unemployment rate, the layoff rate and the injury rate. They are negatively correlated with R&D spending, percent female and all the profitability variables. This component could reflect a declining vs. growing industry pattern. The first two components together account for over half the variance both in the modern data and the 1939 data.

The remaining components add little explanatory power individually, but together with the first two it takes six or fewer components to explain three-fourths of the variance in any of the three data sets. Ninety percent of the variance can be explained with ten or fewer variables. This explains the sensitivity of the coefficient estimates in the preceding analysis. It is fundamentally impossible to untangle the independent effects of all the industry characteristics on wages with these data. A few variables, such as education, profitability and establishment size, have sufficient independent variability so

that they have a consistent relation with wages controlling for a wide range of other variables. For most variables this is not the case. In general all we can do is identify the pattern of the correlations. The principal components analysis provides a useful summary of these results.

V. Conclusion

It has long been noted that wages for apparently similar workers can differ greatly between firms in different industries. The results presented in section II support this view. The most conservative estimates indicate that industry affiliation accounts for seven percent of all inter-personal wage variance for nonunion workers.[19] An upper bound on the importance of industry effects is that they explain thirty percent of wage variance.

While the importance of industry differences is clear, the reasons for the differences are more difficult to establish. Independent of the problems of interpreting the correlates of industry differences, even the sign of the relation of many variables with wages is difficult to discern when other variables are included as controls. This conclusion is suggested by the literature review in section III and confirmed by the detailed analysis of alternative specifications in section IV. What does emerge is a pattern of correlations. There appears to be one major dimension (and perhaps other less important dimensions) along which industry wage patterns differ. Over a third of the standardized variation in the three data sets we examine can be explained by one underlying factor.

Despite these problems, there are three variables which stand out, from the literature survey and the analysis of section IV, as having a consistent relation with wages. Average years of education in an industry is positively related to wages in every study in which it is included. It is also strongly positively related to wages in every specification in section IV even after controlling for

education at the individual level. Though not significantly related to wages in every case, the sign on the coefficients of the profit variables included in the studies surveyed and on two of the three measures used in section IV were consistently positive for nonunion workers. Since we would expect a negative relation between profits and wages, all else held equal, this is a remarkable result. Finally, workers in industries with larger than average establishment sizes and with high capital-labor ratios appear to earn positive wage premiums in most of the specifications reviewed in section III and in most of those tried in section IV for nonunion workers.

The empirical analysis in section IV was not exhaustive. Only one source of micro data from one year was used, and only a small fraction of the different samples and specifications which were possible with the data we collected were estimated. Still, the consistency across the studies reviewed and the equations estimated in section IV should give us some confidence in these findings. What can we make of them?

The results with respect to education are consistent with all of the theories discussed in the introduction. Those with respect to establishment size and capital intensity can be reconciled with any of the theories by postulating a correlation between these variables and some unobserved variable influencing compensation. The same is true for the profit variables, but three types of theories would anticipate a direct relation between profits and wages -- normative wage, insider collective action threat, and expense-preference theories. The observed pattern of correlations can also be reconciled with any of the theories but would only be anticipated from the perspective of these three. Thus, the results presented here can be seen as providing weak support for these non-standard models of wage determination in the nonunion sector.

FOOTNOTES

1. Foulkes (1980) presents numerous examples of large nonunion firms which maintain high wages at least partially to avoid unionization.

2. Bulow and Summers (1986), Dickens (1986), and Stiglitz (1984) provide detailed discussions of the policy implications of alternative wage determination models.

3. Searle (1971) provides a detailed treatment of the techniques of analysis of variance and of analysis of covariance. Wachtel and Betsy (1972) and Kalachek and Raines (1976) provide examples of alternative approaches to decomposing the contribution of personal characteristics and labor market structure variables in explaining wage differences. Groshen (1985) utilizes an analysis of variance approach to examine the importance of establishment and occupational effects in explaining within-industry production worker wage variation.

4. Union workers are those in employment covered by collective bargaining agreements.

5. The share of wage variation explained by industry effects depends to some extent on the fineness of the industry classification scheme used. The three digit classification is probably a bit too broad for the purpose of capturing the relevant product market but is the most detailed breakdown possible with the CPS data. A three digit industry classification yields an average of about 519 observations per industry cell for our nonunion sample and 125 observations per cell

for our union sample. One can reject the restriction that three digit industry wage effects do not differ within one digit industries at any standard level of significance for both the union and nonunion samples. The difference between a three digit and a one digit industry breakdown also seems to be economically as well as statistically significant. The standard error for a log wage equation with the same covariates as listed in table 1 drops from .37 to .35 when one moves from including one digit to three digit industry dummies.

6. An alternative decomposition involves treating both industry and occupation as structural variables. This means removing the occupation dummies from the covariates. The industry and occupation dummies combined explain from 14 to 46 percent of the wage variation in the nonunion sample. The remaining covariates account for 12 to 44 percent of the variation. The addition of industry-occupation interaction dummies raises the overall R-squared to .604. One can reject at any conventional significance level that the interaction terms do not matter. The industry-occupation cell fixed effects explain 17 to 50 percent of the total sum of squares.

7. Direct estimation of the variance components attributable to the covariates and to industry effects is prohibitively expensive for a large data set with a many unbalanced cells. Groshen (1985) provides a more detailed justification for the procedure we utilize for calculating the "standard deviations."

8. The complete earnings variation decompositions by occupational group are contained in an appendix available from the authors upon request.

9. See Lewis (1986) for a detailed critique of macro estimates of the impact of unionization on wages.

10. Freeman and Medoff (1981) present a detailed analysis of the relationship between extent of product market organization and the elasticity of demand for union labor.

11. This improved trade-off between wages and union employment arises when union and management bargain over wages and management has a large degree of unilateral discretion over the level of employment. Fully "efficient" wage bargains merely involve the redistribution of rents between union and the employer with employment set at the competitive level. Abowd (1985) discusses alternative concepts of "efficient" bargains and presents an interesting test of the efficiency of union-management wage settlements.

12. Kahneman, Knetsch, and Thaler (1985) provide evidence that for many people (a majority of Canadian survey respondents) "fair" wages for incumbent employees depend on a firm's profitability and ability-to-pay. Akerlof (1984) presents a wide variety of sociological evidence indicating that the perceived "fairness" of a firm's personnel policies can have large impacts on worker productivity.

13. Heywood (1985) analyzes a simple model of expense-preference behavior of managers in a labor market exhibiting efficiency wage behavior. He shows that wages in an industry are likely to be positively related to industry concentration in these circumstances. Akerlof and Yellen (1985) and Bulow and Summers (1986) show that firms paying "too high" wages in labor markets characterized by efficiency wage payments may face only second-order losses. Weiss (1966) argues that

industries with less competitive structures are subject too more intense public scrutiny. The payment of high wages may help the maintenance of a good public image and reduce the likelihood of anti-trust problems.

14. Fisher and McGowan (1983) argue that accounting rates of return tell one little about relative economic profitability or the presence or absence of monopoly. A recent paper by Kay and Mayer (1986) demonstrates that under some conditions accounting concepts may provide correct measures for economic analysis.

15. Brown and Medoff (1985) and Garen (1985) present detailed discussions of explanations for a positive relationship between employer size and wages.

16. Murphy and Topel (1986) analyze the role of differences in unemployment risk, hours requirements, and income variability in explaining wage differentials.

17. Since only industry level data is available for this period, this analysis is subject to all the criticisms made of industry level studies in section III.

18. Buchele (1976a,b) and Oster (1979) present examples of factor analytic studies of the dual economy. Lang and Dickens (forthcoming) provide a critical survey of the dual economy literature.

19. Saunders and Marsden (1981) find similar results for six European countries. Their study does not distinguish between union and nonunion workers.

APPENDIX 1: INDUSTRY LEVEL DATA SET CIRCA 1983

Table A1.1

Variable	Mean	S.D.	Source
Average Rate of Return on Capital	.059	.034	a
Average Unemployment Rate 79, 82 & 84	.078	.024	b
Average Wage	7.99	2.15	c (Tab.C2)
Average Weekly Income	304	102	c (Tab.C2)
Capital/Labor Ratio	.097	.170	d
Fraction Black	.095	.065	e
Fraction Female	.365	.207	c (Tab.B2,3)
Fraction Production	.765	.124	c (Tab.B2)
Four Firm Concentration Ratio	.372	.146	f
Hours of Overtime	2.47	1.00	c (Tab.C2)
Hours of Work per Week	37.4	3.85	c (Tab.C2)
Injury Rate	4.19	2.47	g
Labor Productivity	74.6	50.5	h
Layoff Rate	.016	.013	i
Net Income/Employee	.059	.090	j
Net Income/Sales	.039	.031	a
Non-Wage and Salary Compensation	.378	.066	k
Quit Rate	1.29	.788	i (not /100)
R&D Expenditures/Sales	.023	.032	l
Sales per Firm	.015	.075	a
Thousand Employees per Establishment	.038	.040	j
Thousand Employees per Firm	.169	.477	j
Union Coverage	.184	.169	m
Years of Education	13.45	1.07	m
Years of Job Tenure	4.68	2.90	n
Years of Experience	18.1	3.53	o

Sources*

a. Three year average. Source Book: Statistics of Income 1979, 1980, 1981. Corporate Income Tax Returns, Treasury Department.
b. Employment and Earnings, January 80, 83 &85, Table 11.
c. Employment and Earnings, March 83.
d. Plant and equipment in 1000s in 1972 dollars/employees. Input/Output Data, Bureau of Economic Analysis, 1984.
e. 1980 Census, Detailed Population Characteristics, Table 286.
f. By value of shipments. 1977 Census of Manufactures, Table 8.
g. Lost workday cases per 100 fulltime employees/100. USBLS, Occupational Injuries and Illnesses 1982, Bulletin 2196; Apr 84, Tab. 1.
h. Total value added/production workers. Annual Survey of Manufactures 1981, Table 4.
i. Per 100 empl. per mo./100. Employment and Earnings, March 82, Tab. D2.
j. Enterprise Statistics, 1977, Table 4. [Income data from source (a)].
k. BLS memo.
l. By sales. NSF R&D in Industry, 1981, Tables A1,B2,B5,B11.

m. 1983 Current Population Survey.
n. USDOL, Job Tenure of Workers, Special Labor Force Report 172, 1975. Employment and Earnings, March 1974, Table B3.
o. Age-6-(last year of school completed). Computed from 1983 CPS.

* A detailed description of how each variable was constructed is available from the authors on request.

APPENDIX 2: 1939 MANUFACTURING INDUSTRIES DATA SET

The 31 industries in the sample are printing, newspaper and magazine; printing, book and job; automobile; rubber; iron and steel; electrical manufacturing; agricultural implements; chemicals; paint and varnish; meat packing; lumber and millwork; paper products; hoisery and knit goods; furniture; wool; paper and pulp; leather tanning; boots and shoes; cotton; foundries; machines and machine tools; heavy equipment; hardware and small parts; other foundry and machine shop products; rubber tires and tubes; other rubber products; silk; woolen and worsted; other woolen products; cement; and petroleum refining.

The definitions, means, standard deviations, and sources of the variables in the data set are presented in Table A2-1. BLS data giving crude measures of the extent of unionization by industry for 1941 is used as a proxy for 1939 unionization rates. These BLS estimates classify manufacturing industries into four categories:

Group I: almost entirely under written agreements
Group II: large proportion under written agreements
Group III: about half under written agreements
Group IV: moderate proportion under written agreements.

We summarize the information from the BLS classifications by assigning each industry the midpoint of Lewis' (1963) informed estimates of the class limits for each group. The variable UNION for each industry takes on the following values depending on its BLS classification:

Group I: 90 percent
Group II: 70 percent
Group III: 50 percent
Group IV: 20 percent.

TABLE A2-1

VARIABLE DEFINITIONS, SOURCES AND MEANS (STANDARD DEVIATIONS) OF THE DATA

MANUFACTURING INDUSTRIES - 1939

Description	Mean (Standard Deviation	Source)
Average hourly earnings, male unskilled (1939)	.586 (.091)	1
Average hourly earnings, male skilled and semiskilled (1939)	.798 (.139)	1
Average hourly earnings, all wage earners (1939)	.723 (.137)	2
Median age, male employees (1940)	35.31 (2.00)	3
Fraction of females among wage earners (1939)	.204 (.183)	1
Discharge rate per worker (1939)	.018 (.009)	4
Layoff rate per worker (1939)	.282 (.179)	4
Quit rate per worker (1939)	.107 (.041)	4
Average hours of work per week (1939)	37.7 (1.96)	2
Fraction of labor force covered by collective bargaining agreements (1941)	.460 (.239)	5
Value added per employee (1939) ($/year)	2545 (1091)	6
Average number of employees per establishment/100 (1939)	1.42 (1.30)	6
Net income after taxes as percentage of sales or total receipts (1939)	4.34 (2.88)	1

Sources:
1. Slichter (1950)
2. Conference Board (1940)
3. 1940 Census
4. Handbook of Labor Statistics (1941)
5. Petersen (1942)
6. Census of Manufactures (1940)

TABLE 1

Analysis of Sources of Wage Variance for Nonunion and Union Workers

Source of Variation	Nonunion Share of Total Sum of Squares	Union Share of Total Sum of Squares
Covariates and Industry (RA)	.582	.478
Error (1 - RA)	.418	.522
Covariates First		
Covariates (RB)	.515	.377
Industry (RA - RB)	.067	.101
Industry First		
Covariates (RA - RC)	.284	.185
Industry (RC)	.298	.293
Total Sum of Squares (SST)	32637.0	4867.6
Variance of log(wage)	.297	.193
Standard Deviation of log(wage)	.545	.440
Mean of log(wage)	1.85	2.17
Total # of observations	109735	25193
# of Industry cells	217	209
# of covariates	82	82

RA is the R-squared from a log wage regression including both the covariates and industry dummies; RB is the R-squared from a regression of log wage on the covariates alone; and RC is the R-squared from a regression of log wage on industry dummies alone. The covariates are education (years of schooling) and its square; experience (age-education-5) and its square; 50 state and 11 occupation dummy variables; dummy variables for marital status, race, sex, part-time work and whether or not an individual lives in an SMSA; and interaction terms for both experience and experience squared with all the other variables except the state and occupation dummies and education squared. Industry refers to 3-digit 1980 Census of Population code industry dummies.

TABLE 2

EMPIRICAL STUDIES OF INDUSTRY ATTRIBUTES AND WAGES UTILIZING INDUSTRY AVERAGE DATA

AUTHORS AND YEAR	DATA	RELEVANT CONCLUSIONS
Rapping (1967)	1960 Census of Population, 1958 Census of Manufacturers, other sources. Dependent variable is log of average hourly wage for 19 manufacturing industries.	Profits per hour, proportion of workers in unionized plants, industry concentration, and assets per hour all have positive wage effects. The wage equations include no controls for labor quality besides a percent black variable.
Masters (1969)	1963 Census of Manufacturers Dependent variable is average hourly wage for 417 manufacturing industries.	Industry union density and proportion of workers in large plants have significant, positive effects on wages; the ratio of wages to value added has a significant negative impact. Concentration appears to be insignificantly related to wages once other industry characteristics are used as controls. The industry wage equations estimated in this study do not include any controls for labor quality or other worker characteristics.
Haworth and Rasmussen (1971)	1963 Census of Manufacturers, 1960 Census of Population Dependent variable is average hourly wage for 390 industries.	This paper adds controls for industry labor force quality and demographic characteristics to a specification and data set similar to Masters (1969). Plant size and the capital/ labor ratio have large positive effects on wages. Union density and concentration have positive, but statistically insignificant impacts.
Ashenfelter and Johnson (1972)	1960 Census of Population, other sources. Dependent variable is log of average hourly wage for 19 manufacturing industries.	Percent union has a large positive effect on wages in an OLS model; but a generally insignificant and quite unstable impact in 2SLS and 3SLS specifications in which percent union and median years of schooling are treated as endogenous. Concentration has a small, insignificant effect on wages. The small sample size limits the authors to few control variables (schooling, percent female, percent south).
Kumar (1972)	Canadian government data. Dependent variable is average hourly wage for unskilled workers in 23 Canadian manufacturing industries.	Value added per hour, industry concentration ratio, and the industry unionization rate have large positive effects on wage rates for unskilled labor. After-tax profits as a percentage of sales has small positive, but insignificant, impact on unskilled wages. Unskilled and skilled wages are strongly positively correlated across industries.
Haworth and Reuther (1978)	Censuses of Manufacturers, Censuses of Population Dependent variable is log of average hourly wage for 207 industries (1958) and 359 industries (1967).	Concentration and percent union have much stronger positive wage effects during periods of slack demand (1958) than during periods of strong demand (1967). Plant size has a strong positive effect on wages of approximately the same magnitude for the sample years. Value added per worker has a larger positive effect on earnings in 1967 than in 1958. Two years of data make it difficult to really differentiate cyclical effects from secular changes in relationships.
Pugel (1980)	73 manufacturing industries based on IRS minor industry classification for 1968-70. Dependent variable is log of average hourly earnings per employee averaged over 1967-70.	A measure of excess profit per hour and fraction workers in large plants have large positive effects on wages. The excess profit measure has a much stronger relationship to wages than does the concentration ratio. Fraction of workers in unionized plants has small and generally insignificant wage impact.

Heywood (1985)	Sample consists of 93 four-digit manufacturing industries for 1970 and 1979. Dependent variable is log of average wage for production workers.	Unionization rate, average industry plant size, and concentration all have positive and significant effects on wages, while percentage of industry supply from imports has a negative and significant impact on wages. The other control variables are median age, percent of industry workers with high school education, percent female, and proportion of industry production in the south.
Lawrence and Lawrence (1985)	Sample consists of 57 manufacturing industries for 1960, 1970, 1980, and 1984; data from various sources. Dependent variables utilized are log of average hourly earnings for production worker and total compensation per employee.	Proportion of workers in large plants and capital/labor ratio have substantial positive effects on earnings across specifications and sample years. Concentration found insignificant for earnings, but positive and significant in some specifications for total compensation. Unionization rate has positive, although not consistently significant, impact on earnings.
Hodson and England (1986)	Industrial Characteristics from the 1970 Census; other sources. Sample consists of 188 private sector industry groups at the three-digit 1970 Census code level. The dependent variables utilized are median earnings for males and median earnings for females.	This paper estimates separate industry median earnings equations for male and females including a large number of industry characteristics and limited labor quality controls as independent variables. The extent of unionization and and profit rate have positive and significant effects on both male and female earnings. The capital/labor ratio and proportion of industry sales to government have strong positive impacts on male earnings and and much weaker relationships to female earnings. Concentration and firm size have small and insignificant effects for both groups.
Moore, Newman, and Cunningham (1985)	Pooled May CPSs for 1973-79. Aggregated separately for union and nonunion workers into broad industry-occupation-region groups. Sample consists of private sector male employees.	Sample stratification into cells of union and nonunion workers permits the authors to estimate the distinct impact of alternative union density measures on union and nonunion wages. Industry union density and average plant size are found to have strong positive effects on both union and nonunion wages. The authors utilize only a limited range of controls for worker characteristics relative to the typical micro earnings equation. The inclusion of the plant size variable substantially reduces the impact of industry union density on nonunion wages for manufacturing.

Statistical significance here refers to statistical significance at the 5 percent level in a one-tail test.

TABLE 3

EMPIRICAL STUDIES OF INDUSTRY ATTRIBUTES AND WAGES UTILIZING INDIVIDUAL DATA ON EARNINGS AND WORKER CHARACTERISTICS

Authors and Year	Data	Relevant Conclusions
Weiss (1966)	1960 Census of Population. 1960 Annual Survey of Manufacturers. 5187 males in various industries. Dependent variable is private wage and salary income for 1959.	Industry concentration and unionization rate have positive effects on annual earnings. These positive impacts are greatly reduced when detailed personal characteristics are included as controls. No control for individual union status is available.
Kalachek and Raines (1976)	National Longitudinal Survey for 1966 and 1969; men aged 45-59 in 1966. Rate of return from IRS Corporation Income Tax Returns (1963,66,68). Dependent variable is log of reported hourly wage.	After controlling for labor quality, the rate of return has significant positive wage effects for union workers and has little wage effect for nonunion workers.
Dalton and Ford (1977)	Public use sample, 1970 Census of Population. Limited to 5353 nonsupervisory workers aged 14-65 in manufacturing or utility industries. Dependent variable annual earnings and log of earnings adjusted by BLS cost of living index.	Industry concentration, employment growth and durable goods industry dummy have strong positive wage effects in equations including extensive individual controls and union density. Union density has only a small impact. No control for individual union status was available.
Bloch and Kuskin (1978)	May 1973 Current Population Survey(CPS) limited to 778 union and 1296 nonunion white non-Spanish males aged 25-64 in manufacturing industries. Dependent variable is log of average hourly earnings.	This study estimates separate union and nonunion wage equations including standard labor quality controls, concentration, and industry average establishment size. Concentration has significant negative wage effects for union workers and insignificant negative effects for nonunion workers. Establishment size is not significant for either group.
Jenny (1978)	5171 individuals from the 1964 French Census. Dependent variable is log of wage income divided by average hours worked in industry.	Industry-level measures of plant size, fixed costs, and union density have strong positive effects on wages. Concentration has a negative effect in highly unionized industries and a positive effect in low union density industries. Equations include no control for individual union status.
Freeman and Medoff (1981)	May CPS for 1973-75 merged with 3-digit SIC code industry data from various sources. Sample is limited to production workers in manufacturing. Dependent variable is log of usual hourly earnings.	This paper estimates separate earnings equations for union members and nonunion workers including labor quality controls, state dummies, 2-digit SIC code industry dummies, and four 3-digit SIC code industry level variables. Industry average firm size and injury rate have significant positive effects on wages for both groups. Industry unionization rate has a significant positive association with union wages and virtually no association with nonunion wages. Concentration is insignificant for both groups.
Mellow (1982)	May 1979 CPS; 18,551 workers. Dependent variable is log of average hourly earnings or log of hourly total compensation.	Individual-level firm and plant size measures and industry union density have strong positive effects on wages. A union status dummy and detailed individual controls are included. Positive effect of concentration is larger for nonunion workers and for workers in large firms.

Kwoka (1983)	1977 Quality of Employment Survey; 250 blue collar workers in manufacturing industries. Dependent variable is log of reported hourly wage.	Concentration and individual-level establishment size measures have a strong positive effect on in equations with a union status dummy and an extensive list of personal, job, and locational characteristics. The positive impact of concentration is much larger for nonunion workers.
Long and Link (1983)	1966 National Longitudinal Survey; 1514 men aged 45-59 in manufacturing and utilities.	Industry concentration, union density, and firm size have strong positive wage effects in equations with controls for personal characteristics but no control for union status. Minimum price regulation has positive association with wages.
Heywood (1986)	1005 household heads in manufacturing industries from Panel Study of Income Dynamics. Dependent variable is log of average hourly wage for 1981.	Concentration and two industry-level measures of establishment size have large positive effects in equations including controls for individual worker characteristics, hours worked, and union status. An interaction term for concentration and union status has a significant negative impact on earnings.
Podgursky (1986)	1979 CPS sample separated by establishment size. Includes only private sector production workers. Dependent variable is log of average hourly earnings.	Union density has strong positive impact on wages for nonunion workers in large and medium plants and little impact on wages for nonunion workers in plants with less than 100 employees. Author interprets his findings as indicating that large nonunion employers tend to match union wages and that small nonunion employers set wages below union scale.

Statistical significance here refers to statistical significance at the 5 percent level in a one-tail test.

TABLE 4

BASIC RESULTS OF INDUSTRY WAGE STUDIES UTILIZING INDUSTRY AVERAGE DATA

	Variable									
Authors and Year	%UNION	CONCEN	CON*UN	PLTSIZE	IMPORTS	K/L	%FEMALE	LC/TC	VA/HRS	PROFIT
Rapping (1967)	+(+)	+	++a			-			-	+(+)b
Masters (1969)	++	+		++				--		
Haworth and Rasmussen (1971)	+(+)	+		++		++	--			
Ashenfelter and Johnson (1972)	+(+)	-(+)c					--			
Kumar (1972)	++	++					-	+(+)d	++	+
Haworth and Reuther (1978)	+(+)	+(+)		++			--		+(+)	
Pugel (1980)	+(+)	+(+)		++			--			++b
Heywood (1985)	++	++		+(+)	--		--			
Lawrence and Lawrence (1985)	+(+)	+(+)		++	-(-)	+(+)	--			
Moore, Newman and Cunningham (1985)	++			++						
Hodson and England (1986)	+	-				++(-)e	+(+)			++

%UNION is the measure of the unionization rate.
CONCEN is the measure of industry concentration.
CON*UN is the interaction between concentration and unionization rate.
PLTSIZE is the measure of establishment size.
IMPORTS is percent of industry supply provided by imports.
K/L is the ratio of capital stock to labor used.
%FEMALE is the percent of the labor force that is female.
LC/TC is the ratio of labor costs to total costs.
VA/HRS is the ratio of value added to hours worked.
PROFIT is an industry profit rate variable.

++, -- statistically significant at .05 level in positive/negative direction.
+(+),-(-) statistically significant at .05 level in some specifications, not significant in others.
+,- direction of effect, not statistically significant at .05 level.
Blank, not included in primary reported specifications.

a. Concentration*union*value added.
b. Profits per manhour.
c. positive in OLS model, negative in 2SLS model.
d. Labor cost/value added.
e. Positive and significant for males; negative and insignificant for females.

Statistical significance here refers to significance in one-tail tests.

TABLE 5

BASIC RESULTS OF INDUSTRY WAGE STUDIES UTILIZING INDIVIDUAL DATA ON EARNINGS AND WORKER CHARACTERISTICS

	Variables									
Authors and Year	%UNION	CONCEN	CON*UN	PLTSIZE	FIRMSIZE	K/L	%FEMALE	EGROWTH	INJURY	PROFIT
Weiss (1966)	++	+(+)	--(+)a	+(+)			--	+		
Kalachek and Raines (1976)										++(+)b
Dalton and Ford (1977)	+	++						++		
Bloch and Kuskin (1978)		-(-)		+(-)c						
Jenny (1978)	++	++	--	++		++d				
Freeman and Medoff (1981)	++(+)b	+(-)c			++				++	
Mellow (1982)	++	++	--e	++	++					
Kwoka (1983)			-e	++						
Long and Link (1983)	++	++	-(-)		+(+)					
Heywood (1986)		++	--e	++						
Podgursky (1986)	++	+(+)		++						

%UNION is the measure of the unionization rate.
CONCEN is the measure of industry concentration.
CON*UN is the interaction between concentration and unionization rate.
PLTSIZE is the measure of establishment size.
FIRMSIZE is the measure of firm size.
K/L is the ratio of capital stock to labor used.
%FEMALE is the percent of the labor force that is female.
EGROWTH is the measure of employment growth.
INJURY is annual number of days lost per worker because of injury.
PROFIT is pretax corporate income/net worth.

++, -- statistically significant at .05 level in positive/negative direction.
+(+),-(-) statistically significant at .05 level in some specifications, not significant in others.
+,- direction of effect, not statistically significant at .05 level.
Blank, not included in primary reported specifications.

a. Negative and significant when no labor quality controls included; positive and insignificant when labor quality controls included.
b. Positive and significant for union workers; positive and insignificant for nonunion workers.
c. Positive for nonunion workers, negative for union workers.
d. Fixed costs/employment.
e. Union status*concentration.

Statisitical significance here refers to significance in one-tail tests.

TABLE 6

CORRELATIONS OF INDUSTRY ATTRIBUTES, 1980S

Variables*	FE Non Union	FE Union	Avg. Wage	Avg. Inc.	Quit Rate	Labor Prdct	Educa-tion	Tenure	Exper-ience	%Fem	%Black	Layoff Rate	Injury Rate	Hours
Industry Fixed Effect for Nonunion Workers	1.000 216													
Industry Fixed Effect for Union Workers	0.647 209	1.000 209												
Average Wage	0.834 160	0.790 159	1.000 160											
Average Weekly Income	0.860 160	0.781 159	0.982 160	1.000 160										
Quit Rate	-0.595 80	-0.568 80	-0.641 80	-0.640 80	1.000 80									
Labor Productivity	0.619 77	0.551 77	0.573 77	0.631 77	-0.427 75	1.000 77								
Years of Education	0.146 216	0.166 209	0.262 160	0.229 160	-0.482 80	0.730 77	1.000 223							
Years of Job Tenure	0.404 194	0.244 190	0.541 152	0.593 152	-0.320 76	0.431 73	-0.166 200	1.000 200						
Years of Experience	0.391 216	0.204 209	0.404 160	0.465 160	-0.362 80	-0.238 77	-0.198 223	0.322 200	1.000 223					
Percent Female	-0.451 173	-0.548 172	-0.671 157	-0.708 157	0.324 78	-0.204 76	0.172 173	-0.388 164	-0.338 173	1.000 173				
Percent Black	-0.025 175	-0.048 172	0.008 154	-0.005 154	0.128 76	-0.054 73	-0.181 180	0.156 172	0.201 180	0.101 163	1.000 180			
Layoff Rate	-0.352 80	-0.286 80	-0.286 80	-0.294 80	0.381 80	-0.389 75	-0.507 80	-0.012 76	0.248 80	0.049 78	0.034 76	1.000 80		
Injury Rate	0.104 147	0.136 146	0.176 141	0.189 141	0.362 80	-0.366 77	-0.555 153	0.204 147	0.246 153	-0.473 145	0.140 146	0.453 80	1.000 153	
Hours of Work per Week	0.737 160	0.579 159	0.684 160	0.797 160	-0.397 80	0.563 77	0.044 160	0.574 152	0.572 160	-0.680 157	-0.033 154	-0.170 80	0.259 141	1.000 160
Hours of Overtime per Week	0.222 77	0.388 77	0.292 77	0.403 77	-0.092 75	0.303 77	0.189 77	0.258 73	-0.071 77	-0.398 76	-0.039 73	0.078 75	0.171 77	0.722 77
Ratio of Total Comp to Wage and Salary	0.591 72	0.607 72	0.726 72	0.743 72	-0.630 70	0.439 72	0.544 72	0.678 68	0.205 72	-0.479 71	-0.152 68	-0.084 70	-0.109 72	0.557 72
Average Unemployment Rate, 79 82 84	-0.075 200	0.009 196	-0.084 157	-0.093 157	0.351 77	-0.375 77	-0.606 204	0.062 194	0.097 204	-0.236 170	0.027 175	0.423 77	0.399 148	-0.084 157
Union Coverage	0.548 216	0.491 209	0.637 160	0.653 160	-0.457 80	-0.067 77	-0.248 223	0.480 200	0.569 223	-0.512 173	0.174 180	0.250 80	0.420 153	0.527 160
Employees per Establishment	0.516 140	0.255 139	0.437 136	0.463 136	-0.388 78	0.113 76	-0.060 140	0.529 134	0.532 140	-0.217 138	0.338 136	-0.178 78	0.029 124	0.408 136
Employees per Firm	0.234 140	0.153 139	0.248 136	0.264 136	-0.296 78	0.629 76	0.127 140	0.301 134	0.125 140	-0.037 138	0.134 136	-0.225 78	-0.087 124	0.127 136
Sales per Firm	0.278 185	0.226 183	0.324 159	0.349 159	-0.172 79	0.657 76	0.103 191	0.272 182	0.110 191	-0.125 172	0.054 174	-0.122 79	-0.094 152	0.226 159
Four Firm Concentration Ratio	0.265 73	0.268 73	0.310 73	0.306 73	-0.385 71	0.172 73	0.239 73	0.128 73	0.302 73	-0.056 72	0.066 69	0.083 71	-0.203 73	0.176 73

* See Appendix 1 for a description of the variables and their sources.

The number below the correlation coefficient is the number of industries with data on both variables.

TABLE 6 (CONTINUED)

CORRELATIONS OF INDUSTRY ATTRIBUTES, 1980S

Variables*	FE Non Union	FE Union	Avg. Wage	Avg. Inc.	Quit Rate	Labor Prdct	Educa-tion	Tenure	Exper-ience	%Fem	%Black	Layoff Rate	Injury Rate	Hours
R&D Expenditures/ Sales	0.394	0.156	0.173	0.207	-0.330	0.262	0.678	-0.006	-0.069	0.078	-0.410	-0.330	-0.459	0.297
	77	77	77	77	75	77	77	73	77	76	73	75	77	77
Capital/Labor Ratio	0.382	0.198	0.373	0.423	-0.224	0.434	-0.073	0.385	0.359	-0.339	0.241	-0.031	0.138	0.438
	158	155	135	135	72	68	159	150	159	140	143	72	127	135
Percent Production Workers	-0.551	-0.399	-0.514	-0.562	0.291	-0.639	-0.268	-0.389	-0.306	0.358	0.089	0.468	0.033	-0.574
	159	158	159	159	80	77	159	151	159	157	153	80	141	159
Net-Income/Sales	0.366	0.138	0.273	0.309	-0.118	0.423	0.190	0.116	0.136	-0.101	0.055	-0.373	-0.150	0.337
	185	183	159	159	79	76	191	182	191	172	174	79	152	159
Avg. Rate of Return on Capital	0.178	-0.002	0.080	0.101	0.131	0.354	0.136	-0.019	0.067	-0.014	-0.086	-0.292	-0.116	0.160
	185	183	159	159	79	76	191	182	191	172	174	79	152	159
Net-Income per worker	0.174	0.121	0.161	0.180	0.193	0.538	0.150	0.103	-0.091	-0.042	-0.021	-0.182	0.033	0.127
	139	138	135	135	77	75	139	133	139	137	135	77	123	135

Variables*	Over-time	Comp.	Avg. Unemp.	Union Covrg	Emply/ Est.	Emply/ Firm	Sales/ Firm	Conc. Ratio	R&D/ Sales	K/L	%Prod. Worker	NetInc /Sales	Return on K	NetInc per E
Hours of Overtime per Week	1.000													
	77													
Ratio of Total Comp to Wage and Salary	0.280	1.000												
	72	72												
Average Unemployment Rate, 79 82 84	-0.041	-0.198	1.000											
	77	72	204											
Union Coverage	0.250	0.531	0.151	1.000										
	77	72	204	223										
Employees per Establishment	-0.078	0.324	0.043	0.580	1.000									
	76	71	137	140	140									
Employees per Firm	0.255	0.293	-0.002	0.201	0.377	1.000								
	76	71	137	140	140	140								
Sales per Firm	0.137	0.231	0.018	0.187	0.096	0.650	1.000							
	76	71	186	191	139	139	191							
Four Firm Concentration Ratio	-0.035	0.340	-0.099	0.342	0.594	0.134	0.041	1.000						
	73	68	73	73	72	72	72	73						
R&D Expenditures/ Sales	-0.067	0.275	-0.416	-0.201	0.491	0.162	-0.014	0.328	1.000					
	77	72	77	77	76	76	76	73	77					
Capital/Labor Ratio	0.562	0.518	0.070	0.399	0.481	0.186	0.173	0.083	0.064	1.000				
	68	63	152	159	124	124	144	65	68	159				
Percent Production Workers	-0.076	-0.338	0.095	-0.292	-0.500	-0.171	-0.184	-0.122	-0.642	-0.515	1.000			
	77	72	156	159	136	136	158	73	77	134	159			
Net-Income/Sales	-0.071	0.141	-0.205	0.084	0.313	0.151	0.126	0.091	0.417	0.357	-0.553	1.000		
	76	71	186	191	139	139	191	72	76	144	158	191		
Avg. Rate of Return on Capital	-0.059	-0.029	-0.065	-0.083	0.031	0.028	0.078	-0.070	0.111	0.191	-0.312	0.628	1.000	
	76	71	186	191	139	139	191	72	76	144	158	191	191	
Net-Income per worker	0.183	0.145	-0.135	-0.123	-0.108	0.017	0.169	0.076	0.067	0.008	-0.170	0.436	0.449	1.000
	75	70	136	139	139	139	139	71	75	123	135	139	139	139

* See Appendix 1 for a description of the variables and their sources.

The number below the correlation coefficient is the number of industries with data on both variables.

TABLE 7

Dependent Variables are Industry Fixed Effects from Nonunion and Union Wage Regressions

Coefficients
(Standard Errors in Parentheses)

Variables	Nonunion Full Sample 1	Nonunion Full Sample 2	Nonunion Manufacturing 3	Nonunion Manufacturing 4	Union Full 5	Union Man 6
Intercept	-.050	.407	-.915	-.269	.229	.619
	(.344)	(.325)	(.419)	(.379)	(.385)	(.395)
Years of Education	.071	.071	.152	.085	.082	.100
	(.018)	(.018)	(.029)	(.024)	(.021)	(.026)
Years of Job Tenure	-.006	-.006	.015	-.013	-.007	-.017
	(.012)	(.008)	(.008)	(.009)	(.007)	(.010)
Years of Experience	.006	.003	.005	.006	-.000	.005
	(.005)	(.004)	(.006)	(.005)	(.005)	(.006)
Fraction Female	-.049	-.223	-.335	-.280	-.343	-.368
	(.079)	(.066)	(.065)	(.079)	(.071)	(.080)
Fraction Black	-.017	-.016	.760	.441	.357	.702
	(.314)	(.323)	(.270)	(.244)	(.361)	(.295)
Layoff Rate	--	--	1.148	.836	--	-.359
			(.747)	(.665)		(.749)
Injury Rate	.007	--	--	.005	--	-.003
	(.005)			(.005)		(.005)
Hours of Work per Week	.012	--	--	.011	--	-.017
	(.005)			(.009)		(.009)
Hours of Overtime per Week	--	--	-.008	-.037	--	.040
			(.011)	(.014)		(.016)
Ratio of Non Wage Comp. to total	--	--	-.669	-.080	--	-.023
			(.273)	(.228)		(.239)
Avg Unemployment Rate, 79 82 84	--	.150	.426	-.138	.012	--
		(.867)	(.531)	(.666)	(.662)	
Union Coverage	.089	.236	.121	.056	.429	.354
	(.087)	(.087)	(.089)	(.082)	(.100)	(.088)
Employees per Establishment/1000	.698	--	--	.168	--	-.260
	(.375)			(.292)		(.323)
Employees per Firm/1000	-.007	--	--	.050	--	-.039
	(.021)			(.041)		(.048)
Sales per Firm (in millions of $)	.228	--	--	.091	--	.319
	(.143)			(.178)		(.201)
Four Firm Concentration Ratio	--	--	.004	-.070	--	.042
			(.065)	(.061)		(.063)
R&D Expenditures/ Sales	--	--	.020	.010	--	.000
			(.005)	(.005)		(.005)
Capital/Labor Ratio	--	.106	.165	.144	.012	--
		(.092)	(.067)	(.058)	(.097)	

Fraction Production Workers	.077 (.117)	.209 (.141)	.546 (.128)	.361 (.120)	.020 (.133)	-.053 (.123)
Net-Income/Sales	--	.791 (.456)	-1.017 (.613)	--	--	-.302 (.534)
Avg Rate of Return on Capital	--	--	1.964 (.517)	.945 (.287)	.277 (.418)	.286 (.467)
Net-Income per Worker	.045 (.106)	--	-.058 (.227)	--	--	.072 (.228)
Includes Missing Value Dummies?	NO*	NO*	NO*	YES	NO*	YES
Includes Industry Dummies?	YES**	YES**	NO	YES***	NO	YES***
N	111	116	52	76	115	76
Standard Error	.072	.086	.049	.046	.118	.051
R^2	.832	.765	.854	.895	.499	.909

* Observations with missing data are deleted

** Dummy variables included for mining, construction, durable manufacturing primary metals, fabricated metals, machinery, transportation, communications, wholesale, retail, FIRE, entertainment, and business, repair, personal and professional services. Left out category is non-durable manufacturing.

***Dummy variables included for durable manufacturing, primary metals fabricated metals, and machinery. Left out category is non-durable manufacturing.

See Appendix 1 for a description of the variables and their sources.

TABLE 8

CORRELATIONS OF INDUSTRY ATTRIBUTES, 1939

Variables*	Skill Wage	Unskill Wage	Avg. Wage	Labor Prdct	Educa-tion	Median Age	%Fem	Dischg Rate	Layoff Rate	Hours	Union Coverg	Empl./ Est.	NetInc /Sales
Hourly Wage for Skilled Workers	1.000 20												
Hourly Wage for Unskilled Workers	0.653 20	1.000 20											
Average Wage in Industry	0.942 20	0.815 20	1.000 32										
Value Added per Worker	0.541 20	0.663 20	0.618 28	1.000 28									
Quit Rate	-0.569 15	-0.411 15	-0.630 22	-0.544 21	1.000 22								
Median Age	0.172 20	0.488 20	0.445 23	0.401 23	-0.526 18	1.000 23							
Percent Female	-0.368 20	-0.490 20	-0.578 28	-0.513 28	0.447 21	-0.529 23	1.000 28						
Discharge Rate	-0.454 15	-0.341 15	-0.303 22	-0.082 21	0.180 22	-0.133 18	-0.170 21	1.000 22					
Layoff Rate	0.180 15	0.302 15	-0.081 22	-0.070 21	0.179 22	0.142 18	-0.051 21	-0.182 22	1.000 22				
Hours of Work per Week	-0.227 20	-0.175 20	-0.186 32	0.230 28	-0.007 22	-0.129 23	-0.257 28	0.704 22	-0.081 22	1.000 32			
Union Coverage	0.629 20	0.471 20	0.639 20	-0.038 20	-0.623 15	0.320 20	-0.127 20	-0.551 15	0.270 15	-0.657 20	1.000 20		
Employees per Establishment	-0.161 20	0.136 20	0.325 28	0.071 28	0.010 21	0.103 23	0.083 28	-0.246 21	-0.097 21	-0.413 28	0.116 20	1.000 28	
Net-Income/Sales	0.427 19	0.695 19	0.496 19	0.653 19	-0.281 14	0.173 19	-0.099 19	-0.519 14	-0.034 14	-0.019 19	0.087 19	0.039 19	1.000 19

* See Appendix 2 for a description of the variables and their sources.

The number below the correlation coefficient is the number of industries with data on both variables.

TABLE 9

Industry Wage Regression for 1939 Data

Dependent Variable is the Average Wage in the Industry

Variables	Coefficients (Standard Errors in Parentheses) 1	2	3	4
Intercept	.804	.400	.573	.718
	(.283)	(1.121)	(.426)	(.666)
Median Age	-.008	-.007	-.001	-.010
	(.008)	(.017)	(.012)	(.013)
Fraction Female	-.399	-.464	-.419	-.505
	(.084)	(.167)	(.123)	(.124)
Layoff Rate per worker	--	-.092	--	-.171
		(.156)		(.111)
Hours Per Week	--	.010	--	.004
		(.020)		(.012)
Employees per Est./1000	--	.051	--	.240
		(.208)		(.086)
Fraction Union Members	.370	.506	.344	.424
	(.066)	(.194)	(.103)	(.127)
Net-Income as % of Sales	.020	.014	.020	.018
	(.005)	(.013)	(.007)	(.007)
Includes Missing Value Dummies?	NO*	NO*	YES	YES
N	19	14	32	32
Standard Error	.059	.071	.095	.083
R^2	.857	.901	.630	.765

* Observations with missing data are deleted

See Appendix 2 for a description of the variables and their sources.

TABLE 10
Principal Components Analysis of Modern Industry Data -- Manufacturing Sample

Variables*	Principal Components 1	2	3	4
Industry Fixed Effect for Nonunion Workers	0.279096	0.040241	0.028349	-.078938
Industry Fixed Effect for Union Workers	0.240699	0.175164	-.103017	0.146879
Average Wage	0.263985	0.185531	-.017910	0.011535
Average Weekly Income	0.278388	0.181349	-.058897	0.001291
Quit Rate	-.258583	-.078123	-.048272	0.231999
Labor Productivity	0.250559	-.128419	0.019524	0.272632
Years of Education	0.273933	-.175471	-.097277	-.068561
Years of Job Tenure	0.176854	0.132270	0.029844	-.116893
Years of Experience	-.054283	0.254256	0.251315	-.213894
Percent Female	-.144813	-.238896	0.276705	-.071100
Percent Black	-.053456	0.150568	0.363469	0.353811
Layoff Rate	-.136996	0.189025	-.020651	0.007460
Injury Rate	-.113896	0.214439	-.271891	0.226371
Hours of Work per Week	0.214410	0.064470	-.229061	-.022335
Hours of Overtime per Week	0.085482	0.139317	-.284982	0.290774
Ratio of Total Comp to Wage and Salary	0.241067	0.144401	-.055856	-.171445
Average Unemployment Rate, 79 82 84	-.198260	0.203757	0.117877	0.072194
Union Coverage	0.051234	0.381811	-.002393	-.006479
Employees per Establishment	0.159122	0.112288	0.335395	-.218529
Employees per Firm	0.179483	0.121971	0.165473	0.063684
Sales per Firm	0.127839	0.074233	0.391611	0.345716
Four Firm Concentration Ratio	0.139215	0.091265	0.330612	-.128959
R&D Expenditures/ Sales	0.169533	-.233373	0.054914	-.280764
Capital/Labor Ratio	0.202029	0.084637	-.094095	0.110411
Percent Production Workers	-.208602	0.246455	0.121315	-.064260
Net-Income/Sales	0.181256	-.294118	0.097990	0.075421
Avg. Rate of Return on Capital	0.098331	-.310545	0.032183	0.087441
Net-Income per worker	0.142578	-.158295	0.187294	0.426753
Eigenvalue	9.612	5.162	2.863	1.870
Percent of Variance Explained	.343	.185	.102	.067
Cumulative Percent of Variance Explained	.343	.528	.630	.697

* See Appendix 1 for a description of variables and sources.

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