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13 The Relationship between Wages and Benefits

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13.1 Introduction

Benefits represent a growing fraction of total labor compensation.[1] In 1977–79 pension costs alone averaged 5.6% of payroll for large United States firms (Kotlikoff and Smith 1983, table 5.1.4). Because benefits are such an important part of compensation, employees and firm owners need to understand how to value benefits packages.

Unfortunately, benefit valuation may not be as simple as valuing a compensation package with only wages. For example, a faculty member at a university may receive a tuition subsidy from his school when his children attend college. Should the university treat this element of compensation differently from wages and spread the cost of this benefit over many years rather than simply expense the cost when incurred? Equivalently, when should the worker include this benefit as part of his income?

In this paper we explore the following questions: First, how should a firm choose the types of benefits it offers, and how will different benefits affect the firm's different worker constituencies? (These are important questions for a positive study of how different types of plans come to exist, as well as for normative analyses of optimal compensation package choice.) Second, what is the appropriate way of accounting for different types of benefits when making a financial appraisal of firm liabilities or workers' wealth? Third, what inferences can be made about firms that offer different sorts of benefits?

We suggest that the answers to these questions depend on one's model of the firm-employee relationship. In section 13.2 we describe three "eco-

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nomic" models of this relationship. A key implication of all of these models is that bargaining between firms and workers is over total compensation, not the components of compensation. Except in cases of asymmetrical information (where the firm and the worker have different information about the cost of providing a specific benefit), in these models it is optimal for the firm to offer workers all possible tax-free benefits and individually reduce salaries by the amount of benefits consumed by the worker.

In Section 13.3 we discuss some noneconomic models of the firm-worker relationship in which elements of compensation may have significance for the worker or the firm that is not strictly monetary or in which the firm's decision-making process may not be centralized or rational (in the classical sense). Specifically, we heuristically describe "equity" models in which workers with similar characteristics are paid identical wages even if they receive different benefits. We also consider "hierarchical" models in which the benefits office is distinct from the offices that determine salary, and information about the expense of providing a given worker's benefits is not internalized by those who set salaries. One implication of these models is that firms that offer specific types of benefits should expect to attract new workers who can particularly use those benefits—the school with large tuition benefits attracting professors planning large families. In this context the firm may find that the best benefits are those that are worth an equal amount to all workers.

Section 12.4 presents some empirical evidence on the relative applicability of economic and noneconomic models of firms and workers. We test whether or not Stanford University implicitly takes into account pension compensation in setting salaries. Our preliminary results are that the university does not take an individual's pension compensation into account when setting his wage, even if they do take into account overall pension compensation in setting the overall wage scale offered.

The crucial point of the noneconomic models is that we can only say a limited amount about the aggregate firm/worker implicit labor contract by looking at individuals' compensation profiles. For example, the fact that Stanford may not look at one's pension compensation in offering a salary does not mean that the university does not consider overall pension compensation in setting the overall level of salaries. Similarly, a firm may set a worker's salary without recognizing whether that worker is receiving a large amount of ancillary compensation through tuition benefits, housing subsidies, becoming vested in early retirement benefits, and so on. Nevertheless, the firm may still take into account aggregate benefits in setting the general level of salaries offered. The implication for defined benefit pension analysis is that individual workers may well be able to anticipate that at certain times they will receive especially high total compensation, but for the purposes of valuing the firm's aggregate pension liability at a given moment the accrued benefit method would still be correct.

13.2 "Economic" Models of the Labor Market

The questions we have asked about wages versus benefits must be answered in the context of specific models of worker-firm relations. In this section we consider three models that employ a traditional microeconomic approach. In each of these models it is assumed that workers value compensation only as a source of their own consumption; for example, the consumption of other workers does not enter into the individual employee's utility function. Workers choose compensation offers from firms which maximize their expected utility. Firms are profit maximizers, implying they are indifferent between alternative compensation packages that induce the same labor input and have the same total cost. In each model, experienced workers are assumed to accumulate firm-specific human capital (but no general skills).

In the first model we look at, individual workers offer their services each period on a spot market. Workers and firms both recognize that they will enter into a bilateral bargaining situation once that specific human capital is acquired, but no long-term bargain is struck.

The second model contains long-term contracts written between the firm and individual workers. The motivation for these contracts will be taken to be a desire for risk sharing, but other motivations (such as the prevention of shirking, as suggested by Lazear [1979]) lead to similar results.

Finally, the third model involves group-negotiated contracts of the sort described by Bulow and Scholes (1984). In this model, employees can be paid more than their individual marginal products, even without an implicit (or explicit) long-term contract, because of their leverage as part of a group.

While each of these models provide different valuations of firms with the same accounting statements, these differences turn out to be independent of the division of compensation between wages and benefits. Bargaining takes place over firm labor costs. The firm always ends up offering all tax-free benefits, the workers use these benefits up to the point where a dollar's worth of a benefit is as valuable as $1 - t$ dollars of income (where t is the tax rate on wage income), and the individual worker's salary is adjusted by the cost to the firm of providing that employee's benefits. These results are somewhat modified if information is asymmetrical, as we shall show.

For each model, the basic environment is the same. We use an overlapping generations framework: Each worker has a potential working life of two periods, followed by retirement. During each working period each worker supplies up to one unit of a homogeneous labor input. Workers get utility from the consumption goods they can buy with their wages; they have no disutility of labor. A constant number of new workers, L, enter the labor force each period.[2] The services of workers are bid for in each

period by firms in a competitive industry with free entry and exit. Young workers are "inexperienced." Old workers who have remained with the same firm into their second period of life are "experienced"; however, old workers who switch firms in the second period are "inexperienced." (That is, specific human capital is accumulated in the first period.) Inexperienced workers, whether old or young, have the same current value in production.

Since in equilibrium it will turn out that all firms are identical, we may freely define notation with reference to the "representative" firm. Let

n_0 = number of inexperienced workers employed in a period,
n_1 = number of experienced workers employed,
F = fixed costs of production per period,
$q(n_0, n_1)$ = gross revenues per period,
r = constant real interest rate,
w_0 = per period wage paid to inexperienced workers,
w_1 = per period wage paid to experienced workers.

Each firm in the economy has the identical production function

$$q(n_0, n_1) = n_0^a + en_1^a - F, \tag{1}$$

where e and a are parameters, with $a < 1$. To make computations easy, we assume

$$e = 1/a > 1 \tag{2}$$

and

$$F = (1 + r + 1/a)(1 - a)/(1 + r). \tag{3}$$

In a competitive environment with zero disutility of labor, it is clear that the only sustainable equilibria are those in which all labor input is employed and the present value of industry gross revenues less fixed costs is at a maximum. Given the greater marginal productivity of experienced workers assumed in (1), it is also evident that in equilibrium workers will stay with their first-period firm through their working life; that is, for each firm, $n_0 = n_1$ in each period. The firm size $n_0 = n_1$ that maximizes the present value of industry gross revenues is easily found as the solution to

$$\max_{n_0} (L/n_0)(1/r)[n_0^a(1 + r) + en_0^a - F(1 + r)], \tag{4}$$

where use has been made of the essential stationarity of the problem. Because of our judicious choice of values for e and F, the optimal firm size that emerges from (4) is

$$n_0^* = n_1^* = 1. \tag{5}$$

This implies directly that the marginal product of an inexperienced worker in the current period will be a and that of an experienced worker will be 1;

equivalently, the expected lifetime value of a worker entering the labor force today is $a + 1/(1 + r)$.

In our first economic model, let us suppose that workers contract with employers each period on a spot labor market. This creates the usual ambiguity in the second period; namely, that because of the accumulation of specific human capital, worker and firm have quasi rents (equal to $1 - a$, where a is the value of an old worker at a new firm) to bargain over. Let us assume that some workers are "good bargainers" while others are "bad bargainers." Good bargainers capture all of the quasi rents from specific human capital in the second period, while bad bargainers capture no quasi rents. A fraction of workers b in each generation are good bargainers; but neither the firm nor the worker knows until the second period whether an individual worker will be a good or bad bargainer.[3]

Under these assumptions, a second-period worker obtains his or her full marginal product (equal to one) with probability b. With probability $1 - b$, he obtains only his opportunity cost a. Thus the expected value of second-period wages is $b + a(1 - b)$.

With free entry of firms into the industry, no worker will sign on with a firm unless he expects to capture his full lifetime marginal product $a + 1/(1 + r)$. Thus, under a spot labor market regime, all first-period workers are paid $w_0 = a + (1 - b)(1 - a)/(1 + r)$—their first-period marginal product plus the present value of the fraction of quasi rents that the firm can expect to capture in the second period.

An obvious problem with the spot labor market is that risk-averse workers may be forced to accept random second-period incomes owing to bargaining uncertainty. Firms and workers may choose to hedge the uncertainty generated by random bargaining abilities by entering into long-term contracts. The assumption that there is long-term contracting defines our second economic model. If two-period contracts that are binding on both parties can be negotiated, then the distribution of compensation over the two periods is indeterminate, so long as $w_0 + w_1/(1 + r) = a + 1/(1 + r)$. In the usual case of "one-way" contracts, where firms cannot back out of an agreement but employees can quit, w_0 must be less than or equal to a. If w_1 is set at less than 1 the worker still has the same threat as in the no-contract case, so a good bargainer should still be able to negotiate second period pay of 1.[4] Therefore, the only way to eliminate second-period uncertainty is to set w_1 greater than or equal to 1. If we also give firms the right to lay off workers, then the unique contract is $w_0 = a$ and $w_1 = 1$. Notice that workers' lifetime expected compensation is the same as in the spot labor market model; however, if workers are risk averse the contract model is Pareto superior ex ante.

Our third economic model is another bargaining model, only this time employees negotiate (either explicitly or implicitly) as a group. The old generation of workers can receive pay of a (their marginal product as "in-

experienced" workers) if they quit the firm, as before. However, they realize that if they all left the average (per worker) cost in output to the firm would be $1/a$. Therefore, with group bargaining w_1 can be anywhere in the range from a to $1/a$. Let the expected wage bargain with a group of old workers be $w_1 = a + B(1/a - a)$, where B is a parameter that measures the bargaining skill of the group. Then $w_0 = a + (1 - a)/(1 + r) - B(1/a - a)/(1 + r)$. If B is greater than $(a - a^2)/(1 - a^2)$, then w_1 is greater than 1 and older workers are being paid more than marginal product in the second period. Of course, it is precisely when B is expected to have such a high value that w_0 will be less than a. Heuristically, we may think of the workers as investing in the firm's capital when young (by taking a low wage) and being repaid in the second period, when the new group of young workers assume the initial investment.

Now let us expand our analysis to include benefits. We may assume the use of benefits is motivated by a tax imposed on wages at rate t but not imposed on benefits. Firms offer workers packages of salary, s_0, and benefits, p_0, with $w_0 = s_0 + p_0$. The firm is indifferent to any combination of s and p with the same total cost. If the amount of benefits provided to any given worker is easily identified, then equilibrium will require that w_0 remain as before and each individual will choose to take benefits up to the point where a dollar's worth of benefits is worth $1 - t$ dollars of salary. The only exception to this rule is if workers' bargaining ability is correlated with their desire for benefits. In that case, the signaling problem adds to the risk-sharing motivation for long-term contracts.

In a contracts model, total compensation in each of the two periods is set at $w_0 = a$ and $w_1 = 1$. In this model and again in the "group" model the firm is indifferent to the distribution of compensation for young workers between s_0 and p_0 and for old workers between s_1 and p_1.

Note that if the benefit in question is deferred compensation (such as a pension), the amount of the benefit a young worker has received, p_0, is defined by his vested benefits. In any bargaining situation (and in the case of a contract written to avoid second-period bargaining problems), first-period compensation is determined by the "threat point" of the worker entering the second period. That threat point may be defined as the present value of lifetime income, including benefits, that the worker receives if no second-period agreement is reached. Therefore, if we are to treat pensions similarly to the way we treat salary and other benefits, we must use an accrued vested benefits approach to defined benefit pension accounting (see Bulow 1982). Similarly, a severance pay benefit is part of compensation in the year accrued. Severance clearly changes the "threat point" in negotiations and therefore the accumulation of severance rights may represent substantial compensation even if (perhaps because of the severance) there is little chance a worker will ever be laid off.[5]

We have presented three models of worker compensation determination that differ in the way firms negotiate with workers. In some sense

these models are all the "same"—the allocations of labor and total expected worker compensation do not vary, though the time path of compensation may. However, for some real-world purposes there are important differences between these models.

For example, depending on the bargaining model chosen, firms with identical accounting balance sheets should be valued differently. First consider the simple "no-contract" model where $w_0 = a + (1 - b)(1 - a)/(1 + r)$ and $w_1 = a + b(1 - a)$. Because all investment in human capital is expensed, the firm will report a loss of $(1 - a)/a(1 + r) + (1 - b)(1 - a)/(1 + r)$ in its start-up period, when it has no experienced workers. However, this initial investment by the stockholders is returned by "profits" equal to r times the start-up loss in all subsequent periods. The market value of the firm always exceeds the book value by the amount of the start-up loss.

In the risk-sharing contract model $w_0 = a$ and $w_1 = 1$ so the start-up loss, and the difference between market and book value, is $(1 - a)/a(1 + r)$. Here the workers make a greater share of the investment in human capital. Consequently, reported start-up losses are lower, as are the subsequent positive cash flows reported as profits.

In the "group" model $w_0 = a + (1 - a)/(1 + r) - B(1/a - a)/(1 + r)$, and $w_1 = a + B(1/a - a)$. Here, in the extreme case where $B = 1$ so that the old workers are paid all the quasi rents from operating, the firm reports zero profits in all periods and market value equals book value.

An analyst trying to compare firms with identical book values would clearly benefit from understanding the nature of the firm's labor contract. The firm's compensation/tenure profile can provide information about the present value of future quasi rents that go to workers, and therefore about the value of stockholders' equity.

Does the *benefit*/tenure profile provide any useful information? That is, we know that if we only knew a firm's current total compensation costs then the compensation/tenure profile would provide us with extra information. If information about the compensation/tenure profile is not directly available, can information about the slope of the firm's benefit/tenure profile (e.g., whether it has a defined benefit pension plan or a defined contribution plan) be used as a proxy?

The question is an empirical one. Our models provide no logical reason why firms that have steep benefit/tenure profiles, or that provide substantial benefits, should have steep compensation/tenure profiles.

For example, unionized workers receive more benefits as a percentage of compensation than nonunionized workers in similar jobs. Many of these benefits, such as health and pension benefits, are most valuable for older workers. However, wage/tenure profiles may be less steep for union workers in these high-benefit firms, so that the total compensation/tenure profile is similar for firms with and without benefits.[6] In economic models the relative levels of employee benefits and salaries are determined by tastes and taxes. Whether there is a correlation between the chosen split

between wages and benefits, and the share of future quasi rents on firm-specific human capital the work force can expect to negotiate, can only be determined empirically.[7] Only in the case of asymmetric information, where workers and firms have different knowledge about the cost of providing a benefit to a specific worker, will firms do anything other than offer all tax-advantaged benefits.[8] With asymmetric information, separating equilibria are possible where workers who most want a benefit will join firms that provide it.

As an example, assume that workers have perfectly inelastic demands for dental care, with individuals' demands uniformly distributed from zero to D. Assume further that firms are only allowed to offer full dental care or no benefits. Then two types of firms would develop, those providing and those not providing benefits. Workers would decide whether or not to join a firm that offered benefits depending on whether their demand was greater than or equal to $(1 - t)D/(1 + t)$. The average employee of a firm that offered benefits would use benefits costing $D/(1 + t)$, so salaries would be lower in benefit firms by that amount. The marginal employee would just break even by receiving the extra salary, paying taxes, and covering his own dental bills.

Therefore, with asymmetric information firms will attract a specific clientele if they offer a given benefit. If it were possible to obtain information ex post on such workers we would find that within the firm workers receiving benefits of different value would receive the same salary, but on a firmwide basis employees would not receive extra total compensation because a firm offered benefits.[9] With asymmetrical information, then, it is possible for workers to receive the same wage even if benefits are different, just as in the insurance-averse selection problem. Our noneconomic models of the next section will be similar to the asymmetric information case in terms of results, with the difference being that the information exists but for some reason is not used.

Summarizing, we have presented several economic models of labor contracting. Each model has different implications for the compensation/tenure profile and for issues of benefit valuation. With full information, the firm should offer workers all potential benefits, in any amount employees desire up to their full compensation, regardless of the model. There is no logical requirement that the benefit/tenure profile of firms be correlated with their compensation/tenure profile. The question of whether the benefit/tenure profile is correlated with labor's expected share of future quasi rents on firm-specific human capital (important for firm valuation) is strictly empirical.

With asymmetric information we would expect to see some firms offering and some not offering a given benefit. Workers would join firms that had the compensation package most valuable to them. Their salaries would be reduced based on the firm's expected cost of providing benefits,

just as insurance premia are based on an insurer's expected cost of providing benefits in the face of asymmetric information.

13.3 Noneconomic Models

In this section we heuristically describe a set of noneconomic models in which workers' utility is a function not only of total compensation but of relative wages. Firms feel constrained to pay identical wages (rather than total compensation) to all workers of similar position and tenure, and may even feel constrained not to negotiate a lower wage bill if future benefit costs rise beyond expectations. In these models the distribution of benefits influences the distribution of total compensation.

Our two classes of noneconomic models are "equity" models and "hierarchical" models. In the equity models relative wages are set according to some equity formula, not taking into account the benefit expense associated with an individual worker. For example, relative wages may be used as a signal to workers about how well they are doing. Wages may provide a clearer signal than total compensation because wages are easier for workers to compare. It is also possible that antidiscrimination laws may make charging women more (and blacks less) for identical pension annuities difficult. While equity models may govern relative wages among workers, they may also cover the worker's *wage*/tenure profile. In this case, as we will emphasize below, a redistribution of a young worker's compensation between salary and benefits may affect the present value of future labor costs.[10]

In our hierarchical model the firm wishes to take benefit information into account in setting salaries; but, because of incentive problems caused by firm structure, the benefit information is mostly not transmitted into salaries.

We divide equity models into two categories. The first is a cross-sectional model. This turns out to be somewhat analogous to the group economic model. The wages and benefits of one cohort have nothing to do with those of another cohort. However, all workers of the same age must be paid the same wage, because of strong worker preferences for intragroup equity. The model produces results similar to those in the group model with asymmetric information. The firm's value is only affected by the total compensation deal it negotiates in a period. The breakdown of the young cohort's income into wages and benefits provides no information about what those workers expect to negotiate in total compensation in the subsequent period, any more than such a breakdown provides information in an economic model.

Alternatively, an equity model may have a time-series component to it, much as the long-term economic contract does. For example, workers and firms may feel that their contract is for a given wage/tenure profile plus a

benefits package, and that alterations in the benefits package do not affect the wage/tenure profile. This is the kind of model required for projected benefit valuations of pension plans.

What are some of the implications of the time-series equity model? We can give some examples. First, if health care costs rose unexpectedly, a firm providing health benefits would decline in value by the increase in the present value of future health benefits to be paid to all current workers, given that plan provisions are not changed. No provision is made for any offsetting adjustment in wages, so a young worker who had recently joined the firm would now possibly represent a substantial net liability.

Second, if wages in the economy were growing at the interest rate young workers should be equally pleased by an increase in (defined benefit) pension benefits as older workers, assuming all workers stay with the firm until retirement age. For example, assume that pension benefits paid to a newly retired employee were \$30 per month per year of service and that pension benefits were historically linked with salary.[11] Then a 10% increase in pension benefits raises all workers' pensions by 10%, and the present value of every worker's pension is identical.

Finally, the mix of wages and benefits matters because the mix is correlated with future compensation costs. For example, assume that medical costs are rising relative to wages. In a model with rigid time-series wage structure a firm would be unwilling to allow its young workers to split compensation w_0 into benefits p_0 and salary s_0 in any manner they desired. The reason is that in this model the rations of p_1 to p_0 and s_1 to s_0 are individually fixed (the benefits because it is assumed the contract provision will be the same in period 1 as in period 0, the salary by the rigid wage structure). This is in contrast to the economic model contract where the overall ratio of w_1 to w_0 is fixed. Therefore, if medical costs are growing faster than wages, p_1/p_0 exceeds s_1/s_0, and total compensation in period 1 will be increased if the workers can bias the composition of w_0 toward benefits.

Accrued pension benefits, like health benefits, go mostly to older workers. Thus, the previous paragraph could be repeated with only the substitution of the "pension" for "medical."

In the time-series equity model an individual's wages may not be affected by the benefits he receives. An alternative model in which this is also true is the hierarchical model. In this model, as in the other noneconomic models, the firm has information about an individual's benefit cost but is somehow restricted in using the information. The information may be stored in one part of the firm's hierarchy but either not made accessible to or at least not used by the part of the firm that negotiates a worker's salary. For example, in a university a department head may set salaries while benefits are determined independently by a university office.

In this model any benefit information made available to the salary negotiator is used, but some information simply is not available. There is no

room in this model, then, for systematic biases in compensation between generations other than those differences that would arise in an economic model. This model is a close substitute for the cross-sectional equity model. The only difference is in the description of why the firm does not use all the information at its disposal. In the equity model a conscious decision is made to discriminate between employees with different characteristics. One way to distinguish the models is to adopt the fiction that wages and benefits are determined sequentially. For example, in the equity model the wages of all graduate students might be set according to merit and seniority, with married students subsequently given preference for housing subsidies. That is, there is a conscious institutional policy that benefits certain well-identified individuals. In the hierarchical model the firm may set benefits before setting salary, but the officer who determines salary may not be able to get good information about who is receiving a married student housing subsidy. The officer could still use whatever information was at his disposal to set salaries (and, for example, offer all married students lower scholarships because on average they receive greater housing benefits) but could not identify the specific individuals who received a specific benefit.

In summary, the noneconomic models generally have much in common with the economic models with asymmetric information. The difference is that in the noneconomic models the firm does not use all available information. Furthermore, in the time-series equity model the firm's value (and the present value of future employee compensation) is affected by the allocation of current compensation between wages and benefits. Thus, in the time-series equity model a firm with a defined benefit pension plan (that causes older workers to accrue a higher fraction of salary as pension benefits than young workers accrue) may be worse off than a defined contribution firm that was providing its current young employees with identical total compensation.

13.4 Empirical Work

We have described a number of alternative models of the worker-firm relationship. It would be interesting to conduct an empirical test of which type of model best describes reality. On way we can hope to do this is by concentrating on the following pivotal implication of our models: In the "economic" models, bargaining is over total compensation only; therefore, if an individual or group were inclined to use more of the firm's offered nonwage benefits, the wages of the individual or group would be adjusted downward accordingly. In contrast, in the basic noneconomic models we have described, a tendency to use more benefits might not result in any adjustment of wages. Therefore, a test of the competing models might be based on a test of whether subgroups of workers in a firm who use more benefits receive less wages than other workers.

We have obtained a microdata set, on Stanford University faculty salaries and pension benefits, that permits just such a test. Stanford University will contribute 10% of a faculty member's salary to a pension plan if the faculty member contributes 5% or more of his salary. If the faculty member pays in less than 5% the university makes no contribution. It is interesting to note that not all faculty members sign up for the program, as is clear from table 13.1. In principle, then, we might test to see if professors who do not sign up receive compensating increases in salary.

We were able to obtain the following data on 993 faculty members: age, year of appointment, year of degree, rank (assistant professor, associate without tenure, associate with tenure, full professor, adjunct, other), school (law, business, humanities and sciences, medicine-clinical, medicine-Ph.D., engineering), salary, and whether the employee was enrolled in the pension plan.[12] The sample has two virtues. First, there were clearly no problems of asymmetric information. The university knows exactly the cost of each employee in the plan. In fact, it would be possible for the university to negotiate a total compensation package directly and then allow each worker to contribute as much as desired to the pension plan, up to the legal limit.[13] Second, the benefit is one that represents a large fraction of the salary of some employees and is not received by others.

Our priors were that the university followed either a cross-sectional equity model or a hierarchical model, so that we would find little or no effect of the pension acceptance variable on salary. The reasons were that (1) the benefits office has a separate budget from the various dean's offices that determine salary, and the deans claim to know nothing about whether a worker is in the pension program; and (2) assistant professors (the group that represent virtually all the action in our sample) tend to consider relative *salaries* as informative signals.[14]

A simple approach would be to regress professors' salaries on the observable determinants of salary, plus a dummy which is equal to one when

Table 13.1 **Faculty in the Pension Plan/Total Faculty (by School and Rank).**

Rank	Business and Law	Engineering	Humanities and Science	Medical Clinic	Medical Ph.D.	Total
Assistant	8/9	5/22	27/63	33/57	10/10	83/161
Associate	8/11	7/10	2/4	7/8	1/1	25/34
Associate with tenure	4/4	13/17	57/64	40/41	11/13	125/139
Full	59/59	125/125	272/287	75/77	38/40	569/588
Adjunct	0/0	10/14	11/11	2/2	1/2	24/29
Other	0/0	0/0	3/4	30/34	3/4	36/42
Total	79/83	160/188	372/433	187/219	64/70	862/993

the faculty member has elected the pension plan. The major problem with this is that the employees' mandatory contribution meant that some workers who did not sign up for the plan could be liquidity constrained. The liquidity constrained workers on average have lower salaries. Therefore, direct estimates of salary as a function of whether a worker received pension benefits are subject to simultaneity bias.[15] To avoid the simultaneity problem, we adopted a two-stage procedure. First we estimated a probability of pension acceptance as a function of all variables other than salary. We also estimated a "fitted salary" variable, which was formed by regressing salary on all the variables other than pension acceptance. In the second stage we regressed all the other variables in our data set plus a 0/1 instrument for the probability of pension acceptance times "fitted salary." The idea was to make the regression coefficient on pension acceptance interpretable as a percentage of salary. Included in the regression were dummies for all the schools and ranks listed in table 13.1. We tried using the estimated probabilities for pension acceptance directly in our second stage. We also ran separate regressions for each of the different ranks. In our pooled regressions we found a significiant coefficient for the pension acceptance variable. However, in the individual regressions by rank we found the reduction in salary for a worker signing up for a pension to be statistically insignificant.

We ran our regressions using two different defintions of salary for people on the medical school faculty, who are paid on an 11-month rather than a nine-month basis. We suspected that this would make almost no difference in our results since there was a school dummy, so on noticing that there was a difference in the estimated effect of pension acceptance, depending on whether the medical salaries were adjusted for a nine-month year, we decided to rerun our regressions excluding the medical school.

When the medical school was excluded we no longer got significant coefficients on the pension acceptance variable. Representative of the results we are now getting is the regression reported below, which estimates the salaries only of people in the school of humanities and sciences.

Variable	Parameter Estimate	Standard Error	t-Ratio
INTERCEPT	31317.	3875.7	8.08
AGE	−17.26	47.770	−.72
PSAL	−.019	.0645	−.30
YEAR-APP	−501.8	47.801	−1.50
PROF	11616.	2836.6	4.10
ASSIST	−9463.	3178.5	−2.98
ASSOC	−4580.	3727.8	−1.23
ASSOT	−1146.	2760.8	−.42
ADJUNCT	3545.	3099.0	1.14
YEARDEG	902.9	66.173	13.64

In the above regression, PSAL is the 0/1 instrument for pension acceptance multiplied by fitted salary. The interpretation of its coefficient is that signing up for the pension plan reduces one's salary by about 1.9% with a standard error of about 6.5%. In our economic models, we would predict a value of $-.10$ for PSAL.[16] Other regressions yield essentially similar results. Therefore, our data seem to indicate that our employer does not subscribe to any economic model. (Most Stanford economists will claim they always knew this about our university.)

We made several efforts to uncover a significant coefficient on the pension acceptance variable. For example, instead of using a 0/1 pension acceptance variable we tried using the probability of pension acceptance. We ran regressions just looking at the assistant professor population as a whole and separate regressions for the assistant professors in three schools. However, the result that an individual's salary was not signficantly affected by his pension acceptance decision was confirmed.

13.5 Conclusion

We have presented several alternative models of labor contracting. In our economic models we argued that, absent asymmetric information, firms would allow workers to choose individually how they would like to have their compensation divided between wages and benefits. Whether firms that offer greater benefit packages, or which skew benefits toward older workers, also tend to give older workers a greater fraction of the quasi rents on their firm-specific human capital is strictly an empirical question.

That part of compensation is paid in pension benefits is irrelevant for valuing the labor contract. Because each worker selects his own benefit package, there is no reason to expect firms to cater to certain types of workers (unless there is asymmetric information, or some benefits are in the nature of a public good).

In our noneconomic models benefits and wages do not necessarily balance. For the cross-sectional equity model the firm negotiates a total compensation package with a generation of workers, and all workers receive the same wage rather than the same total compensation. In the case of, say, health benefits an individual worker's salary would not be reduced if it became apparent that his future health costs would be high. However, growth in the overall cost of health benefits would slow wage growth so that total compensation for the group would be unaffected.

In the hierarchichal model much the same results obtain, though for slightly different reasons. Again, individual levels of total compensation can be affected by a proclivity to take of advantage of various benefits offered, but the firm's aggregate compensation bill is unaffected by projected increases in the relative price of benefits.

In the time-series equity model, firms and workers implicity agree to a rigid rate of wage growth and perhaps a fixed package of benefits. It is only in this model that the firm is not indifferent to the composition of a young worker's compensation package.

We attempted a test meant to distinguish between the economic and noneconomic models. While the results were not fully conclusive, they appeared to lend support to the noneconomic models. However, we cannot devise a test to distinguish among the noneconomic models given our limited data.

Notes

1. Woodbury (1983), using Chamber of Commerce survey data, estimates that employer payments to pension, health and life insurance, and other agreed-on items represented 9.6% of compensation in 1965 and 16.1% in 1978. (Total compensation excluded legally required payments such as social security, workers' compensation, and unemployment insurance.) Woodbury also cites a BLS study which estimates that supplements rose from 4.9% to 9.2% of total compensation from 1966 to 1976. See also Kotlikoff and Smith (1983), table 5.1.4, for more detailed data.

2. We will assume for convenience that workers are measured along a continuum, so that it is sensible to talk about fractional workers within a firm.

3. The assumption that bargaining skills are not revealed until the second period plays no essential role in our analysis. We employ it because it provides a novel yet simple means of motivating a desire for risk sharing. It is essentially equivalent to allowing certainty in bargaining outcomes plus randomness in production.

4. If employees knew their bargaining abilities in advance but firms could not identify bargaining talent, then of course two-period contracts, if enforceable in at least one direction, would cover all workers. This adverse selection motivation does not depend on risk aversion.

5. Kaiser Steel and the New York News are two examples of firms that have been deterred from closing operations and firing workers because paying high wages was preferable to paying high severance. See *Wall Street Journal*, November 29, 1982, p. 23: "High Cost of Liquidation Keeping Some Money-losing Plants Open."

6. See, e.g., Freeman (1985) in this volume.

7. For an early effort in this area, see Kotlikoff and Wise (1985) in this volume.

8. Of course, this analysis does not consider benefits that are public goods, such as a company swimming pool.

9. A firm that had not provided a benefit in the past could begin providing the benefit at a much lower cost than a firm with an established program, simply because its experienced workers may be a group that would not be costly to service.

10. This is the type of model most often implicitly assumed by authors who use a projected benefits method to value pension liabilities.

11. It is irrelevant whether that link occurred through the type of provision found in most pension plans for salaried workers or through periodic benefit increases in line with salary increases of the sort typically negotiated by unions.

12. The data file was produced by merging a provost's office file, with salary data for the last half of August 1982, with a benefits office file containing other data on workers for the first half of September 1982. Since Stanford's fiscal year runs from September 1 to August 31, the merged file unfortunately does not include people who either were not on the faculty or were on leave for the 1981–82 or 1982–83 school year.

13. This strategy, followed by the University of Rochester, has no adverse tax consequences and gives workers much greater flexibility over the timing of their contributions and withdrawals from the plan.

14. But see Scott et al. (1982), p. 32: "*Recommendation 4: The University retirement payment of 10 percent of salary should not be conditional on the amount of the employee's payment.* This would presumably mean that eligible employees not now participants in the plan could choose to enter it, and the University would begin contributing 10 percent of their salary. Currently eligible non-participants should not mistake this recommendation as bestowing a form of sudden pay increase; a decision to take a certain amount of pay in deferred form will of course affect the determination of the salary component of total compensation."

15. Of course, we are also missing many other variables that influence salary—e.g., publications, citations, awards, and other university benefits received. To the extent that any of these variables is correlated with pension acceptance there is an errors-in-variables problem. For example, workers benefiting from housing subsidies for new faculty or from tuition benefits for their children may have worse liquidity problems than other workers of the same age and salary and may not be in the pension plan. These workers may be compensated for lower pension benefits with their higher benefits in other areas rather than with higher salary.

16. The last seven variables in the equation are years since appointment to the university and dummies for the ranks of professor, assistant professor, associate professor, associate with tenure, adjunct, and years since Ph.D. respectively.

Comment Daniel Feenberg

At the last edition of this conference, Jeremy Bulow propounded the notion that a firm's pension liability was best summarized by the present value of vested benefits, discounted at the nominal interest rate. He argued that the apparent backloading of the typical defined benefit plan does not necessarily mean that total compensation is similarly backloaded. Rather, we would expect wages to adjust until total compensation equaled marginal product. At the time many members of this conference found the spot market view of wages extreme, but few would doubt the lesson that compensation policy is part of the financial policy of the firm and that an understanding of the mechanism that determined the path of compensation through time was essential to determine the value of the firm. The present paper extends that argument considerably by showing how an efficient labor policy may be maintained by a firm using almost any compensation policy ranging from spot market wage rates to implicit or explicit contracts but that each rule affects the financial structure of the firm differently.

In the table that accompanies this discussion (table 13.C.1) I have tried to summarize the algebra of Bulow and Landsman's paper. The five compensation rules considered are listed across the top of the chart, and under each rule are expressions for the wage rates that might by paid by a firm that subscribed to that rule, so each column shows the time path of com-

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Table 13.C.1 **Time Path of Compensation with Firm-specific Learning**

Type of Worker	Marginal Product	Spot Wage	Long-Term Contract	Contract Binds Employer	Group Negotiation
Inexperienced	a	$a + \frac{(1-b)(1-a)}{1+r}$	w_0	$\leq a$	$a + \frac{1-a}{1+r} - \frac{a}{1+r}$
Experienced	1	$a+(1-a)b$	$(1+r)(a-w_0)+1$	$(1+r)(a-w_0)+1$	$a + B(\frac{1}{a} - a)$
Water	$\frac{1-a}{a(1+r)}$	$\frac{1-a}{a(1+r)} + \frac{(1-b)(1-a)}{1+r}$	$\frac{(1-a)}{a(1+r)} + a - w_0$	$\frac{(1-a)}{a(1+r)}$	$\frac{a-1}{a(1+r)} + \frac{B-a}{a(1+r)} + \frac{a^2(1-B)}{a(1+r)}$

Note: The model is a follows: firm revenue = $n_0^a + \frac{1}{a}n_1^a$, firm costs = $F + n_0 w_0 + n_1 w_1$ where n_0 = inexperienced workers, n_1 = experienced workers, and $F = (1+r+1/a)(1-a)/(1+r)$. A zero-profit constraint is assumed, and workers go to firms that offer highest PV of total compensation. The entries in the table are mostly copied from Bulow and Landsman, but I have filled in a few.

pensation under the given rule. Each of the paths has the same cost to the firm, the same present value of wages to the workers, and each controls turnover sufficiently well to prevent the waste of any firm-specific human capital. Even so, any positive rate of wage growth is admissible under at least one rule, and several of the rules allow wide variation in the compensation path. Nor is there any need to introduce an explicit pension plan to achieve efficiency. Indeed, the most obvious pay scheme of all (which pays marginal product in each period) has the desired effect on turnover without any deferred compensation. This irrelevance of compensation path to efficiency is not an artifact of the particular model developed here; rather, it is a consequence of firms and workers optimizing over their respective lifetimes.

In the last row of the chart the difference between the market value of the firm and its book value is given for each compensation path. This difference is here given the old-fashioned name "water," but no pejorative connotation is intended here. Water, of course, results from the failure to carry human capital on the books of the firm and the failure to capitalize on the start-up loss of $(1 - a)/a(1 + r)$.

Two empirical possibilities are suggested by the chart. First, one could estimate a wage equation as a function of personal characteristics, the change in present value of vested pension benefits, and the change in the expected value of nonvested benefits, where the last term could be interpreted broadly to include the expectation of future wages in excess of marginal product. Second, one might regress the market value of the firm on capital, debt, the present value of vested pension liabilities, and the present value of expected nonvested liabilities, defined consistent with the wage regression. The implicit contract view of the labor market suggests all four of these benefit coefficients will be minus one while the spot market view suggests that the coefficients on expected benefits will be zero. Consistency requires that firms and workers value benefits similarly. If workers systematically value benefits more highly than firms, it might serve as the basis for some government intervention. Such straightforward regressions may not be possible; certainly none have yet been presented to this conference.

The equation reported by Bulow and Landsman is a wage equation with the addition of a vested benefit to the right-hand side. In spite of the large size of the benefit, it does not seem to affect the wage rate to any measurable extent. Bulow and Landsman attribute this irrationality to the employer; however, surely it is as easy to attribute to the employees who decline the benefit.

The open discussion centered on the possible motivations of those who declined Stanford's generous offer. Albert Rees brought up the case of a well-known econometrician, formerly of Princeton, who was refused permission to decline a similar benefit offered by Princeton University. This

individual argued that by the assumption of additional risk he might do better with 5% of his salary than CREF could do with 15%. Professors Samuelson and Summers agreed that over 30 years only a modest additional risk would be required to accomplish this seemingly herculean task. A few moments' reflection will suffice to recognize the limited applicability of this result. Unless the person is liquidity constrained, it is clear that accepting the pension contributions does not in any way limit their ability to bear risk, and that the optimal procedure would be to accept the pension and increase the riskiness of the nonpension portfolio by, for example, purchasing stocks on margin. Nor can a liquidity constraint be a convincing explanation, for the sum of money involved is less that $2000. In any case, the liquidity constraint must be temporary if the person is accumulating assets.

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