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ABSTRACT

In a market where salary adjustment is limited by equity constraints within ranks and across fields, non-salary adjustment to changing market conditions is likely to occur. Changes in the rate at which nontenured faculty are granted tenure is one such adjustment. A logit model that explains time to tenure as dependent on the time since an individual received his Ph.D. and market conditions is estimated using data from two large surveys of faculty. Estimated time to tenure is then related to other possible measures of excess demand or supply. It is found that the smaller the increase in starting salary, controlling for salary level, the lower is time to tenure. (Author)

TIME TO TENURE AND THE MARKET FOR PH.D.'S IN U.S. HIGHER EDUCATION

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Abstract

In a market where salary adjustment is limited by equity constraints within ranks and across fields, non-salary adjustment to changing market conditions is likely to occur. Changes in the rate at which non-tenured faculty are granted tenure is one such adjustment. A logit model which explains time to tenure as dependent on the time since an individual received his Ph.D. and market conditions is estimated using data from two large surveys of faculty. Estimated time to tenure is then related to other possible measures of excess demand or supply. It is found that the smaller the increase in starting salary, controlling for salary level, the lower is time to tenure.

TIME TO TENURE AND THE MARKET FOR PH.D.'S IN U.S. HIGHER EDUCATION

The argument most frequently given for the existence and extension of tenure is that of academic freedom. Yet, as Machlup (12) pointed out in his 1964 AAUP Presidential Address, tenure has economic as well as political implications for both faculty members and the institutions of higher education in which they work. It is the question of tenure as an economic variable that will be addressed in this paper. How has tenure changed as conditions in the academic labor market have changed? How may it change in the future as the academic labor market enters a period of what may, at best, be called the "steady state"?

It is surprising and disturbing that very little is known about the labor market flows -- quits, new hires and retirements -- in an industry that produces most of the trained manpower in the economy, higher education. There have been some theoretical analyses of adjustment in markets for professional manpower (2,4) as well as some attempts to combine theory and sketchy data in order to predict or to describe adjustment in markets in particular fields (8,9). In the absence of adequate labor market data, however, the problem of finding indicators of aggregate excess demand or supply in the academic labor market remains.

It is argued in this paper that the time it takes a new Ph.D. to gain tenure is one such measure of excess demand or supply. As enrollemnts expanded in the 1960's, academic employers had to compete with non-academic employers for a supply of Ph.D.'s that could only adjust slowly. In addition to competitive increases in salaries, we might expect that the time to tenure would fall in response to competitive pressure. In this case, the time to tenure may be viewed as a non-wage form of compensation that could be offered by academic employers. We would also suspect that as the growth in enrollments levelled off in the late 1960's, and as the supply of Ph.D.'s expanded, the time to tenure would remain constant or rise.

Changes in the time to tenure, however, are of more serious importance

in academia than if tenure were simply an academic form of seniority. If, in the future, faculty/student ratios are relatively constant and enrollment becomes stable, institutions of higher education will be limited to two main sources of attrition, which can create places for new hires: retirement and non-renewal of contracts for non-tenured faculty. The higher the proportion of tenured faculty, the relatively greater will be the dependence on retirement as a source of slots. Academia will become a victim of having successfully used tenure as a competitive weapon in the past. In particular, the younger the tenured faculty, the smaller will be retirements as a proportion of the faculty and the less flexibility in hiring will institutions have. When enrollments are growing this apparent loss of flexibility is less, since faculty can grow as well, and a high rate of new hiring can provide that growth.

Clearly, the time to tenure also has implications for the age structure of the faculty. The younger are those that are given tenure during a period of growth or shortage of faculty, the longer is the tenure commitment of the institution. The result of failure to plan for a decline in demand following a period of growth is a lengthy commitment to a young but aging faculty. It is commonly assumed in academic circles that there is a relation between the age of a faculty member and ability to produce instruction and research. Thus, changes in the age structure of the academic labor force resulting from past tenure practices may have implications for the quantity and quality of the output of higher education as a whole. Analytically, the changing age structure of the faculty means that a statistical model is necessary to separate the effect of the length of time a faculty member has held his Ph.D. from the effect of his being in the market but untenured at a particular point in time.

The statistical model that is described below estimates the tenure rate, which is defined as the chance that a nontenured faculty member will be granted tenure in any given year. The tenure rate is dependent upon conditions specific to that year and on the time that has elapsed since the faculty member obtained the Ph.D. degree. Time since the Ph.D. (which we often refer to as "age") is presumably correlated with the accumulation

of those things upon which the decision to grant tenure is based: publications, teaching experience, reputation, etc. It also reflects the institutional fact of the guideline effect of the 1940 AAUP Statement on Academic Tenure, although surveys of tenure practices have shown that few institutions adhere to all the guidelines in the 1940 Statement (6). This age effect, however, is modified by market conditions for which the date effect is a proxy. For example, simply by virtue of being non-tenured and available in the expanding academic market of the early 1960's, we would think that a faculty member would have a greater chance of being given tenure than if he had been non-tenured in the early 1960's, at the same age.

Before describing the statistical model, I shall briefly discuss the more general model of the academic labor market in which the time to tenure is an important element. The statistical model of time to tenure and the results of the estimation of it will then be described. The final section of the paper will relate the estimated date corrected median time to tenure to other measures that we have of changes in the academic labor market: change in the stock of faculty relative to the stock of Ph.D.'s and average assistant professor salaries. As the data that we have on these magnitudes are not especially dependable or consistent, the aim of this section will be to show: 1) that time to tenure does indeed respond to demand, as measured by these variables, 2) that salaries and time to tenure are inversely related, in the sense that time to tenure fell and real salaries rose during the period of excess demand for Ph.D.'s in the 1960's and that the change in salaries and time to tenure are directly related so that the greater the change in salaries, the higher is time to tenure. If the market responds to excess supply in a symmetrical manner, we would expect that time to tenure will rise and average real salaries decline in the late 1970's and 1980's. There is already some evidence of such a response to the slowdown of the rate of growth of enrollments in the early 1970's.

To briefly summarize the most important result: we find that the tenure

rate did indeed increase during the period of rapid growth in academia from 1960 to 1968 in all types of institutions and in all fields within these institutions. After 1968, the tenure rate continued to increase in public institutions, but more slowly. However, in private institutions, the tenure rate remained constant or declined between 1968 and 1972. Thus it would appear that tenure rate did, indeed, behave as an economic variable in the sense that higher tenure rates occurred at the same time as the rapid increase in employment in academia. In private institutions, which were relatively harder hit by the declining rate of increase in enrollments in the late 1960's, we see quite rapid downward adjustment of tenure rates at the same time.

The Economic Framework

Before we proceed to examine the statistical model of time to tenure, it is worthwhile to sketch the broader aspects of the model in which time to tenure plays an important part.

We assume that, in the steady state, there is a constant faculty/student ratio and the demand for new hiring is simply demand to replace those who have retired so as to keep the faculty/student ratio constant. Growth in enrollments however, creates an additional demand for new faculty. If there has been equilibrium in the academic labor market in the past, in the sense that the supply of Ph.D.'s to academia has equalled the steady state demand, the change in the rate of growth in enrollment will result in the demand for new Ph.D.'s exceeding supply.

The usual mechanism by which equilibrium would be restored would be that salaries would rise until excess demand was zero. The possible adjustment paths in a market where there is a lagged response in supply of Ph.D.'s to demand have been described by Freeman (7). In the academic labor market, however, how long it takes a faculty member to achieve tenure is one form of non-salary adjustment. When the demand for new faculty increases, institutions compete for new Ph.D.'s and faculty employed at other institutions by lowering the time to tenure as well as by raising salaries. In fact, it may be that lowering time to tenure will be preferred to salary competition

because of equity constraints on salaries across departments within any given institution.

What we wish to accomplish in the statistical model described below, then, is to obtain a measure of market conditions as reflected in the independent effect of the date at which a faculty member is non-tenured on the probability that he will be promoted to tenure. We can then look at the relation of salaries, salary change, faculty stock change, and growth in the stock of Ph.D.'s to the median time to tenure over the period 1958-1974.

Data

The estimation that is reported below uses as data information from the 1973 American Council on Education Survey of Teaching Faculty (3) and from the 1975 Survey of Teaching Faculty sponsored by the Carnegie Council on Policy Studies in Higher Education, which will hereafter be referred to as the ACE and Carnegie Surveys. In each survey, faculty members were asked the date at which they obtained their highest degree and the date at which they became tenured, if they were tenured. We define "age" as the time from Ph.D. We limited our sample to Ph.D.'s with full-time teaching positions, and estimated age and date effects for four types of institutions of higher education. The distribution of the samples by type of institution is shown in Table 1.

(Table 1 here)

The proportions of those who were non-tenured in the previous year who were granted tenure, for each year since receipt of highest degree and for each date since 1947, are presented in Tables 2a and 2b, respectively.[2] These raw tenure rates taken alone, however, do not allow us to isolate market effects from the effects of changing age structure on the chances of promotion to tenure. For example, very young faculty will, typically, have low raw tenure rates because the young faculty have not yet had time to make

Table 1

Sample Sizes by Type of Institution:
1973 ACE Survey and 1975 Carnegie Survey

Year of Sample	Type of Institution			
	Public University	Private University	Public 4 Year	Private 4 Year
1973	14255	4748	1960	3058
1975	4226	2445	2070	2059

a case for promotion. Raw tenure rates thus confound the effects of age structure and market pressure. A statistical model is necessary to separate these effects.[3]

(Table 2a and 2b here)

A Statistical Model

The observations that we use as data for our model can be summarized by a matrix whose dimensions are years since highest degree, i, and date, t. An element in the matrix is P_{it}, the number of faculty of age i at date t who have not yet received tenure. If we consider a cohort of those who received their highest degree at a particular date, between any two years $P_{it} - P_{i+1,t+1} = S_{it}$ will have received tenure.

With the S_{it} as observations of "successes" we seek to estimate ϕ_{it}, the probability of obtaining tenure as a faculty member moves from age i at date t to age i+1 at date t+1. This estimated probability depends on an age effect, a_i, and a date effect, b_t. In particular, we fit a logistic function which assumes that:

$$\log \frac{\phi_{it}}{1 - \phi_{it}} = a_i + b_t$$

or

$$\phi_{it} = \frac{e^{a_i + b_t}}{1 + e^{a_i + b_t}} = \frac{A_i B_t}{1 + A_i B_t}$$

Where $A_i = e^{a_i}$ and $B_t = e^{b_t}$.

The logit function can be thought of as the log of the odds of getting tenure for an individual i years past his highest degree and the date effects can be thought of as a sort of "correction" to this odds ratio that depends on market conditions at date t. If market conditions had no effect on a faculty member's chance of promotion, then the b_t would be equal to zero and

Table 2a

Raw Age-Related Promotion Rates
1973 Survey

Age	Public University	Private University	Public 4 Year	Private 4 Year
1	0.022	0.014	0.037	0.028
2	0.043	0.020	0.063	0.035
3	0.092	0.050	0.116	0.054
4	0.121	0.079	0.145	0.102
5	0.152	0.112	0.142	0.126
6	0.168	0.131	0.163	0.144
7	0.185	0.159	0.135	0.148
8	0.172	0.145	0.142	0.155
9	0.150	0.139	0.138	0.124
10	0.153	0.155	0.128	0.122
11	0.143	0.162	0.155	0.142
12	0.153	0.138	0.129	0.160
13	0.151	0.149	0.120	0.135
14	0.169	0.158	0.108	0.129
15	0.145	0.133	0.153	0.122
16	0.157	0.142	0.212	0.094
17	0.131	0.120	0.136	0.113
18	0.143	0.143	0.098	0.118
19	0.113	0.146	0.061	0.089
20	0.134	0.114	0.108	0.097

Table 2b

Raw Date-Related Promotion Rates
1973 Survey

Date	Public Univeresity	Private Univeresity	Public 4 Year	Private 4 Year
1947	0.066	0.064	0.027	0.041
1948	0.078	0.068	0.012	0.094
1949	0.057	0.040	0.075	0.053
1950	0.065	0.056	0.043	0.069
1951	0.071	0.046	0.042	0.048
1952	0.073	0.051	0.029	0.073
1953	0.062	0.048	0.032	0.054
1954	0.070	0.065	0.027	0.060
1955	0.063	0.052	0.026	0.052
1956	0.074	0.060	0.043	0.061
1957	0.072	0.059	0.048	0.064
1958	0.077	0.053	0.055	0.070
1959	0.077	0.070	0.036	0.074
1960	0.084	0.081	0.072	0.094
1961	0.080	0.075	0.063	0.068
1962	0.085	0.088	0.072	0.081
1963	0.097	0.091	0.066	0.089
1964	0.099	0.095	0.095	0.075
1965	0.108	0.110	0.102	0.116
1966	0.123	0.106	0.119	0.100
1967	0.139	0.119	0.117	0.142
1968	0.156	0.159	0.177	0.158
1969	0.181	0.154	0.208	0.218
1970	0.190	0.140	0.223	0.135
1971	0.182	0.127	0.190	0.114
1972	0.197	0.143	0.239	0.143

the B_t equal to 1. The ϕ_{it} would then be independent of time, or

$$\phi_{it} = \phi_i = \frac{A_i}{1 + A_i}.$$

An age effect, A_i, of .10 would mean that if one did not yet have tenure at i years from one's highest degree, the odds in favor of obtaining tenure between that year and the next would be .10, or 1 to 10. The corresponding probability is .09, or 1/11. A date effect, B_t of say, .5, would imply that the actual odds ratio of obtaining tenure between year i and i+1 and between the dates t and t+1 would be only half as great as would be predicted on the basis of age alone. (The corresponding probability is .048.) Similarly, a B_t of 1.5 would imply a probability of getting tenure of .13, or an odds ratio of .15 (that is, $.1 \times 1.5 = A_i \times B_t$). In years of increasing demand for faculty, we should expect the B_t to be greater than 1. In years of declining demand, we should expect the B_t to be less than 1 if our hypothesis of tenure as a method of competitive adjustment is correct.[4]

Results

The estimated age and date effects, for data from both surveys, are given in the Appendix. Taken by themselves, they are not particularly easy to interpret. However, we can see that the age effect is largest (i.e., the odds in favor of promotion are greatest) from 7 to 12 years after receipt of Ph.D. Generally, the maximum values of the age effects are reached at earlier ages in public universities than in other types of institutions. The age effects become easier to interpret if we convert the estimated odds into probabilities and construct the corresponding probability distribution function. We can then calculate a cumulative distribution function from it (which tells us the chance of promotion at or before a particular age, assuming that date has no effect), and examine the median time to tenure, by type of institution. In Table 3, these medians, along with the interquartile ranges, allow us to contrast differences in time to tenure for different types of institutions. As estimated from age effects

alone (assuming that the date effects are constant over time and equal to 1), the time to tenure is shorter in public institutions than in private institutions. The dispersion of time to tenure is least for public universities and greatest for public four-year colleges.

(Table 3 here)

An intuitively understandable interpretation of the way that the date effects influence the time to tenure based on age alone is found by examining the date-corrected median times to tenure. The date-corrected median time to tenure in year t can be interpreted as the median time to tenure that would be experienced by the cohort that enters the academic labor market in year t <u>if</u> market conditions were to remain unchanged thereafter. These are calculated by taking the age effects and, for each year, applying the appropriate date effect. The median of the corresponding probability distribution is the date-corrected median time to tenure. The date-corrected median times to tenure estimated from the two surveys are shown in Table 4a, for the 1975 Survey and 4b for the 1973 Survey. These median times to tenure are plotted in Figure 1. Qualitatively, the results from both surveys are similar. In universities, the median times to tenure dropped in both public and private universities until 1968. Thereafter, it rose. In general, the time to tenure in private universities is longer than in public universities. In four-year institutions, the same difference between public and private institutions can be seen, particularly in the later years. The turn-around in the date-corrected median times to tenure, however, is not as evident. It appears that the decline in the median time to tenure slowed, for public institutions, after 1969, while for private institutions the time to tenure rose sporadically, after 1969.

(Fig. 1 here)
(Table 4a and 4b here)

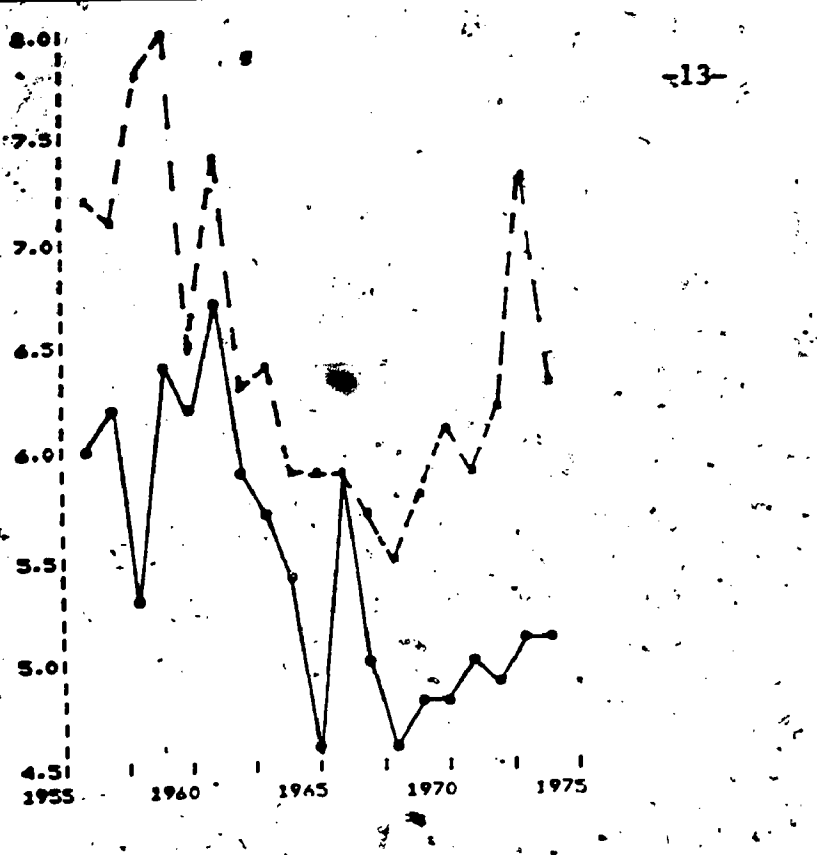
Brief mention should be made of the possible explanations of the quanti-

Table 3

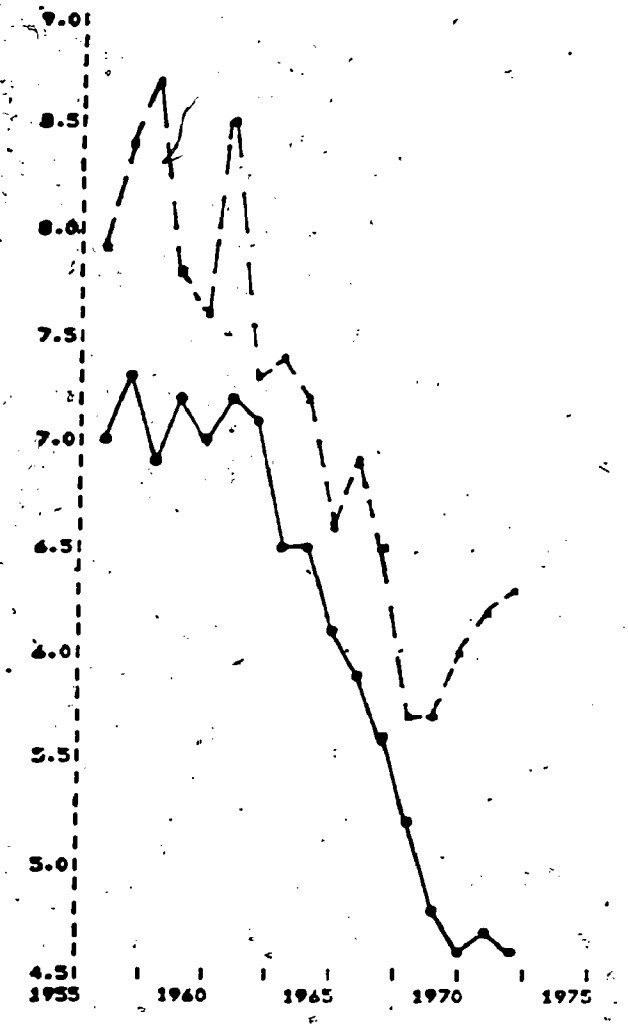
Median and Interquartile Ranges of Time to Tenure Uncorrected for Date Effects

	1973 Survey		1975 Survey	
	Median	Interquartile Range	Median	Interquartile Range
olic Universities	6.3	5.6	5.6	4.5
ivate Universities	7.2	6.0	6.6	5.3
olic Four-Year	6.9	7.8	5.1	5.1
ivate Four-Year	7.3	7.3	6.1	5.1

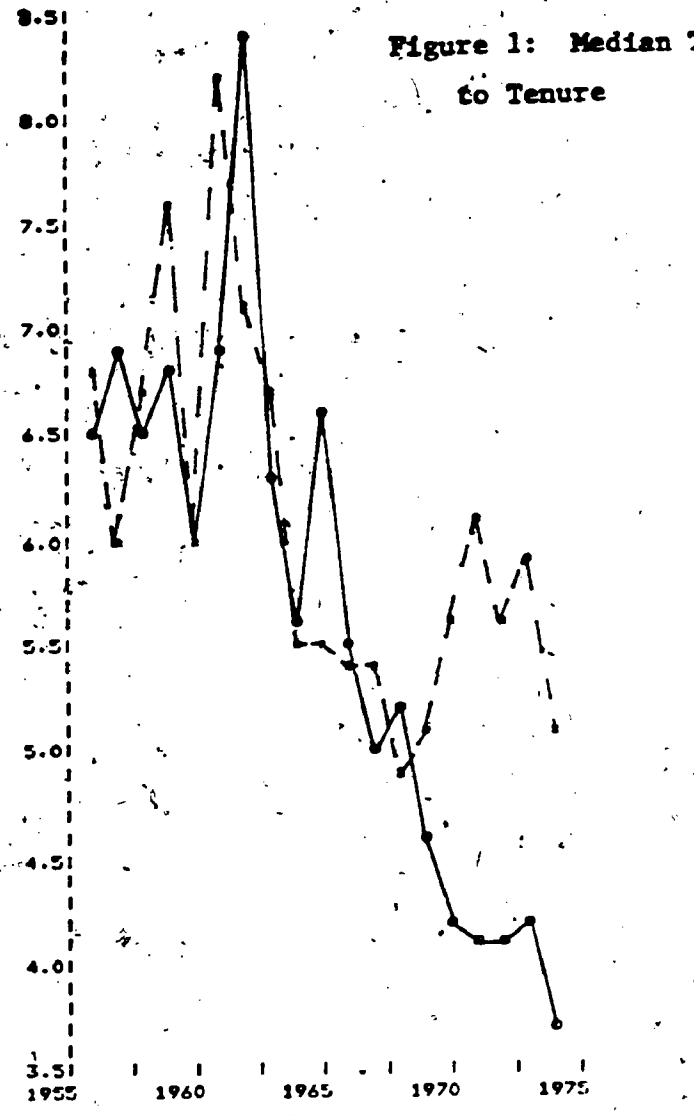
Figure 1: Median Times to Tenure



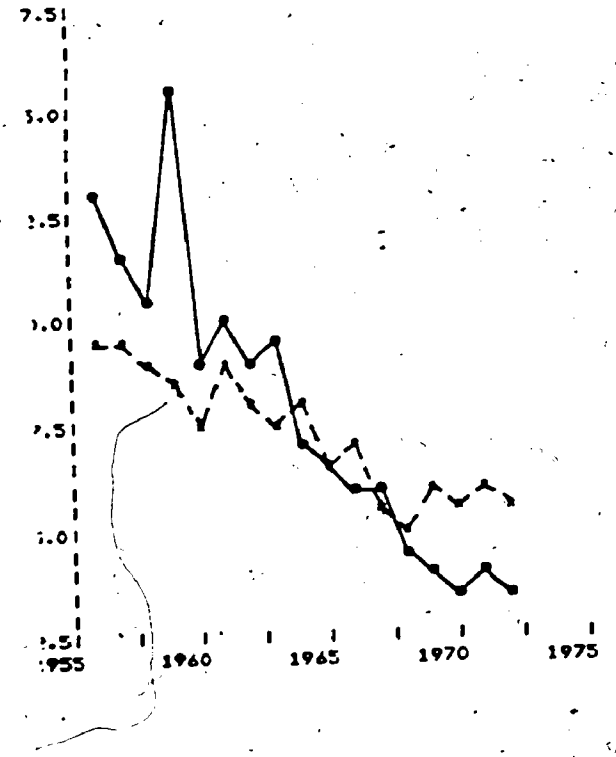
MEDIAN TIMES TO TENURE - PUBLIC (-) AND PRIVATE UNIVERSITIES (--)
1975 SURVEY



MEDIAN TIMES TO TENURE - PUBLIC (-) AND PRIVATE UNIVERSITIES (--)
1973 SURVEY



MEDIAN TIMES TO TENURE - PUBLIC (-) AND PRIVATE 4 YR (--)
1975 SURVEY



MEDIAN TIMES TO TENURE - PUBLIC (-) AND PRIVATE 4 YR (--)
1973 SURVEY

Table 4a

Date-Corrected Median
Times to Tenure: 1975 Survey

Date	Public Universities	Private Universities	Public 4 year	Private 4 year
1956	6.05	7.23	6.47	6.84
1957	6.17	7.05	6.89	5.99
1958	5.29	7.78	6.46	6.72
1959	6.39	8.01	6.83	7.59
1960	6.19	6.51	6.04	5.98
1961	6.66	7.43	6.86	8.32
1962	5.91	6.31	8.38	7.15
1963	5.74	6.38	6.29	6.67
1964	5.43	5.93	5.55	5.54
1965	4.64	5.94	6.61	5.47
1966	5.93	5.86	5.50	5.42
1967	5.01	5.74	5.03	5.36
1968	4.60	5.51	5.15	4.89
1969	4.83	5.82	4.58	5.09
1970	4.84	6.05	4.20	5.61
1971	5.01	5.90	4.11	6.13
1972	4.86	6.24	4.05	5.58
1973	5.14	7.30	4.16	5.87
1974	5.09	6.28	3.71	5.12

Table 4b

Date-Corrected Median

Times to Tenure: 1973 Survey

Date	Public Universities	Private Universities	Public 4 Year	Private 4 Year
1956	7.00	7.86	12.94	9.43
1957	7.30	8.38	11.66	9.33
1958	6.94	8.72	10.65	8.94
1959	7.18	7.80	15.73	8.75
1960	7.00	7.56	9.08	7.36
1961	7.24	8.55	10.24	9.09
1962	7.06	7.32	8.90	7.91
1963	6.53	7.43	9.53	7.45
1964	6.46	7.20	7.01	8.22
1965	6.14	6.61	6.57	6.29
1966	5.92	6.91	5.76	6.84
1967	5.58	6.49	5.85	5.56
1968	5.16	5.67	4.42	5.14
1969	4.78	5.73	3.87	5.93
1970	4.60	5.99	3.62	5.49
1971	4.75	6.20	3.96	5.93
1972	4.63	6.26	3.57	5.34

tative differences between the median times to tenure estimated by the two surveys. Until 1966, for public universities, and 1969, for private universities, for example, the medians estimated from the 1973 sample are higher than those estimated from the 1975 sample. The sources of this difference remain something of a mystery, although an investigation of such sources is reported elsewhere (10).

First, it is likely that the considerably smaller size of the 1975 sample accounts for the greater variability of the estimates. The main systematic difference is that the time to tenure for the earlier Ph.D. cohorts in the 1975 sample is lower than for the same cohorts in the 1973 sample. This is in part due to a different wording of the tenure question on the two questionnaires. The 1973 Survey asks when the respondent received tenure at his current institution. The 1975 Survey asks when the respondent first obtained tenure. It is quite obvious, however, that most respondents to the 1973 Survey read the question as asking when they first received tenure since, for public universities, for example, over 80% of the respondents with tenure report receiving tenure before the date at which they began continuous service at their current institution. We also know that the date the respondent first became tenured if he received tenure after moving to his current institution. The "questionable" group is a very small proportion of those in four year institutions. However, it forms 14% and 15% of the tenured sample in public and private universities, respectively. Unfortunately, this group contains two parts: those who first received tenure when they moved to their current institution and those who already had tenure when they moved. The way we dealt with this problem was to eliminate the questionable group from the sample when we estimated the age and date effects. The results for this "corrected" sample are those reported above. However, this may have resulted in eliminating from the 1973 sample a group that got tenure early and moved. We do, however, observe this group in the 1975 sample and thus get shorter times to tenure, particularly for the old cohorts. We are unable, however, to estimate the extent of the error that results in the estimates from the 1973 sample.

One other possible explanation is selective attrition between the two

sample dates from the old cohorts. It could be that institutions let go older untenured faculty between 1973 and 1975. This would result in higher tenure rates for the members of those cohorts who remain in academia. Such selective attrition, however, would have had to be quite large to result in the differences in raw promotion rates in the two samples.

The important point to be made, however, is that the two samples do give qualitatively similar results, and that the upward adjustment of median times to tenure that had just begun in the later years of the 1973 Survey is continued in the additional two years that we can estimate by using the 1975 Survey.

Time to tenure and other indicators of market condition

Although it is not difficult to specify a disequilibrium model in which salaries and time to tenure adjust to the difference in supply and demand for college faculty, it is difficult to estimate such a model satisfactorily. Data on salaries and faculty size for example, were collected only biennially until 1969, and the published data are disaggregated by type of institution or control of institution, but not both. There are no data on new hiring. A complete model also would take into account non-academic demand for Ph.D.'s, but data in this area are even scantier than those related to academic demand. There have been attempts by Freeman(8) and Hansen, et al. (9) to construct models of demand and supply for particular fields for which more complete data exist. The Hansen model is particularly interesting in that it includes government as well as academic demand for Ph.D. economists. The model, however, requires that markets clear in every period, with the result that wages, which mediate adjustment, would fall by unbelievably large amounts when demand for Ph.D's declines.

In this section, I shall present correlation and regression results in order to demonstrate the association of time to tenure with other measures of market demand and supply. These measures are: real assistant professor salaries, the percentage change in these salaries and the ratio of the change of the stock of faculty to the stock of Ph.D.'s. The salary

variables are indicators of price adjustment. Assistant professor real salaries rose at an increasing rate from 1958 to 1964. Thereafter, the rate of increase fell until 1970, when assistant professor real salaries actually declined or rose very slowly until 1975. The ratio of change in faculty to change in the stock of Ph.D.'s is viewed as a rough indicator of excess demand or supply as indicated by quantities in the market. This ratio rose between 1958 and 1964 indicating a rise in demand relative to supply. It then fell until 1971 as Ph.D. production increased dramatically. After 1971, it began slowly to rise again.[5]

Table 5 gives the correlations between median time to tenure by type and control of institution and other measures of demand. It is evident that median times to tenure are highly negatively correlated with the real salary of assistant professors (APSAL), both lagged and unlagged.

(Table 5)

These times also appear to be more highly correlated with the lagged ratio of change in faculty to change in Ph.D.'s than to the same ratio unlagged. Interestingly, this correlation is considerably higher for private institutions than for public institutions, which suggests a greater degree of market responsiveness. The ratio of change in faculty to change in the stock of Ph.D.'s is also fairly highly positively correlated with the change in real assistant professor salaries. It should also be noted that time to tenure is positively correlated with <u>change</u> in real assistant professor salaries--i.e., the greater the change in salaries, the higher the level of time to tenure. In a period of excess demand, this is consistent with the hypothesis that the greater the adjustment in salaries, the less time to tenure needs to adjust downward.

Table 6 displays the results of regressions of time to tenure for each type and control of institution on lagged values of the variables discussed above. Although there are problems with collinearity that are evident in the correlation matrix. We find, as we would expect, that the estimated median time to tenure is negatively associated with excess

Table 5: Correlation Matrix

	T1	T2	T3	T4	APSAL	ΔAPSAL	$\frac{\Delta FAC}{\Delta PhD}$	$APSAL_{t-2}$	$\Delta APSAL_{t-2}$	$\frac{\Delta FAC}{\Delta PhD}_{t-2}$
T1	1									
T2	.6114	1								
T3	.6445	.4028	1							
T4	.7521	.7355	.6593	1						
APSAL	-.7605	-.7541	-.7273	-.6658	1					
ΔAPSAL	.5884	.2000	.8004	.4898	-.6587	1				
ΔFAC/ΔPhD	.0416	-.3405	.3015	-.0947	-.0753	.4787	1			
$APSAL_{t-2}$	-.8147	-.4178	-.8410	-.6367	.9676	-.7145	-.2537	1		
$\Delta APSAL_{t-2}$	.5789	-.0660	.7779	.4152	-.5257	.4426	.6335	-.6929	1	
$\frac{\Delta FAC}{\Delta PhD}_{t-2}$	-.3460	-.7418	-.1119	-.6462	.2813	.2406	.4131	.1116	.3379	1

List of variables (sources in parenthesis)

T1 - date-corrected median time to tenure - public universities
T2 - " " " " - private universities
T3 - " " " " - public four-year colleges
T4 - " " " " - private four-year college

APSAL - real average salaries of assistant professors (AAUP data deflated by CPI)
ΔAPSAL - percentage change in APSAL
ΔFAC/ΔPhD - ratio of change in FTE faculty (14) to change in stock of Ph.D.'s (1,5)

demand for faculty and with the level of assistant professor salaries.

(Tables 6 and 7 here)

It is positively associated with lagged change in assistant professor salaries, i.e. the greater the rate at which past salaries adjusted, the higher the median time to tenure. This result is consistent with the notion of time to tenure as a "compensating differential" in the academic labor market. The more salaries adjust, controlling for excess demand, the less adjustment in time to tenure is required to attract the desired number of Ph.D.'s to academic jobs. All the regressions appear to explain a large part of the variance in median time to tenure, although given the fact that we only have 13 observations and that some of those observations have been interpolated, this is not surprising. The elasticities of time to tenure with respect to those variables whose coefficients are significantly different from zero are presented in Table 7. It is interesting to note that in public institutions the time to tenure appears to be more sensitive to salary levels than in private institutions, while for private institutions time to tenure is more sensitive to our quantity measure of excess demand.

Table 6: Regression Results
(t - statistics in parenthesis)

	Public Universities			Private Universities		
Constant	8.46	5.31	9.35	6.73	6.65	7.13
$(\Delta FAC/\Delta PhD)_{t-2}$	-.179 (2.63)	-.318 (3.03)	-.123 (1.15)	-.337 (5.46)	-.336 (4.68)	-.313 (3.15)
$\Delta PSAl_{t-2}$	-.00034 (4.69)	-	-.00043 (2.80)	-.0000098 (.15)	-	-.000051 (.36)
$\Delta\Delta PSAl_{t-2}$	-	.0021 (2.84)	-.00081 (.697)	-	-.000017 (.03)	-.00036 (.33)
R^2	.73	.53	.75	.75	.75	.75

	Public 4 year colleges			Private 4 year colleges		
Constant	15.8	5.05	16.4	10.2	6.33	12.7
$(\Delta FAC/\Delta PhD)_{t-2}$	-.211 (3.35)	-.723 (3.37)	-.172 (1.72)	-.641 (4.9)	-.611 (4.12)	-.305 (2.25)
$\Delta PSAl_{t-2}$	-.0012 (17.3)	-	-.0012 (8.4)	-.00042 (4.2)	-	-.00068 (3.46)
$\Delta\Delta PSAL_{t-2}$	-	.0075 (5.09)	-.00056 (.51)	-	.00225 (2.2)	-.00224 (1.[illegible])
R^2	.97	.73	.97	.80	.63	.84

Table 7: Elasticities for significant coefficients

	Public University			Private University			Public 4 Year			Private 4 Year		
$(\Delta FAC/\Delta PhD)_{-2}$	-.05	-.09	-	-.08	-.08	-.08	-.06	-.2	-.05	-.12	-.16	-.08
$\Delta PSAL_{t-2}$	-.58	-	-.73	-	-	-	2.0	-	2.0	-.64	-	1.04
$\Delta\Delta PSal_{t-2}$	-	.07	-	-	-	-	-	.26	-	-	.07	-

Conclusions

In this paper, we have used a statistical model to estimate time from Ph.D. to tenure. We have been able to separate the effects of time since Ph.D. (age effects) from effects that are associated with changes in market conditions (date effects). We find that the tenure rate did, indeed, increase during the period of rapid enrollment growth in academia from 1960 to 1968 in all types of institution. After 1968, the tenure rate continued to increase in public institutions, but more slowly. In private institutions, however, the tenure rate remained constant or declined in later years. Thus, it would appear that the tenure rate did behave as an economic variable in the sense that higher tenure rates occurred at same time as the rapid increase in employment in academia. In private institutions, which were relatively harder hit by the declining rate of increase in enrollments in the late 1960's, we see quite rapid downward adjustment of tenure rates at the same time.

Although data limitations prevent us from estimating a disequilibrium model of demand and supply for faculty in which time to tenure adjusts endogenously, we do relate our estimates of median time to tenure to other measures of market conditions: the ratio of the change in faculty stock to change in the stock of Ph.D.'s, and levels and changes in the real salaries of assistant professors. Much of the variation in median time to tenure is explained by lagged values of these variables. Time to tenure in private institutions appears to be more responsive to the quantity indicator of excess demand while time to tenure in public institutions seems to be more sensitive to changes in the price indicator of excess demand.

BIBLIOGRAPHY

1. Douglas Adkins. The Great American Degree Machine, Berkeley: Carnegie Commission on Higher Education, 1975.

2. Kenneth Arrow and William Capron. "Dynamic Shortage and Price Rises: the Scientist-Engineer the Engineer-Scientist Case," Quarterly Journal of Economics. May 1959.

3. Alan Bayer. Teaching Faculty in Academe 1972-73. ACE Research Reports Vol. 8, No. 2, Washington, D.C.: American Council on Education, 1973.

4. D. Blank and G. Stigler. The Demand and Supply of Scientific Personnel. Washington, D.C.: National Bureau of Economic Research, 1957.

5. Allan Cartter. Ph.D.'s and the Academic Labor Market. Berkeley: Carnegie Commission on Higher Education, 1976.

6. Commission on Academic Tenure in Higher Education. Faculty Tenure. San Francisco: Jossey-Bass, 1973.

7. Richard B. Freeman. The Market for College-Trained Manpower. Cambridge: Harvard University Press, 1972.

8. Richard B. Freeman. "Supply and Salary Adjustments to the Changing Science Manpower Market: Physics, 1948-1973," American Economic Review. May, 1975.

9. W. Lee Hansen, H.B. Newburger, F.J. Schroeder, D.C. Stapleton, and D.J. Youngday. "The Market for New Ph.D. Economics: An Econometric Model", unpublished paper, University of Wisconsin-Madison, December, 1977.

10. Charlotte Kuh. "Market Conditions and Tenure for Ph.D.'s in U.S. Higher Education: Results from the 1975 Carnegie Faculty Survey and a Comparison with Results from the 1973 ACE Survey" Carnegie Council on Policy Studies in Higher Education, Technical Report No. 3, July, 1977.

11. Charlotte Kuh and Roy Radner. "Market Conditions and Tenure in U.S. Higher Education, 1955-1973," Carnegie Council on Policy Studies in Higher Education, Technical Report No. 2, July, 1977.

12. Fritz Machlup. "In Defense of Academic Tenure," American Association of University Professors Bulletin. Summer, 1964.

13. Martin Trow. "The Distribution of Academic Tenure in American Higher Education." In B.L. Smith and Associates (Eds.), The Tenure Debate. San Francisco: Jossey-Bass Publishers, 1973.

14. U.S. National Center for Educational Statistics. Projections of Educational Statistics. Washington: Government Printing Office, various editions.

FOOTNOTES

1. There was a slight difference in the wording of the tenure question on the two surveys, which may have resulted in some difference in the estimates from the two sources. This question is discussed below.

2. The numbers reported in this and following tables are all unweighted and thus not strictly comparable to the results from the 1969 Carnegie Commission Survey reported by Trow (13). Both surveys were stratified by type and selectivity by institution. Weighting would make the magnitude of the numbers the same as the magnitude of the entire population (institutions of higher education). However, since the sample was not stratified to be representative of institutions according to their tenure ratios, it is possible that blowing up the sample using institutional weights could be misleading, since our interest here is to study promotion to tenure of those within the sample.

3. The statistical model is described in greater detail in Kuh and Radner (11)

4. The date effects are normalized so that $\sum_{i=1}^{t} B_t = 1$

5. Of course, if this were a good measure of excess demand, we wouldn't need to look at time to tenure as such a measure as well. However, it is not, first, because change in faculty stock is not a measure of vacancies and, second, because the share of Ph.D's that go into academic employment may also vary. The "ideal" measure would be the ratio of academic vacancies to Ph.D.'s desiring academic employment.)

APPENDIX

LOGIT AGE EFFECTS
1975 SURVEY

AGE	PUBLIC UNIVERSITIES	PRIVATE UNIVERSITIES	PUBLIC COLLEGES	PRIVATE COLLEGES
1	0.024	0.017	0.052	0.043
2	0.045	0.032	0.094	0.039
3	0.100	0.052	0.141	0.075
4	0.175	0.[illegible]	0.223	0.104
5	0.213	0.151	0.253	0.201
6	0.307	0.253	0.274	0.246
7	0.297	0.230	0.217	0.267
8	0.337	0.221	0.215	0.250
9	0.239	0.219	0.232	0.231
10	0.256	0.274	0.250	0.211
11	0.247	0.213	0.200	0.193
12	0.222	0.174	0.233	0.137
13	0.192	0.183	0.134	0.124
14	0.224	0.163	0.226	0.177
15	0.154	0.316	0.223	0.164
16	0.169	0.210	0.251	0.131
17	0.327	0.301	0.186	0.212
18	0.229	0.134	0.114	0.111
19	0.139	0.092	0.243	0.114
20	0.222	0.12[illegible]	0.040	0.097

LOGIT DATE EFFECTS
1973 SURVEY

DATE	PUBLIC UNIVERSITY	PRIVATE UNIVERSITY	PUBLIC COLLEGE	PRIVATE COLLEGE
1955	0.63	0.63	0.27	0.59
1956	0.72	0.71	0.44	0.67
1957	0.68	0.67	0.49	0.68
1958	0.71	0.58	0.55	0.72
1959	0.69	0.76	0.34	0.74
1960	0.76	0.89	0.68	0.98
1961	0.72	0.81	0.58	0.70
1962	0.78	0.98	0.70	0.85
1963	0.93	1.03	0.64	0.96
1964	0.99	1.13	0.96	0.81
1965	1.12	1.33	1.08	1.32
1966	1.33	1.31	1.34	1.12
1967	1.56	1.55	1.30	1.71
1968	1.83	2.29	2.18	2.03
1969	2.24	2.33	2.78	1.48
1970	2.42	2.14	3.21	1.76
1971	2.24	1.87	2.64	1.48
1972	2.34	1.98	3.32	1.87

LOGIT AGE EFFECTS
1973 SURVEY

AGE	PUBLIC UNIVERSITY	PRIVATE UNIVERSITY	PUBLIC COLLEGE	PRIVATE COLLEGE
1	0.019	0.012	0.028	0.026
2	0.037	0.017	0.057	0.033
3	0.082	0.044	0.095	0.053
4	0.114	0.073	0.130	0.105
5	0.154	0.109	0.135	0.137
6	0.182	0.135	0.169	0.163
7	0.210	0.177	0.149	0.172
8	0.203	0.162	0.154	0.184
9	0.173	0.155	0.152	0.141
10	0.178	0.182	0.142	0.139
11	0.161	0.190	0.173	0.161
12	0.169	0.155	0.137	0.184
13	0.162	0.164	0.124	0.149
14	0.181	0.172	0.099	0.140
15	0.149	0.143	0.147	0.125
16	0.166	0.153	0.213	0.093
17	0.134	0.123	0.129	0.115
18	0.149	0.152	0.056	0.117
19	0.114	0.160	0.049	0.085
20	0.140	0.117	0.095	0.093

LOGIT DATE EFFECTS
1975 SURVEY

DATE	PUBLIC UNIVERSITIES	PRIVATE UNIVERSITIES	PUBLIC COLLEGES	PRIVATE COLLEGES
1955	0.504	1.094	0.699	0.835
1956	0.445	0.903	0.550	0.761
1957	0.810	0.949	0.592	1.044
1958	1.192	0.994	0.651	0.795
1959	0.750	0.557	0.501	0.593
1960	0.805	1.019	0.715	1.054
1961	0.641	0.764	0.595	0.495
1962	0.895	1.091	0.441	0.583
1963	0.956	1.054	0.677	0.811
1964	1.114	1.250	0.841	1.244
1965	1.534	1.250	0.631	1.322
1966	0.898	1.307	0.858	1.353
1967	1.362	1.389	1.011	1.393
1968	1.656	1.563	0.957	1.738
1969	1.489	1.330	1.230	1.577
1970	1.492	1.194	1.472	1.242
1971	1.364	1.278	1.540	0.994
1972	1.456	1.119	1.578	1.256
1973	1.281	0.794	1.497	1.103
1974	1.315	1.101	1.939	1.553