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TAXES, FRINGE BENEFITS AND FACULTY

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ABSTRACT

The growth of employee benefits in academe has closely paralleled their economy-wide growth. This study estimates a complete system describing the demand for benefits and wages using panel data on nearly 1500 institutions of higher learning. The demand for benefits is quite responsive both to changes in real income and to variations in the tax price of benefits. These conclusions are robust with respect to varying definitions of the sample and of the tax price. They are not altered by estimates that account for unmeasured individual effects on demand. Simulations using the estimates suggest that the Tax Reform Act of 1986 sharply reduced the demand for benefits. Extrapolating the impact to the entire economy suggests that the annual flow of compensation shifted away from benefits by at least $9 billion.

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I. Introduction

Salaries received by academics have attracted much attention from economists and others.[1] Yet amid all of that attention no study has examined the pecuniary nonwage benefits received by university and college faculties. This is especially surprising given our interest in studying our economic situation, both as a microcosm of broader labor markets and as a matter of immediate personal concern to us. Is the determination of employee benefits different in academe from elsewhere? If not, can we learn anything from it that is generally applicable?

A substantial literature has arisen studying the role of pecuniary benefits in compensation. These benefits have increased in importance in the past forty years. Their growth and, more generally, workers' interest in them, has been attributed to changing preferences of employees (Lester, 1967); changing tax laws (Long and Scott, 1982; Woodbury, 1983); the role of unions (Freeman, 1981); scale economies in their provision (Mitchell and Andrews, 1981), and to miscellaneous other sources. These potential causes have been studied using aggregate time-series data, and using cross-section data reflecting either aggregates or, in a few cases (for example, Woodbury, 1983, and Sloan and Adamache, 1986), microeconomic units.

The general approach has been to model pecuniary benefits as being traded off by workers subject to the employer's budget constraint on total compensation. The terms of the trade-off depend on the tax price of benefits, and the demand for benefits is shifted by factors thought to cause parallel shifts in the constraint and by other effects on workers' preferences. While the results demonstrate the correlation of taxes and the share of benefits in total compensation, they have several problems. One less important issue is the divorce in most studies

between the level at which choices are made and the aggregate levels at which most studies examine the results of those choices. Decisions that result in nonlinear relationships at the micro level are examined using aggregate data, with little attention to what might be lost by aggregation

A more serious problem is the lack of unanimity in the literature about the appropriate measure of the price of benefits. The most important difficulty, though, is the inability of all previous research to extricate workers' preferences from differences in prices and incomes. The problem is inherent in any cross-section or time-series study of demand; but it is especially severe in the consumer-theoretic approach to choices where relative prices are explicitly a nonlinear function of income because tax rates are a function of income. The estimation of price effects on employee benefits is a good example of this difficulty; estimating demand elasticities for charitable giving (Clotfelter, 1985) is another.

This study of college and university professors' demand for nonwage benefits offers solutions to these difficulties. Because the data describe outcomes at individual campuses, problems of overaggregation are obviated. We use a variety of measures of the tax price of benefits. By using a panel of campuses, we can determine whether any relationship between incomes (and tax prices) and the demand for benefits is real or instead results from the correlation of worker preferences for benefits with incomes and prices. Before analyzing faculties' demand for benefits formally, we first study the growth and structure of benefits in higher education compared to the broader labor market. This comparison answers the question whether, at least in terms of outcomes, the academic labor market is typical of labor markets

generally, and thus whether analyzing the determination of benefits in academe can be more than a case study.

The data we use cover cross sections before and after the Tax Reform Act of 1986. The TRA offers a natural experiment that allows us to infer the impact of taxes on the demand for benefits in academe and perhaps in labor markets more generally. Also, the 1980s have seen very rapid growth in the relative price of employer-provided health insurance. We use our results to infer how that increase has affected the structure of compensation.

II. Faculty Benefits --- Developments and Comparisons

Differences in measurement practices across sets of data, and within those sets over time, make it difficult to infer whether the growth of benefits in academe is similar to that in the rest of the economy. The data on faculty come from annual surveys conducted by the American Association of University Professors (AAUP). The problem with comparing these surveys over time is that the sample size has grown greatly. Data on the broader labor market also present problems. A leading private survey (Chamber of Commerce, 1989) provides excellent detail on benefits by type; but like the AAUP data, its scope grew greatly during the postwar period. Also, the survey has always been based on larger firms. Fortunately, the national income and product accounts (NIPA) provide a comprehensive measure of nonwage compensation whose definition has changed little over the years. If benefits in academe are not determined too differently from the rest of the economy, the NIPA data should show similar trends to the AAUP data.

Throughout we define benefits as the sum of voluntarily provided nonwage payments plus legally mandated nonwage payments. This definition differs from that in most studies (which include only voluntarily

provided benefits); we account for the difference in our formal analysis. Table 1 presents the percentages of benefits in total compensation at four-year intervals since 1960. Column (1) presents the AAUP data for faculty; column (2) lists the percentages for large firms in the Chamber of Commerce survey; and column (3) shows the percentages from the NIPA. Like the other data, the AAUP data exclude time off with pay, so that total benefits are clearly a greater share of compensation than the Table indicates. Also, beginning with the 1984-85 data the AAUP survey included retirement contributions whether vested or not, perhaps explaining the sharp increase in the share of benefits between 1980-81 and 1984-85.

The most striking feature is how closely the growth of benefits in academic pay tracks that in the other series during this twenty-eight year period. Even the levels are now quite close. Benefits were a much greater percentage of compensation at the start of the period in the Chamber of Commerce data, reflecting the early restriction of that survey to very large firms. By 1988, though, the expansion of that survey and the growth of faculty benefits had removed most of the differences. Despite the differences and changes in definitions, the growth in benefits paid to faculty members mirrors almost perfectly the similar growth in the share of benefits in total compensation outside of academe. Indeed, even the sudden halt in the relative growth of benefits that occurred nationally in the late 1980s is reflected in the data covering faculty members.[2]

What employee benefits are received by faculty, and how has their relative importance changed? We obtained a short time series of data detailing the structure of benefits at a major public university.[3] This information is shown in Table 2. Medical and retirement benefits

Table 1. Benefits as a Percent of Compensation, Faculty, Large Companies and National Income Accounts, 1960-88

	Faculty[a]	Large Firms[b]	National Income Accounts[c]
1960-61	6.07	12.82	7.92
1964-65	7.05	12.66	8.68
1968-69	9.38	14.31	9.99
1972-73	11.18	16.67	12.28
1976-77	13.26	18.96	14.60
1980-81	15.38	19.29	15.47
1984-85	18.12	19.87	17.01
1988-89	18.49	19.42	16.46

[a]For the academic year; all schools with professorial ranks, AAUP Bulletin, Academe, selected years.

[b]For the calendar year 1961, ..., 1985, and 1988; from U.S. Chamber of Commerce, Employee Benefits, selected issues. The data exclude payments for time not worked, such as vacations, paid holidays, personal days, etc.

[c]For the calendar year 1961, ..., 1985, same source as b, and 1988, Survey of Current Business, July 1989.

(both legally mandated FICA and employer-paid TIAA-CREF contributions) constituted 94.9 percent of total benefit costs in 1988-89. This compares quite closely to the 90.1 percent among large firms in the Chamber of Commerce survey in 1987. The other benefits over which so much discussion occurs --- subsidized tuition for faculty children, employer-subsidized life insurance, and others --- are relatively unimportant at this particular institution.

The obvious trend in these data is the increasing share of benefit costs allotted to medical/dental insurance. Again, the faculty experience parallels that elsewhere. The second column of Table 2 shows the percentage of total employer contributions to private pension and welfare plans in the NIPA data that is accounted for by contributions to group health plans. It is clear that health insurance is an increasing fraction of benefit costs, and that the rate of increase has been especially pronounced in the 1980s.

Taken together, the data on faculty compensation and the comparisons with other surveys suggest that faculty benefits are remarkably similar to those elsewhere in the economy. Although we cannot be certain that the structure of demand for benefits in academe is typical, we can be fairly sure that the levels, growth and structure of benefits are not unusual.

III. Theory and Data

Since benefits are only rarely determined on an individual basis, implicit in any model of benefits must be some social welfare function defined over the members of the work group in the particular establishment, firm or set of firms. We do not examine the source of this function; instead, we take it as predetermined. Workers in the group face the university's budget constraint, which is more or less tilted

Table 2. Trends in Employee Benefits by Type, a Major Public University, and Employer Contributions in the National Income Accounts, 1960-1988

Academic or Calendar Year	Percentage Distribution, One Public University				NIPA, Medical Percentage of Total Private Funds
	Health and Dental Insurance	Retirement	FICA	Other	
1960					30.8
1964					33.7
1968					33.9
1972					38.2
1976					40.9
1980-1981	24.3	38.3	29.5	7.9	43.6
1984-1985	32.5	32.8	27.9	6.8	53.8
1988-1989	36.0	32.1	26.8	5.1	59.1

Sources: Private information, Michigan State University, Employee Benefits Office. Bureau of Economic Affairs, National Income and Product Accounts of the United States, 1929-82, Table 6.13; and Survery of Current Business, July 1988 and July 1989, Table 6.13.

toward offering benefits the lesser or greater is the relative cost of offering those benefits. Relative costs will be affected by any heterotheticity in the production of benefits versus straight wage payments and by any tax advantages to the employer.

We thus assume that workers maximize this social welfare function subject to the total bargained compensation, the relative costs to the employer of providing wage and nonwage compensation, and the prices of each that face the typical worker.[4] We assume these choices are based on a utility function that generates a system of demand equations for fringe benefits (F) and wages (W):

$$(1) \quad s_{it} = \alpha_{it} + \beta_i \ln\left(\frac{C_t}{P_t}\right) + \gamma_i \ln\left(\frac{p_{it}}{p_{jt}}\right) + \delta_i X_t + \mu_{it} \; ; \; i = F, W \; ,$$

where the α, β, γ and δ are parameters; i and j index types of compensation; s_i is the share of the i'th form of compensation in net (after-tax) total compensation, C; p_i is the price of the i'th form of compensation; μ is an error term with mean zero and variance σ_μ^2; X is a vector of other measurable characteristics of the employer and the workers, and t denotes the year. This system is defined in terms of the <u>shares</u> of benefits and wages in total compensation; but the parameter estimates allow us to infer the effects of price and income changes on the <u>amount</u> of benefits that employees demand.

Equation system (1) is Deaton and Muellbauer's (1980) almost ideal demand system (referred to henceforth here as the DM system).[5] The system (1) is general enough to allow for heterotheticity of the preference function and for substantial flexibility in the implied substitution between benefits and wages. It is also econometrically tractable and provides estimates of demand (income and relative price)

elasticities. For ease of estimation we follow Deaton and Muellbauer's suggestion and assume $\ln(P_t) \cong \Sigma s_j \ln(p_{jt})$.

The error term μ_{it} can be decomposed into:

(2) $\mu_{it} = \epsilon_i + \nu_{it}$,

where the ϵ_i and ν_{it} have zero means and variances σ^2_ϵ and σ^2_ν respectively. The ϵ_i in (2) reflect two sets of unmeasurable characteristics that remain constant over time for a particular observation. The first is the idiosyncratic nature of preferences for benefits that causes workers in a particular institution to seek above- or below-average benefits given their compensation and the relative prices they face. The second is the technology for producing benefits and wages that is unique to the employer and not captured in the vector X. To the extent that ϵ_i is correlated with relative prices or with C, failure to account for the <u>fixed</u> individual effect will generate biased estimates of the parameters.

The concern about the structure of the error term is not idle. A faculty that has traded off compensation for nonpecuniary benefits, and thus whose observed C is unexpectedly low, is also likely to have unusual tastes for nonwage monetary benefits compared to wages. Similar arguments can be made about the employer's technology for paying benefits or wages; and the same sorts of worries should pervade the interpretation of any previous cross-section study of the determination of benefits. To examine this concern, substitute (2) into (1) and, assuming there are two years in the sample, difference the result:

$$(3) \quad \Delta s_i = [\alpha_{it} - \alpha_{it-1}] + \beta_i \Delta \ln\left(\frac{C}{P}\right) + \gamma_i \Delta \ln\left(\frac{P_i}{P_j}\right) + \delta_i \Delta X_i + \Delta \nu_i \; ; \; i = F, W \; .$$

Equation (3) provides "within" estimates of the parameters β, γ and δ (Judge et al, 1980). Any change in these estimates from the cross-section estimates of (1) indicates the importance of the correlation of the unobservables with relative prices and compensation. It thus provides a very stringent test of the demand model.

A welter of issues relating to the taxes consumers face clouds the calculation of the appropriate relative price measure, $\frac{P_F}{P_W}$. Do we assume that the median faculty member in an institution is single or married? How many dependents does this person have? What other income (beyond the academic-year salary) affects the marginal tax rate paid, and thus the relative price of benefits? Most important, what taxes do we consider?

We answer the first question by calculating the marginal and average tax rates facing the median faculty member under the alternative assumptions that he or she is single, or is married with two children. In both cases we calculate the sum of the federal and state marginal income tax rates, t_f and t_s, using, e.g., the tax schedules for 1984 for salaries in the 1984-85 academic year.[6] We assume in all cases that the academic-year salary is the only income received by the median faculty member. This is clearly incorrect; but the error it induces is at least partly offset by the conservative assumption that the faculty member takes only the standard deduction.[7]

The biggest problem is the treatment of the payroll tax for OASDHI. For both single and joint income tax schedules we estimate the DM system using three alternative approaches. The first simply assumes that workers receive an actuarially fair return on all Social Security contributions and calculates:

$$(4a)\quad \frac{P_F}{P_W} = 1 - t_f - t_s \ .$$

The second recognizes that this tax can be substantial and that it does not apply to benefits. It implicitly assumes further that employers either bear their share of the tax, or that workers bear the entire tax and expect that they will receive benefits with a present value equalling fifty percent of the total tax paid. It thus sets:

$$(4b)\quad \frac{p_F}{p_W} = 1 - t_f - t_s - t_{ss}\ ,$$

where t_{ss} is the marginal OASDHI tax rate on the worker.[8] The final approach assumes that the worker bears the entire tax and assumes that the present value of any future benefits is zero. The relative price is then:

$$(4c)\quad \frac{p_F}{p_W} = \frac{1 - t_f - t_s - t_{ss}}{1 + t_{ss}}\ .$$

Associated with each tax scheme is a different computation of s_F that results from the assumptions about what is to be included in the tax price of benefits. For the first tax scheme we compute the net salary as the actual salary less the federal and state tax bill. Under the second and third tax schemes we assume that the net salary equals the actual salary minus the sum of the federal, state and (the worker's share of) OASDHI taxes. Net compensation C is computed as compensation (salary plus reported employer-paid benefits) minus this tax bill minus the employer's share of OASDHI taxes. Thus in estimating (1) both s_F and C as well as the $\frac{p_F}{p_W}$ vary with the assumptions made about taxes.[9]

The demand system (1) is based on the assumption that there are no constraints on workers' and schools' joint maximization other than the given total compensation. That assumption is invalidated by the requirement that all private schools, and many public institutions too during our sample period, were required to pay taxes into the Old Age Survivors, Disability and Health Insurance (Social Security) system. For some schools this may have increased the amount of benefits bought

beyond what would have been freely chosen. We cannot observe which schools are covered by OASDHI. To account at least in part for this problem, though, and to prevent biases in the estimates of the β and γ, we include in the vector X for each public school a measure of the fraction of public employees in each state who are covered by OASDHI. An increase in this fraction will increase the benefit share so long as OASDHI coverage is a binding constraint on choices about alternative forms of compensation.[10]

The data on salaries and benefits were obtained for the academic years 1984-85 and 1988-89 from the AAUP. For nearly thirty years these data have been collected for the AAUP in a mail survey with follow-up. They cover academic-year payments to instructional faculty. Benefits include employers' contributions to retirement, medical insurance, disability insurance, life insurance, FICA, worker's compensation and unemployment insurance, tuition, and some in-kind benefits. Measured gross (pre-tax) compensation, is the sum of reported salaries plus the monetary cost of benefits. The 1984-85 data were for a sample of 2071 two- and four-year institutions; those for 1988-89 covered 1729 institutions. We formed a panel of 1477 schools that appeared in both sets of data and that were located in the fifty states or the District of Columbia.

Table 3 shows some of the characteristics of schools in the panel for 1988-89, for the total sample and for disaggregations by category of school and type of control. Benefits form a substantial fraction of compensation in all categories of institution and under all types of control. The share of benefits is among the highest in private, doctoral-level schools, where the average salary is also highest; it is lowest in private and church-controlled two-year colleges, where

Table 3. Weighted Means and Standard Deviations of Benefit Share and Salary, By Category and Type of Control, 1988-89

Category		Control: Public	Private	Church	All Control
Doctoral level	s_F	17.96 (2.94)	19.14 (2.21)	18.38 (2.64)	18.2 (2.76)
	Salary	$43,051 (5,961)	50,532 (6,571)	43,374 (4,401)	44,461 (6,769)
	N	115	43	13	171
Comprehensive	s_F	18.50 (3.30)	19.08 (2.54)	18.76 (4.70)	18.61 (3.45)
	Salary	$38,044 (5,580)	37,650 (6,753)	35,349 (5,236)	37,741 (5,916)
	N	210	78	64	352
General Baccalaureate	s_F	18.29 (3.41)	19.02 (3.10)	18.14 (4.37)	18.47 (3.81)
	Salary	$33,688 (4,070)	35,094 (7,198)	29,809 (4,616)	32,626 (5,965)
	N	106	177	261	544
Two-year Colleges	s_F	19.25 (3.53)	16.98 (4.06)	17.17 (3.02)	19.20 (3.60)
	Salary	$32,546 (5,233)	23,450 (2,978)	22,570 (3,076)	32,346 (5,553)
	N	380	18	12	410
All Categories	s_F	18.36 (3.39)	19.077 (2.99)	18.33 (4.35)	18.48 (3.57)
	Salary	$39,240 (6,627)	43,006 (9,275)	33,568 (9,275)	39,299 (7,444)
	N	811	316	350	1477

salaries are lowest. This is an initial indication either that there are relative price effects, or that the demand for benefits does not have a unitary income elasticity.

Despite the limitation of our samples to college and university faculty, variations in earnings and in state tax laws generate substantial variation in the marginal tax rates facing the median faculty member. Table 4 shows that this is especially true if we use the single-taxpayer schedule. Even if we apply tax schedules facing joint filers, though, the range of tax rates is substantial. The data also show that the Tax Reform Act reduced the variance of tax rates across institutions. Even in 1988-89, though, the range is nearly as wide as the mean value, and the coefficients of variation that are implied by these statistics are actually higher than in 1984-85. By reducing the average marginal tax rate it also, of course, raised the average $\frac{p_r}{p_w}$.

The AAUP data contain some of the information on the institutions' characteristics that is necessary to construct variables in the vector X. In order to distinguish differences resulting from faculty preferences from those arising from different costs facing the employer, we include from this source: 1) A set of three dummy variables indicating the level of the institution --- doctoral level, comprehensive universities, and four-year colleges. (The excluded category is two-year colleges.) 2) A dummy variable for public control of the institution. (The excluded category is private or church control.) 3) The size of the faculty. This is designed to reflect any economies of scale in the provision of benefits (see Mitchell and Andrews, 1981).

There is substantial evidence (Lewis, 1986) that unions' effects on benefits exceed those on wages. That being so, we obtained data on the collective-bargaining status of each faculty in January 1984 and January

Table 4. Marginal Tax Rates Facing the Median Faculty Member, 1984-85 and 1988-89, Means, Standard Deviations, and Ranges

Tax Scheme:	Academic Year: 1984-1985	1988-1989
Single	.420	.394
	(.055)	(.041)
	(.277, .578)	(.225, .495)
Joint	.336	.278
	(.055)	(.045)
	(.220, .513)	(.211, .431)

1988, and formed a variable indicating whether the campus was unionized.[11] There is also some evidence (Ichniowski et al, 1989) that the extent of unionism and the general pro- or anti-union atmosphere in a labor market has an effect on compensation that is independent of whether the particular workplace is unionized. This suggests including in (1) some wider measure of pro-union sentiment in the labor market where the school is located. We include the fraction of public-school teachers in the state in 1982 who were unionized.[12] The final dummy variable in the vector X indicates location in the South. Wages, and probably compensation too, are lower in the South, other things equal (Johnson, 1983). Accordingly, at a given value of compensation faculty in a southern school have a higher real income. Assuming their preferences do not differ from those of their northern counterparts, we should expect that the share of benefits in their compensation will be higher if the income elasticity of demand for benefits exceeds one.[13]

IV. Estimates of the Demand System

Table 5 presents the estimates of equation (1) for the share of benefits, s_r. We make the standard assumptions of symmetry and homogeneity, so that only N-1 (= 1) of the share equations need be estimated. The estimates are shown for the tax scheme represented by (4b) for each of the two academic years and for the differenced data as described in equation (3). Before discussing the central parameters of interest, β and γ, consider the the results on the control variables. The share of benefits is smaller in larger institutions, though the effect is not large compared to the standard deviation of the size of faculties. Moreover, the effect disappears in the estimates using the differenced data.

Table 5. Estimates of the DM Demand for Benefits, 1984-85, 1988-89 and Differenced Data[a]

	Sample and Tax Scheme					
	1984-85		1988-89		Differenced	
Variable	Single	Joint	Single	Joint	Single	Joint
Constant	-1.948	-1.804	-1.715	-1.467	-.074	-.067
	(.058)	(.061)	(.051)	(.052)	(.002)	(.003)
log (p_f/p_w)	-.151	-.123	-.146	-.095	-.277	-.222
	(.012)	(.014)	(.014)	(.016)	(.013)	(.015)
log (C/P)	.211	.194	.184	.157	.324	.275
	(.006)	(.006)	(.005)	(.005)	(.009)	(.010)
Public Sector OASDHI Coverage	.010	.008	.010	.010		
	(.003)	(.003)	(.003)	(.003)		
Faculty Size (thousands)	-.021	-.020	-.025	-.022	-.002	-.014
	(.006)	(.006)	(.005)	(.005)	(.019)	(.020)
Doctoral Level (or Change in Category)	-.040	-.038	-.039	-.034	.004	.004
	(.006)	(.006)	(.005)	(.005)	(.002)	(.003)
Comprehensive Universities	-.028	-.027	-.022	-.022		
	(.003)	(.003)	(.003)	(.003)		
Four-year Colleges	-.013	-.012	-.013	-.013		
	(.003)	(.003)	(.003)	(.003)		
Teachers Unionized (fraction)	.032	.040	.021	.030		
	(.007)	(.007)	(.007)	(.007)		
Faculty Unionized	.002	.003	-.008	-.008	-.001	.001
	(.003)	(.003)	(.003)	(.003)	(.008)	(.008)
South	.013	.014	.010	.013		
	(.003)	(.003)	(.003)	(.003)		
Public Control	.008	.008	-.004	.003		
	(.003)	(.003)	(.003)	(.003)		
R^2	.566	.513	.525	.441	.493	.355

[a]Standard errors in parentheses, here and in Tables 6 and 7.

We have no good explanation for this finding; it is, though, the only anomalous result we obtain for the variables in X. The positive effect of location in the South on s_F is as predicted by our argument that equal nominal compensation in the South implies higher real compensation there. Once unionization and the level of the school are held constant, whether the institution is publicly or privately controlled has no effect on the share of benefits in total compensation. The coefficients on the dummy variables show clearly that the share of benefits decreases steadily as the level of the school increases, other things equal. This effect too disappears in the estimates based on the differenced data (though the paucity of observations on schools that change category makes this inference unreliable).

The results on the two unionization variables are interesting and somewhat surprising. The share of benefits was (insignificantly) larger on campuses with collective bargaining for faculty in 1984-85, but it was (significantly) lower in 1988-89. Moreover, the results for the differenced sample show that there is no effect of changing collective-bargaining status on the share of benefits (though again, very few campuses changed status). These results are consistent with findings in other studies (Freeman, 1978; Barbezat, 1989) that the average pay of unionized faculty differs little from that of their nonunion counterparts. Teacher unionization in the entire state where the campus is located does matter: Moving from the least to the most heavily unionized state (an increase from 14.6 to 100 percent) would raise the share of benefits in otherwise identical schools by 2.7 percentage points (based on the results using the single taxpayer's schedule for 1984-85). This represents an increase of roughly 15 percent. The spillover effects of unionization on the demand for

benefits by faculty members are far more important in this sample than is the union status of the particular institution.

A greater likelihood that a public university is covered by OASDHI increases the benefit ratio at that campus. Comparing schools where no state employees are covered to ones where coverage is universal, we see that the ratio is increased by about 1 percentage point (roughly 5 percent). This result is consistent with our argument that total benefits provided under the mandatory coverage of the OASDHI system exceed what workers and firms agree upon in the absence of coverage: Mandatory OASDHI coverage shifts compensation further in the direction of benefits than would occur under purely atomistic behavior.

The most striking results are those on the relative price and compensation variables. For both 1984-85 and 1988-89 the coefficients of the price variables are significantly negative and quite close in magnitude. The same conclusion holds for the compensation measure. Benefits are clearly a luxury good; and the share of benefits is clearly responsive to the tax price of benefits in these two cross sections of microeconomic data.

The significance and signs of the price and income terms are robust to inclusion of school-specific fixed effects: The results for the differenced data also show very significant price effects and heterothetic preferences (with benefits being relatively preferred as compensation increases). Indeed, their magnitude is larger than in the cross section. At the very least, the results show that the importance of the tax price in these samples (and perhaps elsewhere in the literature) is not an artifact produced by unobservable individual effects.

Table 6 presents various price and income elasticities based on the estimates shown in Table 5. In the DM system with just two commodities

Table 6. Estimates of Substitution, Income and Uncompensated Price Elasticities, 1984-85, 1988-89 and Differenced Data

	1984-85		1988-89		Differenced	
	Single	Joint	Single	Joint	Single	Joint
Parameter						
σ_{WF}	2.053	1.912	2.008	1.697	2.912	2.641
	(.282)	(.263)	(.253)	(.203)	(.382)	(.351)
η_{FF}	-2.080	-1.958	-2.013	-1.741	-2.901	-2.651
	(.290)	(.265)	(.257)	(.214)	(.396)	(.359)
η_{WF}	0.228	0.184	0.218	0.144	0.405	0.318
	(.033)	(.029)	(.031)	(.058)	(.042)	(.034)
η_{FC}	2.210	2.201	2.039	1.970	2.846	2.701
	(.395)	(.395)	(.307)	(.288)	(.458)	(.431)
η_{WC}	0.744	0.769	0.776	0.812	0.607	0.672
	(.019)	(.016)	(.015)	(.012)	(.023)	(.020)

the estimated elasticity of substitution between wages and benefits is:

$$\hat{\sigma}_{WF} = \frac{-\hat{\gamma}_F}{\hat{s}_F[1 - \hat{s}_F]} + 1 .$$

The uncompensated price elasticities are estimated as:

$$\hat{\eta}_{FF} = \frac{\hat{\gamma}_F - \hat{\beta}_F\hat{s}_F}{\hat{s}_F} - 1 ,$$

and

$$\hat{\eta}_{WF} = \frac{-\hat{\gamma}_F + \hat{\beta}_F\hat{s}_F}{\hat{s}_W} .$$

The income elasticities are:

$$\hat{\eta}_{FC} = 1 + \frac{\hat{\beta}_F}{\hat{s}_F} ,$$

and

$$\hat{\eta}_{WC} = 1 - \frac{\hat{\beta}_F}{\hat{s}_W} .$$

The standard errors of these estimates are estimated based on the variance and covariances of the $\hat{\gamma}_F$ and $\hat{\beta}_F$ and on the fitted shares of benefits and wages.

The income elasticities make it clear that benefits are a "preferred form of compensation." While the magnitudes vary, the income elasticities in these samples of faculty cluster around two. These effects are quite independent of any correlation of prices with compensation that is induced by progressive income tax schedules. The estimated uncompensated price elasticities demonstrate that the demand for benefits is price elastic. Changes in income taxes induce a change in the relative price of benefits and wages that in these samples generates substantial substitution between wages and nonwage compensation.

As the final two columns in Table 6 show, the highly price- and income-elastic demand for benefits is not an artifact of omitted unobservables. In the differenced data the results are even stronger than in the cross sections. At least for this fairly homogeneous sample of workers observed at the workplace level, which is the appropriate unit of observation, the price of benefits affects the demand for them.

The demand is also clearly heterothetic, even accounting for differences in preferences that may be correlated with unmeasured differences in faculty members' characteristics.

The estimates of these parameters are remarkably robust to various changes in the assumptions that we have made. Using the measures of the tax price of benefits in (4a) or (4c) instead of that in (4b) makes little difference. For example, using the tax schedules for single taxpayers, and estimating the model based on the 1984-85 data, we find that $\hat{\eta}_{FF}$ is -2.07 if tax scheme (4a) is used, and is -2.13 if tax scheme (4c) is used. These are virtually identical to the estimate in Table 6. Similarly, suppose that, instead of the Deaton-Muellbauer demand system, one characterizes the demand for benefits and wages by a heterothetic translog approximation. This too produces only minor changes in the results. Again taking η_{FF} as an example, the estimate for 1984-85 becomes -2.29.

These price and income elasticities differ little from those obtained by Woodbury (1983) using data covering a cross section of school districts. They are, though, somewhat higher than most of the estimates of the effect of prices (through taxes) and incomes on the supply of charitable contributions, a subject that poses related issues. Even there, though, many of the estimates summarized by Clotfelter (1985, Table 2.12) indicate the demand is price-elastic, and a few suggest the demand is income elastic too.

Are there differences in the sensitivity of faculty members in different types of institutions to changes in the tax price of benefits? Table 7 presents the estimates for 1984-85 of the same five parameters shown in Table 6. These are based on the tax scheme in (4b) and use the single taxpayers' schedule. There are few significant differences

Table 7. Estimates of Substitution, Price and Income Elasticities for Various Subsamples[a]

Subsample	σ_{WF}	η_{FF}	η_{WF}	η_{FC}	η_{WC}
Public Institutions	2.451	-2.390	0.310	2.117	0.751
	(.339)	(.350)	(.038)	(.324)	(.020)
Public Institutions, excluding 2-year	2.800	-2.734	0.387	2.530	0.659
	(.409)	(.422)	(.048)	(.436)	(.027)
Private Institutions	1.714	-1.817	0.161	2.341	0.736
	(.247)	(.244)	(.035)	(.494)	(.021)
Private Institutions, excluding 2-year	2.092	-2.106	0.217	2.176	0.769
	(.285)	(.288)	(.030)	(.356)	(.017)
All Institutions, excluding 2-year	2.296	-2.284	0.267	2.227	0.745
	(.315)	(.325)	(.033)	(.365)	(.018)
Doctoral-Level Institutions	2.485	-2.441	0.333	2.252	0.711
	(.318)	(.318)	(.045)	(.317)	(.030)
Comprehensive Institutions	2.795	-2.731	0.380	2.442	0.683
	(.443)	(.456)	(.049)	(.439)	(.027)
General Baccalaureate Institutions	2.081	-2.118	0.215	2.310	0.748
	(.295)	(.295)	(.033)	(.398)	(.018)
Two-Year Institutions	1.607	-1.722	0.157	2.254	0.728
	(.245)	(.230)	(.043)	(.465)	(.026)

[a]Estimates throughout are from the 1984-85 cross-section using the single taxpayer's schedule.

among the various types of institutions; but the demand for benefits by faculty in two-year institutions responds significantly less than that of their counterparts in comprehensive institutions. Perhaps somewhat surprisingly, the demand for benefits in public institutions is significantly more elastic than that in private schools. No matter which category of institution we choose, though, the demand for benefits is highly price- and income-elastic.

V. Simulating the Effects of Tax and Other Changes

The Tax Reform Act of 1986 sharply reduced the marginal tax rate facing the typical faculty member, as the statistics for our samples presented in Table 4 demonstrate. As such, it raised the relative price of benefits and presumably reduced the growth of benefits relative to salaries. How large was this effect? For example, if the 1988 tax structure had existed in 1984, how much lower would the share of benefits have been in 1984-85 than it actually was?

To answer this question we compare the actual shares of benefits (the dependent variables in equation (1)) first to the shares adjusted for changes in the tax laws, and then adjusted for changes in tax laws and all other factors that we assume influence the demand for benefits. The first adjustment yields an adjusted share of benefits for 1988-89 as:

$$s^{a}_{84} = \hat{\alpha}_{84} + \hat{\beta}_{84}\ln\left(\frac{C_{84}}{P^{S88}_{84}}\right) + \hat{\gamma}_{84}\ln\left(\frac{P_{F84}}{P_{W84}}\right)^{S88} + \hat{\delta}_{84}X_{84} \ ,$$

where $\hat{\alpha}_{84}$, $\hat{\beta}_{84}$, $\hat{\gamma}_{84}$ and $\hat{\delta}_{84}$ are the estimates based on the 1984-85 data, and P^{S88}_{84} and $\left(\frac{P_{F84}}{P_{W84}}\right)^{S88}$ are a price index and relative prices for 1984, simulated using the 1988 tax structure. The second adjustment uses the same parameter estimates to calculate:

$$s^b_{84} = \hat{\alpha}_{84} + \hat{\beta}_{84} \ln\left(\frac{C_{88}}{P_{88}}\right) + \hat{\gamma}_{84} \ln\left(\frac{P_{F88}}{P_{W88}}\right) + \hat{\delta}_{84} X_{88} \ .$$

The difference between the means of s^a_{84} and s_{84} (the actual share of benefits in 1984-85) is an estimate of the change induced by the revision in the tax laws. Similar adjustments using the parameter estimates based on the 1988-89 data can be made, and the difference between the means of s^a_{88} and s_{88} yields an alternative estimate of the effect of the revisions in tax laws.

The difference between the means of s^b_{84} and s_{88} is a residual that shows the total change in the benefit share caused by changes in the parameters in (1). This difference indicates the change in the share that would have occurred if taxes, compensation and the X variables had not changed, but people's responses to them, including an intercept term, had changed. Comparing s^b_{88} to s_{84} provides an alternative estimate of this effect.

The means of the actual and adjusted shares are shown in Table 8. The most striking comparisons are between the actual shares of benefits (s_t) and those that would have been observed had tax laws, most importantly, the federal tax law, not been revised (s^a_t). The first two means in the first row show that, had the 1988 tax laws been in effect in 1984, the share of benefits would have been 1.2 percentage points lower. Obversely, as shown in the third row, had the 1984 tax laws remained in effect in 1988, the share of benefits would have been 1.9 percentage points higher. The change in the share of benefits produced by the drastic alteration in the tax laws appears smaller if we base the

Table 8. Decompositions of Changes in the Demand for Benefits

Coefficients and Tax Schedule	Benefit Share s_t	s_t^a	s_t^b
1984-85			
Single	0.174	0.162	0.192
Joint	0.161	0.158	0.181
1988-89			
Single	0.176	0.195	0.162
Joint	0.163	0.166	0.146

comparisons on the estimates using the joint tax schedules, only .3 percentage points.

Taken together, these simulations imply that legislated reductions in marginal tax rates reduced the share of benefits in total compensation of academics by between .3 and 1.9 percentage points. The importance of these induced changes is demonstrated by inquiring how a continuation of the 1984 tax laws would have affected the mix of compensation nationally, assuming that the tax laws had the same effect on the benefits paid to all workers over this four-year period as they did on benefits in academe. Total compensation in 1988 was $2.91 trillion. Using the low estimates based on the joint tax schedules, we estimate that employers' spending on benefits in 1988 would have been $9 billion higher. Extrapolating from our model, we may infer that the revisions in the tax law induced employers to switch at least this amount from benefit to wage and salary payments. While we do not claim that inferring the demand by all workers for benefits from faculties' demand is entirely justified, the similarity of the trends in compensation between academics and all workers makes it at least a reasonable extrapolation.[14]

These simulations suggest that the Tax Reform Act generated a major change in the outcomes of worker-employer contracting, and, in particular, that it met one of its goals of inducing shifts of income from nontaxed to taxable forms. This corroborates evidence (Slemrod, 1990) for the effect of taxes on the timing of activities, though it is inconsistent with the apparent small long-run effects found on much real behavior.

The effect on the share of benefits of changes in the coefficients is also substantial. Using the single taxpayers' schedule, the share of benefits would have been .192 in 1988-89 if the coefficients had not

changed from 1984-85, not the .174 that was observed. Obversely, had the responses that prevailed in 1988-89 existed in 1984-85, the average share of benefits would have been only .162, not .176. The change in the share due to changing coefficients ranges between -.014 and -.020 in the four possible comparisons.

The source of this change can be seen clearly without doing a complete decomposition. Pooling the observations for the two years, but including a separate intercept for 1988-89, gives results that are consistent with the hypothesis that there was no structural change in the α, β, γ and δ. The estimated separate intercept for 1988-89, though, equals -.012 using the single tax schedule to form the tax-price measure, and -.014 using the joint tax schedule. Both intercepts have small standard errors. Something that changed over this period and for which we have not controlled caused the intercept of the demand function for employee benefits to shift down during this period.

We saw in Table 2 that the share of health-care costs in total benefits rose rapidly during the 1980s. We also know that the real price of health insurance rose by 28.5 percent.[15] This suggests that the short-run demand for health-care benefits is price inelastic. It must therefore be the case that the cross-price elasticities of demand for other benefits with respect to the price of health care are negative (as found by Woodbury and Huang, 1989). Only with this combination of unobserved parameters can we reconcile the unexplained decrease in benefits with the observed greater share of health-care benefits and the estimated price-elastic demand for all benefits together.

VI. Conclusions and Implications for Academic Labor Markets

We have examined the determinants of variations in the demand for employee benefits among academic institutions and over time. The

evidence demonstrates clearly that the demand for benefits with respect to taxes is quite elastic. Our use of longitudinal establishment-level data and a variety of different measures of marginal tax rates make this demonstration the strongest available. The results also show that the demand for benefits is income elastic.

The simulations provide striking evidence on the impact of the Tax Reform Act of 1986 on the demand for employee benefits. Because of the declines in average marginal tax rates that occurred between 1984 and 1988 (between 3 and 6 percentage points in our sample), the share of benefits in 1988 was lower by roughly one-half percentage point than it would otherwise have been. That share was also lower by an additional percentage point due to factors that could not be included in the estimation.

Employee benefits have been a large and growing form of academic compensation. Interpreting these trends in light of our estimates and simulations, their growth was stimulated during the 1960s by the rapid growth of real compensation of academics and by a small increase in the average marginal tax rate.[16] During the 1970s marginal tax rates rose rapidly, while income effects resulting from the decline in real academic compensation were insufficient to offset the price effects. In the 1980s, with real academic compensation again increasing, the positive income effect on benefits was mostly offset by the price effects as marginal tax rates declined and the cost of health insurance rose. Supply and demand conditions during the 1990s are likely to cause real academic compensation to rise. It is not likely that marginal tax rates will be reduced further. Unless the cost of benefits, especially health insurance, continues to escalate, we can predict that the share of benefits in total compensation will resume its growth during the 1990s.

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FOOTNOTES

1. For example, Johnson and Stafford (1974); Hamermesh et al (1982).

2. Additional evidence of this turnaround is reported in a survey of smaller firms, which reported that total benefits declined from 29 to 25 percent of payroll between 1985 and 1988. (Wall Street Journal, October 24, 1989, page 1)

3. We are indebted to Ms. Kristine Hynes who made these data available to us.

4. Implicitly here and in formulating tax prices in the empirical work we assume that it is the preferences of the median (in terms of wages) worker that determine the choices made about the compensation package.

5. The utility function that produces (1) is not standard or easily tractable analytically. It does, though, satisfy the conventional requirements of such functions, and, most important, it generates the empirically convenient yet general DM system.

6. The calculation of federal marginal personal income tax rates (t_f) proceeds as follows. First, we assume that the median faculty member is single, subtract from the average faculty salary one exemption and the standard deduction for a single filer, and apply the remainder to the single-filing tax schedule. Second, we assume the median faculty member is married with two children, subtract from the average faculty salary four exemptions and the standard deduction for married joint filers, and apply the remainder to the married-filing jointly tax schedule. Calculation of state marginal personal income tax rates (t_s) proceeds by analogy, using the appropriate tax structure in each state for the cases of single and married-filing jointly.

7. Johnson and Stafford (1974) present estimates of nine-month salaries and gross professional earnings in six academic specialities in 1970. Among academics with 15 years of post-degree experience average other earnings ranged from 12 percent of the nine-month salary (in physics) to 44 percent (in biology), with the unweighted average being 25 percent. It is not likely that this percentage is higher today.

8. Using the nominal OASDHI rate would ignore the likelihood that the fraction of faculty earnings that exceeds the OASDHI tax base differs across institutions. To measure the actual OASDHI rate facing the typical faculty member at each institution we took random samples of nine-month salaries of 100 faculty members at our own school in 1984-85 and 1988-89 and calculated the fraction e^* of their total earnings that escaped the tax. We shifted this distribution up or down (maintaining its coefficient of variation) to derive an estimate of e^* for each other school under the assumption that the distribution of pay was a multiple of that at our school. Each e^* was then used to adjust the nominal tax rate to yield:

$$t_{ss} = [1 - e^*]t_{nom} .$$

This measure was used in (4b) and (4c). As an illustration of its importance, in 1984-85, when t_{nom} equalled .07, t_{ss} ranged from .043 to .07, with a mean of .064 and a standard deviation of .005.

9. The approaches implicit in (4a)-(4c) are highly structured transformations of the tax rates imputed for each institution. An alternative, atheoretic approach would simply enter each tax rate, t_f, t_s and t_{ss}, for each observation when estimating (1) and (3). We tried this approach also. The tax rates generally had significant positive effects on the benefit-compensation ratios that form the dependent variables. Most important, in the differenced data for both single and joint filers each of the three tax rates had a significant positive effect on the ratio of benefits to total compensation.

10. The data are from Census of Governments, 1982, Volume II, No. 1, Table 9. All the estimates were also produced without this variable, with little change in the implied values of the price and income elasticities of demand for benefits, but with some slight reduction in the explanatory power of the equations.

11. These data are tabulated by Douglas (1984, 1988) based on information accrued from a variety of reports on collective-bargaining activity.

12. The data are from Census of Governments, 1982, Volume III, No. 3, Table 2. As an alternative, we substituted the fraction of workers in the state who were union members in 1981 (from Kokkelenberg and Sockell, 1985). Using this alternative had only minute effects on the estimates of the other parameters.

13. The age distribution of the faculty (the age of the median faculty member if one assumes the median voter's preferences determine the mix of wages and benefits in an institution) might also affect s_f. We do not have data on the age distribution, but there were data on the distribution of faculty by professorial rank. Equations (1) and (3) were also estimated with variables measuring the fraction of the faculty at each rank, and with the rank of the median faculty member. Both measures had coefficients that were small and insignificant; their inclusion produced only tiny changes in the other parameter estimates.

14. Regarding benefits, "You now have learned enough to see/ That cats [faculty] are much like you and me/ And other people whom we find/ Possessed of various types of mind." (T. S. Eliot, "The Addressing of Cats," Old Possum's Book of Practical Cats, London: Faber and Faber, 1940

15. The rates of increase used in the rest of this Section are calculated from Bureau of Economic Affairs, National Income and Product Accounts of the United States, 1929-82, and Survey of Current Business, subsequent July issues.

16. In 1982 dollars average academic nine-month compensation in 1960-61 was $27,781; in 1970-71 it was $37,354; in 1980-81, $32,275, and in 1988-89, $40,149. (See AAUP Bulletin and Academe, selected issues.) Barro and Sahasakul (1983) provide a time series of the path of average (federal) marginal income tax rates, which rose from 23 percent in 1960 to 24 percent in 1970 to 30 percent in 1980. The tax rate for the employee's OASDHI contribution rose from 3 percent in 1960 to 4.8 percent in 1970 to 6.13 percent in 1980. (Social Security Bulletin, Annual Statistical Supplement, 1986.) In 1988 the average federal marginal income tax rate was certainly below 28 percent, and the OASDHI tax rate on employees was 7.51 percent.