An empirical derivation of the industry wage equation

Mason, Patrick L.

1994

Mason, Patrick L. (1994)."An empirical derivation of the industry wage equation." Journal of Quantitative Economics, 10(1) (January):155-170.

I am indebted to Anwar Shaikh and Howard Botwinick for many useful discussions. Michel Julliard and John Jeffries provided exceptional comments on the statistical model. The editorial and substantive comments of the JQE's anonymous referees greatly improved the quality of this paper. Research on this paper was funded by the Academic Senate Research Committee of the University of California. The usual disclaimers are applicable.

ABSTRACT

This paper utilizes the Box-Cox transformation of variables technique to empirically derive an industry wage equation. Section I presents the determinants of potential wage differentials between and within industries. Section II estimates a Box-Cox industry wage equation. Likelihood ratio tests on alternative specifications of this equation affirm that competitive structure is a significant determinant of the industry wage rate and that human capital specifications of the industry wage equation (for the manufacturing sector) are not statistically valid. Section III summarizes the results.

I. INTRODUCTION

There is a growing body of theoretical and empirical literature which suggests that the inter- and intraindustry distribution of wages is determined by individual productive characteristics, job desirability, as well as the competitive structure of cost minimizing firms. Analysts from Marx (1906) to

Becker (1975) agree that skill differentials will lead to differentials in labor market compensation. Smith’s (1976) theory of compensating differentials -- differences in remuneration associated with occupational risks, pleasantness of work, and so forth -- is, also, a popular notion among orthodox labor economics; however, Brown (1980) casts doubt on the empirical validity of compensating differentials.

This paper empirically derives an industry wage equation, which includes a set of covariates that have been hypothesized as indicators of the presence of noncompensating wage differentials. By noncompensating wage differentials, I mean the fraction of the wage payment that is disassociated with both individual productive attributes and job desirability. Theoretical and empirical work on these types of differentials -- sometimes referred to as labor rents (Katz and Summers, 1989) -- is of a more recent vintage and considerably more controversial with respect to their existence and the policy implications that flow from their existence. The phrase "wage differentials" in this paper shall refer exclusively to noncompensating wage differentials.

Botwinick (1993) provides a theoretical treatment of inter- and intraindustry wage differentials from a Marxian perspective. He argues that the differential competitive structure of firms, that is differences in variables such as capital intensity, establishment size, profitability, location of firms using the best reproducible conditions of production (regulating firms), size of fixed capital investment, and so forth, between and within industries establishes "limits" to the size of wage increases. These limits (sources of downward pressure on wage rates) establish upper bounds on industry and firm wage rates and the height of these limits varies between and within industries. The nature and extent of worker organization is an important element in determining actual wage differentials because such organization strengthens the collective power of workers to push wages towards the competitive limits.

Botwinick is not alone in attempting to explain or measure the extent of wage differentials. Groshen (1988) compares theories of intraindustry wage differentials. Dickens and Katz (1987) explores the issue of wage differentials from the perspective of efficiency wage theory, while Williams (1987) examines the intersection of discrimination and differential wages from a Marxian perspective. Finally, Howell (1989) presents a "structural" theory of wage differentials.

Although the theoretical details of these models differ considerably, each approach suggests that the competitive process is compatible with multiple inter- and intraindustry wage, price, and profit configurations. Second, there is substantial agreement that wage differentials are positively correlated with such variables as capital intensity, establishment size, and, of course, the extent of unionization. Botwinick also argues that wage payments should be positively correlated with the differential profitability of industries and firms.

This paper does not attempt to statistically differentiate among the competing explanations of wage differentials. Rather, I empirically derive the wage equation. Empirical derivation is necessitated by the absence of a clear theoretical guide to the functional form of the wage equation when competitive structure variables are present. Given the empirically derived specification, I then test for the statistical significance of the structure variables as well as alternative specifications of the wage equation.

II. THE MODEL AND ITS HYPOTHESES

The Mincer human capital equation is the unrivaled specification of the wage equation in empirical studies of the labor market. This equation posits that the natural log of earnings is a function of education, experience and its square, and "other variables" (Blinder, 1976). Econometrically:

$\ln W = \beta_0 + \beta_1 * Ed + \beta_2 * Exp + \beta_3 * Exp^2 + \beta_4 * Z_1 + \beta_5 * Z_2 + \varepsilon$, where W is alternatively used to represent earnings or the wage rate; ε is a residual which follows the usual Gauss-Markov assumptions; β_3 is negative; Z_1 is a vector which may include such individual characteristics as health, marital status, and hours worked; Z_2 is a vector which may include such (neoclassical) competitive "imperfections" and compensating differentials as unionization, industry concentration, and commuting time to work. The only popular alternative to the log-linear functional form is the linear functional form. However, there is no compelling theoretical reason to accept the supremacy of the log-linear or linear functional forms.

Blinder has argued that the functional form of the earnings equation ought to be made on empirical grounds. Yet, there are only a handful of studies that have followed Blinder's suggestion (Heckman and Polachek, 1974; Hodson, 1985; White and Olson, 1981).[1]

This study, like its predecessors, utilizes the Box-Cox transformation of variables technique to derive the wage (earnings) equation (Spitzer, 1982, and 1978; Blackley, et al., 1983; Seaks and Layson, 1982; Lahiri and Egy, 1981). The Box-Cox specification is a flexible functional form.[2] For each independent and dependent variable X, $X(\theta)$ represents a power transformation of X, such that $X(\theta) = (X^{\theta} - 1)/\theta$. L'Hospital's rule implies that $\lim_{\theta \to 0} X(\theta) = \text{Ln } X$. Also, $X(\theta=1) = X - 1$. One does not have to assume an inherently linear model *a priori*, rather statistical tests can be employed to see if $\theta = 0$ or $\theta = 1$ are appropriate restrictions. If there is theoretical dissension regarding the propriety of a subset of X as explanatory variables then the appropriate statistical tests of an empirically derived model will help shed some light on this debate. Consider the following model.

(1) $Y(\theta_0) = \alpha_0 + \alpha_1 X_1(\theta_1) + \alpha_2 X_2(\theta_2) + \alpha_3 X_3(\theta_3) + \varepsilon.$

An unrestricted version of this model yields estimates of θ_0, θ_1, θ_2, θ_3, α_0, α_1, α_2, α_3, where the θ's are power transformations and the α's are slope coefficients.

If the null hypothesis is $\alpha_2 = \alpha_3 = 0$, then a separate estimation of (2)allows one to use a likelihood ratio test to examine the null hypothesis.

(2) $Y(\theta_0) = \alpha_0 + \alpha_1 X_1(\theta_1) + \varepsilon$

Although one may be able to reject the null hypothesis $\alpha_2 = \alpha_3 = 0$ when there are no restrictions on the θ's, one may want to examine the robustness of this conclusion under alternative specifications, e.g., when the equation is log-linear as is the standard human capital equation.

Again, this is a simple procedure. A likelihood ratio test of equations (1) and (3) allows one to test the null hypothesis of a log-linear functional form. Similarly, a likelihood ratio test of equations (1) and (4) allows one to test the joint null hypotheses that the correct specification is log-linear and that $\alpha_2 = \alpha_3 = 0$.

(3) $Y(\theta_0{=}0) = \alpha_0 + \alpha_1 X_1(\theta_1{=}1) + \alpha_2 X_2(\theta_2{=}1) + \alpha_3 X_3(\theta_3{=}1) + \varepsilon$

(4) $Y(\theta_0{=}0) = \alpha_0 + \alpha_1 X_1(\theta_1{=}1) + \varepsilon$

The analytical core of the model to be estimated is:

(5) $F(W) = f(Y, D, C)$.

The industry wage[3] (W) is determined by three sets of variables: labor quality (Y), job desirability and the current state of the demand for laborers (D), and the industry's competitive structure

(C).

As discussed, the specification of the wage equation cannot be determined solely on the basis of economic theory. Theory, however, does place general restrictions on the specification of (5). Theoretical consistency requires that the wage rate is nondecreasing with respect to increases in the competitive limits to wage payments, the quality of labor power, the unpleasantness of work, and increases in the demand for labor.[4]

The hypothesized equation is:

$$\begin{aligned}\text{Indwage}(\theta_0) = {} & \beta_0 + \beta_1{*}\text{Educate}(\theta_1) + \beta_2{*}\text{Indexp}(\theta_2) + \beta_3{*}\text{Tenure}(\theta_3) \\ & + \beta_4{*}\text{Percfem}(\theta_4) + \beta_5{*}\text{Overtime}(\theta_5) + \beta_6{*}\text{Layoffs}(\theta_6) \\ & + \beta_7{*}\text{Hours}(\theta_7) + \beta_8{*}\text{Quits}(\theta_8) + \beta_9{*}\text{Injcases}(\theta_9) \\ & + \beta_{10}{*}\text{Rokdif}(\theta_{10}) + \beta_{11}{*}\text{Koverl}(\theta_{11}) + \beta_{12}{*}\text{Uncov}(\theta_{12}) \\ & + \beta_{13}{*}\text{Estsize}(\theta_{13}) + \beta_{14}{*}\text{Tensize}(\theta_{14}) + \beta_{15}{*}\text{CR4}(\theta 15) \\ & + \beta_{16}{*}\text{Percprod}(\theta_{16}) + \varepsilon\end{aligned}$$

Table 1 provides descriptive statistics on the industry wage rate and accompanying explanatory variables. The variables are:

Indwage = industry wage rate;

Educate = the level of education for the industry’s workforce;

Indexp= years of work experience, computed as age-schooling-6;

Tenure = number of years at current job;

Percfem = fraction of workforce that is female;

Overtime = hours of overtime per week;

Hours = length of workweek;

Layoffs = number of layoffs per 100 workers per month/100;

Quits = number of quits per 100 workers per month/100;

Injcases = lost workday cases per 100 fulltime employees/100;

Indrok = return on capital;

Rokdif = Indrok - .07 (mean value of Indrok)

Koverl = $1,000’s of capital per worker;

Uncov = fraction of workforce covered by unions;

Estsize = number of workers per establishment;

Percprod = fraction of production (nonsupervisory) workers;

Cr4 = four-firm concentration ratio;

Tensize = Tenure*Estsize.

The data for this study is taken from the Dickens-Katz Industry Level Data Set Circa 1983.[5] I note here, however, two problems in the data set: (1) missing observations because industry level data were combined from a number of different governmental sources; and (2) some degree of collinearity between variables due to the level of aggregation; the data were collected at the level of three digit Census Industrial Classification Codes.

The sample is limited to manufacturing data. Data on such variables as capital intensity are much easier to obtain for manufacturing and are much more meaningful with respect to understanding the competitive structure of firms. Missing observations have been deleted.

The power transformations (θ_1, θ_2, ... , θ_{16}) imply that the wage equation is inherently nonlinear in its coefficients. Analytical solutions for this type of equation are sometimes impossible to obtain (Greene, 1990:239-276, 363-377). Accordingly, standard econometric software packages generally rely on an iterative search procedure to maximize the likelihood function $L = L(\beta, \theta, \sigma^2)$.[6]

However, estimation does not require complete agnosticism regarding the model's parameters. In particular, there is *a priori* information which suggests the imposition of linearity restrictions on the transformation coefficients of Indexp, Overtime, and Rokdif.

The linearity restrictions on Overtime and Indexp are justified by appealing to institutional considerations and the characteristics of the data set. There simply is not a great deal of variation in Indexp (the coefficient of variation is less than 10%); since Indexp = age - schooling - 6, the minimum and maximum values would indicate an average age spread of 32 to 41 years. A linearity restriction on experience for this sample of workers is a reasonable approximation given the limited variation in the data and the average ages of the workers. On the other hand, fixed rate overtime premiums, for example time-and-one-half pay per hour of overtime, are a widely accepted practice in the American labor market; hence, each additional hour of overtime yields a constant increase in pay.

The differential profitability variable (Rokdif) contains negative values. Therefore, it must enter the Box-Cox specification with a linearity constraint.

Finally, separate power transformations for each group of variables and the dependent variable were obtained:[7] θ_0 for the dependent variable; θ_Y for Educate, Tenure, and Percfem; θ_D for Layoffs, Hours, Quits, Injcases; and θ_C for Koverl, Uncov, Tensize, Percprod, and Cr4.

The foregoing simplifying restrictions and *a priori* information implies that the estimated equation will have the form:

$$\begin{aligned}\text{Indwage}(\theta_0) = {} & \beta_0 + \beta_1{*}\text{Educate}(\theta_Y) + \beta_2{*}\text{Indexp} + \beta_3{*}\text{Tenure}(\theta_Y) \\ & + \beta_4{*}\text{Percfem}(\theta_Y) + \beta_5{*}\text{Overtime} + \beta_6{*}\text{Layoffs}(\theta_D) \\ & + \beta_7{*}\text{Hours}(\theta_D) + \beta_8{*}\text{Quits}(\theta_D) + \beta_9{*}\text{Injcases}(\theta_D) \\ & + \beta_{10}{*}\text{Rokdif} + \beta_{11}{*}\text{Koverl}(\theta_C) + \beta_{12}{*}\text{Uncov}(\theta_C) \\ & + \beta_{13}{*}\text{Estsize}(\theta_C) + \beta_{14}{*}\text{Tensize}(\theta_C) + \beta_{15}{*}\text{CR4}(\theta_C) \\ & + \beta_{16}{*}\text{Percprod}(\theta_C) + \varepsilon\end{aligned}$$

Educate, Indexp, Tenure, Percfem are the empirical proxies for labor quality. However, Percfem may be as much an indicator of the prevalence of wage discrimination and involuntary parttime labor as an alledged indicator of (lower) labor quality (Ehrenberg and Smith, 1985:539-544; Gunderson, 1989).

To the extent that actual job attainment is solely a function of utility maximization then the human capital approach is correct to argue that Overtime, Layoffs, Hours,[8] Quits, and

Injcases are indicators of job desirability. These variables may also be proxies for the state of the industry's demand for labor. For example, tight labor markets tend to be characterized by large amounts of overtime, fewer layoffs, and long workweeks; Katz and Summers (1989) make the persuasive argument that the quit rate should have a negative correlation with the industry wage rate since workers are less likely to abandon jobs with large wage differentials, that is, Quits is a proxy for the size of the labor queue, which tends to be greater for high wage jobs. However, these variables and their interpretation are not the primary focus of this paper and whether one views them as empirical proxies for the current state of the demand for labor across industries or job desirability, there is a theoretical justification for their inclusion in the wage equation.

Establishment size (Estsize), percent unionized (Uncov), capital intensity (Koverl), and percent production workers (Percprod) are empirical proxies for the industry's competitive structure. The model implies that the industry wage rate should have a positive correlation with all of these variables, except Percprod.

Finally, differential profitability (Rokdif) is also a measure of competitive structure and Botwinick's analysis indicates that this variable should have a positive correlation with the industry wage rate. If, however, workers are able to capture all of the differential rent associated with above average productiveness then the coefficient on this variable may be equal to zero. An appropriate null hypothesis is that this variable has a nonnegative slope coefficient.

Segmentation analysis (Edwards, 1979) suggests that under a bureaucratic labor process job tenure is likely to have a greater (positive) impact on wage rates in large establishments than in smaller ones. This theoretical information should be included in the wage equation prior to estimation. Empirically, the model may be improved with the job tenure-establishment size interaction variable, Tensize = Tenure*Estsize (Pearce, 1990). The operative assumptions regarding Tenure and Estsize are $\delta W/\delta(\text{Tenure}) > 0$, $\delta W/\delta(\text{Estsize}) > 0$, $\delta^2 W/\delta(\text{Tenure})^2 < 0$, $\delta^2 W/\delta(\text{Tenure})\delta(\text{Estsize}) < 0$, and $\delta^2 W/\delta(\text{Estsize})^2 < 0$.

The primary null hypotheses are that the slope coefficients on the competitive structure variables are jointly and individually equal to zero, i.e., $ß_{10}=ß_{11}=ß_{13}=ß_{14}=ß_{15}=ß_{16}=0$. If these hypotheses cannot be rejected then the statistical results support the human capital claim that jobs are allocated on the basis of individual productive capacity and individual preferences for the various characteristics of employment. Rejection of these hypotheses implies that the statistical model is consistent with the notion that both individual and job attributes are determinants of the distribution of wages.

The inclusion of product market concentration (CR4) in the wage equation allows for a test of the market power hypothesis.[9]

Neoclassicals and segmentation theorists use product market concentration as a measure of imperfect competition. In Marxian economics, product market concentration is not a causal variable in the factor or goods market pricing process (Semmler, 1984). The null hypothesis is that the industry concentration ratio is a statistically insignificant determinant of the industry wage rate, i.e., $\beta_{15}=0$.

If the industry wage equation is linear or log-log then the appropriate null hypotheses are $\theta_0=\theta_Y=\theta_D=\theta_C=1$ or $\theta_0=\theta_Y=\theta_D=\theta_C=0$, respectively. A log-linear specification is consistent with null hypothesis is $\theta_0=0$ <u>and</u> $\theta_Y=\theta_D=\theta_C=1$. Continuing, the standard human capital specification implies $\theta_0=0$ <u>and</u> $\beta_{10}=\beta_{11}=\beta_{13}=\beta_{14}=\beta_{15}=\beta_{16}=0$.

Whether the dependent variable should enter the wage equation with a logarithmic or a linear restraint requires evaluating the separate null hypotheses $\theta_0=0$ and $\theta_0=1$, respectively.

Finally, testing the joint hypotheses $\beta_5=\beta_6=\beta_7=\beta_8=\beta_9=0$ determines whether or not the job desirability and current state of demand for laborers variables are collectively significant.

Collectively, this series of statistical tests allows one to examine the robustness of the statistical results under alternative functional forms. They also allow one to examine the validity of the orthodox wage equation.

2. The Industry Wage Equation

The estimated equation is reported in Table 2. The results are unsurprising with respect to Educate, Indexp, Tenure, Percfem, Overtime, Injcases, Koverl, Estsize, Tensize, and Uncov. These variables are statistically significant and have the expected signs. The Hours and Layoffs coefficients are significant and negative. The negative coefficient on the Hours variable is not particularly troubling; the average length of the workweek is included here as a normalizing variable. On the other hand, under orthodox analysis, the coefficient on Layoffs should be positive; workers are compensated for the greater risk of unemployment by receiving a higher wage rate (Topel and Murphy, 1987).

The negative coefficient on Layoffs would tend to be in line with the Botwinick approach to wage determination. A high layoff rate reduces the organizational capacity of workers and hence restricts their ability to extract a favorable wage from capital.

The negative coefficient on Quits affirms the Katz-Summers contention that this variable is a proxy variable for the size of labor queues.

The remaining variables are statistically insignificant. This is not troubling with respect to the coefficient on CR4 since the Marxian approach argues that industry concentration (as a measure of monopoly power) is not a significant explanatory variable of inter- and intraindustry wage differences. Neoclassical and segmentation theory argues that this variable should have a positive and significant coefficient. Also, the coefficient on Rokdif is not statistically significant.

Interpretation of the model’s parameters is not straightforward. In order to the compare the efficacy of the current specification of the wage equation with alternative specifications, I have used the estimated value of the model's parameters and the mean value of the independent and dependent variables to calculate the percentage change in the wage rate associated with a one unit interindustry difference, ceteris paribus, in an explanatory variable. These descriptive "rates of return" are presented in Table 3.

Column 2 of Table 3 presents the results for the current specification of the wage equation, which I have labeled the "unrestricted" wage equation. Columns 3 - 10 presents the results of several restrictions on the wage equation.[10] Indexp, Overtime, and Rokdif continue to have linear power transformations in all regressions. The "restricted" specification contains the restriction $\theta_0 = \theta_Y = \theta_D = \theta_C = -.44$, where -.44 was determined by maximizing the likelihood function. Columns 4 and 5, the log dependent variable and linear dependent variable specifications, respectively, were estimated with the restriction that $\theta_0 = 0$ and $\theta_0 = 1$, respectively, while all other power restrictions are identical to the unrestricted model.

Columns 6 - 8 are inherently linear specifications of the wage equation. They represent completely linear, log-linear and log-log regressions, respectively.

Finally, columns 9 and 10 are alternative specifications of human capital type wage regressions. Both regressions assume the slope coefficients on the competitive structure variables, except union coverage, are equal to zero. Column 9 has the additional restriction that $\theta_0 = 0$ while the other power transformations have their unrestricted values, i.e., $\theta_Y = -.27$, $\theta_D = -2.89$. Column 10 is the ubiquitous Mincer earnings equation and, as such, it provides a useful comparative specification.

The magnitude and direction of the "rates of return" associated with the unrestricted Box-Cox regression (column 2) compare quite favorably with the other specifications. For example, both the Mincer and unrestricted Box-Cox specification imply a 20% "return to education" in the manufacturing sector. The statistical significance and qualitative impact of each variable is quite stable across alternative specifications.

Table 4 presents the results of several hypothesis tests on the specification of the wage equation. Column 1 provides a brief description of the nature of the test while column two lists the null hypotheses. The critical value of the X^2 statistic at the 5% significance level, where the degrees of freedom equal the number of restrictions (Greene, 1990: 354), is provided in column 3. Using the value of the log likelihood (Log L) function of the estimated equation (reported in column 4) and the log likelihood value from the unrestricted equation (-24.8887), the likelihood ratio (LR) test statistic is reported in column 5. The null hypothesis is rejected if LR exceeds the critical value of the X^2 statistic. The decision to accept or reject the null hypotheses is reported in column 6.

The first row is a test of the hypothesis that the coefficients on the competitive structure variables (excluding the coefficient on Uncov) are jointly equal to zero. It is strongly rejected. Competitive structure cannot be ignored as a determinant of the industry wage rate. Similarly, the second row is a test of the hypothesis that the job desirability and state of demand variables are jointly equal to zero. Again, the hypothesis is strongly rejected.

Rows 3 and 4 test whether logarithmic and linear transformations, respectively, of the dependent variable are acceptable. The null hypothesis cannot be rejected in either case, indicating that inherently linear power transformations on the industry wage rate are statistically acceptable.

Rows 5 - 7 provide test on the hypotheses that the correct functional form is log-linear, linear, and log-log, respectively. All null hypotheses are strongly rejected. This result, combined with the earlier hypothesis tests on the dependent variable, implies that although inherently linear transformations of the dependent variable may be permissible, inherently linear transformations of the independent variables are not permissible.

The last row in Table 4 is a test of the null hypothesis that the human capital style equation is an appropriate representation of the wage equation. The null hypothesis is strongly rejected. Logarithmic regressions of the industry wage on labor quality and job desirability variables represent an inappropriate specification of the industry wage equation.

Informal model selection techniques (Kmenta, 1986: 599-600) list theoretical consistency, parameter constancy, parsimonious parametrization and interpretable parameters of interest, and encompassing (the ability to explain the characteristics of rival models) among the important elements of model selection. These criteria support the convincing results of the likelihood ratio tests and affirm the specification of a nonlinear wage equation which includes competitive structure variables as an appropriate statistical description of the economic process involved in the determination of interindustry wage rates; persistent interindustry wage differentials may be established for reasons disassociated with variations in labor quality and job desirability.[11],[12]

The general structure of the Box-Cox regression model and the statistically significant coefficient on Tensize indicates that competitive structure and labor quality may interact in a rather complex manner to determine wage rates. Consider the simple Box-Cox model: $Y(\theta_0) = \beta_0 + \beta_1 * X_1(\theta_1) + \beta_2 * X_2(\theta_2) + e$. Taking the expected value of both sides, rearranging terms and differentiating, $(dY/Y)/dX_i = g(\beta_0, \beta_1, \beta_2, \theta_0, \theta_1, \theta_2, X_1, X_2)$. Human capital style wage equations obliterate the interdependence of regression covariates in the determination of wage rates, whereas a specification consistent with Marxian analysis implicitly and explicitly acknowledges this interconnection. But, if it is conceptually and empirically incorrect to enforce additive separability on the specification of the wage equation, then one simply cannot meaningfully derive the aggregate distribution of labor income from the incorrectly specified microeconomic wage equations of the human capital sort. The theoretical mapping from the distribution of productive characteristics to the distribution of labor income must account for noncompensating wage differentials.

III. SUMMARY AND IMPLICATIONS

The collective implication of the statistical results are: (1) the labor earnings process is inherently nonlinear; (2) there is a complex relationship between competitive structure and the interindustry distribution of wages; (3) competitive structure and labor quality may interact to determine industry wage rates; and, by extension, (4) individual remuneration for labor services depends on individual labor quality, (possibly) job preferences, <u>and</u> the competitive structure of firms where the individual is employed; hence, the wage-productivity connection is somewhat "loose."

These preliminary results provide support for the notion that individual compensation is not solely a function of individual productive attributes, at least within the manufacturing sector. Moreover, they also suggest that our understanding of the earnings process would be improved if we incorporate structural variables, e.g., capital intensity, into the estimated wage equation.

NOTES

1.These studies provide tentative affirmation of the Mincer earnings equation. Hodson’s theoretical analysis is in the spirit of the current model.

2.The Box-Cox specification is "flexible" relative to the standard (inherently linear) specification of the wage equation. It is however considerably less flexible than a fully nonparametric specification, see Ullah (1988) and Hardle (1990).

3.The theoretical analysis is applicable at both the industry and firm levels. However, the current data contains only industry level variables.

4.For a more detailed theoretical analysis see Mason (forthcoming).

5.This data was graciously provided by Lawrence F. Katz, Ph. D., Harvard and National Bureau of Economic Research. The original sources of the raw data are listed with Table 1.

6.I utilize K. White’s SHAZAM (1990) to estimate the parameters of this equation.

7.As a practical matter, these groupings help preserve degrees of freedom (in an admittedly small sample).

8.With individual level data, the "hours" variable might be associated with simultaneous equation bias. However, with industry level data it is reasonable to accept the average level of the workweek as institutionally determined. Individuals who wish to work greater or lesser hours then seek employment in those industries whose workweek is conformable to their preferences. Using "hours" as an explanatory variable eliminates the distinction between earnings and the wage rate.

9.The market power hypothesis is a summary phrase for the human capital result that the wage rate will equal the value of the marginal product of labor, unless monopoly or monopsony power exists in the labor market.

10.The full set of regressions are available from the author upon request.

11.Koverl and Estsize are not proxies for the value of fringe benefits. Including the latter as an explanatory variable does not alter the statistical results.

12.Zarembka (1974) indicates that the Box-Cox transformation is not robust with respect to heteroskedasticity. However, a series of of diagnostic tests in our case revealed that the null hypothesis of homoskedasticity cannot be rejected at conventional test levels. Various collinearity (Belsey, et al., 1980)checks revealed that the Hours and Indexp variables are most certainly degraded by collinearity. This is perhaps the reason for the insignificant coefficients on Hours and Indexp in Table 3.

TABLE 1
DESCRIPTIVE STATISTICS

VARIABLE	N	MEAN	STD DEV	MINIMUM	MAXIMUM	SOURCE
Educate	54	12.9320	0.7869	11.5870	15.0360	m
Indexp	54	20.3770	1.8635	13.5390	23.3150	o
Tenure	54	5.2611	1.2755	2.3000	9.8000	n
Percfem	54	0.2900	0.1499	0.0779	0.8377	c (tab.B2,3)
Overtime	54	2.5299	0.9662	0.9016	6.2129	c (tab.C2)
Layoffs	54	1.6699	1.3793	0.1000	9.3000	i
Hours	54	39.2840	1.7828	33.1000	44.1610	c (tab.C2)
Quits	54	1.2949	0.6756	0.3000	3.2000	i
Injcases	54	5.0114	2.2564	1.5000	11.4000	g
Rokdif	54	0.0023	0.0277	-0.0512	0.0682	
Indrok	54	0.0723	0.0277	0.0188	0.1382	a
Koverl	54	23.2090	16.4520	2.5153	71.8670	d
Uncov	54	0.3107	0.1369	0.0558	0.6639	m
Estsize	54	58.6930	34.2970	16.1790	186.3500	j
Percprod	54	0.6961	0.1283	0.3792	0.8814	c (tab.B2)
Cr4	54	35.4780	14.8260	7.0000	81.4000	f
Indwage	54	8.48	1.7209	5.0193	13.36	c (tab.C2)

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.

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, table 1.

i Per 100 empl. per mo./100. Employment and Earnings, March 82,table D2.

j Enterprise Statistics, 1977, table 4. [Income data from source (a)].

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 minus 6 minus (last year of school completed). Computed from CPS.

Dickens and Katz, 1987:84-85.

TABLE 2
UNRESTRICTED BOX-COX WAGE EQUATION

```
Indwage(.47) = 30045 + 14.04*Educate(-.27) + .0537*Indexp
                [2.60]  [9.64]                [3.24]
              + 8.6892*Tenure(-.27) - .2589*Percfem(-.27)
                 [3.315]              [-7.23]
              + .0634*Overtime - .0021*Layoffs(-2.89)
                 [2.02]          [-3.96]
              - 86895*Hours(-2.89) - .0183*Quits(-2.89)
                 [-2.60]             [-1.74]
              + 2.178*Injcases(-2.89) + .3324*Rokdif
                 [1.70]                  [-.39]
              + .1124*Koverl(-.11) + .1979*Uncov(-.11)
                 [1.76]               [4.31]
              + 8.3022*Estsize(-.11) + -9.8511*Tensize(-.11)
                 [3.29]                [-3.24]
              - 1.04*Cr4(-.11) - .0173*Percprod(-.11)
                 [-1.19]         [-1.57]
```

R^2 = .9365 Adj R^2 = .9090 N = 54 Log L = -24.8887
θ_0 = .47 θ_Y = -.27 θ_D = -2.89 θ_C = -.11
The t-statistics are in brackets.

TABLE 3

DESCRIPTIVE RATES OF RETURN

VARIABLE	UNRE-STRICTED	RE-STRICTED	LOG DEPEND	LINEAR DEPEND
educate	19.92%	21.58%	20.57%	19.28%
indexp	1.97%	1.71%	1.73%	2.22%
tenure	2.09%	2.27%	2.02%	2.21%
percfem	-45.66%	-36.48%	-45.24%	-46.31%
overtime	2.32%	3.63%	1.74%*	2.92%
layoffs	-0.01%	-1.58%	-0.01%	-0.01%
hours	-2.00%	-3.75%	-1.55%	-2.48%
quits	-0.25%	-2.90%*	-0.11%*	-0.41%
injcases	0.15%	1.41%	0.16%	0.15%*
rokdif	-12.17%*	4.17%*	-4.56%	-21.10%*
koverl	0.13%	0.16%	0.14%	0.11%+
uncov	26.52%	26.42%	30.34%	22.57%
estsize	.04%	.02%	.03%	.05%
tensize				
percprod	15.68%+	17.04%+	18.02%	13.16%+
cr4	-0.05%*	-0.03%*	-0.05%*	-0.06%*
R^2	0.95	.94	0.95	0.95
Log L	-24.8887	-31.46	-25.3993	-25.4689
θ_0	0.47	-0.44	0	1.0
θ_Y	-0.27	-0.44	-0.27	-0.27
θ_D	-2.89	-0.44	-2.89	-2.89
θ_C	-0.11	-0.44	-0.11	-0.11

TABLE 3 (CONT'D)
DESCRIPTIVE RATES OF RETURN

VARIABLE	LINEAR	LOG-LINEAR	LOG-LOG	HUMAN CAPITAL	REGULAR MINCER
educate	22.49%	23.67%	20.14%	17.49%	19.64%
indexp	2.60%	2.45%	1.51%	1.84%	3.05%+
expsqred	n.a.	n.a.	n.a.	n.a.	
tenure	.73%*	1.39%*	.71%*	1.37%	1.38%
percfem	-64.23%	-68.42%	-48.56%	-49.71%	-68.62%
overtime	6.02%	6.01%	4.58%	1.85%+	5.31%
layoffs	-1.68%	-1.25%+	-1.27%*	-0.01%	-0.89%*
hours	-6.27%	-6.13%	-4.99%	-0.86%*	-4.73%
quits	0.83%*	0.34%*	-5.70%	-0.29%	-0.61%*
injcases	-0.42%*	-0.00%*	0.96%+	0.06%*	-0.17%*
rokdif	26.79%*	38.77%*	7.09%*	n.a.	n.a.
koverl	0.09%*	0.07%*	0.17%	n.a.	n.a.
uncov	49.28%	45.56%	30.81%	32.27%	44.23%
estsize	.02%+	.05%*	.03%*	n.a.	n.a.
tensize		*	*	n.a.	n.a.
percprod	27.17%	25.07%+	17.70%+	n.a.	n.a.
cr4	0.05%*	0.06%*	-0.02%*	n.a.	n.a.
R^2	.91	.92	.93	.93	0.89
Log L	-40.78	-37.18	-34.5889	-34.4739	-44.6
θ_0	1.0	0	0	0	0
θ_Y	1.0	1.0	0	-0.27	1.0
θ_D	1.0	1.0	0	-2.89	1.0
θ_C	1.0	1.0	0	n.a.	n.a.

* Variable is insignificant at either the 1%, 5%, or 10% level of significance.
\+ Variable is significant only at 10% level of significance.

TABLE 4

LIKELIHOOD RATIO TESTS OF FUNCTIONAL FORM

TEST	NULL HYPOTHESES	CRITICAL $X^2(n)$	LOG L	LR STAT	RESULT
Competitive Structure	$\beta_{10}=\beta_{11}=\beta_{13}=$ $\beta_{14}=\beta_{15}=\beta_{16}=0$	12.59	-34.42	19.07	Reject
Job Desireability	$\beta_5=\beta_6=\beta_7=$ $\beta_8=\beta_9=0$	11.07	-49.50	49.22	Reject
Log Wage	$\theta_0=0$	3.84	-25.40	1.02	Cannot Reject
Linear Wage	$\theta_0=1$	3.84	-25.47	1.16	Cannot Reject
Log-Linear	$\theta_0=0$ $\theta_Y=\theta_D=\theta_C=1$	9.49	-37.18	24.58	Reject
Linear	$\theta_0=\theta_Y=\theta_D=\theta_C=1$	9.49	-40.78	31.78	Reject
Log-Log	$\theta_0=\theta_Y=\theta_D=\theta_C=0$	9.49	-34.59	19.40	Reject
Human Capital	$\theta_0=0$ $\beta_{10}=\beta_{11}=\beta_{13}=$ $\beta_{14}=\beta_{15}=\beta_{16}=0$	14.07	-34.44	19.10	Reject

REFERENCES

Becker, G. S. (1975). Human Capital, 2nd ed., Chicago: The University of Chicago Press.

Belsley, D., E. Kuh, and R. Welsch. (1980). Regression Diagnostics, Identifying Influential Data and Sources of Collinearity, New York: Wiley.

Blinder, A. (1976). "On Dogmaticism in Human Capital Theory," Journal of Human Resources, VIII(4)(Fall):436-455.

Brown, C. (1980). "Equalizing Differences in the Labor Market," Quarterly Journal of Economics, 94(1) (February): 113-134.

Botwinick, H. (1993). Persistent Inequalities: Wage Disparity under Capitalist Competition. New York: Princeton Universtiy Press.

Dickens, W. and L. Katz. (1987). "Inter-Industry Wage Differences and Industry Characteristics," in K. Lang and J. S. Leonard, eds., Unemployment and the Structure of Labor Markets, New York: Basil Blackwell, Inc.

Edwards, R. (1979). Contested Terrain: The Transformation of The Workplace in the Twentieth Century, New York: Basic Books, Inc.

Ehrenberg, R. and R. Smith. (1985). Modern Labor Economics: Theory and Public Policy, Glenview, IL: Scott, Foresman and Company.

Greene, W. H. (1990). Econometric Analysis. New York:

MacMillan Publishing Company.

Groshen, E. (1988). "Why Do Wages Vary Among Employers?" Economic Review, Federal Reserve Bank of Cleveland, 24 (1):19-38.

Gunderson, M. (1989). "Male-Female Wage Differentials and Policy Responses," Journal of Economic Literature, XXVII (1) (March): 46 - 72.

Hardle, W. (1990). Applied Nonparametric Regression, New York: Cambridge University Press.

Heckman, J. and S. Polachek. (1974). "Empirical Evidence on the Functional Form of the Earnings-Schooling Relationship," Journal of the American Statistical Association, 69 (346) (June): 350 - 354.

Hodson, R. (1985). "Some Considerations Concerning the Functional Form of Earnings," Social Science Research 14: 374 - 394.

Howell, D. (1989). "Production Technology and the Interindustry Wage Structure," Industrial Relations, 28:32-50.

Katz, L. and L. Summers. (1989). "Industry Rents: Evidence and Implications," Brookings Papers on Economic Activity, 209-275.

Kmenta, J. (1986). Elements of Econometrics, New York: MacMillan.

Marx, K. (1906). Capital, Volume I, Clark H. Kerr & Co.

Mason, P. (forthcoming). "Race, Competition, and Differential Wages," Cambridge Journal of Economics.

Pearce, J. (1990). "Tenure, Unions, and the Relationship

Between Employer Size and Wages," Journal of Labor Economics 8 (2) (April): 251 - 269.

Seaks, T. G. and S. K. Layson. (1983). "Box-Cox Estimation with Standard Econometric Problems," Review of Economics and Statistics, 65 (February): 160 - 164.

Semmler, W. (1984). Competition, Monopoly, and Differential Profit Rates, New York: Columbia University Press.

Smith, A. (1976). An Inquiry Into The Nature and Causes of the Wealth of Nations, Chicago: The University of Chicago Press.

Spitzer, J. J. (1982). "A Primer on Box-Cox Estimation," Review of Economics and Statistics, 64 (May): 307 - 313.

Spitzer, J. J. (1978). "A Monte Carlo Investigation of the Box-Cox Transformation in Small Samples," Journal of the American Statistical Association, 73(363) (September):488 - 495.

Topel, R. and K. Murphy. (1987). "Unemployment, Risk, and Earnings: Testing for Equalizing Wage Differences in the Labor Market," in K. Lang and J. S. Leonard, eds., Unemployment and the Structure of Labor Markets, New York: Basil Blackwell, Inc.

Ullah, A. (1988). "Nonparametric Estimation of Economic Functions," Canadian Journal of Economics 21:625-658.

White, H. and L. Olson. (1981). "Conditional Distributions of Earnings, Wages and Hours for Blacks and Whites," Journal of Econometrics, 17(3) (December): 263 - 286.

White, K., S. D. Wong, D. Whistler, and S. A. Haun. (1990). SHAZAM: Econometrics Computer Program, User’s Reference Manual

Version 6.2, New York: McGraw-Hill Book Company.

Williams, R. M. (1987). "Capital, Competition, and Discrimination: A Reconsideration of Racial Earnings Inequality," Review of Radical Political Economy, 19(2):1-15.

Zarembka, P. (1974). "Transformation of Variables in Econometrics," in P. Zarembka, ed., Frontiers in Econometrics, New York: Academic Press, 810 - 1040.