Volume Title: The Measurement of Labor Cost

Volume Author/Editor: Jack E. Triplett, ed.

Volume Publisher: University of Chicago Press

Volume ISBN: 0-226-81256-1

Volume URL: http://www.nber.org/books/trip83-1

Publication Date: 1983

Chapter Title: Estimating Wage-Fringe Trade-Offs: Some Data Problems

Chapter Author: Robert S. Smith, Ronald G. Ehrenberg

Chapter URL: http://www.nber.org/chapters/c7384

Chapter pages in book: (p. 347 - 370)

10 Estimating Wage-Fringe Trade-Offs: Some Data Problems

Robert S. Smith and Ronald G. Ehrenberg

Fringe benefits are a growing component of total compensation, and their growth presents a number of challenges to economists on both the scientific and policymaking level. For example, when the government passes legislation requiring that pensions be made more generous or more widely available, it is natural to ask just who will pay the cost. Economic theory, as we will show, is quite clear on this point. It suggests that when pensions increase wages will decrease, other things equal, thus implying that it is workers themselves who will pay the cost of pension reform legislation. The view that wages and pensions are negatively related (if other things are held constant) is not widely held among noneconomists, however. Casual observation, in fact, yields quite the opposite view. The highest-wage workers receive the best pensions, and high-wage firms are the very ones with the most generous pensions. Even sophisticated studies that attempt to control for the "other things" influencing total compensation sometimes estimate that wages and pensions are positively related (Blinder, Gordon, and Wise 1979).

To take another example, federal/private sector wage comparability studies have historically ignored fringe benefits. If increases in earnings and increases in fringe benefits are roughly *proportional* within each sector, then changes in earnings may serve as an adequate index (given the cost of acquiring fringe benefit data) for changes in total compensation. However, if, as economists suspect, earnings and fringe benefits are

Robert S. Smith and Ronald G. Ehrenberg are with the New York State School of Industrial and Labor Relations, Cornell University, Ithaca, New York.

An earlier version of this study was done for the President's Commission on Pension Policy, but the views presented herein are solely those of the authors. The authors wish to thank Dan Sherman for his invaluable assistance on this project. The paper has also benefited from excellent comments by Charles Brown and Jack Triplett on earlier drafts.

inversely related within each sector, other things equal, then comparability studies that ignore fringes could be seriously deficient.

Finally, many labor market studies that *should* be measuring and analyzing total compensation focus instead on wages or earnings owing to the general paucity of fringe benefit data. If marginal changes in wages and fringe benefits are proportionally related, other things equal, these studies may not contain fatal biases; however, if such changes can be shown to be inversely related, then problems of unknown magnitude could arise in such important areas as judging sectors with labor surpluses and shortages, assessing the existence and size of compensating wage differentials, measuring the returns to human capital investments, and measuring the "unexplained residual" for minorities and women.

Common to the above examples is the problem of estimating the trade-off between wages and fringe benefits. While estimating this trade-off might appear on the surface to be a straightforward matter of obtaining data on fringe benefits, we will show in this paper that it is not. Instead, there are potentially serious biases that arise when standard data sets are used. Thus, if we are to successfully shed light on the important issues of wage-fringe trade-offs, some rather unique data requirements must be met.

This paper represents an inquiry into some of the data related difficulties inherent in estimating wage-fringe trade-offs, and it explores the usefulness of a particular source of data in meeting these difficulties.

In section 10.1 we briefly present the theory underlying economists' notions about the trade-offs between wages and fringe benefits. Section 10.2 discusses the unique data required to test this theory, and section 10.3 describes a test using such data. In section 10.4 tests for wage-fringe trade-offs using conventional data are described and analyzed for the purpose of assessing the extent of any biases that arise when such data are used. The paper concludes with a section on data recommendations.

10.1 The Theory of the Wage-Fringe Relationship

Economic theory of the relationship between wages and fringe benefits in competitive markets starts with the notion that it is *total compensation* that matters to employers. They are trying to maximize profits and, in so doing, will endeavor to assemble a labor force of sufficient quality and size to enable them to produce output that they can sell at competitive prices. To attract the desired quantity and quality of labor requires that they offer a compensation bundle the total value of which is at least as good as other employers are offering. However, if they offer total compensation that is too high, they will find their costs are such that they cannot compete in the product market. The result of these forces is that they will offer total compensation that is no more or less than is offered by other employers to workers in the same labor market. In short, for every type of worker or skill grade, there will be a "going rate" of total compensation that firms must pay.

Employees, on the supply side of the market, will of course want to obtain offers that are as large as possible. They will find, however, that firms are unwilling to offer compensation packages that are more in total value than the going rate. Their problem, then, is to choose the package whose *composition* best suits their tastes.

The employer and employee sides of the market, discussed above, are summarized graphically in figure 10.1, using pensions as an example of a

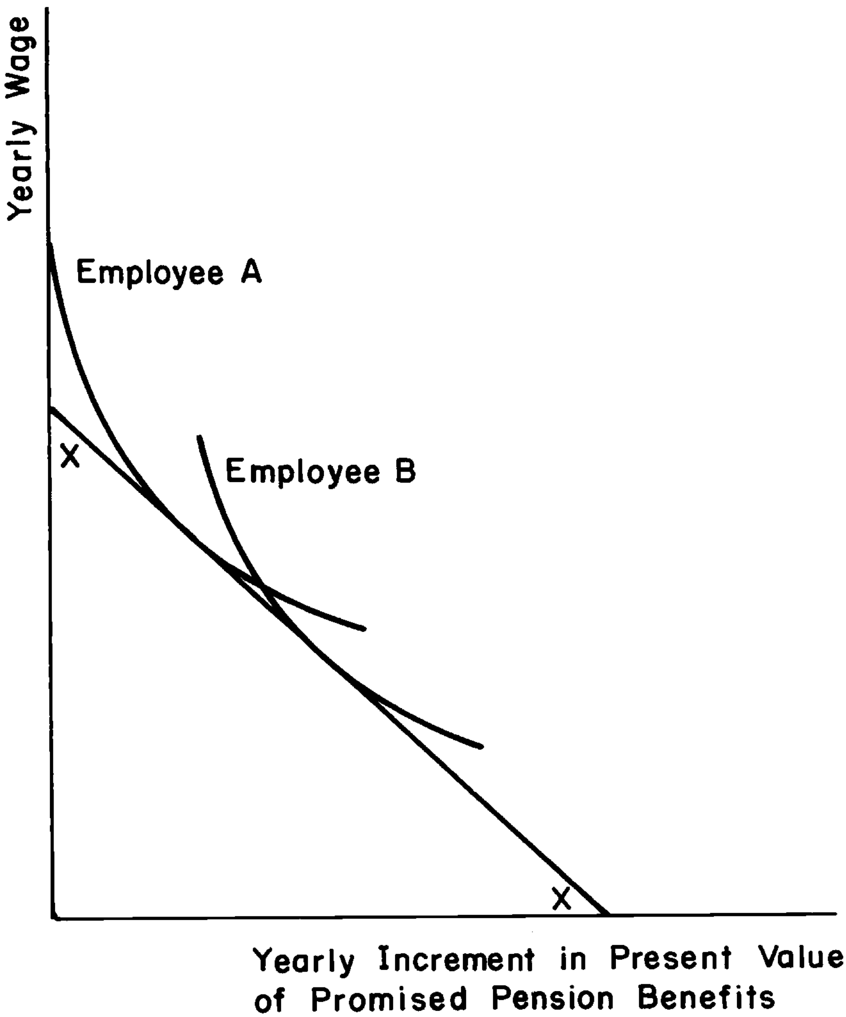

Fig. 10.1 The trade-off between wages and promised pension benefits.

fringe benefit. This graph depicts the relationship between pensions and wages, and it implicitly assumes all *other* job characteristics and elements of compensation are already determined. We have argued that employers must pay the "going rate" in terms of total compensation, and that at this compensation level they will be competitive in both the labor and product markets. The employer side of the labor market can thus be represented by an "isoprofit curve"—a curve along which any combination of wages and pensions yields equal profits to the firm. The isoprofit curve shown, XX, is the zero-profit (competitive) curve, and it implies that the firm must pay $\$X$ in total compensation to be competitive in the labor market. If we ignore, for the moment, the effects of pensions on absenteeism, turnover, and work effort, the firm's total costs will be the same whether the firm spends $\$X$ on wages or $\$X$ on pensions; hence, the isoprofit "curve" shown is a straight line with a slope of (minus) unity. If all firms in the labor market depicted by figure 10.1 have isoprofit curves with a unitary slope, the "offer curve" facing employees in that market will be a straight line (XX) with the same unitary slope.

While the assumption underlying figure 10.1 is one of a linear offer curve with a slope of unity, the locus of offers *could* trace out either a straight line or a curve that has a slope, the absolute value of which is greater (or less) than unity, depending upon whether the presence of pensions reduces (or enhances) worker productivity. Specifically, suppose pension plans that do not offer immediate vesting reduce employee turnover and increase employee work effort (Lazear 1979, 1981). Some firms might thus find that the marginal dollar spent on increasing pension benefits would entail a net cost of less than a dollar; this phenomenon would tend to flatten the isoprofit curves drawn in wage-pension space. On the other hand, if pension benefits (or other fringe benefits) are essentially independent of hours currently worked per year, firms with relatively generous pension plans and correspondingly lower wages may find that they experience greater absenteeism than they otherwise would (Allen 1981). Thus, one could also argue that isoprofit curves can have a slope greater than unity in absolute value.

If the cost-reducing effects of pensions always dominate the cost-increasing effects, but the marginal effect of an additional dollar of pension benefits on costs diminishes with the level of pension benefits, then the isoprofit curve, and hence market offer curve, will have a concave shape as shown in figure 10.2 (the curve yy). In contrast, if firms with isoprofit curves whose slope is always greater than unity coexist in the market with those whose isoprofit curves have a less than unitary slope, the locus of offers to employees could fall along a convex curve—$QRST'$ as shown in figure 10.3.

The above arguments concerning the offer curve, which are derived from an analysis of the employer side of the market, suggest that the

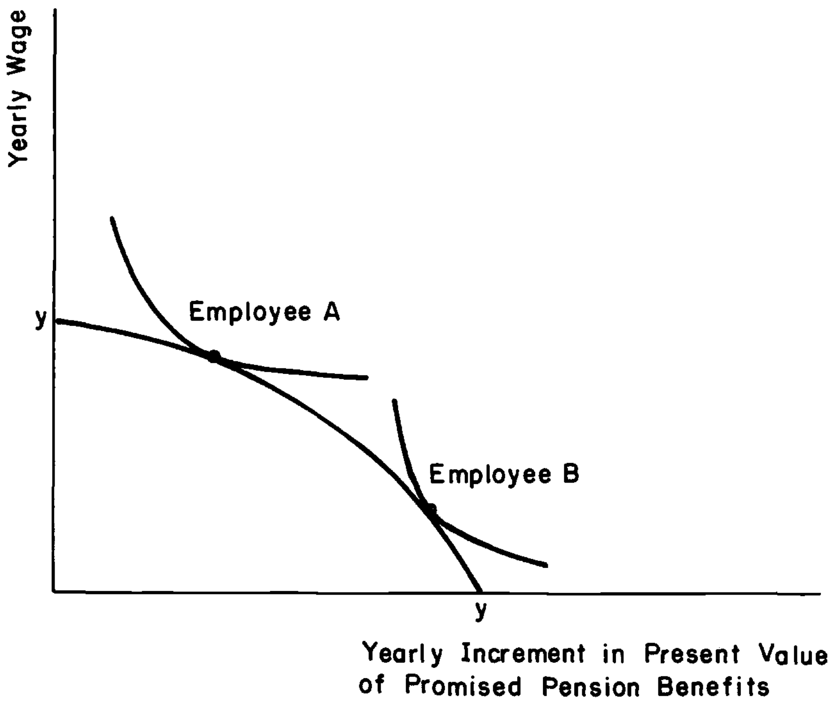

Fig. 10.2 A concave offer curve resulting from diminishing marginal effects of pensions on costs.

problem facing employees is one of choosing the compensation package that maximizes utility. That is, the observed compensation packages in a given labor market will trace out the offer curve that exists at any point in time, and the package chosen by any employee will reflect his or her utility function. The *exact* shapes of employee indifference curves in wage-pension space are not critical to our analysis, although linear or concave indifference curves would in general lead to corner solutions (in which case a variety of wage/pension "mixes" would *not* be observed in a given market). We have thus drawn the indifference curves in figures 10.1, 10.2, and 10.3 as convex. Are there other reasons to suppose these indifference curves are convex?

In the life cycle context, workers could be viewed as maximizing a lifetime stream of utility; thus, different wage-pension combinations could simply be viewed as different asset portfolios. However, given one's tastes, the marginal rate of substitution between wage goods and pensions is likely to be diminishing. As wages are *increased* and pensions are *reduced*, more of one's total compensation becomes taxable (at

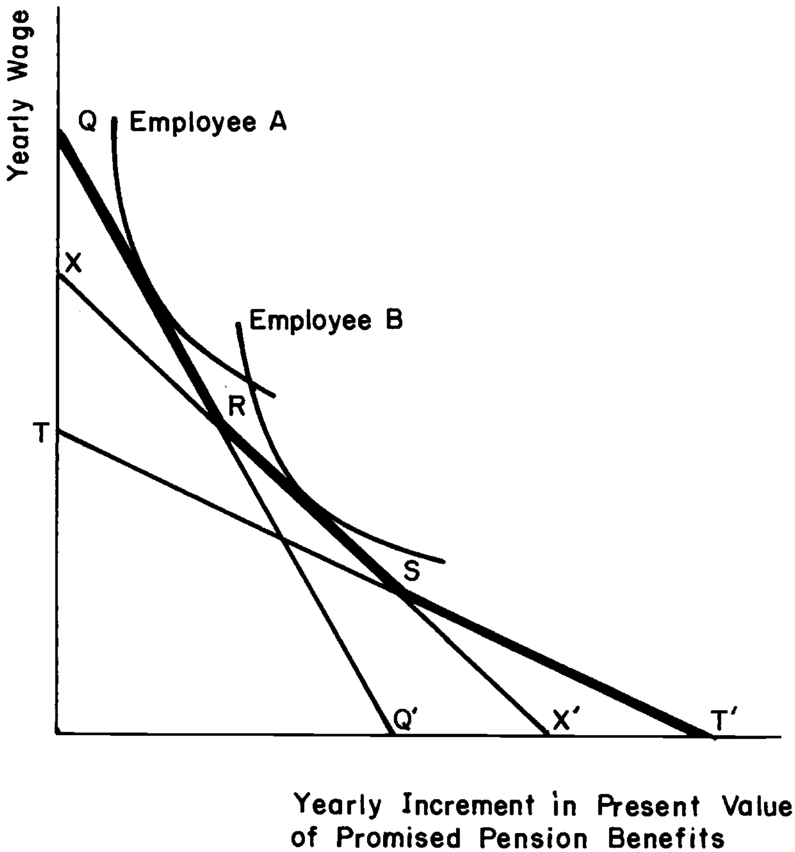

Fig. 10.3 A convex offer curve: XX', pensions do not change productivity; TT', pensions increase productivity; QQ', pensions reduce productivity.

progressively increasing rates) at the relatively high tax rates that prevail during one's working years. These relatively high and increasing rates tend to progressively increase the amount of pretax wages employees would require to compensate them for successive reductions in pension benefits. Conversely, as wages are *reduced* and pension benefits are *increased*, less of one's total compensation becomes accessible for current expenditure—a fact suggesting that workers will be willing to accept ever-smaller wage reductions in return for progressive increases in pension benefits.[1] Thus convex indifference curves in wage-pension space seem likely to exist.

Figures 10.1, 10.2, and 10.3, and the associated theory behind them suggest three things about the relationship between wages and pensions.

First, they suggest that employees pay for their own pensions through a lowered wage. That is, there should be a negative wage-pension relationship once other things that affect compensation have been controlled for (as they have by assumption in all figures). Second, theory also suggests that the above negative trade-off might be close to (or fluctuate around) unity. Third, the observed trade-off could be linear, convex, or concave.

Similar reasoning about how labor markets work leads us, more generally, to expect that the trade-off between wages and *any* fringe benefit, ceteris paribus, will be negative. Moreover, when such benefits are expressed in terms of employer cost, the trade-off we can observe should be close to unitary. Thus, companies with a more generous fringe benefit package will tend to pay lower wages, other things equal.

The theoretical considerations noted here suggest the outlines of an empirical study wherein the determinants of wages could be estimated by an equation such as

$$W = a_0 + a_1 P + a_f F + a_x X + e, \tag{1}$$

where W is the wage or salary paid to workers, P is the present value of yearly per worker pension accruals ("normal cost"),[2] F is the employer cost of other fringe benefits per worker, X is a vector of all other factors that influence wages or salaries, and e is a random error term. The coefficients a_i are to be estimated, and it is predicted that a_1 and a_f will be negative and close to unitary in absolute value.[3]

10.2 Data Requirements

While equation (1) appears to offer a rather simple empirical test, to estimate it requires data that do not normally exist in standard household or firm surveys. In particular, equation (1) imposes three data requirements that are difficult to meet. First, the variables P and F require the availability of data on employers' costs of fringe benefits. That is, we need to have access to estimates of "normal pension cost" and the cost of other fringe benefits—which in many cases requires actuarial estimates that take into account employee turnover and other factors affecting the probability that they will be eligible for, or choose to receive, a given benefit. These data can only be found in *employer*-based data sets—and even there only rarely.

Second, many fringe benefits are explicitly stated as a function of wages, so that detailed information on the determinants of their actuarial value are required to estimate equation (1) in an unbiased way. W and P in equation (1), for example, are closely related for more than the *behavioral* reason suggested by theory. They are related in a very *technical* sense, because pension benefits are normally calculated as some fraction of wages. We are interested in the behavioral relationship, not the technical one, but the latter relationship (which is a *positive* one) may obscure the former (which we hypothesize to be negative). We must therefore find a way to filter out the technical from the behavioral relationship.

One very simple filtering process consists of specifying that P (normal cost) is a linear function of W and a vector (Z) of all pension characteristics (vesting, replacement rates, COLA adjustments, etc.):

$$P = b_0 + b_1 W + b_z Z + u. \tag{2}$$

One could then proceed to estimate equations (1) and (2) using a two-stage least-squares estimator. What this essentially involves is regressing P on all independent variables in (1) and (2) except W. Using these regression estimates, an instrument for P (call it $\hat{P}$) is calculated and entered as an independent variable in equation (1), replacing P.[4] The variable $\hat{P}$ is an estimate of normal cost that is "purged" of the effects of wages. Using $\hat{P}$ in equation (1) thus would allow us to observe the behavioral relationship.

Variables that belong in vector Z are thus necessary to an unbiased estimate of equation (1). Like actuarial estimates of the cost of fringe benefits, these variables are not commonly found in data sets; however, when they can be had, they are found only in *employer* data sets.

The third need is for measures of the variables in vector X—the "other things" that influence wages. Economists normally use data on education, age, race, sex, marital status, and so forth, to control for these things, but such variables are not usually found in *employer* data sets. Thus, we must either find ways to match employer and household data sets or take pains to address some rather severe problems inherent in employer data.

In particular, it is likely that a firm—through its use of hiring standards and a particular compensation package—will assemble a fairly homogeneous work force. However, its work force will tend to systematically vary from the work force in other firms in characteristics that are very difficult to measure: motivation, dependability, competence, and aggressiveness. In using employer based data, the problem created by firms' employment of homogeneous workers who differ in unmeasurable ways from those employed by other firms is the classic one of "omitted variables bias." Firms that offer higher total compensation will in general be able to select employees with higher motivation, dependability, etc. High-ability workers thus receive higher wages and higher fringe benefits, so that unless data on ability are available, the fringe benefit variables in equation (1) will pick up the effects of ability. A positive bias on the coefficients of the fringe benefit variables is thus distinctly possible when one is using a data set in which worker quality is unobservable and potentially varies across firms.

Previous studies we have done on the wage-pension trade-off in the public sector do not appear to have suffered much from the above problem of omitted variables bias (Ehrenberg and Smith 1981). The local government employers in those data sets were hiring workers—police, firefighters, and nonuniformed employees—who all worked in the same "industry" and had very similar duties across cities; thus, it is unlikely that employee quality varied substantially across cities. However, when one moves to tests for wage-fringe trade-offs in the *private* sector, homogeneity of worker quality across employers is much less likely. The managers of a company producing sophisticated technical equipment are likely to have different characteristics from those in a trucking firm, and those in highly competitive industries are likely to differ from those in a public utility. One purpose of this paper is to inquire into the significance of, and a solution to, this problem of unmeasured heterogeneity of workers across firms.

10.3 Estimating Wage-Fringe Trade-Offs

We were able to obtain an employer based data set that generally met the requirements outlined in the previous section. These data were provided to us by Hay Associates, a large compensation consulting firm. Hay conducts its own survey of cash and noncash compensation within client firms and was able to provide us with a sample of roughly two hundred usable observations. The sample has several rather unique characteristics.

10.3.1 Controls for Other Influences on Wages

First, salary and fringe benefit data were provided to us for three different white-collar job grades within each company. Hay evaluates every job within a client company using three principal criteria: required "know-how," accountability, and the degree of problem solving involved. It assigns point values to each job characteristic, totals them, and uses these "Hay Point" evaluations as points of reference when comparing compensation within and across firms.

We were interested in obtaining the compensation associated with given Hay Point levels as one means of controlling for the "other things" that influence wages. Thus, we asked Hay to provide us with data at three different Hay Point levels in each of the firms: 100 Hay Points (entry level white-collar job for someone with a Bachelor's degree), 200 Hay Points (supervision of a small staff section), and 400 Hay Points (lower middle management position or a department head in a small organization). It normally takes three to six years to go from a 100 to a 200 Hay Point job, and seven to fifteen years to go from a 100 to a 400 point position within an organization.

Another crucial advantage to obtaining data on different job grades within each company is that it permits one to employ a procedure that, in effect, controls for the firm-specific effects of unmeasured worker characteristics. For example, suppose that salaries at the 100 Hay Point level are given by the following variant of equation (1):

$$W_{100} = a_0 + a_1 P_{100} + a_f F_{100} + a_x X + a_m M + e, \tag{3}$$

where M stands for the unmeasured worker characteristics, and X contains other measurable variables that influence wages. Suppose also that a similar equation describes wages at, say 400 Hay Points:

$$W_{400} = a_0' + a_1 P_{400} + a_f F_{400} + a_x' X + a_m M + e'. \tag{4}$$

The assumptions underlying equations (3) and (4) are that the wage-fringe trade-offs (a_1 and a_f) are the same at each Hay Point level, but that the intercept terms (a_0 and a_0') differ. We also assume that the coefficients on the variables in the X vector differ, but that the X variables (firm size and industry, for example) are the *same* at each Hay Point level within a firm. Finally we assume that the unobservable worker characteristics (M) are constant within a firm and that their marginal effects (a_m) are the same in each equation (in effect, they add a constant absolute amount to compensation at each job level within a given firm).

Subtracting equation (3) and (4), we arrive at an equation that explains the *difference* in salaries across Hay Point levels *within* each firm:

$$\begin{aligned} W_{400} - W_{100} = {} & (a_0' - a_0) + a_1 (P_{400} - P_{100}) \\ & + a_f (F_{400} - F_{100}) + (a_x' - a_x) X + e''. \end{aligned} \tag{5}$$

One can note from equation (5) that the unobservable effects of worker quality drop out of the equation (we are explaining *within-firm* wage profiles now). Thus, having access to compensation data at different job grades within firms should allow us to work around at least some of the problems of omitted variables bias.

10.3.2 Employer Cost Data on Fringe Benefits

The second unique feature of our data set is that it contains actuarial estimates of employers' costs of all privately provided fringe benefits—pensions, paid vacations and holidays, medical-dental plans, death and disability benefits, and capital accumulation plans (profit sharing or stock options). The means of each element in total compensation (excluding government mandated items) are displayed for each Hay Point level in table 10.1. In the case of pensions, death and disability benefits, and

Table 10.1 **Means of Hay Compensation Data Per Year**

	Hay Point Level		
	100	200	400
Salary	$13,434	$20,646	$34,862
Pension value	816	1,450	2,870
Value of vacations and holidays	1,334	2,057	3,490
Death benefit value	234	346	595
Disability benefit value	447	694	1,221
Capital accumulation value	385	600	1,034
Medical-dental plan value (same for all H.P. levels)	1,114	1,114	1,114

NOTE: The range (standard deviation) of the salary data are as follows:
100 H.P.: 8,200–26,100 (2,407)
200 H.P.: 13,700–31,000 (2,972)
400 H.P.: 24,700–50,700 (4,749)

capital accumulation plans, values shown indicate the present value of the estimated increase in firm liabilities accruing during a year.

10.3.3 Data on Pension Characteristics

A third feature of our data set is that it contains information on several important pension characteristics: the effects of social security benefits on the pension benefits promised by the firm, eligibility and vesting provisions, replacement rates, cost-of-living adjustments to benefits, death benefits, and retirement age. The means of several of these pension characteristics are summarized in table 10.2. These data permit us to estimate wage equations using the instrumental variables procedure outlined in section 10.2—the purpose of which is to purge the wage equation of the technical dependence of pension costs on wages.

Unfortunately, the actuarial calculations of capital accumulation and death/disability benefit values were highly complex and we were not provided with sufficient data to meaningfully purge them of their technical dependence on wages. Our solution to this problem was to *assume* a

Table 10.2 **Summary Statistics on Selected Pension Plan Characteristics**

Percent of plans with full vesting after 10 years	72%
Percent integrated with social security	87%
Percent with formal or informal COLA	45%
Mean replacement rate for 30-year employee with a salary base of $25,000	56%
Mean replacement rate for 30-year employee with a salary base of $50,000	47%
Percent with disability retirement	32%

one-for-one trade-off between them and wages and move the values of these three fringe benefits from the F vectors to the left-hand side of equation (5)—adding them to salaries (W_{100} and W_{400}) to form W'_{100} and W'_{400}, respectively.

10.3.4 The Estimating Equations

The wage equations we ultimately estimated had the form

(6) $$\Delta W' = a''_0 + a_1(\Delta P) + a_3 \Delta F + a_4(S) + a_5(T) + a_d D + e'',$$

where $\Delta W'$ is the change in salaries plus death, disability, and capital accumulation fringe benefits from one Hay Point level to another within a firm; ΔP is the change in pension value from one Hay Point level to another (an instrumental variable, $\Delta \hat{P}$, was substituted for ΔP as noted above); ΔF is the change in days of paid leave from one Hay Point level to another (the value of medical-dental plans dropped out of the vector F because it was constant across Hay Point levels within a firm); and the observed firm characteristics variables are firm size (S), a dichotomous variable taking the value of 1 if the firm has a mandatory retirement policy and 0 if it does not (T), and vector of industry dummy variables (D). The mandatory retirement variable, (T), is included because firms with mandatory retirement may well have steeper earnings profiles than those that do not (Lazear 1979). The average company size in this sample was 12,360 employees, and 50% were in manufacturing industries. No firm in the sample required pension contributions of its employees.

Equation (6) was estimated using the two-stage least-squares procedure outlined in section 10.2. To simultaneously estimate the "normal cost" function approximated by equation (2) in the context of explaining salary differentials across job grades within firms, we had to reformulate the equation as follows:[5]

(7) $$\Delta P = b_0 + b_1 \Delta W' + b_z Z + u.$$

The variables in Z include the replacement rate (assuming workers retire at age 65 with thirty years of service), whether or not employees are immediately members of the pension plan, whether or not the plan fully vests after ten years of service, whether or not benefits are adjusted to reflect cost-of-living increases, whether or not disability retirement provisions are present, the degree to which retirement benefits are offset by social security benefits, and whether or not an assumption of future salary increases was made in the actuarial calculation of normal pension cost.

Three versions of equation (6) were estimated: differences between 200 and 100 Hay Points, differences between 400 and 200 Hay Points, and differences between 400 and 100 Hay Points. The results are presented in table 10.3. (Results of the first-stage estimation are presented in table 10.A.1 in the appendix.)

Table 10.3 **Estimates of Equation (6) Determinants of the Change in Salary Plus Selected Fringe Benefits across Hay Point Levels within Firms (method: two-stage least squares)**

	Coefficients (standard errors) of Independent Variables		
	400–100 H.P.	200–100 H.P.	400–200 H.P.
Change in paid holidays (days)	109.49(186.81)	−220.32(176.16)	80.88(149.85)
Change in pension value (dollars)	−.106(.466)	−.445(.642)	.085(.472)
Presence of mandatory retirement	−187.46(586.65)	41.07(239.26)	−229.04(421.04)
Firm size (number of employees)	.021(.009)	.009(.004)	.012(.006)
Industrywide effects (financial, insurance, real estate omitted):			
Durable mfg.	643.32(757.78)	79.47(309.64)	513.50(546.93)
Nondurable mfg.	3,229.67(803.63)	957.80(327.40)	2,210.88(581.30)
Transportation, communications, and public utility	1,036.58(1,015.00)	802.47(413.89)	354.80(732.21)
Service	−415.23(1,143.15)	−227.06(464.46)	−220.83(824.07)
Firms with missing data on firm size	1,216.80(791.45)	565.70(320.08)	620.65(568.46)
Constant	22,019.01(1,097.47)	7,546.97(447.87)	14,468.68(784.09)
R^2	.14	.13	.12
Number of observations	193	193	193

The results of most interest for our current purposes, of course, are the estimated coefficients on the pension and paid leave variables. Theory led us to expect that the coefficient on the pension variable should be roughly -1 in magnitude, and that the coefficient on the paid leave variable should be approximately equal to the negative of the change in the daily wage from one Hay Point level to another (which was about $30 for 100 to 200 Hay Points, $57 for 200 to 400 Hay Points, and $87 for 100 to 400 Hay Points). Of the six estimated coefficients, only three have the expected negative sign. While none is significantly different from its expected magnitude, the estimates are so imprecise that none is significantly different from zero either. Thus, the results of this test give no support for our theory of the wage-fringe relationship.

Two possible explanations for these disappointing results must be considered. First, it is possible, as noted earlier, that our procedure for finding an instrument for ΔP in equation (6) is too crude, so that the relationship between ΔP and $\Delta \hat{P}$ is not very close. This seems unlikely, however, because, as can be seen from table 10.A.1 in the appendix, the variables in the first stage of our estimating procedure explain 55–60% of the variance in ΔP.

Second, our assumption that unmeasured employee characteristics add a constant dollar amount to total compensation at each Hay Point level may be incorrect. A tractable alternative assumption is that these unobserved characteristics affect total compensation *equiproportionally* at each Hay Point level.[6] Suppose, for example, that total compensation at any Hay Point level can be expressed as

$$W(1 + p + f) = Ae^{(a_0 + a_x X + \phi M + u)}, \tag{8}$$

where p and f are employers' costs of pensions and other fringe benefits expressed as a fraction of wages, and ϕ is the fraction by which marginal changes in unmeasured employee characteristics increase total compensation. Taking logs and using the fact that $\ln(1 + r) \approx r$, when r is small, equation (8) can be approximated by

$$\ln W = a_0' + a_x X + \phi M + a_1 p + a_f f + u, \tag{9}$$

where a_1 and a_f are predicted to be negative and equal to unity in absolute value.

The effects of unmeasured employee characteristics, ϕM, can be eliminated by differencing equation (9) across Hay Point levels within a firm to obtain

$$\Delta(\ln W) = a_0'' + a_1(\Delta p) + a_f(\Delta f) + a_x'' X + u'', \tag{10}$$

where Δ indicates the change in the relevant variables across Hay Point levels. Because Δp will in general depend on changes in salaries across Hay Point levels, equation (10) was estimated using the instrumental variables approach analogous to that explained earlier.[7] The results of major interest are shown in table 10.4.

As with the results presented in table 10.3, those in table 10.4 offer no support for the theory outlined in section 10.1. We will return to a brief discussion of these negative findings in section 10.5. However, before doing so, it will be instructive to consider the biases that could exist if alternative procedures or data were used.

10.4 The Potential Biases Using Standard Data Sets

Sections 10.2 and 10.3 emphasized two potential biases in estimating wage-fringe trade-offs using conventional data sets. First, unless account is taken of the *technical* dependence of many fringe benefits on wages, the behavioral trade-off will be obscured. We dealt with this potential bias by using an instrumental variables approach. Second, it is possible that workers in roughly the same jobs will differ widely in certain unmeasurable characteristics across firms; that is, workers *within* firms may be fairly homogeneous, while *across* firms they may not be. The procedure we adopted in section 10.3 to deal with this problem was to purge the estimating equations of firm-specific "fixed effects" of these unmeasured characteristics by analyzing within-firm salary changes. In this section we analyze these two potential biases by investigating what happens when the above problems cannot be circumvented owing to lack of data.

10.4.1 Ordinary Least-Squares Estimates of Equations (6) and (10)

Suppose that we had data on employers' "normal cost" of pensions, but that we did not have information on the characteristics of the pension plan. This lack of data would preclude our use of the instrumental variables approach described in section 10.3, and we might be forced to use an ordinary least-squares estimating procedure. What would be the consequences of this defect in our data set?

The ordinary least-squares estimates of the coefficients of major interest in equations (6) and (10) are given in table 10.5. These estimates demonstrate very clearly the strong positive bias that emerges when one is unable to control for the technical dependence of pensions on wages.

Table 10.4 Estimated Wage-Fringe Trade-Offs, Equation (10)

Equation	Estimated Coefficient (standard error)	
	Pensions (a_1)	Paid Holidays (a_f)
400–100 H.P.	.359(.687)	−.362(1.555)
200–100 H.P.	.136(1.049)	1.615(2.553)
400–200 H.P.	.373(.682)	−.175(.958)

Table 10.5 **Estimates of the Wage-Fringe Trade-Off Using Ordinary Least Squares to Estimate Equations (6) and (10)**

		Estimated Coefficient (standard error)	
		Pension (a_1)	Paid Holidays (a_f)
Equation (6):	400–100 H.P.	1.513 (.323)	60.809 (174.922)
	200–100 H.P.	2.391 (.379)	−318.369 (153.482)
	400–200 H.P.	1.609 (.324)	40.730 (141.333)
Equation (10):	400–100 H.P.	1.247 (.501)	−.585 (1.538)
	200–100 H.P.	2.268 (.714)	−.185 (2.415)
	400–200 H.P.	.926 (.451)	−.259 (.951)

Estimated coefficients on the pension variables, which were close to zero and smaller than their standard errors in tables 10.3 and 10.4, are all strongly positive here. Thus, data sets that do not permit the researcher to disentangle the technical from the behavioral relationship between wages and pension costs will yield biased estimates of the trade-off.

10.4.2 Estimates Ignoring Firm-Specific Fixed Effects

Suppose now that we had access to data on employers' fringe benefit costs and pension plan characteristics, but that we had only one observation per firm. Lacking the data required to filter out the "fixed effects" of unmeasured worker quality within a firm, one would have to attempt to estimate trade-offs across firms at a fixed skill level. Estimates of equations like (3), (4), and (9) at each of the three Hay Point levels, using our instrumental variables approach described earlier, but of course omitting the variable M, were made in the course of our research. The results of major interest are reported in table 10.6.

In equations using the levels of salaries and fringe benefits, one can see (by comparing tables 10.3 and 10.6) that ignoring the fixed effects of

Table 10.6 **Estimates of the Wage-Fringe Trade-Off Ignoring the "Fixed Effects" of Unmeasured Worker Quality**

	Estimated Coefficient (standard error)	
Dependent Variable	Pensions (a_1)	Paid Holidays (a_f)
Salary level at 100 H.P.	−.006 (.686)	140.291 (75.550)
200 H.P.	−.059 (.512)	330.955 (102.806)
400 H.P.	−.126 (.480)	529.145 (146.000)
Log of salary at 100 H.P.	.506 (.590)	2.445 (1.386)
200 H.P.	−.187 (.509)	2.284 (1.227)
400 H.P.	−.635 (.451)	2.403 (1.034)

unmeasured worker characteristics does not alter the size or quality of the estimated wage-pension trade-off. However, ignoring these effects imparts a very definite positive bias to the trade-off between wages and paid holidays. Further, the fact that the estimated coefficient grows more positive as one moves up the Hay Point scale tends to suggest the effects of unmeasured characteristics may also tend to grow absolutely larger as workers are promoted. Generally, similar observations can be made by comparing the results of our logarithmic specification in table 10.4 with the corresponding results in table 10.6. Thus, there is clear evidence that omitted variables bias associated with unobserved worker characteristics is a problem that must be addressed when generating a data set for the purpose of estimating wage-fringe trade-offs.

10.5 Data Recommendations

This paper has attempted to identify the data needed to estimate trade-offs between wages and fringe benefits, and it has sought to explore the usefulness of one particular data set in this context. We have stressed that meaningful estimates of these trade-offs require data possessing three somewhat unique characteristics. First, estimates of the *magnitude* of any trade-offs require employer cost data—which, for many fringe benefits, entail actuarial estimation. Thus, researchers must have access to employer based data of a detailed nature.

Second, because pensions and many other fringe benefits are actuarial functions of wages or salaries, this technical relationship must be accounted for when estimating the behavioral relationship of interest. The data required to do this properly are those *other* variables also affecting the actuarial value of fringe benefits. In the case of pensions, data on replacement rates, vesting, COLA adjustments, the existence of death or disability benefits, and the like are required. We have demonstrated that ignoring this issue can result in seriously biased estimates.

Finally, heterogeneity of employees across employers presents researchers using employer based data with potentially severe problems of omitted variables bias. Unmeasured within-firm worker characteristics will tend to affect wages and fringes in the same direction, thus imparting a positive bias to the estimated coefficients on fringe benefits. We attempted to circumvent this by obtaining multiple observations per firm and analyzing within-firm compensation changes. While these procedures eliminated the countertheoretical estimates of a strong positive trade-off between wages and paid holidays, they did not allow us to find the predicted trade-off between wages and fringe benefits. In point of fact, we found no evidence in our data set to support the predictions of theory.

Explaining our negative findings cannot be done with certainty at this point. It may be that the theory is wrong, or at least not predictive of "real world" behavior. Given our earlier findings for the public sector, we are reluctant to embrace this explanation—at least until the weight of replicative findings mounts up. It may also be that our theory is correct, but that it is difficult to isolate the wage-fringe trade-off in the private sector; other nonpecuniary job characteristics (e.g., working conditions) may vary systematically.

A third possible explanation is that in our data set, skill level and fringe benefits were measured with so much error that estimates of existing negative trade-offs were biased toward zero. This possibility receives support from some of the errors we encountered in using the data and from the wide, overlapping ranges of salary levels at each of the three Hay Point levels (see the note to table 10.1). It may be that the Hay system of job rating is so arbitrary that across-firm comparisons are rendered essentially meaningless—and that the actuarial estimates of fringe benefit costs are so crude as to be unreliable. However, the Hay Point system of job evaluation is perhaps the foremost rating system of its kind in the world, the company is large and employs a battery of actuaries and other specialists, and the data we used were derived from a routine survey used and paid for by its clientele. It is hard to reconcile the hypothesis of sloppy or meaningless comparisons with the reputation and continued prosperity of the Hay company. If their work is of poor quality, would not they be punished by the market?

While we cannot answer the preceding question, there remains a fourth possible explanation. Perhaps the lack of data on employee characteristics caused the poor results. It could be that, despite our best efforts, we were really not able to completely avoid the positive biases associated with the problem of unmeasured worker characteristics. If this explanation is correct, it would suggest that some means must be found to include *employee* characteristics into employer based data sets. It suggests, in other words, that unless the employer based data that researchers must use contain information on the education, experience, training, etc., of employees, unbiased estimates of wage-fringe trade-offs may not be possible. We recommend, then, that to the three data requirements discussed at length in this paper, a fourth be added. Namely, employer based data sets should either include measures of average employee characteristics directly, or they should contain sufficient identification so that they can be cross-referenced to employee based data sets.

Appendix

Table 10.A.1 Estimated Coefficients Produced by Regressing ΔP on All Exogenous Variables in Equations (6) and (7)

	Estimated Coefficients (standard errors)		
Variable	400–100 H.P.	200–100 H.P.	400–200 H.P.
Paid holidays	26.65(28.06)	27.07(23.42)	26.39(22.98)
Firm size ÷ 1000	.02(1.33)	.41(.47)	.38(.98)
Firm size missing (0, 1)	210.89(122.12)	87.37(42.77)	123.41(89.66)
Durable mfg. (0, 1)	−25.84(122.62)	−22.57(43.77)	−3.04(90.41)
Nondurable mfg. (0, 1)	147.69(128.57)	46.45(45.80)	101.46(94.74)
Trans., public utility (0, 1)	−39.38(161.87)	75.29(56.90)	−114.61(118.69)
Service industry (0, 1)	221.33(173.21)	91.94(61.27)	129.58(127.27)
Mandatory retirement (0, 1)	82.83(85.94)	33.62(30.27)	49.19(63.05)
Pension replacement rate	.21(.03)	.07(.01)	.13(.02)
Immediate membership in plan (0, 1)	157.32(90.80)	63.59(31.99)	93.73(66.59)
Full vesting at ten years (0, 1)	−85.73(101.23)	−22.60(35.74)	−63.19(74.27)
COLA provided to benefits (0, 1)	467.12(92.12)	118.35(32.37)	348.79(67.45)
Disability retirement allowed (0, 1)	67.18(93.36)	13.64(33.31)	53.41(68.56)
Social security offset, flat %	.56(.53)	.09(.19)	.48(.39)
Social security offset, yearly level	14.61(17.02)	.67(5.98)	13.93(12.48)
Social security offset capped by max.	3.86(4.59)	.88(1.61)	2.98(3.37)
Social security offset by step rate (0, 1)	187.97(144.84)	23.24(51.48)	164.58(106.14)
Actuarial assumption of rising salaries (0, 1)	12.38(94.63)	24.82(33.32)	−12.56(69.67)
Intercept	218.19(163.65)	59.10(57.67)	159.06(119.89)
R^2	.60	.54	.58

Notes

1. While in theory people could borrow against their future pension promises, capital markets are not likely to be so perfect that they can do so without facing interest rates that rise with the size of the desired loan.
2. "Normal cost" is the actuarial value (in the present) of the increase in pension liabilities incurred during the current year—or the yearly contribution to the pension fund needed to keep it fully funded.
3. Equation (1), of course, restricts the wage-fringe trade-offs to be constant (linear). Alternative specifications of this "basic" equation would allow the trade-offs to be nonlinear, as suggested by our discussions of figures 10.2 and 10.3. While for the sake of convenience our analysis of the data and estimation problems will center on equation (1), we will briefly discuss our results using other functional forms.
4. Equation (2) can be viewed as a linear approximation to the complex way in which pension benefits are actually computed. There is no reason, of course, to think that a linear approximation is sacred, and future researchers might use more complex forms (e.g., higher order polynomials) to increase the precision of the instrument for P that is obtained. We should note, however, that this linear approximation has been used with some success in prior research (Smith 1981).
5. Equation (7) is derived by assuming that the following equations hold for, say the 400 and 100 Hay Point levels:

$$P_{400} = b_0'' + b_1 W_{400}' + b_z'' Z + u'' , \tag{7a}$$

$$P_{100} = b_0' + b_1 W_{100}' + b_z' Z + u' . \tag{7b}$$

Subtracting (7b) from (7a) results in equation (7), where

$$b_0 = b_0'' - b_0'; \; \Delta W' = W_{400}' - W_{100}'; \; b_z = b_z'' - b_z'; \text{ and } u = u'' - u' .$$

6. We are indebted to Charles Brown for this suggestion.
7. For reasons discussed earlier, fringe benefits except "paid days off" were added to the salary variable.

References

Allen, Steven G. 1981. Compensation, safety, and absenteeism: Evidence from the paper industry. *Industrial and Labor Relations Review* 34: 207–18.

Blinder, Alan S., Roger H. Gordon, and Donald E. Wise. 1979. Market wages, reservation wages, and retirement decisions. Paper read at the NBER Workshop on Social Security, 28–29 December 1979, Stanford University. Mimeo.

Ehrenberg, Ronald G., and Robert S. Smith. 1981. A framework for evaluating state and local government pension reform. In *Public sector labor markets*, ed. Peter Mieszkowski and George Peterson. COUPE Papers on Public Economics, no. 4. Washington, D.C: The Urban Institute Press.

Lazear, Edward P. 1979. Why is there mandatory retirement? *Journal of Political Economy* 87: 1261–84.

———. 1981. Agency, earnings profiles, productivity, and hours restrictions. *American Economic Review* 71: 606–20.
Smith, Robert S. 1981. Compensating differentials for pensions and underfunding in the public sector. *Review of Economics and Statistics* 63: 463–68.

Comment

Charles Brown

Smith and Ehrenberg have brought an interesting source of data (compensation information from a major compensation consulting firm) to an interesting question (do workers pay for fringe benefits by receiving lower wages?). The paper is, in my view, no less interesting because the results do not support the theoretical model, which predicts that fringe benefits will generate compensating differentials in the wage rate.

The theory outlines an interesting special case of the general compensating differentials model. If one neglects the impact of pensions on worker productivity, etc., *each* firm's isoprofit curve for wages and pensions has a slope of minus one. Thus, in equilibrium the observed wage-pension locus will also have a slope of minus one, even though workers are not continually indifferent between equally costly wage-pension mixes.

Once the restriction that pensions have no effect on productivity is relaxed, this strong conclusion no longer holds. Indeed, with linear isoprofit curves with different slopes, the market wage-pension locus will be convex. This may establish a *loose presumption* that the market locus will be convex if not linear, but (as Smith and Ehrenberg indicate) this is not a *necessary* result without further assumptions. If individual isoprofit curves are concave, the market wage-pension curve could be concave too.

My comments on the empirical work fall into two groups. The first group concerns what they did to test their hypothesis. These are minor points, in the sense that they do not lead me to doubt their basic finding. I then consider why they didn't find the hypothesized trade-off between wages and fringes.

In estimating this locus, they use an instrumental variable estimate $\hat{P}$ instead of actual pension expense P, in order to remove the "technical" dependence of P on W. Unfortunately, this does not remove all correlation between P and the error term in equation (1). Smith and Ehrenberg clearly recognize this but don't explain why it is so: Part of this error term corresponds to omitted worker quality, and this is surely correlated with

Charles Brown is associate professor of economics, University of Maryland, College Park, and a research associate of the National Bureau of Economic Research.

the pension characteristic Z's in equation (2). This is why differencing across Hay Point levels is necessary and omitted quality problems assume a large role in the discussion at the end of the paper.

The specification with $\Delta \ln W$ as dependent variable (eq. [10]) is preferable to that using ΔW (eq. [6]) apart from the handling of the firm-specific effects (which the authors emphasize). Equation (6) assumes that $\partial W/\partial F$, the earnings loss from each day off, is constant at different salary levels. Equation (10), in contrast assumes that $\partial \ln W/\partial f$ is constant, where f is the ratio of vacation cost to wages. If workers are in fact paid for the time they work, $\partial W/\partial F$ equals minus the daily wage (and cannot be constant across job levels), but $\partial \ln W/\partial f$ will equal -1 (see eq. [8]) at all job levels. Unfortunately, as table 10.4 (which uses eq. [10]) shows, my "preferred" specification only shows that neither $a_1 = -1$ *nor* $a_f = -1$ are supported by the data.

Finally, if the firm effects ($a_M M$ in eq. [3]–[4] or ϕM in eq. [9]) are really fixed across job levels, deviating all variables from their firm-specific means and estimating the model with the transformed data would give us single estimates of a_1 and a_f, rather than the trio of nonindependent estimates in tables 10.3 and 10.4. This "pooling" should give slightly tighter standard errors than does differencing, since each differenced equation leaves out the information for one job level. This would not alter the basic conclusions (though it might allow us to reject $a_1 = -1$ or $a_f = -1$ more decisively than the standard errors in table 10.4 permit).

What went wrong? If one thinks the compensating differentials hypothesis is plausible (as I do), why is there so little evidence for it in the data?

The compensating differential hypothesis is usually supported with the argument that a firm which has a good pension, generous vacations, and the like will be able to pay a lower wage (to attract a given quality of labor). A more institutional story is that a firm which offers a good pension and high wages gets the "pick of the litter" of job applicants; only firms offering equally attractive pension-wage packages will end up with comparably able workers. This rephrasing makes it clear that unions, custom, or other institutional forces *do not* undercut what I take to be the essential prediction of the compensating differential argument, whatever their effect on wage flexibility may be.

This rephrasing also makes more apparent the plausibility of Smith and Ehrenberg's suggestion that omitted worker characteristics are important. If we were to fix P and W with the sort of positive correlation we observe, and told *each* firm to hire the best workers it could attract, we might still find no evidence of a negative relationship between P and W among "comparable" workers—unless we knew (nearly) all the characteristics firms use in choosing among workers. Even with the easily observed personal characteristics, such as schooling or age-experience, we would still have workers who are equivalent to the researcher but not equivalent to firms. Indeed, it may well be higher levels of effort (or "esprit de corps," Clague 1977) rather than of worker quality that firms offering the best compensation packages are buying. If so, the omitted variable problem could be murderous even with ideal measures of worker quality.

A second explanation is based on the fact that, after differencing across job levels in a sample of firms, the estimates are based on comparisons across job levels in the same firm. Is there really any reason to think, if firms have relatively stable promotion ladders, that the theory should hold at each job level rather than over a career? Suppose P_{400} is high in one firm relative to others. Should I expect W_{400} to be low? Or should I expect $P_{100} + W_{100}$ to be lower? Suppose one "pays" for the prospect of generous pension additions as a 400-level worker by accepting lower *wages* as a 100-level worker. Then $W_{400} - W_{100}$ will be positively correlated with $P_{400} - P_{100}$, even if there are no variations in worker quality and the theory is, in a fundamental sense, true. This is consistent with Lazear's (1979) argument that compensation can differ systematically from marginal product, with young workers underpaid and old workers overpaid. Schiller and Weiss (1980) suggest a cross-age adjustment of this sort in discussing their rather mixed findings for pensions and wages.

Unfortunately, this explanation will not persuade the noneconomist Smith and Ehrenberg mention in their introduction. He will recognize what we're saying: The theory is so true that we can't show you any evidence for it! This is not *quite* true—in principle, the problem could be solved with whole career data on pensions and wages. But the very real problems one points to when one gets wrong-signed estimates leaves on wondering whether the *magnitude* of right-*signed* coefficients in the literature shouldn't be viewed more skeptically.

References

Clague, Christopher. 1977. Information costs, corporate hierarchies, and earnings inequality. *American Economic Review* 67: 81–85.

Lazear, Edward P. 1979. Why is there mandatory retirement? *Journal of Political Economy* 87: 1251–84

Schiller, Bradley R., and Randall D. Weiss. 1980. Pensions and wages: A test for equalizing differences. *Review of Economics and Statistics* 62: 529–37.

This Page Intentionally Left Blank