A time allocation study of university faculty.

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Abstract:

Many previous time allocation studies treat work as a single activity and examine trade-offs between work and other activities. This paper investigates the at-work allocation of time among teaching, research, grant writing and service by science and engineering faculty at top US research universities. We focus on the relationship between tenure (and promotion) and time allocation, and we find that tenure and promotion do affect the allocation of time. The specific trade-offs are related to particular career paths. For example, full professors spend increasing time on service at the expense of teaching and research while longer-term associate professors who have not been promoted to full professor spend significantly more time teaching at the expense of research time. Finally, our results suggest that women, on average, allocate more hours to university service and less time to research than do men.

Keywords: time allocation | academic research | tenure | university faculty | economics | education

Article:

1. Introduction

The allocation of time by university faculty to teaching, research, grant writing, service, and other activities is important for a number of reasons. For individual faculty members, different investments in teaching, research, grant writing, service, and other activities affect the probability of success in different career paths. Colleges and universities may wish to encourage time allocation patterns that are consistent with particular institutional goals or missions. More broadly, because most universities receive public monies, the larger society may have preferences over both inputs to and outputs of the education process.

The confirmation of tenure and subsequent promotion to full professor may influence the allocation of time in a number of ways. First, the job security afforded by tenure may provide an incentive for individuals to reduce overall work effort thereby allocating more time to non-work

(leisure) activities. Given the total hours of work, tenure may also affect the allocation of work time. For the institutions we study, tenure decisions are based primarily on research output. Consequently, the confirmation of tenure reduces the incentive for research in order to maintain employment. At the same time, future promotion and salary adjustments, as well as the possibility of receiving job offers from other institutions, provide continued incentives for research. Institutional factors will also affect the post-tenure allocation of time. For example, university administrators may want to encourage research and grant writing to maintain or increase their institution's reputation. They may also want to maintain research activity under the belief that research and teaching are complementary activities (e.g., Chen & Ferris, 1999).1

Additionally, the under representation of women in science and engineering within academics and the difficulty that universities face with retention and promotion issues have recently received much attention (National Academy of Sciences (2006a) and National Academy of Sciences (2006b)). Differing preferences, family responsibilities, and institutional biases may result in different time allocation paths by gender, and these outcomes may have implications for the likelihood of academic success. Empirical insights into these differences in the allocation of time are critical if university administrators are considering differential rewards systems to overcome these trends.

Economists have extensively studied the allocation of time between market work and leisure and among market work, home production, and leisure.2 More recently, specialized time-use data have made it possible to examine other issues such as time spent in parental care giving (Bianchi, Wight, & Raley, 2005) and the division of time spent on household production by married couples (Friedberg & Webb, 2005).3 and 4 Compared to these studies of non-work time, there is a comparative lack of studies of how time at work is allocated among competing activities. The primary reason for this gap is that data on how individual workers divide their work time among different activities are not commonly available.

Perhaps the most notable area where such data are available and where such studies have been undertaken relates to how college and university faculty members allocate their time among teaching, research, and service responsibilities. Yuker (1984) provides a summary of the literature on faculty workload as of the early 1980s. More recently, Singell, Lillydahl, and Singell (1996) use individual level data to explore differences in time allocation over the life-cycle and across types of institutions; Milem, Berger, and Dey (2000) study changes in time allocation over time across types of institutions; and Bellas and Toutkoushian (1999) explore differences in time allocation by gender, family status, and race.

In comparison, the present study focuses on the roles played by tenure and promotion and gender. Rather than make comparison across different types of institutions which may have very different environments, we focus specifically on institutions that are classified as Carnegie Extensive Doctoral/Research Universities. Because of the concerns about the experiences of women in the sciences, our study focuses only on the science and engineering disciples. By focusing on the relatively homogenous group of science and engineering disciplines at Carnegie Extensive Doctoral/Research Universities, we hope to minimize type-of-institution (e.g., liberal arts college vs. research university) and field-specific (e.g., humanities vs. sciences) differences that we may not be able to adequately control for in the analysis.

The remainder of the paper is outlined as follows. In Section 2 we describe the database that we used for this study and our findings. In Section 3 we discuss some implications of our findings.

2. Empirical analysis

2.1. The data set and descriptive patterns

The data for this study come from the National Science Foundation/Department of Energy Survey of Academic Researchers. This database was constructed under the sponsorship of these agencies within the Research Value Mapping Program at Georgia Tech for the purpose of understanding the teaching, research, and grant experiences of university scientists and engineers and their career trajectories. We used these data rather than the Department of Education's National Survey of Postsecondary Faculty for a number of reasons. First, and most important, our data allow us to disaggregate faculty allocations of time among finer work categories including extramural grants activities. Second, our data allow us to control for the institutional affiliation of the faculty member to capture any school-specific effect on time allocation. Finally, we are specifically interested in the research activity of scientists and engineers at major research universities because of the policy implications associated with relative declines in such post-baccalaureate graduates, especially female graduates.

Survey data were collected from a sample of non-administrative US university scientists and engineers with the Ph.D. at the 150 Carnegie Extensive Doctoral/Research Universities during the time period spring 2004 to spring 2005.5 The sample of researchers selected to receive the survey is stratified by gender and by academic field.6 The stratified sampling leads to a sample that is substantially different than the population of faculty. For example, over 50% of the analysis sample is female compared to 11% of the faculty population. Consequently, we

construct sample weights so that the analyzed sample is representative of the population of academic scientists and engineers. All of the analyses that follow are based on weighted data, and our conclusions therefore pertain to the population of academic scientists and engineers at the 150 top research universities in the United States.7

The variable of interest in this paper is the allocation of faculty time. Faculty were asked to estimate over the past full academic term the average number of hours per week devoted to 10 different activities such as research related to grants, non-grant research, graduate teaching, undergraduate teaching, advising students, and departmental service.8 We combined these 10 categories into four: research, grant writing, teaching, and service. Descriptive statistics of hours per week and the calculated fraction of time per week for these four activities are in Table 1, along with specifics of the activities in each of the four categories.9 Faculty work, on average, 54 h per week with most of those hours being allocated to research (36%) followed closely by teaching (nearly 32%).10 Less than 10% of faculty time is devoted to extramural grant writing.

Table 1. Mean allocation of faculty time by category of activity

Activity	Hours per week		Fraction of time per week	
	Mean hours	Standard error	Mean fraction	Standard error
All activities	53.96	0.53	1.000	–
Teaching[a]	16.74	0.33	0.317	0.006
Research[b]	19.42	0.42	0.357	0.007
Grant writing	4.58	0.17	0.082	0.003
Service[c]	13.22	0.36	0.244	0.006

Notes: sample size=1365; population size=33,813.

a Includes preparation time and meetings outside of class.

b Includes both grant and non-grant research.

c Includes administering grants, advising students, paid consulting, and all levels of service.

Table 2 reports mean hours per week and the percentage of time per week allocated to teaching, research, grant writing, and service for faculty with and without tenure and, separately, by gender. Non-tenured faculty spend about 2.5 h more per week working; they allocate more hours to research and grant writing and fewer hours to service. In terms of gender differences, women work slightly more hours than men, and they spend more time on teaching, grant writing, and service but less time on research.11

Table 2. Mean time allocations by tenure status and gender

	Total	Teaching	Research	Grant writing	Service
Mean hours					
Tenured	53.46	16.51	18.63	4.12	14.19
Not tenured	56.01	17.66	22.68	6.49	9.18
Mean fraction of time					
Tenured	1.00	0.318	0.346	0.074	0.263
Not tenured	1.00	0.315	0.401	0.116	0.168
Mean hours					
Women	55.02	17.61	17.98	5.80	13.63
Men	53.83	16.63	19.60	4.43	13.16
Mean fraction of time					
Women	1.00	0.321	0.325	0.104	0.250
Men	1.00	0.317	0.360	0.079	0.243

Notes: standard errors are available from the authors on request.Hours may not add to the total due to rounding; percentages may not add to 1 due to rounding.Sample size=1365; population size=33,813.

Table 3 segments hours of work by rank and gender. Assistant professors work more hours than do tenured associates or full professors, and full professors work slightly more than do associate professors.12 This pattern is about the same by gender. Several other patterns exist, both in terms of number of hours and fraction of time, across allocation categories. For example, assistant professors allocate most of their time to research, but with tenure this decreases more so among women than among men. Grant writing decreases with rank (except for women), and service increases with rank. Male associate professors spend more time on teaching than do assistant professors or full professors. Women who are full professors teach the least and do the most of the service.

Table 3. Mean time allocations by rank and gender

	Total			Teaching			Research			Grant writing			Service		
	All	Women	Men	All	Women	Men	All	Women	Men	All	Woman	Men	All	Woman	Men
Mean hours															
Assistant	56.01	56.17	55.98	17.66	19.53	17.25	22.68	20.39	23.18	6.49	6.86	6.41	9.18	9.40	9.14
Associate	52.49	54.27	52.20	18.54	19.26	18.42	17.36	15.87	17.59	4.13	4.93	4.01	12.46	14.22	12.18
Full	53.85	54.62	53.79	15.68	14.73	15.76	19.16	17.57	19.28	4.11	5.58	4.00	14.90	16.74	14.76
Mean fraction of time															
Assistant	1.00	1.00	1.00	0.315	0.343	0.309	0.401	0.364	0.409	0.116	0.122	0.115	0.168	0.171	0.167
Associate	1.00	1.00	1.00	0.364	0.365	0.363	0.329	0.290	0.335	0.076	0.086	0.074	0.231	0.259	0.227
Full	1.00	1.00	1.00	0.300	0.270	0.302	0.352	0.318	0.355	0.073	0.101	0.070	0.276	0.311	0.273

Notes: standard errors are available from the authors on request.All assistant professors are untenured; all associate and full professors hold tenure.No adjustments made for how long each faculty member is within rank.Sample size=1365; population size=33,813.

To summarize, these results show the amount of time spent overall, on research, and on grant writing falls with the granting of tenure. Focusing specifically on untenured faculty, we find that male assistant professors work slightly less, on average, than female assistant professors, but these same males spend almost three more hours a week on research than their female counterparts. If this average difference is maintained for 50 weeks each year, after 6 years as an assistant professor, the average male will have spent 900 more hours on research than the average female. This difference may have an appreciable effect on the likelihood of receiving tenure. It does not, however, account for differences in individual characteristics, academic field, or school which may affect time allocation.

2.2. Multivariate analysis

The Survey of Academic Researchers contains detailed information on tenure status, career path, and selected demographic variables. The demographic variables include race, nationality, marital status, and the presence of children. Table 4 presents descriptive statistics on all of these variables, and Table 5 presents means for key demographic variables by rank and gender. Because many of the demographic variables are related to rank and gender in systematic ways, we control for these variables in the analysis below.

Table 4. Variables considered in alternative specifications

Variable	Description	Mean	Standard error
Variables describing the career path			
Tenure	1 if faculty member holds tenure, 0 otherwise	0.805	0.01
Yrstenure	Years faculty member has held tenure	13.680	0.47
Assist. 3–5	1 if assistant prof. with 3–5 years of experience	0.135	0.01
Assist. >5	1 if assistant prof. with more than 5 years of experience	0.040	0.01
Assoc. 1–3	1 if assoc. prof. with 1–3 years as associate prof.	0.070	0.01
Assoc. 4–6	1 if assoc. prof. with 4–6 years as associate prof.	0.071	0.01
Assoc. 7–9	1 if assoc. prof. with 7–9 years as associate prof.	0.029	0.01
Assoc. 10–14	1 if assoc. prof. with 10–14 years as associate prof.	0.020	0.005
Assoc. 15–19	1 if assoc. prof. with 15–19 years as associate prof.	0.019	0.005
Assoc. >19	1 if assoc. prof. with more than 19 years as associate prof.	0.025	0.006

Variable	Description	Mean	Standard error
Full 1–5	1 if full prof. with 1–5 years as full prof.	0.106	0.01
Full 6–10	1 if full prof. with 6–10 years as full prof.	0.112	0.01
Full 11–15	1 if full prof. with 11–15 years as full prof.	0.098	0.01
Full 16–20	1 if full prof. with 16–20 years as full prof.	0.088	0.01
Full >20	1 if full prof. with more than years as full prof.	0.168	0.02
Demographic variables			
Age	Age in years	50.899	0.43
Male	1 if faculty member male, 0 if female	0.892	0.01
White	1 if faculty member white; 0 otherwise	0.796	0.02
Asian	1 if faculty member Asian; 0 otherwise	0.139	0.01
Citizen	1 if faculty member born or naturalized US citizen; 0 otherwise	0.854	0.01
Married	1 if faculty member married; 0 otherwise	0.897	0.01
Child	1 if child living at home with faculty member, 0 otherwise	0.492	0.02

Notes: sample size=1365; population size=33,813. Models also include indicator variables for field and school.

Table 5. Sample means for selected control variables by rank and gender

	White			Asian			Citizen			Married			Child		
	All	Women	Men	All	Women	Men	All	Women	Men	All	Woman	Men	All	Woman	Men
Assistant	0.684	0.785	0.662	0.236	0.120	0.261	0.596	0.700	0.573	0.854	0.740	0.878	0.533	0.349	0.573
Associate	0.790	0.891	0.774	0.171	0.065	0.188	0.860	0.887	0.856	0.80	0.784	0.873	0.611	0.498	0.629
Full	0.837	0.897	0.832	0.093	0.071	0.095	0.939	0.944	0.939	0.927	0.873	0.931	0.430	0.503	0.424

Notes: sample size=1365; population size=33,813.Standard errors are available from the authors on request.All assistant professors are untenured; all associate and full professors hold tenure.

In this section we present results using both hours and the fraction of time allocated to teaching, research, grant writing, and service as dependent variables. In all cases we control for race, citizenship status, marital status, the presence of children, and the academic discipline and university of the faculty member. The first specification adds to these controls a binary variable indicating that the faculty member is tenured or not. The second replaces the binary variable with a variable indicating the number of years the faculty member has held tenure. Finally, the last specification models the roll of tenure and promotion as a step function with a number of different steps for each rank. This last specification allows for time allocation to evolve in a non-linear way, and it allows us to include a separate measure of the faculty member's age.

The Hours Allocation models are estimated using OLS, and the coefficient estimates and heteroskedasticity-robust standard errors for the first two specifications are reported in Table 6.13 The results with respect to tenure and gender are similar to the descriptions in Table 2 and Table 3. Tenured faculty, ceteris paribus, work less and allocate fewer hours to teaching, research, and grant writing but more hours to service. When tenure is alternatively measured in terms of years with tenure, significant differences are seen with respect to research, grant writing, and service.14

Table 6. OLS estimates from hours allocation models (robust standard errors in parentheses; *n*=1365)

Variable	Total		Teaching		Research		Grant writing		Service	
Tenure	−2.13 (1.30)	–	−1.66□(0.86)	–	−3.89□□□(1.01)	–	−2.03□□□(0.56)	–	5.46□□□(0.81)	–
Years with tenure	–	−0.08 (0.05)	–	−0.01 (0.04)	–	−0.103□□□(0.04)	–	−0.08□□□(0.02)	–	0.12□□□(0.04)
Male	−1.16 (0.96)	−0.90 (0.96)	−0.27 (0.74)	−0.42 (0.75)	1.80□□(0.74)	1.99□□(0.76)	−1.06□□(0.36)	−0.74□(0.39)	−1.64□□□(0.60)	−1.73□□□(0.63)
White	2.32 (1.84)	2.25 (1.85)	1.40 (1.26)	1.37 (1.29)	2.24 (1.64)	2.13 (1.63)	0.69 (0.54)	0.62 (0.54)	−2.00 (1.66)	−1.87 (1.69)
Asian	5.91□□(2.18)	5.67□□(2.22)	1.43 (1.46)	1.50 (1.48)	4.37□□(1.91)	4.15□□(1.94)	2.34□□□(0.70)	2.06□□□(0.70)	−2.23 (1.66)	−2.03 (1.67)
Citizen	0.49 (1.53)	0.38 (1.55)	1.12 (0.91)	0.57 (0.94)	−1.72 (1.26)	−2.29□(1.26)	0.54 (0.45)	0.53 (0.44)	0.56 (0.98)	1.56 (0.98)

Variable	Total		Teaching		Research		Grant writing		Service	
Married	−2.72 (1.61)	−2.45 (1.70)	−3.78□□□ (1.35)	−3.77□□□ (1.37)	−0.05 (1.30)	0.28 (1.33)	−0.36 (0.49)	−0.06 (0.50)	1.46 (1.07)	1.11 (1.16)
Child	0.83 (1.04)	0.30 (1.04)	−0.25 (0.69)	−0.30 (0.69)	0.95 (0.78)	0.29 (0.78)	0.98□□□ (0.34)	0.40 (0.39)	−0.85 (0.70)	−0.09 (0.76)
R^2	0.279	0.280	0.195	0.191	0.294	0.287	0.318	0.324	0.309	0.287
F-statistic	5.22□□□	5.79□□□	17.24□□□	56.33□□□	6.57□□□	5.78□□□	15.59□□□	10.21□□□	7.43□□□	5.59□□□

Notes: academic field dummies and university dummies are includes in all specifications. As a group, both the field effects and the university effects are significant.

□□□ Significant at 0.01 level.

□□ Significant at 0.05 level.

□ Significant at 0.10 level.

The regression results show that males are more research active and less involved in university service. Also, whites devote more total hours to work than blacks but not as many hours as Asians. Asians also allocate more hours to research and grant writing than do whites or blacks. Married faulty work fewer total hours, and they teach less, but the hours allocated to other activities are similar as non-married faculty. Lastly, the time allocation of faculty with children is about the same as faculty who do not have children.15

An alternative approach to the hour regressions is to model the fraction of time spent on each activity, and the results from the time allocation models in Table 7 take the fraction of time allocated to each activity as the dependent variable. Because the dependant variables are fractions, we use the generalized linear model (GLM) framework (see, for example, Papke & Wooldridge, 1996) rather than OLS.16 When using these shares, we find that the behavioral patterns are similar to those reported in Table 6.

Table 7. GLM estimates from fraction of time allocation models (robust standard errors in parentheses; *n*=1365)

Variable	Teaching		Research		Grant writing		Service	
Tenure	−0.004 (0.014)	–	−0.059□□□(0.015)	–	−0.031□□□(0.008)	–	0.095□□□(0.01)	–
Yrstenure	–	0.0004 (0.0006)	–	−0.001□□(0.0006)	–	−0.001 (0.0003)	–	0.002□□□(0.001)
Male	0.007 (0.011)	0.004 (0.012)	0.077□□□(0.010)	0.039□□□(0.011)	−0.016□□□(0.006)	−0.010□(0.006)	−0.027□□(0.010)	−0.031□□□(0.011)
White	−0.0003 (0.029)	−0.0002 (0.030)	0.040 (0.029)	0.038 (0.029)	0.003 (0.007)	0.004 (0.007)	−0.047□(0.025)	−0.045□(0.025)
Asian	−0.026 (0.030)	−0.023 (0.030)	0.055□(0.031)	0.052□(0.031)	0.027□□□(0.010)	0.022□□(0.009)	−0.067□□(0.027)	−0.063□□(0.027)
Citizen	0.018 (0.016)	0.011 (0.016)	−0.040□(0.020)	−0.048□□(0.020)	0.004 (0.006)	0.004 (0.006)	0.018 (0.016)	0.034□□(0.015)
Married	−0.053□□(0.024)	−0.055□□(0.024)	0.023 (0.020)	0.027 (0.020)	−0.005 (0.008)	0.0006 0.007	0.031□(0.016)	0.025 (0.019)
Child	−0.010 (0.012)	−0.006 (0.013)	0.012 (0.012)	0.003 (0.013)	0.017□□□(0.005)	0.008 (0.005)	−0.020□(0.011)	−0.005 (0.012)
Log pseudo-likelihood	−14,350.9	−14,349.7	−14,807.9	−14,821.7	−6853.3	−6838.0	−12,810.6	−12,868.8

Notes: academic field dummies and university dummies are includes in all specifications. As a group, both the field effects and the university effects are significant.

□□□ Significant at 0.01 level.

□□ Significant at 0.05 level.

□ Significant at 0.10 level.

Finally, we expand the career path variables beyond a simple tenure dummy or trend by modeling the career path using a step function. Specifically, we include indicator variables for faculty who have been assistant professors for 3–5 years, and 6–7 years; associate professors for 1–3 years, 4–6 years, 7–9 years, and 10–14 years; and full professors for 1–5 years, 6–10 years, 11–15 years, 16–20 years, and more than 20 years. Because the OLS and GLM results above are so similar, we use OLS to estimate this expanded model with hours in each activity as the dependent variable. The results of this estimation are reported in Table 8.17 The first panel of

Table 8 reports the results for the career path variables. For total hours, there is no statistically significant discernable pattern over the career. There are, however, interesting effects on the different activities. For example, full professors spend less time on teaching. New full professors also spend less time on research than new assistant professors. Also interesting is the fact that long-time associate professors (e.g., someone who has been an associate professor for at least 7 years) spend significantly less time on research than others. Finally, time spent on service increases throughout the career. Interestingly, unlike research, promotion to full professor has little effect on time spent on service.

Table 8. OLS estimates for expanded hours allocation model (robust standard errors in parentheses; *n*=1365)

Variable	Total	Teaching	Research	Grant writing	Service
Career path variables					
Assistant 3–5	−2.210 (4.41)	−2.468 (2.72)	−3.941 (2.79)	0.650 (1.53)	3.549□□ (1.40)
Assistant >5	−3.917 (5.61)	−3.629 (3.31)	−4.622 (3.37)	−2.130 (1.73)	6.465□□□ (2.01)
Associate 1–3	−3.873 (4.63)	−4.100 (2.85)	−7.243□□ (3.02)	−0.806 (1.57)	8.274□□□ (1.76)
Associate 4–6	−3.919 (4.63)	−5.718□□ (2.85)	−4.998 (3.06)	−1.931 (1.61)	8.728□□□ (1.81)
Associate 7–9	−3.504 (4.89)	−3.891 (3.07)	−9.663□□□ (3.07)	0.752 (1.80)	9.298□□□ (2.05)
Associate 10–14	−6.787 (4.96)	−5.442 (3.46)	−10.649□□□(4.05)	−3.123□ (1.73)	12.428□□□(2.51)
Associate 15–19	−3.439 (6.05)	−1.183 (3.93)	−12.414□□□(3.58)	−1.806 (1.85)	11.964□□□(3.39)
Associate >19	−1.986 (6.06)	3.522 (3.75)	−14.970□□□(3.91)	−1.869 (1.88)	11.330□□□(3.01)
Full 1–5	−3.050 (4.71)	−6.932□□ (2.90)	−5.859□ (3.21)	−0.865 (1.64)	10.606□□□(1.80)
Full 6–10	−3.115 (4.88)	−6.354□□ (3.03)	−8.070□□ (3.24)	−0.765 (1.65)	12.074□□□(1.93)
Full 11–15	−1.811 (5.10)	−7.742□□ (3.05)	8.687□□ (3.46)	0.652 (1.71)	13.967□□□(2.24)

Full 16–20	−2.251 (5.39)	−9.868□□□(3.42)	−5.574 (3.90)	−0.286 (1.83)	13.477□□□(2.46)
Full >20	−3.887 (5.51)	−9.974□□□(3.42)	−6.443 (3.85)	−0.696 (1.81)	13.227□□□(2.81)
Demographic variables					
Age	−0.088 (0.10)	0.173□□ (0.07)	−0.020 (0.08)	−0.094□□□(0.03)	−0.146□ (0.08)
Male	−0.937 (0.97)	−0.536 (0.73)	2.068□□□ (0.75)	−0.777□□ (0.38)	−1.692□□□(0.61)
White	2.200 (1.89)	1.173 (1.26)	2.464 (1.64)	0.582 (0.54)	−2.019 (1.61)
Asian	5.810 (2.26)	1.347 (1.47)	4.427□□ (1.90)	2.185 (0.71)	−2.148 (1.58)
Citizen	0.955 (1.63)	1.346 (0.98)	−1.411 (1.28)	1.060□□ (0.47)	−0.040 (0.99)
Married	−2.388 (1.72)	−3.086□□ (1.21)	−0.381 (1.25)	−0.199 (0.48)	1.278 (1.05)
Child	0.210 (1.13)	−0.342 (0.73)	1.179 (0.82)	0.535 (0.39)	−1.162 (0.75)
R^2	0.2855	0.243	0.320	0.362	0.327
F-statistic	6.56□□□	4.13□□□	12.82□□□	6.40□□□	7.22□□□

Notes: academic field dummies and university dummies are includes in all specifications. As a group, both the field effects and the university effects are significant.

□□□ Significant at 0.01 level.

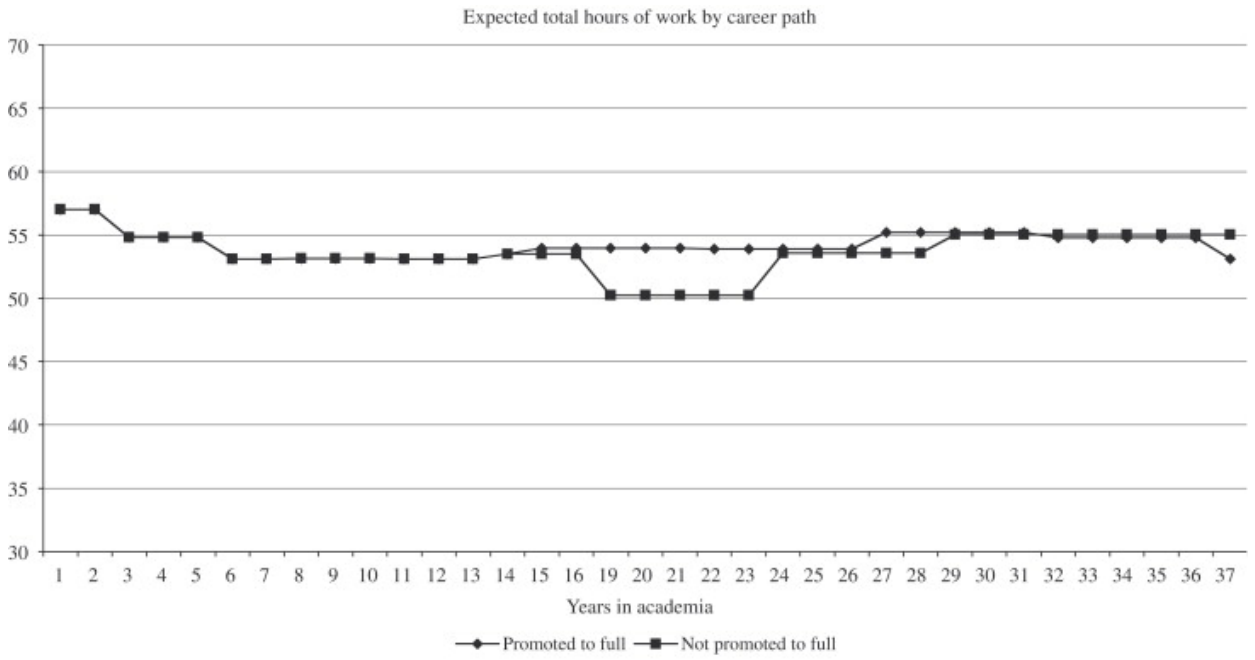
□□ Significant at 0.05 level.

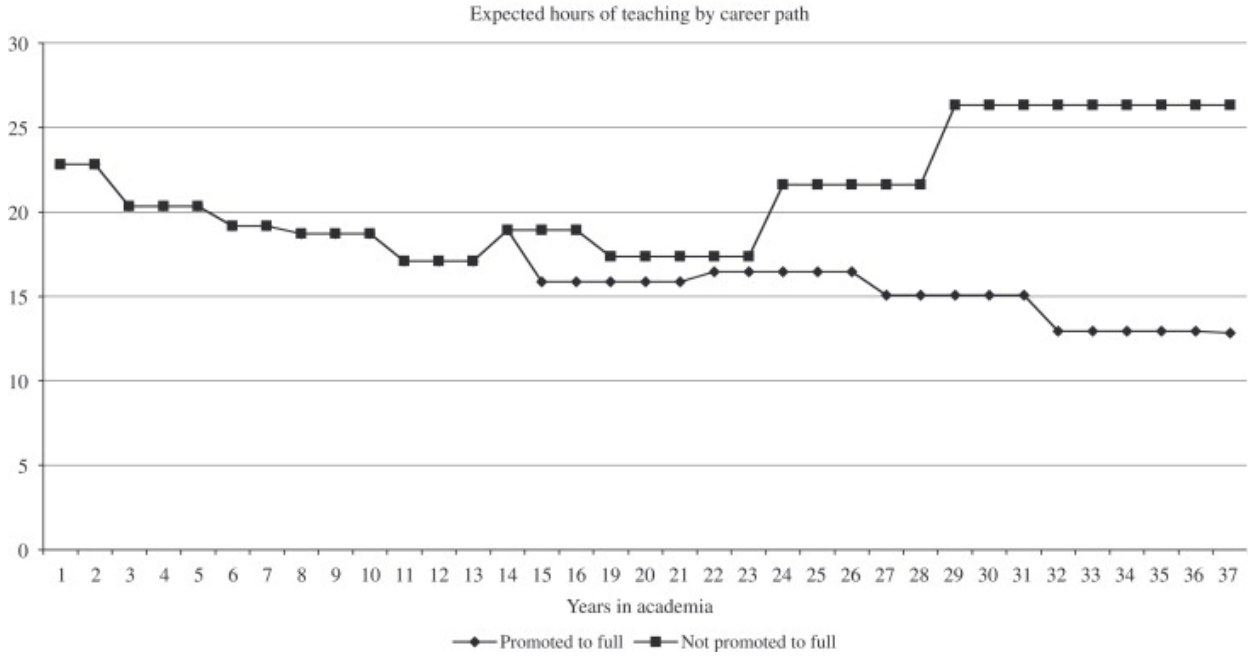
□ Significant at 0.10 level.

Turning to the demographic variables in the second panel of Table 8, the more flexible specification of the career path allows us to include the age of the faculty member in the analysis, and we find, that holding all else constant, older faculty spend more time teaching and less time on service than others. Similar to above, we also find that, holding all else constant, men tend to spend more time on research and less time on service and that Asians spend more time overall and on research than blacks.

The model predicts that male faculty, regardless of rank, spend two more hours per week on research than female faculty. Focusing again on assistant professors, these multivariate results imply that about one-third of the 3 h difference in mean research time found in Table 3 above is due to differences in the explanatory variables included in the model. The remaining 2 h gap implies a total difference in time spent on research over six years of 600 h.

To illustrate the findings in Table 8, we calculate the expected hours of work, in total and by allocation category, and we present our findings in Fig. 1. The time allocation paths in Fig. 1 plot expected hours of work over two different career paths for a hypothetical faculty member. This faculty member has the population average characteristics for all variables except the rank/experience variables. The career paths are generated using the coefficients on the rank/experience step function described above (the first panel of Table 8) combined with an assumption about the timing of promotion. In all cases, the faculty member is promoted to associate professor after seven years. In the lines labeled “Promoted to Full Professor”, the individual is promoted to full professor after eight years as an associate professor. In the lines labeled “Not Promoted to Full Professor”, the individual is never promoted to full professor.





It is important to note that, because we are not following a specific cohort over time, these time allocation paths are intended to be illustrative rather than depictive of a causal relationship. Specifically, the group of current assistant professors consists of individuals who will and will not be promoted to associate professors. To the degree that work effort and time allocation help determine who is promoted to associate professor, the assistants who are promoted will be a selected sample of all assistants. Because this was true when the current associates and fulls were assistants, the sample of associates and fulls is non-random. Thus, the time allocation paths

illustrate a point-in-time snapshot of expected career paths without accounting for any of this selection.

The first time allocation path in Fig. 1 shows that the workload over the faculty member's career is relatively constant at around 55 h. Interestingly, the total hours worked do not substantially depend on whether the individual is promoted to full professor or not. In contrast, allocation paths for teaching and research show differences in time allocations based on promotion status. An associate professor who is not promoted spends an increasing number of hours of work on teaching with that time primarily coming from research activities. In contrast, an associate professor who is promoted to full professor can be expected to spend increasing amounts of time on service over her career with this time coming from both teaching and research. Similarly, grant writing generally declines over the career with a larger decline if the faculty member is not promoted to full professor. Finally, time spent on service increases during the first 20 years of the career with some drop-off if the faculty member is not promoted.

3. Implications of our findings

To the best of our knowledge this paper is the first systematic effort to examine the effect of tenure and promotion on the disaggregated time allocation of university faculty. There are, however, a number of reasons care should be exercised in interpreting our findings. First, our data do not allow us to quantify either the effectiveness of time spent or the output from time spent.18 Tenure could proxy what we call the “accumulated advantage” of faculty, meaning that tenured faculty are tenured faculty at the top research universities because of their demonstrated research and grant writing ability. Thus, it could be the case that tenured faculty are able to devote fewer hours to research and grant writing over time while maintaining their pre-tenure level of quality. Second, our data are cross sectional; a study of the time allocation of faculty using panel data would be, of course, more desirable.

Caveats aside, our findings clearly illustrate the trade-offs among faculty activities once tenure is awarded. One might conclude that tenure is detrimental to a research university because faculty reduce their time allocated toward research and grant writing, those activities that, in general, are associated with the ethos of a research institution. Even with a reduction in research time, tenure may be rational for a university because, as our results clearly show, time spent on service increases over the career. From an administrative point of view, using “their own” for service functions may be desirable because such faculty understand institution culture in ways that outsiders would not.19

Our findings also illustrate gender differences in the time allocation of faculty. Our results suggest that women spend more time on service and less time on research than their male colleagues. To the extent that the time allocation of faculty is related to subsequent academic success (e.g., substantial time spent on research and grant writing early in ones career may be related to later success) then understanding gender differences in time spent on different work activities may have, albeit in a general way, policy implications for balancing the representation of women in science and engineering.20 Our data do not allow us to understand whether the different allocation decisions are due to different preferences, teaching or service assignments, or other factors. The appropriate policy response depends on the reasons for different time allocations. If the differences were driven largely by differences in preferences for research across male and female academics, the introduction of "differentiated roles" may help encourage women, who have been under represented for decades, to pursue academic careers in science and engineering. Alternatively, if the differences are due to a more general culture or differing assignments or rules, then changes in these dimensions will be required.21 More data will be required for any attempt to explore causal relationships between time allocation on the one hand and individual preferences and institutional details on the other.

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1 A number of studies explore the relationship of tenure to other outcomes. Thursby, Thursby, and Mukherjee (2005) found theoretically that less licensing is done by non-tenured faculty than tenured faculty; and Goldfarb, Marschke, and Smith (2003) showed that the quality of publications is unaffected by the tenure decision.

2 See Pencavel (1986) and Killingsworth and Heckman (1986) for surveys of the labor supply literature.

3 See Juster and Stafford (1991) for a survey of time use data in economics.

4 Another line of research motivates its empirical work with time use models even when time use data are not available. See, for example, Grogger (1998) and Leung (2004).

5 See, http://www.carnegiefoundation.org/Classification/index.htm.

6 The 12 National Science Foundation science and technology disciplines are biology, computer science, mathematics, physics, earth and atmospheric science, chemistry, agriculture, chemical engineering, civil engineering, electrical engineering, mechanical engineering, and materials engineering (http://www.nsf.gov/sbe/srs/nsf03310/start.htm).

7 The target sample was 200 men and 200 women from each field except for fields where the population of women is smaller than 200. In those cases, all women were sampled. The weights used in the analysis account for the differing sampling probabilities, for non-response, and for missing data. The response rates for males and females were 31% and 41%, respectively. The differing response rates may be a concern if they are due to differences in work behavior. Information about the construction of the weights is available upon request form the authors, as is the survey instrument.

8 Yuker (1984) has an extensive discussion of the pros and cons of different ways to measure faculty time. Juster and Stafford (1991) discuss the problems with recall as opposed to time diary data.

9 In constructing the estimation sample, we deleted 16 faculties who are assistant professors with tenure, we deleted 42 associate and full professors who do not hold tenure, and we deleted 17 full professors who became full professors in the same year as they entered academe (presumably coming from industry).

10 Singell et al., (1996) reported an average of 51.6 h per week in 1987 for all faculty at the then Carnegie “premier” public institutions. Similar historical trends are discussed in Yuker (1984).

11 Bellas and Toutkoushian (1999) report a similar finding.

12 All associate professors in the sample are tenured.

13 The models in Table 6 were also estimated using Tobit. The empirical findings did not change; these results are available upon request from the authors. Also note that the models in Table 6 (and in Table 7 and Table 8 below) control for field effects and university effects.

14 We found no evidence that years with tenure by itself entered the models non-linearly.

15 We estimated the models in Table 6 (and in Table 7, below) separately by gender. The estimated effects of married and child on time allocations for men are similar to the effects reported in the tables while we find no effect of married and child on time allocations for women. These results mirror the results in Table 3 (where average hours for males are most similar to the overall results) and are available upon request from the authors.

16 Specifically, we assume that $E(yi|xi)=G(xi\beta)$ where yi is the proportion of time person i spends on one of the activities, xi, is a vector of characteristics, and $G(\cdot)$ is the logistic distribution function. The likelihood contribution for individual i is then View the MathML source. See Papke and Wooldridge (1996) for further details. See also Kieschnick and McCullough (2003).

17 The models in Table 8 were also estimated using Tobit. The empirical findings did not change; these results are available upon request from the authors.

18 To obtain such information, a longitudinal database would need to be constructed that mapped time allocated to activity i in period t to the output of that activity in period (t+n). This is possible with teaching and service. It is unlikely that a faculty member could match time allocated to, say, do research in year t for a given journal article to the output from that research time in year (t+n) unless such mapping was conducted and recorded in real time. Survey data of faculty at a point in time would not accurately capture such a time dimension. The same is like to the case with respect to grant writing. And, to compound the matter, there is rarely a one-to-one mapping of time inputs to publication or grant outputs because the knowledge gained during the research process is fungible across projects.

19 Stated alternatively, administrators (principals) realize that difficulty in monitoring faculty (agents) time, much less how they use that time, and thus imbue a culture of trust which is reflected in greater voluntary service by tenured faculty.

20 The issue first gained the national spotlight with the publication of the 1989 White House Report, Changing America: The New Face of Science and Technology.

21 Hamermesh (2005) provides an example of differing assignments: universities may wish to have gender balanced committees. However, because there are fewer female faculty, the goal of gender balance on committees may result of higher service loads for female faculty.