FACULTY PRODUCTIVITY, SENIORITY, AND SALARY COMPRESSION

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INTRODUCTION

For decades, many senior professors have noticed that the earnings of entry-level faculty are often very close to, or greater than their own. This trend in faculty life-cycle earnings can be illustrated by the 1998 salary and seniority data obtained from a public, liberal arts college (PLAC) that are reported in Table 1. Salary compression is evidenced by the narrow earnings difference ($2,300) between the highest-paid assistant professor and the lowest-paid full professor in this department. Salary inversion can be illustrated by differences in the averages, or in the range of salaries between assistant and associate professors. For example, the average assistant professor in Department X earns approximately $200 more than the average associate professor. Also, the highest paid assistant in this department earns $2,000 more than the highest-paid associate. These data indicate a U-shaped wage-tenure profile. Such a profile suggests that faculty with low levels of seniority can expect their earnings to fall, or invert, relative to the salaries of new hires as their careers unfold at this institution. Similarly, the earnings gap between new hires and faculty with high levels of seniority will compress over time.

Concern over salary compression and inversion has prompted many campuses to develop policies to correct for these kinds of salary inequities. These policies typically have two goals. The first addresses setting aside a portion of the annual university budget to be used for salary adjustments and the second, which concerns us, has to do with methods of identifying those faculty most in need of equity adjustments.

The standard approach to ranking faculty in need of adjustments begins with a regression estimate of faculty salaries as a function of years of seniority and other

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TABLE 1
Illustration of Faculty Salary Compression and Salary Inversion Department X at PLAC, 1998

Rank	Average Salary	Average Years of Seniority	Rank Salary Range (highest or lowest)
Full	$51,000	20.75	$43,300 (lowest)
Associate	$38,900	8	$39,000 (highest)
Assistant	$39,100	4.5	$41,000 (highest)

Data for full time faculty. Salary data rounded to nearest $100.

characteristics. Regression residuals from this estimate are used to rank candidates for salary adjustments. Those with negative residuals, indicating earnings below the fitted campus trend, are included in the eligibility pool.[1] From this pool those with the largest (absolute value) residual are ranked the highest. Controlling for differences in faculty productivity is a key issue in the estimation and ranking process. For example, consider two senior faculty with salary levels below the estimated line, the same years of tenure, but differing levels of performance. The higher performing professor will have accumulated more productivity-related merit pay over time and will likely have a smaller residual (in absolute value) than the lower performer. Rankings based on these results may be interpreted as unfair because the high performer is penalized. This outcome may also conflict with university goals of retaining productive faculty. The estimation problem described above is usually addressed by including additional independent variables that measure faculty performance. It is difficult to control, however, for all aspects of faculty productivity related to teaching, research, and service that affect earnings. As a consequence, any omission related to the incomplete measure of faculty performance will affect regression residuals and the ranking of faculty.

We overcome this estimation problem by taking advantage of the administrative practice at PLAC of separating merit from cost-of-living salary increases. This enables us to subtract all accumulated merit from each faculty member's salary. In this way, we are able to control for differences in faculty productivity by removing the earnings consequences of performance from the dependent variable. This method avoids the bias associated with the use of incomplete measures of faculty productivity described above. We demonstrate below that this method provides an estimate of salary compression and inversion that can be used to rank faculty in a way that does not penalize high performers. Our method and findings, therefore, are of particular interest to those involved with, or affected by, university salary equity practices.

The remainder of the paper is organized as follows. The next section surveys the literature addressing the returns to seniority and the causes of salary compression in academia. Based on this review, we offer a new explanation of the U-shaped wage-tenure profile described in Table 1. We also explain the traditional estimation approach used to identify eligible faculty and our suggestion for improving this method. In the following sections the data, the models and results of both approaches are presented and compared. The paper concludes with suggestions on how this method can be used to address other aspects of salary equity.

LITERATURE REVIEW

A variety of theories of the labor market predict higher earnings for more senior workers. The most conspicuous of these is the theory of specific human capital. This model suggests that senior workers who have learned firm-specific skills are paid more to discourage them from leaving with the skill investments paid for by the firm [Becker, 1993]. By contrast, Lazear [1981] suggests that a desire to maintain work incentives, rather than rewarding skill acquisition, leads firms to offer higher pay with seniority. See Topel [1991] for other examples.

Without providing support for any particular explanation, Ransom [1993] finds empirical evidence of a positive relation between seniority and salary. Using data from the *May 1988 Current Population Survey,* Ransom reports that higher levels of seniority are rewarded with higher pay for all of the occupations examined, except college and university professors. In fact, for this group salaries are negatively correlated with seniority.[2] Ransom attributes this finding to the market power enjoyed by U.S. colleges and universities. Specifically, since campuses are geographically separated, colleges possess a high degree of monopsony power. As a consequence of the distance between employers, professors face considerable mobility costs (moving dependents, separation from friends and family). Further, these costs increase with time spent at an institution and limit the desire to move to take advantage of higher salaries elsewhere. According to Ransom, university administrators are aware of this and do not need to offer higher wages to more senior faculty in order to retain them.[3]

Ransom's monopsony model is consistent with the downward-sloping portion of the U-shaped wage-tenure profile that was described by the data in Table 1. This portion indicates a negative relation between seniority and faculty salaries. Monopsony is inconsistent, however, with the upward-sloping portion, or right tail of the profile, indicating a positive relation between tenure and the salaries of the most senior faculty. This upward sloping portion of the U-shaped profile is not unique to the faculty sample used in the present study. Indeed, in an examination of the wage-tenure profiles of faculty from the University of Arizona (UA) for 1972 and 1977, Ransom reports U-shaped profiles with the log of salary falling until 14.5 or 24 years of seniority, respectively, before rising again.[4] These profile-minimizing levels of seniority are well within the observed range of seniority for the faculty samples examined. Further, Ransom's estimate of the wage-tenure profile based on the 1972 UA data indicates that after approximately 28 years of tenure the salaries of the most senior faculty rise above the level paid to new hires. If higher seniority implies greater vulnerability to monopsony exploitation, why would the salaries of the most senior faculty be equal to, or greater than the salaries of faculty with less seniority? This inconsistency suggests that the monopsony model provides an incomplete explanation for the U-shaped life-cycle earnings pattern experienced by many college and university professors.

It is possible that the U-shaped wage-tenure profile is an artifact of the market conditions under which faculty started their careers. For example, those with levels of seniority that place them at the bottom of the profile may have entered when academic salaries were depressed. Those with higher earnings, who have very low or very high levels of seniority, may have entered the academic labor market when starting salaries were relatively high.[5] It is unlikely, however, that fluctuations in starting salaries can explain the persistent pattern in wage-tenure profiles reported by numerous studies covering several decades. As mentioned above, Ransom reports U-shaped faculty wage-tenure profiles for 1972 and 1977. Brown and Woodbury [1998] also report U-shaped profiles based on data from 1981, 1986 and 1990. Finally, the present study reports a "U" shape based on faculty salary data from 1998. Short of continuous waves of fluctuations in academic starting salaries that would string these profiles from different periods together, it is unlikely that changes in starting salaries can explain this durable profile pattern. Rather, the persistence of this pattern suggests it is the result of the wage policy adopted by many U.S. universities.

The descriptive wage theory developed by Baker, Gibbs and Holmstrom [1994] may offer the best insight into the causes of the U-shaped wage-tenure profile experienced by professors. Baker, Gibbs and Holmstrom use longitudinal personnel data for managerial employees from a single employer to examine wage progression and rigidity from 1969 to 1988. The authors report that entry level salaries fluctuate with changing market conditions and often result in higher salaries for more recently hired cohorts. As is the case with Ransom's monopsony explanation, Baker, Gibbs and Holmstrom hypothesize that mobility costs discourage lower paid, older cohorts from moving to another employer. The outcome of this process is that cohort wage differentials are preserved as tenure with the employer increases.

In an examination of individual wage behavior within the firm, Baker, Gibbs and Holmstrom find that earnings decrease, both in real and in relative terms, the longer the time to promotion. Alternatively, those with high salary growth rates received quick promotions. Deciding that theories of on-the-job training, learning, and incentives cannot explain the data described above, Baker, Gibbs and Holmstrom offer a simple descriptive model where starting salaries are set according to existing market rates. Annual rewards are based on the employee's performance in that year and the best performers are promoted to higher levels with more demanding tasks. Consequently, new employees may find their earnings to be greater than older employee cohorts. Further, more productive employees receive larger annual increases and early promotions resulting in more rapid salary growth.

The cohort and promotion effects described by Baker, Gibbs and Holmstrom are of particular use in explaining the negative- and positive-sloped portions of the U-shaped wage-tenure profile. For example, the data reported in Table 1, indicating that the average assistant in Department X at PLAC earns more than the average associate, is consistent with a durable cohort effect where new hires start their careers under more favorable market conditions.[6] The cohort effect describes the negatively-sloped portion of the U-shaped profile. Data used in this table also provide insight into the effect of early promotion on the positively-sloped portion of the profile. Table 1 reports an average full professor's salary in Department X of $51,000. When we exclude those who were promoted in less than the average time for this department, the average full professor's salary falls to $49,000. Accumulated merit and the promotion pay steps at PLAC have pulled the earnings of this group to a level that is higher than new assistants.[7] By including the senior faculty who received early promotions, however, the effect is more pronounced. The right side, or positively-sloped portion of the U-shaped profile, is extended upward by $2,000 when these individuals are included.

We find a similar pattern when examining the earnings effect of early promotion across the PLAC campus. For example, full professors who are promoted in less than the average time (12.5 years) for this rank at this institution, earn an additional $5,200 ($t$-value = 3.13). Estimated from the other perspective, results indicate that full professors taking longer than the average time to promotion earn $5,200 less, despite the salary steps that occur with promotion to this rank. These results are consistent with the wage policy developed by Baker, Gibbs and Holmstrom where high performers are rewarded with quick promotions and rapid wage growth. These results also suggest that rewarding high performers with early promotions may offset the cohort effect with the salaries of productive senior faculty extending up the positively-sloped tail of the U-shaped profile.

The data described above suggest that the often observed U-shaped wage-tenure profile in academia may be the result of a wage policy adopted by many U.S. colleges and universities where entry level wages fluctuate with changing market rates. Mobility costs preserve salary differences between faculty cohorts. Earnings rise for more productive faculty, however, through early promotions and large raises that offset the cohort effect yielding a U-shaped pattern of life-cycle earnings.

While the discussion above may provide a firmer theoretical explanation for faculty salary compression and inversion, interest in this problem has been more than academic. It affects a university's costs with regard to faculty turnover and creates the imperative for salary equity adjustments. As a consequence, there has been a long history of interest among institutional researchers to develop statistical methods that can be used by campuses concerned with correcting the salary, incentive and retention problems associated with salary compression, and inversion [Wall, 1976; Pezzullo and Brittingham, 1979; Suskie and Shearer, 1983; and Moore, 1992]. As mentioned previously, the standard approach employed on many campuses and by institutional researchers is to rely on the value and size of the regression residuals from salary estimates to rank faculty in need of equity adjustments. Controlling for faculty productivity is crucial in this process because the omission, or incomplete measure, of performance can affect the size of residuals and the faculty rankings. It is difficult, however, to quantify all aspects of faculty productivity and many researchers have ignored this issue altogether [Brown and Woodbury, 1998; Hallock, 1995].

We contribute to this body of research by comparing the results of the standard method, which attempts to control for faculty performance, to an approach that nets out the earnings effect of past productivity from faculty salary. This is accomplished by subtracting past merit increases from the current salaries of PLAC faculty. By adjusting the dependent variable we avoid the specification problems associated with the use of independent variables that do not completely control for faculty performance. In this way we are able to obtain a more accurate measure of salary compression and inversion.

Specifically, we estimate two models. The first model uses total faculty salary, inclusive of merit increases, as the dependent variable. We then attempt to control for performance differences among faculty by including the appropriate independent variables. In the second model we subtract accumulated merit from faculty salary. In this way, we are able to estimate the effect of years of seniority on salaries, independent of previous salary increases due to high productivity.

Our approach yields the following predictions:

Prediction #1: When the earnings effects of past performance are removed from faculty salaries, the regression estimate will indicate a greater penalty for seniority. That is, the wage-tenure profile will be steeper and deeper in the second model.[8]

Prediction #2: The rankings of faculty most in need of equity adjustments will differ between the two models. Once the effects of past productivity have been removed, more productive faculty will move up in the rankings while faculty with a history of lower performance will move down the list of those eligible for equity adjustments.

Finding a method of controlling for differences in faculty performance is also important in equity issues related to race and gender. In the following we also illustrate how removing the earnings effect of productivity from faculty salary provides insight into the source of earnings differences between male and female faculty.

DATA AND MODELS

Previous research has estimated the returns to seniority at large, research institutions [Brown and Woodbury, 1998; Ransom, 1993]. In addition, Hallock [1995] and Barbezat [1989] have found that unionization is associated with positive returns to seniority. Our data are from a medium-sized, unionized, public liberal arts college. Like many other state institutions in the United States, this college has recently experienced low annual salary increases that have compounded problems of salary compression and inversion. Our data allow us to examine the effect of unionization on the return to seniority at a mid-sized institution in the kind of financial circumstances described above. In this way we are able to provide insight into the pattern of life-cycle earnings at a typical, middle-tier, public institution representative of many others in the United States.

The PLAC data contain information on faculty salaries, merit increases, performance, years of service at the present institution and years of prior experience. We use faculty survey data from the 1998-1999 academic year. The PLAC data are somewhat unique in that it is an administrative practice at this college to separate salary increases due to cost-of-living from merit adjustments.[9] Because of this distinction we are able to subtract past merit increases from a faculty member's salary to estimate the effect of seniority on salaries, independent of the faculty member's past productivity achievements.[10] PLAC is not alone with regard to the administrative practice of separating merit from cost-of-living increases. To the extent that this distinction is made at other campuses, our suggested method can be employed by those concerned with salary equity issues. Regardless of recording methods, the main thrust of our technique is that it is easier and more appropriate to adjust recorded faculty salaries for past productivity increases, rather than attempt to include all the necessary independent variables needed to adequately control for faculty productivity.

To illustrate the advantages of this technique, we estimate two faculty salary equations. The first model follows the standard approach and includes faculty salary inclusive of past merit increases. In this model we also include measures to attempt to control for faculty productivity. In the second model, we subtract the earnings effects of past productivity from the salary data. These models are described below:

$$(1)\ \mathrm{Ln}\mathit{TOTAL\ SALARY} = \beta_0 + \beta_1 \mathit{SENIORITY} + \beta_2 \mathit{SENIORITY}^2 + \beta_3 \mathit{PRIOR\ EXPERIENCE} + \beta_4 X + \beta_5 \mathrm{Ln}\mathit{STARTSAL} + \beta_6 \mathit{PERFORM} + \mu$$

$$(2)\ \mathrm{Ln}\mathit{SALARY-MERIT} = \beta_0 + \beta_1 \mathit{SENIORITY} + \beta_2 \mathit{SENIORITY}^2 + \beta_3 \mathit{PRIOR\ EXPERIENCE} + \beta_4 X + \beta_5 \mathrm{Ln}\mathit{STARTSAL} + \beta_6 \mathit{PERFORM} + \mu$$

where the dependent variable for model (1), Ln*TOTAL SALARY*, is the natural log of the faculty member's contractual salary inclusive of accumulated merit, but minus stipends for department chairs. For model (2), the dependent variable is the natural log of contractual salary minus stipends and past merit increases. For new hires in 1998, Ln *SALARY-MERIT* equals the log of the accepted starting salary. We use the same independent variables in both models so that we can isolate changes in the wage-tenure profile that are due to changes in the measurement of the dependent variable.

The specification of the right-hand side of the equation is typical of other studies in this literature. For example, Ransom [1993], and Brown and Woodbury [1998] use the semi-log form of the dependent variable and the quadratic form for the years of seniority (*SENIORITY* and *SENIORITY*^{2}). A negative sign for the linear term and a positive coefficient for the quadratic term would be consistent with the results of these studies and with the results presented in Table 1. All of these suggest a U-shaped wage-tenure profile. We also specify an alternative to avoid the problem of collinearity between the two continuous measures of seniority by using a set of dummy variables for discrete increments of seniority. This dummy variable specification measures the salary difference between a particular seniority cohort and the reference category (new hires to three years of tenure). The coefficients for the dummy variables describing the wage-tenure profile are reported in Table 4.

PRIOR EXPERIENCE is the number of years of work experience a faculty member has accumulated prior to coming to PLAC. **X** is a vector of faculty characteristics such as rank, degree status, and gender. We follow the example set by Barbezat [1989] and Hallock [1995] and include measures of faculty rank. Brown and Woodbury [1998] argue, however, that since rank and salary are jointly determined, least squares estimates will be biased and inconsistent if rank is included as a regressor. Hallock [1995] reports that including measures of rank results in a flatter wage-tenure estimate.

Ln *START SAL* is the log of the 1998 College and University Personnel Administration (CUPA) market salary for new assistant professors for each faculty member's discipline. Brown and Woodbury [1998] use this variable to determine if changes in external salaries are transmitted to an institution's faculty. Since Ln *START SAL* matches with any faculty member's field, we omit department variables to avoid redundancy. We discuss, however, the results of alternative specifications that control for the faculty member's department.

We include two measures of faculty performance in an attempt to control for the effect of productivity on salary. First, we derive *HIGH PERFORM* from the previous year's merit increase. Those faculty who received a merit increase, based on their performance in 1997, received a value of one for this variable. *HIGH PERFORM* is zero for those who did not receive a merit increase in 1997. Previous studies have relied on publication records as a measure of faculty productivity. This is appropriate when measuring productivity for faculty at research institutions. Merit pay at PLAC, however, is based on weighted performance in teaching, research, and service, hence *HIGH PERFORM* is a more appropriate measure of performance for faculty at this teaching institution. The limitation of this measure of productivity is that we have data for only one year. It is very likely, however, that faculty receiving merit increases in one year have a history of high performance. If the coefficient for *HIGH PERFORM* indicates an impact on salary that is greater than the average merit award from the previous year, this variable is capturing more of the history of faculty productivity.[11]

We also include *CHAIR*, a measure for those holding a position as department chair (equals one if a chair, else 0). If more productive faculty move into these positions, this variable may also measure performance. The use of these performance variables is of particular importance in model (1). Here, we need to attempt to control for differences in productivity across the sample. We leave *HIGH PERFORM* and *CHAIR*, however, in the estimate of model (2) for two reasons. First, high performers may have received a higher base salary upon appointment and, second, consistent specification across equations allows for the comparison of wage-tenure profiles discussed above. The error term in both models is μ.

A possible criticism of our suggested approach is that model (2) is completely determined. That is, since the dependent variable in this specification is essentially a faculty member's starting salary, adjusted for cost-of-living and promotion increments, variables like race, gender, and performance play no role unless they affect the starting salary. Further, whether or not seniority is penalized can be simply determined if the relation between seniority and salary is linear. Given a linear relation, if percentage increases in starting salaries for newly hired faculty exceed the percentage cost-of-living increases and the promotion increments received by more senior faculty, then seniority is penalized. If the reverse is true, then seniority is not penalized. If the relationship between seniority and salary is linear, that is, if the salaries for more senior faculty continue to fall (or rise) with additional years of tenure, there may be nothing to estimate. The discussion by Baker, Gibbs and Holmstrom and the U-shaped wage-tenure profile described above, however, suggests that the relation between salaries and seniority is not linear and that influences other than deterministic steps may be shaping the return to seniority. Further, the estimate of model (2) is a way of testing for the kind of cohort and promotion effects described by Baker, Gibbs and Holmstrom and to determine if these are part of a university's wage policy.

TABLE 2
Brief Variable Description and Summary Statistics

Variable	Brief Description	Means	(Std. Dev.)
Ln *TOTAL SAL.*	Log of 1998-1999 salary for full-time faculty minus stipends	10.73	(.22)
Ln *SAL.-MERIT*	Log of 1998-1999 full-time salary minus past merit increases and stipends	10.64	(.18)
SENIORITY	Full-time years of service at PLAC	15.02	(11.6)
PRIOR EXPERIENCE	Full-time years of service prior to PLAC	.19	(.80)
RANK	Dummy variables for distinguished professors	.04	(.21)
	Full professors	.33	(.47)
	Associate professors	.33	(.47)
	Lecturers with assistants as the reference category	.05	(.23)
PHD	Equal to one for Ph.D.s and zero for M.A.	.86	(.34)
CHAIR	Equal to one for department chairs, zero otherwise	.09	(.29)
Ln *CUPA SAL*	Log of CUPA salary data for new assistants in discipline	10.53	(.06)
SEX	One if female, zero if male	36	(.48)
RACE	One if non-white, zero if white	.10	(.30)
PERFORMANCE	Equal to one for those receiving merit increases for 1998-1999, zero otherwise.	.31	(.47)

RESULTS

Summary statistics are presented in Table 2. In 1998, average salaries (minus stipends) were $46,743 and $42,496 if past merit increases are deleted. The data for years of seniority and years of prior experience indicate that many faculty began their careers at this institution. The average faculty member has 15 years of seniority and only .19 years of service at other institutions. There are a total of 466 full- and part-time faculty at this institution. The salary equity policy at PLAC, however, covers only full-time faculty (tenure and non-tenure track). Our sample of 238 includes all PLAC faculty covered by the policy. Consequently, this sample contains some lecturers (5 percent). Some of these individuals have years of service dating back to 1984. Four percent of the faculty are distinguished professors. Full and associate professors each constitute one-third of the sample. Assistant professors are the reference cat-

TABLE 3
Estimated Salary Functions With and Without Merit Increases
Model (1): Dependent Variable = Log of (Total Salary – Stipends)
Model (2): Dependent Variable = Log of (Total Salary – Stipends – Merit)

Variable	Model (1) Coefficient	Model (2) Coefficient
Constant	7.94	8.12
	(7.07)	(6.50)
SENIORITY	–.0014	–.011
	(–.48)	(–3.50)
SENIORITY^2	.0003	.0005
	(3.98)	(6.54)
PRIOR EXP	.011	.016
	(1.26)	(1.74)
LECTURER	.00001	.005
	(0.0)	(–.15)
ASST. PROF	.104	.106
	(4.36)	(4.00)
FULL PROF.	.250	.205
	(8.61)	(6.37)
DIST. PROF.	.390	.319
	(9.66)	(7.14)
PHD	.039	.031
	(1.69)	(1.20)
CHAIR	.011	–.087
	(0.47)	(–3.42)
SEX	–.019	–.002
	(–1.28)	(–.99)
RACE	–.011	–.004
	(–.50)	(–.16)
Ln *START SAL*	.240	.225
	(2.24)	(1.89)
HIGH PERFORM	.042	.001
	(2.94)	(.63)
N	238	238
$\bar{R}^2$	.82	.68
F	83.5	39.64
SEE	2.02	2.50

t-values in parentheses

egory and comprise the remaining 25 percent of this faculty. Eighty-six percent of the faculty have Ph.D.s and the remainder have Master's degrees. Nine percent of the faculty hold positions as department chairs, 36 percent are female and 10 percent are nonwhite. Given the distribution of positions at PLAC, the average starting salary according to the CUPA data (*START SAL*) is $37,584 for new assistant professors in the United States in 1998. Finally, 31 percent of the faculty were high performers in 1997.

Regression results for models (1) and (2) are reported in Table 3. The coefficients for seniority from either model suggest a U-shaped wage-tenure profile. The *t*-value for the linear term is not significant in model (1), but is for model (2). Further, the

TABLE 4
Wage-Tenure Profile Estimated with Dummy Seniority Variables
Model (1): Dependent Variable = Log of (Total Salary – Stipends)
Model (2): Dependent Variable = Log of (Total Salary – Stipends – Merit)
Reference Seniority Category = New Hires to 3 Years of Seniority.

Years of Seniority	Model (1) Coefficient	Model (2) Coefficient
4-7 years	.0001	–.005
	(.01)	(–.19)
8-11 years	–.040	–.082
	–1.25)	(–2.39)
12-15 years	.052	–.015
	(1.56)	(–.41)
16-19 years	.013	–.113
	(.35)	(–2.90)
20-23 years	.034	–.076
	(.82)	(–1.73)
24-27 years	.140	.052
	(3.98)	(1.37)
28-31 years	.222	.158
	(6.57)	(4.35)
32-35 years	.270	.224
	(7.03)	(5.42)
+ 35 years	.291	.255
	(5.86)	(4.77)
Constant	8.263	8.185
	(7.49)	(6.88)

Dummy seniority coefficients obtained from a regression model containing the same independent variables (excluding years of seniority and its square) reported in Table 3 (*t*-values in parentheses).

first and second derivatives of the equations with respect to seniority indicate that salaries fall until approximately 2.3 years, based on model (1), or 11 years of service, based on model (2), before rising with additional years of seniority. These estimates are consistent with our first prediction. The results indicate a steeper wage-tenure profile and a greater penalty for seniority when accumulated merit is subtracted from salary.[12]

The different estimates of the wage-tenure profile reported for models (1) and (2) may be due to removing the earnings effect of past productivity, as we hypothesized above. Or, the change in the coefficients between the two estimates may be due to instability caused by collinearity between the seniority variables. For example, the correlation coefficient between years of seniority at PLAC and its square is .96. This high level of correlation between the variables used to estimate the profile may result in unstable and changing profile estimates when the different models are used. Results that replace the continuous seniority variables with dummy variables are shown in Table 4. Regardless of this measurement difference, the results reported in Table 3 and 4 provide similar wage-tenure profile descriptions. For example, the results from model (1) in Table 4 indicate that only for cohorts with 24 or more years of seniority do salaries significantly rise above those of the reference category (significant at the 5 percent level, or lower, for two-tailed tests). These results are consistent with the shallow, U-shaped profile with an insignificant linear coefficient reported for model (1) in Table 3. On the other hand, results for model (2) in Table 4 indicate consistently lower salaries for older cohorts with statistically significant differences for those with 8 to 11 and 16 to 19 years of seniority (significant at the 5 percent level, or lower, for two-tailed tests). It is only for cohorts with 28 or more years of seniority that salaries are significantly higher than the reference category. This is consistent with the steeper and deeper wage-tenure profile described by model (2) from Table 3. In sum, the change in the profile results between models (1) and (2) reported in Table 3 do not appear to be the result of collinearity between the continuous measures of seniority.

As mentioned above, not all researchers have found U-shaped wage-tenure profiles among college and university faculty. For example, Hallock [1995] suggests that since the collective bargaining agreement at UMASS grants cost-of-living increases to all faculty, the wage-tenure profile for faculty at that campus is concave. Barbezat [1989] has also found that unionization offsets an otherwise negative return to seniority. Our results are based on a campus with union negotiated, across the board cost-of-living increases, yet the wage-tenure profile is U-shaped. This finding suggests that faculty unions are not always successful in providing positive returns to seniority.

Other results reported in Table 3 indicate that an increase in prior experience is associated with higher earnings only in model (2) (at the 5 percent level, one-tailed test). This estimate is based on eleven PLAC faculty who have from two to six years of prior experience.[13] Results from both models indicate that all but lecturers earn significantly higher salaries than assistants. Ph.D.s do not earn significantly more than other faculty according to model (2), but do in model (1) (at the 5 percent level with a one-tailed test). Contrary to our expectation, chairs earn significantly less according to model (2). This finding may indicate lower productivity by individuals who become chairs. Or, perhaps lower-paid faculty seek these positions in order to increase their income through the stipend.

While the low t-value for the *RACE* coefficient from model (1) suggests the absence of racial earnings disparity among the faculty at this campus, the results for the *SEX* variable from this model indicate a small (2 percent) and statistically significant gender earnings difference (based on the 10 percent level for a one-tailed test). Gender differences in earnings may result from female-male differences in productivity, or from discrimination. If the performance variables included in model (1) completely control for productivity, the results from this estimate imply that the earnings difference is due to discrimination. The results from model (2), however, indicate that when the earnings effect of productivity is more completely removed from the salaries of male and female faculty, there is no longer a significant gender earnings difference. Comparing the results of the two models indicates that the implied earnings difference from model (1) is due not to discrimination, but to inadequate control of productivity differences between male and female faculty. The above illustrates the benefit of removing the earnings effect of performance when seeking to determine the source of gender differences in pay.[14]

Results from either model indicate that changes in entry level salaries (measured by Ln *CUPA SAL*) are transmitted to faculty at PLAC. These starting salary elasticities indicate, however, that a one percent increase in entry level salaries results in only a .24, or .23, percent increase in salaries for faculty at this institution (based on models (1) and (2), respectively). In contrast, Brown and Woodbury [1998] report elasticities between .71 and .91 indicating that the salaries at the institution they examine are more sensitive to changes in market rates.

As mentioned above, since Ln *CUPA SAL* measures the starting salary for the faculty member's field, additional controls for the faculty member's department are redundant. We also estimated models (1) and (2), however, replacing Ln *START SAL* with 22 PLAC department dummy variables (with the economics department as the reference category). None of the dummy department variables were significant (with a two-tailed test at the 10 percent level). Faulty rank variables, however, remained significant in the new estimates suggesting that position, or promotion, means more in terms of salary than department.

The use of department dummy controls resulted in only minor changes in the estimate of the wage-tenure profile. The results indicate that the linear slope term for years of seniority from model (1) was sensitive to the specification. This coefficient changed from negative (as reported in Table 3) to positive (.0008) when the department dummy variables were used. This coefficient, however, remained statistically insignificant in both specifications.[15]

We also estimated the two models without Ln *START SAL* or dummy department variables to estimate the wage-tenure profile across departments. Once again, the linear seniority term from model (1) was sensitive to the specification change. This coefficient changed slightly (to $-.0011$ from $-.0014$, as reported in Table 3) when the seniority profile was estimated across departments. All other coefficients for linear and quadratic seniority variables are unchanged in size and significance from those reported in Table 3.

Finally, the results from model (1) indicate that those who received merit increases in the previous year earn significantly higher salaries. The dollar equivalent of the coefficient from the semi-log estimate is $1,963. This result is consistent with our expectation since the dollar equivalent of the coefficient exceeds the average level of awarded merit ($243) for the previous year's performance. This indicates that *HIGH PERFORM* captures more than the previous year's performance impact on salary. Consequently, this finding suggests that these individuals are consistently high performers.[16]

As stated above, our approach implies two predictions. The discussion above is consistent with the first prediction, indicating a steeper wage-tenure profile for model (2). Below, we examine the implications of the second prediction. We expect the ranking of faculty most eligible for equity adjustments to differ between the two models. Specifically, we expect the results from model (2) to move higher performers up in the rankings because removing the effect of past performance from salary will provide a purer measure of the effect of seniority. To illustrate this point, we selected seven faculty with six to eight years of seniority, with varying levels of performance and who were identified as being eligible for equity consideration (based on model (1) negative regression residuals). Performance is indicated by the level of accumulated merit pay. In Table 5, faculty A-G are initially ranked according to the size of their

TABLE 5
Changes in Faculty Salary Adjustment Eligibility Rankings Based on Regression Residuals from Models (1) and (2)

Faculty Member	Total Merit	Residual Model (1)	Residual Model (2)	Eligibility Ranking Model (1)	Eligibility Ranking Model (2)
A	$3,450	−.1288	−.1298	1	1
B	$2,200	−.0630	−.0681	2	3
C	$3,100	−.0607	−.0905	3	2
D	$1,000	−.0418	−.0086	4	5
E	$500	−.0377	.0157[a]	5	—
F	$500	−.0282	−.0330	6	4
G	0	−.0219	.0421[a]	7	—

Example based high- and low-performing faculty with six to eight years of seniority. Regression residual = observed Y − predicted Y.
a. Positive residual removes a faculty member from equity consideration.

regression residual from model (1). It is important to keep in mind that seniority and performance are not the only factors affecting this ranking. How far a faculty member is out of campus-wide salary trends for reasons other than specified in the model will also have an influence. Regardless, the rankings change in a manner that is generally consistent with Prediction #2. For example, higher-performing Faculty C replaces lower-performing Faculty B in the second rank based on results from model (2). While the movement of lower-performing Faculty F up into the number four rank is contrary to our expectation, the effect of model (2) is to remove lower-performing Faculty E and lowest-performing Faculty G from salary adjustment consideration because their residuals have become positive. In sum, these findings support the notion implied by Prediction #2 that the relative rankings of faculty will vary when the salary effect of past performance has been netted out. In this way, faculty are more appropriately ranked when considered for equity adjustments.

CONCLUSION

Many campuses have, or are developing, policies to address salary inequity and ways of distributing salary adjustments. It is important that the methods used to rank faculty in need of salary adjustments provide fair and accurate outcomes. The role of faculty performance is a sensitive one in this process. Consequently, there is a need for methods of ranking faculty that do not penalize those who have increased their earnings through high performance. Our analysis provides insight into how this goal can be achieved. Specifically, our findings suggest that it may be more appropriate and accurate to adjust the salary data for performance rather than to attempt to control for all of the factors that measure productivity when equity eligibility is determined. Other universities in the United States share the administrative practice of separating merit from cost-of-living salary adjustments. This practice simplifies the estimation and equity ranking process. For institutions that do not record the distinction between merit and cost-of-living, the task is more daunting. Implementing the method we have suggested may present computational challenges, but given the importance of the issues involved, this method warrants the additional effort.

Controlling for faculty productivity has also posed a problem for studies that have addressed equity issues related to race and gender [Riggs and Dwyer, 1998; and Williams, 1987). We have illustrated that attempting to control for productivity by including additional independent variables, versus removing the earnings effect of productivity from faculty salaries, results in conflicting conclusions concerning the cause of gender differences.

Finally, other than the descriptive wage theory developed by Baker, Gibbs, and Holmstrom [1994], we have found very little theoretical explanation for the U-shaped wage-tenure profile characteristic of many U.S. colleges and universities. Clearly, there is evidence in our own backyard suggesting a need for further examination of the cause of this trend in life-cycle earnings.

NOTES

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1. Whether this method is appropriate is open to discussion. The residual may simply be measurement error or may be sensitive to alternative specifications. The omission of critical explanatory variables, or inappropriate inclusion of other information, can affect the residual and lead to arbitrary identification of inequities. For more discussion see Moore, [1992], Suskie and Shearer, [1983], Pezzullo and Brittingham, [1979] and Wall [1976].
2. Other researchers have found similar results with respect to professors. For example, in addition to finding a penalty for seniority among faculty at their university, Brown and Woodbury [1998] report that the earnings of senior faculty are relatively less sensitive to changes in entry level market salaries. This lower elasticity for senior faculty compounds salary compression. There is additional evidence that faculty unionization is associated with positive returns to seniority. Barbezat's [1989] results based on a 1977 cross-campus survey of faculty indicate that seniority is associated with lower salaries, unless faculty are unionized. Also, Hallock [1995] reports positive returns to seniority among unionized University of Massachusetts faculty in 1974. In contrast to Ransom's findings, Barbezat and Donihue [1998] report a positive return when seniority is measured over a lengthy employment spell.
3. Harris and Holmstrom [1982] and Lazear [1986] have developed models suggesting that more senior workers receive lower pay because of their lower worker quality. However, even when Ransom controls for publications, a key measure of worker quality for faculty at the research institution he examines, the negative association between seniority and salaries persists. By contrast, Moore et al. [1998] report that the negative return to seniority disappears when faculty research productivity is controlled. Using a broader measure of faculty productivity, which is discussed below, we find a persistent U-shaped wage-tenure profile.
4. Ransom also reports that the faculty data from this same institution for 1982 indicates a minimum salary level at 55 years of seniority.
5. Evidence of fluctuating entry level salaries in academic labor markets can be found in Bok [1993] who argues that the tightening of faculty labor supply in the 1980s caused upward pressure on entry-level salaries while enrollment contractions strained state support for public higher education. As a result, administrators have recently offered competitive salaries to new faculty, but have not had the funds to reward the job tenure of more experienced staff.
6. Additional evidence of a cohort effect across the PLAC campus can be obtained by tracking the relative position of recently hired assistant professors. For example, the 12 new assistant professors who started at PLAC in 1998, without any prior experience, received an average salary of $35,889 (with a minimum of $34,000 and a maximum of $42,000). On the other hand, the 14 assistant professors who started their careers at PLAC a year earlier received an averages of $34,862 in 1998 (with a minimum of

$32,598 and a maximum of $37,777). Data from the College and University Personnel Administration (CUPA) indicate that the average starting salary for the fields in which the 1998 cohort consists of was $37,733. The average for the 1997 cohort was $37,363. The similarity in these averages suggests that only a small portion of the salary difference between these cohorts can be explained by differences in field rates of pay. A large percent is due to a cohort effect.

7. The salary steps associated with promotion at PLAC vary over time. In 1998 the steps were $1,500 for promotion to associate professor and $2,000 for promotion to full professor.

8. This is the case because we are subtracting more from the salaries of senior faculty. For example, associate professors have more seniority and accumulated merit pay than assistants. When we subtract accumulated merit pay from the salaries of associate professors, the salary measure used in the regression will be relatively lower. Consequently, the fitted line between faculty of these two ranks will have a steeper negative slope.

9. The above assumes that faculty productivity and merit awards are positively correlated. However, merit pay may not be allocated in accordance with productivity. For example, mistakes may be made in assessing faculty productivity, or favoritism may interfere with the objective distribution of merit pay. The benefit of our suggested method is that regardless of the decision processes that influence the allocation of merit pay, the estimation of the wage-tenure profile is independent of the merit award process because this salary component is removed from the estimate. Of course, our suggested method cannot remove any bias resulting from favoritism, or mistakes that affect starting salaries.

10. Our data do not allow us to completely remove the effect of performance from faculty salary because one year's merit is included in the next year's base salary which will be adjusted by future cost-of-living increases. The following example illustrates the extent to which we are able to remove the earnings effect of productivity from faculty salary. Consider a faculty member who has completed two years of service at PLAC. At the end of each year this faculty member received a 3 percent cost-of-living adjustment, plus $500 in merit pay. Because the first year's merit ($500) becomes part of the base salary which is adjusted for the cost-of-living in the second year (3 percent times $500 = $15), the accumulated earnings effect of this faculty member's merit is $1,015. Because of the manner in which merit increases are recorded at PLAC, we are unable to remove that amount of the merit increase that is affected by the cost-of-living adjustment. Consequently, recorded merit for this faculty member is $1,000, or $15 less than the accumulated affect for merit. Since cost-of-living adjustments at PLAC have historically been quite low, ranging from 0 percent to 4 percent annually for the last 10 years, errors originating from this source are expected to be low. Even with this shortcoming, our method yields a more accurate measure of salary compression, or inversion, which would allow administrators to better identify those in need of equity adjustments.

11. This is precisely the effect that is measured by *HIGH PERFORM*. For example, the coefficient for *HIGH PERFORM* from model (1) is 4.2 percent indicating that those who received merit pay in the previous year had salaries that were $1963 higher compared to the average salary. On the other hand, the average merit award for the previous year is $243.90 (standard deviation of $389.0). There are other ways we can use merit pay as a measure of performance. For example, we could use the total, or accumulated, merit a faculty member has received as a measure of performance over their career. However, by definition such a measure would be related to the salary variable in model (1). Also, such a measure would be highly correlated with seniority. Another option is to construct *HIGH PERFORM* on the basis of the percent of a faculty member's career in which they received merit pay. The problem with this approach is that it overstates or understates the performance of faculty members with one year of service. These individuals would have a value of 100 or 0 percent based on whether they received merit after their first year. While the method that we employ to measure faculty productivity is not perfect, it avoids the problems of the methods described above. Furthermore, one of the purposes of this paper is to illustrate that since it is very difficult to measure faculty productivity, it is best to remove its effect from the dependent variable when estimating the return to seniority. The productivity variable we have created for illustrative purposes is the best that our data allow and the benefit of this measure is that it provides results that are consistent with expectations. It is important to note that any measure of performance that is based on a faculty member's history of merit pay cannot address the performance of new faculty members. Indeed, there are very few ways in which to measure the productivity of new faculty because of the lack of any indicators such as publications or teaching evaluations. To address this shortcoming we have also estimated the models with a dummy variable to identify new faculty. The results of these estimates are discussed below.

12. We also estimated the models without the measures of productivity (*CHAIR* and *HIGH PERFORM*). The coefficients for model (1) indicated, as expected, a more shallow profile with a linear term of .00018 (*t*-value = .06) and a quadratic term of .0002 (*t*-value = 3.37). Results from model (2) indicated a slightly steeper profile with a linear term of −.012 and a quadratic term of .0005. Both of these coefficients were significant at the 1 percent level.

13. We also estimated this model using linear and quadratic variables for prior experience. However, none of the coefficients for the linear or quadratic terms achieved statistical significance. For example, for model (1), the linear experience coefficient is −.005 (t-value = −.20) and .004 (with a *t*-value of .67) for the quadratic term. The adjusted R^2 for this estimate of model (1) is .83. For model (2) the linear coefficient for years of prior experience is −.006 (*t*-value =−.23) and .005 (with a *t*-value of .88) for the quadratic term. The adjusted R^2 for this estimate of model (2) is .68. Since the coefficients from the specification for the linear estimate of the models (reported in Table 3) are consistent with expectations and since the significance levels are higher, we base our results on these.

14. Since we remove the earnings effect of productivity from salary, this test addresses gender differences in base pay plus cost-of-living adjustments. Gender differences in merit increases may still exist.

15. For example, in model (1) the linear slope term for years of seniority becomes positive (.0008), but remained statistically insignificant (*t*-value = .24). The coefficient for the squared term in this model is essentially unchanged (.0002) and remains significant (with a *t*-value of 2.75). The adjusted R^2 from the new estimate of model (1) is .82. Results regarding the returns to seniority for model (2), with the dummy department variables, are very similar to the estimates of this model when Ln *START SAL* is used as an independent variable. For example, the linear slope term for the new estimate is −.010 compared to −.011 reported in Table 3. The coefficient for the squared terms are the same for both estimates. The adjusted R^2 for the department dummy variable estimate for model (2) is .67.

16. We also estimated models (1) and (2) with a dummy variable identifying new faculty members who do not have a history of merit pay. The results indicated that new faculty do not receive statistically different salaries, holding all else constant. Including this variable does not have a significant impact on the other estimates. Results of this estimate aré available from the authors upon request.

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