Another Look at Compensating Differentials

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ABSTRACT: Empirical tests of the theory of compensating differentials using a wage-change formulation have had mixed success in providing support for the theory. Previous studies have differed with respect to the measurement and type of working conditions, the sample of workers examined, and the inclusion of firm-specific information. To isolate the role of the differences between previous studies in providing support for the theory, the author estimates a wage-change model using data from a broad sample of workers with self-reported job characteristics. The conclusion is that the general theory of compensating differentials be revised to include firm-specific information. However, it is not clear if any test of the theory can be supported over a broad range of occupations in the short run.

I. INTRODUCTION

The intuitive appeal of compensating differentials is undeniable. Jobs may differ in their unpleasantness. Pleasant jobs find many applicants bidding down wages, while wages for less attractive jobs may have to be raised to coax people into these jobs. This intuitive concept of compensating differentials acquired theoretical rigor in the context of hedonic price theory.[4] A competitive market in long-run equilibrium will produce a market clearing wage-job condition curve on which workers with a given level of human capital locate according to their preferences, and firms locate according to their costs of providing job conditions.

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In this framework, it is the preferences of the marginal worker that determine whether a particular job condition has a significant relationship with wages. However, the heterogeneity of worker tastes make it difficult to specify unpleasant job characteristics a priori. As Smith[5] points out (p. 343), it is highly uncertain whether jobs that are physical, repetitious, or have little freedom are unpleasant to the marginal worker, other things equal. Further, many job conditions, such as repetition or stress, are likely to have entirely different meanings to the marginal worker in different occupations.

Thus it is not surprising that most attempts to test the theory of compensating differentials have failed to find empirical support. This failure is generally attributed to the omission of important but unmeasured productivity related individual characteristics. To mitigate the problem of omitted variable bias, Brown[1] estimates an augmented human capital model in differences rather than levels. This procedure "nets out" the fixed effects of unmeasured individual characteristics that are presumed to remain constant over time, and thus reduces biases caused by omitted variables.

Using this method, the strongest evidence of compensating differentials is found by Eberts and Stone,[3] using data for public school teachers and including firm-specific information. Some support is found for the theory by Duncan and Holmlund,[2] using data from a national sample of male Swedish workers with self-reported job characteristics. No support for the theory is found by Brown,[1] who estimated his model using a national sample of American workers and imputed job characteristics.

I address three issues in this study:

1. Will Brown's rejection of compensating differentials using data for a broad sample of American workers be reversed when self-reported rather than imputed job conditions are used, as Duncan and Holmland suggest? Or was Duncan and Holmlund's success due instead to using a more homogeneous sample of workers than that examined by Brown?

2. What role does analyzing a single occupation and including firm-specific information (as in Eberts and Stone) play in providing support for the theory?

3. Neither Duncan and Holmlund nor Brown examine pecuniary benefits, whereas Eberts and Stone found the predicted inverse relation between wages and benefits. Will the predicted inverse relation between benefits and wages hold over a broader class of workers than that examined by Eberts and Stone?

To answer these questions, I estimate a human capital earnings equation with self-reported job characteristics in difference form. The model is presented in Section II; the data are described in Section III. The results are presented in Section IV. Section V provides a discussion of the results and their implications.

II. MODEL

The basic model is a human capital earnings equation, augmented by measures of job conditions:

$$w = f(X,J)$$

where w is earnings, X is a vector of personal job-related attributes, and J is a vector of job conditions scaled so that higher values represent less-desirable working conditions. Thus I expect to find positive coefficients on all job conditions. Assuming the semilog specification typically found in human capital earnings regressions, in levels form this equation is

$$ln\ w = \beta\ X + \gamma\ J + u.$$

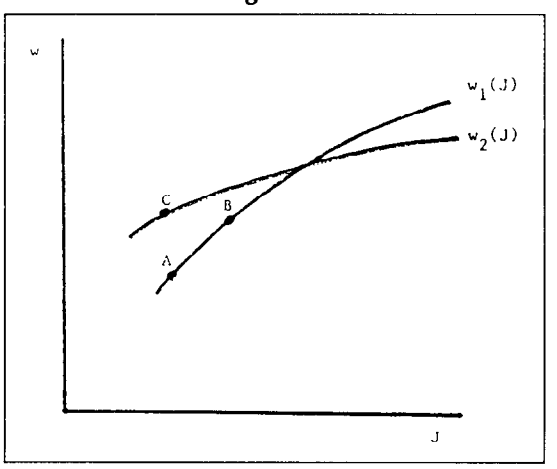
In difference form this equation becomes

$$\Delta\ ln\ w = \beta'\ \Delta\ X + \gamma'\ \Delta\ J + \Delta\ u$$

where u is a random disturbance term. Differences in job conditions are scaled so that J is positive when job conditions worsen; I expect positive coefficients on changes in all job conditions.

Two important assumptions underlie this specification. First, this assumes that workers are on the market clearing wage-job condition curve in both years. In Figure 1, the market clearing curve for the first period is represented by $w_1(J)$, where J is an unpleasant job condition. Assuming the curve is stable between the two periods, a change in real wages comes about by movements such as from point A to point B. However, as Smith[5] points out (p. 341), the market clearing curve may shift over time due to changes in technology or in worker preferences. If preferences change so that relatively more workers prefer higher wage, less pleasant jobs than in the first period, the new market clearing curve will resemble $w_2(J)$. In Figure 1, point C represents the same change in wages attained at point B, but with no change in job conditions.

Figure 1.



Little can be done about the possibility of the market clearing curve shifting over time beyond pointing out the difficulty it presents in interpreting empirical results. However, I employ one strategy to increase the odds that workers are in equilibrium positions in both periods. I estimate my model across all workers as Duncan and Holmlund[2] do, but I also estimate specifications in which I restrict the sample to workers who are in the same 3-digit occupation in both years and who have not changed employers. This isolates the source of changes in job conditions to changes in the employer's situation, and provides a sample most comparable to Eberts and Stone,[3] who examine workers that have changed neither employer nor occupation.

The second assumption is that the preferences of the marginal worker are independent of occupation. I relax this assumption by stratifying workers by white-collar/blue-collar status in some specifications.

III. DATA

The data used in this study are from the Quality of Employment Survey 1973-1977 Panel.[1] This dataset was selected because it provides self-reported information on a large number of job conditions for individuals in 1973 and 1977, as well as measures of standard individual job-related variables.[2] The panel study contains data for 1,455 individuals, but I restrict the sample to male wage and salary workers who were employed 20 hours a week or more in both 1973 and 1977, who were between age 18 and 61 in 1973, and who are white. The sample is restricted to males in order to facilitate comparisons with other studies, and because it is well known that male and female earnings functions exhibit structural differences. The age restriction is imposed to exclude workers who have taken new jobs after facing mandatory retirement. I restrict the sample to white workers to avoid any possible confounding effects due to racial discrimination.

I further restrict the sample to individuals who report that they consider their job one of "regular, steady employment" rather than seasonal or one with frequent layoffs. Because annual earnings from the respondent's primary job is the only earnings variable available in 1973, this restriction is made so that the earnings variables for 1973 and 1977 are comparable. These restrictions yield a sample of 389 workers.

The variables are defined in Table 1. The dependent variable is the change in the natural logarithm of annual earnings. The job-related individual characteristics typically found in estimations of earnings equations are used in this study, including experience, tenure with employer, education, union membership, handicap, marital status, region, and city size.

The job characteristics fall into five categories: job safety, effort, hours, transportation to work, and benefits. Job safety is measured by an index ranging from 0 to 4 representing the severity of the problem with exposure to each of

Table 1: Variable Definitions and Sample Means (1977 Value–1973 Value, Sample Size 389)

Variable	*Definition*	*Mean of 1977 Value–1973 Value*
Individual Characteristics		
ΔWAGE	Change in the log of annual earnings	.431
ΔEXPERIENCE	Change in years of experience	4.110
ΔTENURE	+1(-1) if worker gained (lost) tenure with employer	.458
ΔEDUCATION	No change or gained less than high school degree = 0; gained high school degree = 1; gained some college = 2; gained college degree = 3; gained some postcollege education = 4	.221
ΔUNION	+1(-1) if joined (quit) union	-.049
ΔHANDICAP	Change in index ranging from 0 (no handicap) to 4 (handicap greatly limits work)	.028
ΔMARRIED	+1(-1) if worker marries (divorces)	-.012
ΔREGION	+1(-1) if worker moves from (to) the South	.139
ΔCITY	+1(-1) if worker moved to (from) an SMSA	.003
Job Characteristics		
Job Safety: Index ranging from 0 (not exposed to hazard) to 4 (problem with hazard is severe)		
DANGEROUS MATERIALS	Job requires exposure to dangerous materials	.206
DANGEROUS EQUIPMENT	Job requires working with dangerous equipment, tools, or machines	.481
DANGEROUS METHODS	Job requires dangerous work methods or procedures	.224
Effort: Index ranging from 1 (not at all required of job) to 4 (required a lot)		
WORK FAST	Job requires working fast	-.334
WORK HARD	Job requires working very hard	-.193
REPETITIVE	Job requires repetitive work	-.822
Hours		
HOURS	Hours worked per week	-.714
REGULAR SCHEDULE	Same days, same hours each week = 1; same days, but irregular hours, or irregular days but same hours, = 2; irregular days, irregular hours = 3	-.018
HOURS PROBLEM	Severity of problem with hours, schedule, or overtime, ranging from 0 (no problem) to 4 (severe problem)	-.185
Transportation		
COMMUTING TIME	Time from home to work in minutes	1.330
TRANSPORTATION PROBLEM	Severity of problem with transportation to and from work, ranging from 0 (no problem) to 4 (severe problem)	-.016
Benefits: Dummy = if benefit is available; 0 otherwise		
MEDICAL INSURANCE		-.003
LIFE INSURANCE		-.021
RETIREMENT PROGRAM		.023

these hazards: dangerous materials; dangerous equipment, tools, or machines; and dangerous work methods. Effort is represented by three variables, measured on a scale from 1 to 4, where higher values are assigned if the job requires working fast, working hard, or repetitive work. Hours are represented by three variables:the number of hours worked per week, an index for the regularity of work schedule, and an index for severity of problem with hours, scheduling, or overtime. Transportation is represented by commuting time in minutes and an index for severity of transportation problem. Medical insurance, life insurance, and a retirement program are benefits assigned 1 if available to the worker, and 0 otherwise. In addition to the index version of these variables, I also estimate the models defining these variables as dummy variables, where the variable equals 1 if the problem exists and 0 otherwise.[3]

Changes in each of these variables are equal to the 1977 value minus the 1973 value. The coefficients on all changes in job conditions are expected to be positive, with the exception of benefits. If benefits are a substitute for income then we would expect an inverse relationship with wages.

Table 2: Estimates of Earnings Equation in Differences for All Workers
Dependent Variable: Difference in Log of Annual Earnings[a]

Variable	*Without Benefits*		*With Benefits*	
ΔEXPERIENCE	.00900	(.670)	.0120	(.87)
ΔEXPERIENCE SQUARED	-.00050**	(2.420)	-.0004**	(2.33)
ΔTENURE	.02200	(.940)	.0080	(.36)
ΔEDUCATION	.04800**	(2.240)	.0250*	(1.67)
ΔUNION	.08000*	(1.800)	.0350*	(1.23)
ΔHANDICAP	.06600	(1.150)	.0560	(1.00)
ΔMARRIED	.03900	(.760)	.0370	(.75)
ΔREGION	.04400	(.039)	.0440	(1.18)
ΔCITY	1.61000**	(4.940)	1.7200**	(5.42)
ΔDANGEROUS MATERIALS	-.02000	(.570)	-.0190	(.52)
ΔDANGEROUS EQUIPMENT	.02900	(.780)	.0290	(.79)
ΔDANGEROUS METHODS	-.00500	(.040)	-.0120	(.31)
ΔWORK FAST	.04500	(.860)	.0320	(.63)
ΔWORK HARD	-.03800	(.570)	-.0530	(.81)
ΔREPETITIVE	-.04100	(.890)	-.0240	(.53)
ΔHOURS WORKED	.00500**	(3.040)	.0050**	(3.07)
ΔREGULAR SCHEDULE	.01200	(.360)	-.0040	(.14)
ΔHOURS PROBLEM	.00003	(.001)	-.0003	(.01)
ΔCOMMUTING TIME	.00010	(.120)	-.0010	(.47)
ΔTRANSPORTATION PROBLEM	.01500	(.540)	.0120	(.45)
ΔMEDICAL INSURANCE	— —		.1540**	(3.14)
ΔLIFE INSURANCE	— —		.0590*	(1.33)
ΔRETIREMENT PROGRAM	— —		.0950**	(2.34)
INTERCEPT	.43700		.4330	
R^2	.16000		.2200	
Adjusted R^2	.11000		.1800	

Note: [a]Absolute *t*-values in parentheses. Single (double) asterisk denotes significance at the .10 (.05) level (one-sided tests). The job condition variables are dummy variables equal to 1 if the characteristic is true of the job, and 0 otherwise.

IV. RESULTS

The estimates of the earnings equations in differences for all workers are presented in Table 2. The first equation is most similar to the specification used by Duncan and Holmlund[2] and excludes benefits, whereas the second equation includes benefits. Increasing years of education, joining a union, moving to a Standard Metropolitan Statistical Area (SMSA) and increasing hours worked are positively and significantly (at the 10% level or better) related to changes in earnings. However, none of the job conditions are significantly different from 0. Gaining medical insurance or a retirement plan is positively and significantly related to changes in earnings, which suggests that benefits are a supplement and not a substitute for income.

Table 3 presents the estimated results in differences for workers who are in the same 3-digit occupation and working for the same employer in both years. The equation presented in the first column includes a dummy variable for white-collar workers, followed by equations estimated separately for white-collar and blue-collar workers. Gaining education or a wife significantly

Table 3: Estimates of Earnings Equation in Differences for Workers in Same 3-Digit Occupation Working for the Same Employer Dependent Variable: Difference in Log of Annual Earnings[a]

Variable	*Combined Subsample*		*White-Collar*		*Blue-Collar*	
ΔEDUCATION	.008	(.39)	.0130*	(1.47)	.0040	(.12)
ΔUNION	-.010	(.18)	-.0330	(.33)	-.0330	(.36)
ΔHANDICAP	-.062**	(2.62)	-.0510*	(1.42)	-.0520*	(1.44)
ΔMARRIED	.050	(.85)	.1550*	(1.86)	.0450	(.47)
ΔREGION	-.005	(.11)	.1370*	(1.60)	-.0090	(.13)
ΔDANGEROUS MATERIALS	.012	(.80)	-.0040	(.11)	.0110	(.54)
ΔDANGEROUS EQUIPMENT	.009	(.49)	.0460	(1.17)	.0070	(.32)
ΔDANGEROUS METHODS	.005	(.29)	.0510	(1.10)	.0010	(.05)
ΔWORK FAST	.041**	(2.17)	.0030	(.11)	.0640**	(2.25)
ΔWORK HARD	.011	(.58)	.0110	(.39)	-.0020	(.06)
ΔREPETITIVE	-.011	(.59)	.0090	(.35)	-.0140	(.41)
ΔHOURS WORKED	.002	(.83)	-.0001	(.04)	.0040	(1.20)
ΔREGULAR SCHEDULE	.050**	(1.96)	.0500*	(1.30)	.0630*	(1.57)
ΔHOURS PROBLEM	-.027**	(2.14)	-.0550**	(2.90)	-.0130	(.69)
ΔCOMMUTING TIME	-.001	(1.08)	-.0020*	(1.63)	-.0008	(.31)
ΔTRANSPORTATION PROBLEM	.021**	(1.82)	-.0060	(.35)	.0320**	(1.74)
ΔMEDICAL INSURANCE	.100**	(1.68)	.1360*	(1.65)	.1220	(1.17)
ΔLIFE INSURANCE	.118**	(1.97)	-.0210	(.20)	.1280*	(1.40)
ΔRETIREMENT PROGRAM	.068*	(1.35)	.0990*	(1.49)	.0390	(.41)
WHITE-COLLAR	.041	(1.17)	— —		— —	
INTERCEPT	.360		.3790		.3790	
R^2	.240		.3900		.3400	
Adjusted R^2	.100		.1100		.0600	

Note: [a]Absolute *t*-values in parentheses. Single (double) asterisk denotes significance at the .10 (.05) level (one-sided tests). The job condition variables are indexes defined in Table 1.

increases the growth rate of earnings for white-collar workers. Blue-collar workers whose jobs require working faster or who have transportation problems have a significantly higher rate of earnings growth. All workers whose schedules became less regular have a significantly higher growth rate of earnings. Again, benefits are positively and significantly related to the growth of earnings.

To isolate whether Brown[1] failed to find compensating differentials because he used imputed job characteristics, or because he used a broad sample of workers, I reestimated the equations presented in Table 2, restricting my sample, as Brown did, to noncollege graduates. The complete results are omitted for brevity. Although this sample represents a broader range of ages than Brown's, more variables are significant in this sample than in Brown's or in the sample of all workers presented in Table 2. In particular, jobs requiring working faster or those with a less regular schedule have a significantly higher growth rate of earnings. Jobs that are more repetitive (indicating less discretion over the performance of tasks) have a significantly lower growth rate of earnings. This suggests that Brown's failure is due, at least in part, to his use of imputed rather than self-reported job characteristics. In addition, the overall results probably improve because the sample is restricted to a more homogeneous sample of noncollege graduates.

V. DISCUSSION

Placed on a continuum of success in detecting significant compensating differentials (based on a number of significant variables), the results of this study fall above Brown,[1] somewhat short of Duncan and Holmlund,[2] and well below Eberts and Stone.[3] These studies differ in at least four important respects, which may partially explain the differences in results.

The most obvious difference is the range of worker tastes examined. The strongest support for the theory, provided by Eberts and Stone,[3] is for the narrowest class of workers—public school teachers working for the same employer (district) in both years of the study. Although Duncan and Holmlund[2] use a sample of Swedish workers across a variety of occupations, the distribution of occupations is narrower, the work force more stable, and tastes presumably more similar than in the United States. In addition, my results become more supportive of the theory when the sample was restricted to noncollege graduates, who face a narrower distribution of occupations and who are likely to have more similar tastes than the full sample.

The second difference is in the measurement of job conditions. Eberts and Stone[2] use well-defined, objective job conditions for each individual in the sample. The job conditions are specific to teachers. Brown[1] uses data from the National Longitudinal Survey Young Men's sample and matches occupational characteristics to individuals from the Dictionary of Occupational Titles file.

This procedure assigns averages of job conditions for occupations to individuals. Duncan and Holmlund[2] and the present study use general job conditions that are self-reported. This suggests two things. First, job conditions specific to the occupation are superior to general job conditions. Second, it is important to use individual job conditions, but self-reported characteristics may still be somewhat subjective. Although differencing may reduce the tendency of individuals to apply different frames of reference, an individual's own frame of reference may shift over time.

The third point relates to the role of firm-specific information. As Eberts and Stone[2] point out, firm-specific information is needed to reduce omitted variable bias if profitability and labor bargaining strength are related to other benefits and job conditions. Although Eberts and Stone[3] find benefits to have the predicted inverse relationship with wages, my results indicate the opposite relationship holds. The implication is that better paying jobs have better pecuniary benefits as well. One reason for this result is that firms in a position to pay well may also be in a position to provide better benefits. Eberts and Stone[3] found their estimates of compensating differentials are weakened or even reversed when district-specific variables are omitted.

Another use of firm-specific information is to control for the possibility that the market clearing curve shifts over time in response to differences in firms' profitability. An examination of the results estimated in levels for the two years suggest this may have occurred.[4] To control for the possibility that the market clearing curve shifted, Brown[1] added rates of growth in employment in the individual's occupation and employment as explanatory variables. Although this failed to change his results, rate of employment growth is a weak proxy for profitability, and is also subject to the same measurement error associated with assigning average values to individuals.

A fourth point relates to the likelihood that the workers are in equilibrium positions in both periods. An explicit effort to examine workers likely to meet this condition was made in this study and by Eberts and Stone,[3] by examining workers employed in the same occupation and for the same employer in both years. Given the stability of the Swedish work force, this same situation probably held for the majority of the workers examined by Duncan and Holmlund.[2] Thus, the source of changes in job conditions is isolated to be changes in the employer's situation, which again underscores the need for firm-specific information.

In sum, the results of this article suggest that the general theory of compensating differentials be revised to include firm-specific information, for two reasons. First, as Eberts and Stone[3] point out, labor markets do not adjust instantaneously. Omitting firm-specific information will bias the estimated coefficients on job conditions, if factors such as profitability and labor bargaining strength are related to other benefits and working conditions. Second, changes in firms' profitability cause the market clearing curve itself to shift over time.

However, it is not clear if any test of the theory can be supported over a broad range of occupations in the short run. People have limited information when they choose occupations, tastes evolve over time, and occupational entry and exit are often costly. It is probably easier for an individual to make small adjustments in working conditions within an occupation than to change occupations and adjust working conditions simultaneously. This suggests that the best test of the theory remains within a narrow range of occupations, or for workers with similar tastes.

NOTES

1. The data utilized in this article were made available by the Inter-University Consortium for Political and Social Research. The data for Quality of Employment Survey, 1973-1977: Panel were originally collected by Robert Quinn and Graham Staines and sponsored by the Employee Standards Administration. U.S. Department of Labor. Neither the original collectors of the data nor the Consortium bear any responsibility for the analyses or interpretations presented here.
2. Interviews were taken in the first two months of 1973 and the last three months of 1977. The interview dates are nearly five years apart, which is why the difference in average years of experience is more than four years. Annual earnings refer to 1972 and 1977 earnings.
3. The advantage of measuring the job characteristics on a 4- or 5-point ordinal scale is that it allows greater variation in the independent variables and therefore greater precision in estimating the models. The disadvantage is that it treats changes from, say, "no problem" to "slight problem" as equivalent to changes from "moderate problem" to "severe problem," which may not be the interpretation used by the respondents. On the other hand, using dummy variables treats a change from "no problem" to "slight problem" as equivalent to a change from "no problem" to "severe problem," and also ignores a change from "slight problem" to "severe problem" because both "slight problem" and "severe problem" have the value of 1 in the dummy variable specification. Neither the ordinal scale nor the dummy variable specification is clearly superior, therefore I use both forms of the variables in this article.
4. These results are omitted for brevity.

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