THE EFFECTS OF STUDENTS' ACADEMIC, FINANCIAL, AND DEMOGRAPHIC VARIABLES ON TIME TO THE DOCTORATE

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The time taken to earn doctorates is of major importance to administrators and faculty. By using stepwise multiple regression techniques, this study predicted time to doctorate from the available demographic, academic, and financial variables and determined the significance of each variable on time to the doctorate. The data for this study came from the National Research Council's Doctorate Records File extract prepared for UCLA. This institution is particularly appropriate for a study of this kind, since it annually awards over 400 doctorates in over 75 different majors. Its doctoral recipients represent the range of academic fields of study. The results of this study indicated that source of support was the most important variable in predicting time to doctorate. Following source of support were postdoctoral plans, number of dependents, sex, and field of study. Together these variables explained a significant amount of variation in the criterion variable.

Discussions of the quality of doctoral programs often mention two factors: the proportion of admitted students who actually complete their degrees, and the time it takes completers to do so. The purpose of this study is to examine an identified set of variables to determine to what degree each, or a combination, of them predicts a students time to a doctoral degree.

As a review of the literature shows, there has been little empirical research into the factors directly related to time to degree. Recently, however, a pressing need for new doctoral recipients to serve as faculty during the anticipated growth in higher education enrollments has been identified. The Woodrow Wilson Foundation, for example, established the prestigious Mellon fellowship program specifically to train the best humanities graduate students for faculty careers. Clearly, shortening the time it takes students to achieve degrees is one

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approach to increasing the number of available doctorate holders for service in universities. Thus, this is a particularly appropriate time to do research into the variables identified as affecting the time to degrees.

REVIEW OF THE LITERATURE

The literature on graduate students, and specifically on the time it takes doctoral students to complete degrees, can be charitably described as sparse. Nevertheless, a few themes emerge. The following review summarizes three studies published in the early 1960s that included multiinstitutional and multidisciplinary research, several recent dissertations, and the most recent publication, which discusses doctoral students in Great Britain.

Chronologically, the first comprehensive study of graduate education was Berelson's *Graduate Education in the United States* (1960). Although this deals with graduate education over 25 years ago, it is still one of the major sources of information on the topic and is cited in almost all the sources that follow.

Berelson analyzed data from the National Research Council for doctoral recipients in 1936 and 1957, and data from his own sample of degree recipients (also in 1957), to show that the median time from award of the baccalaureate to award of the doctorate remained essentially the same in various fields of study over the 21 year period. In 1936, the median was 8 years for the total population; 6 years in the physical and biological sciences, 8 years in the social sciences, 10 years in the humanities, and 11 years in professional fields. In 1957 the overall median was still 8 years; 6 years in the physical sciences, 7 years in the biological sciences, 8 years in the social sciences, and 10 years in the humanities and the professional fields (Berelson, p. 157).

Another multidisciplinary study was *Attrition of Graduate Students at the Ph.D. Level in the Traditional Arts and Sciences,* by Tucker, Gottlieb, and Pease (1964). Although this research was designed to study attrition, one of its contributions is a discussion of the difficulties of defining attrition in a population in which it is relatively common for individuals to take more than 10 years to complete their degree programs. Thus, although the focus of the study was on attrition, a person in this category was defined as one who had not completed a doctoral degree after 10 years.

For their total sample, the mean number of years from receipt of the bachelor's degree to the Ph.D. was 8.9 years, with the expected pattern by field of study: physical sciences, 7.3 years; biological sciences, 7.9 years; social sciences, 9.4 years; and humanities, 11.7 years (Tucker et al., p. 58). The authors speculated about the reasons for the discrepancies in times to degrees between major fields and attributed these to factors associated with the dissertation.

A third multidisciplinary study was *Of Time and the Doctorate,* by Kenneth Wilson (1965). Wilson's sample included 1,929 doctoral degree recipients who

had received their degrees between 1950 and 1958 from 20 institutions in the southern U.S. The median elapsed time from first registration in graduate school to the award of the Ph.D. was 6.1 years, with a median of 4.2 years of registration in graduate school.

Wilson's major contribution was the discussion of the factors that his respondents identified as having the most influence on the duration of their doctoral studies. The five factors most often cited as reasons for extended times were, in order of frequency: discontinuity of attendance, work as a teaching assistant, the nature of the dissertation topic, writing the dissertation while not in attendance and while working full-time, and financial problems. Like Berelson, he reviewed the ABD (All But Dissertation) problem, which is characterized by students not completing their dissertations and, thus, their degrees. This was discussed not as an attrition issue, but one of lengthening the time to degree because of inadequate financial support and the need to work full-time away from the university.

In a study of women doctoral students at Auburn (Rice, 1981), age, support of significant others, and financial freedom were identified as important in the completion of doctoral degrees. A study of doctoral students at Georgia State University (Dolph, 1983) identified the following factors as important in relation to the completion of doctoral degrees: financial assistance, amount of full-time study, time spent with faculty, and scores on comprehensive examinations.

A study of doctoral students at UCLA, including attrition and time to degree (Benkin, 1984), focused on 4,256 students who entered doctoral programs, with the doctorate as their degree objective, in the fall terms of 1969, 1970, and 1971. The status of the students in this population was examined at the end of spring term 1981, giving them 10 to 12 years to have completed their degrees. At that time, 24% of the sample had completed doctorates, and, as with all previous research, the times they took were related to their fields of study. The mean times from admission to graduate school to the award of the degrees were: life sciences, 5.7 years, physical sciences, 4.6 years; humanities, 6.3 years; fine arts, 7 years; social sciences, 7 years; and professional schools, 5.9 years.

In the most recent study, *A New Look At Postgraduate Failure,* by Ernest Rudd (1985), over 100 research students in Great Britain who had taken extended times working on their degrees were interviewed about the factors that had affected their academic progress. Again, problems related to dissertation research, such as the timing of the choice of topic and the scope of the project, were identified and associated with the students' fields of study, and with the financial support given to students.

DATA SOURCE

The source of data for this study was the Doctorate Record File created by the Office of Scientific and Engineering Personnel of the National Research

Council. That organization collects, via the "Survey of Earned Doctorates," data on each individual receiving a doctorate from a U.S. institution. Each year the NRC makes available for purchase a computer tape containing data relating to each institution's degree recipients. UCLA has participated in collecting these data since first awarding doctoral degree in 1938, and the tape purchased from the NRC includes data on each of the over 12,000 UCLA doctorates awarded since that time in over 90 majors.

A total of 4,814 students in the Doctorate Record File received their doctoral degrees from UCLA between 1976 and 1985. The subjects in this study include 4,255 students for whom we had complete data.

DATA DEFINITIONS

The dependent variable was the mean time to degree. Mean time, rather than median time, was used because the distribution of time to doctorate was relatively normal and also because mean time is used more frequently in the literature. Two models were created and in the first, time to degree was defined as the elapsed time from the beginning of graduate school at UCLA to award of the doctoral degree by UCLA. In the second model time to degree was defined as total registered time.

The predictor variables were aggregated into demographic, financial, and academic categories. The *demographic* variables included:

1. Sex.
2. Age at the time graduate school begun.
3. Citizenship.
   In this variable, U.S. citizens, permanent residents, and immigrants were classified as domestic. All others were foreign.
4. Ethnicity. This variable was applied only to domestic students. Ethnicities were collapsed into Asian, black, Hispanic, white, and others. American Indians were included with others because there were too few to be analyzed as a separate category.
5. Marital status. Doctoral recipients were classified as married if they indicated this; all others were classified as unmarried.
6. Number of dependents.

The *financial* variables included:

1. The major source of support during doctoral studies. This variable was categorized as follows:

   a. Personal sources including off-campus earnings.
   b. Family and/or spouse.

c. On-campus employment, including teaching and research assistantships.
d. Fellowships and grants.
e. Loans.

2. Postdoctoral plans. This variable was categorized into (a) plans for postdoctoral study or further training, and (b) employment.

The *academic* variables included:

1. Local (or home grown) undergraduate. This variable was defined as whether the individual received his or her baccalaureate at UCLA, the University of California, or any other institution.
2. Field of study. This was determined by the individual's major field for the doctorate. The fields were: humanities and fine arts, life and health sciences, physical sciences, social sciences, education, engineering, and other professional fields. (At UCLA, the other professional fields that award doctorates are: architecture and urban planning, environmental science and engineering, library and information science, management, public health, and social welfare.)

DESCRIPTION OF THE POPULATION

The population studied included 4,255 UCLA students who received their doctorates between 1976 and 1985. We chose to limit our population to this 10 year span for two reasons: (1) During that decade there were no major external changes that would cause students to finish more quickly or more slowly, and (2) some of the items in the Survey of Earned Doctorates relating to the variables we wanted to study were changed in 1976 but have not been changed since that time.

It took these students an average of 8.7 years from the beginning of graduate study to complete their doctoral degrees.

There was a fairly even distribution among the fields of study: 530 (12.5%) were in humanities and fine arts, 788 (18.5%) were in life and health sciences, 749 (17.6%) were in physical sciences, 662 (15.6%) were in social sciences, 500 (11.8%) were in professional schools other than education or engineering, 527 (12.4%) were in education, and 499 (11.7%) were in engineering.

Thirty percent of the degree recipients were women, 13% were foreign, 17% were affirmative action minorities, 58% were married when they received their doctorates, and the average age when they began their graduate studies was 24.6. Fifty eight percent had fathers with at least some college education, 45% had mothers with at least some college education. Thirty percent had received their baccalaureate degrees at the University of California.

The primary source of support was evenly distributed among personal

sources, family sources, on-campus earnings, and fellowships/grants. Although loans were included as a category, only 25 (.6%) indicated that this was a primary source of support. Seventy-four percent of the population indicated postdoctoral employment plans, and 26% indicated that they would be involved in postdoctoral study or further training.

METHODS AND STATISTICS

Because we were interested in identifying the variables that had the greatest effect on the time it took students to complete doctorates, we chose to use multiple regression techniques to analyze the data. Since there were no *a priori* hypotheses regarding the importance of any of the existing variables for time to degree, a stepwise method multiple regression analysis was deemed appropriate. Two regression models were constructed. In the first model, total time to doctorate (including both registered and nonregistered time) was used as the criterion variable. In the second model, the criterion was the total registered time.

The independent (predictor) variables were introduced and defined above. There were two major problems with these variables. First, most of these variables were categorical data and could not be entered directly into the regression equation, and second, there was strong evidence indicating significant interactions between the predictors.

Categorical variables (like sex, ethnicity, field of study, source of support, etc.) were converted to dummy variables by creating vectors of ones and zeros; 1 if the characteristics existed, 0 otherwise. For each variable $k-1$ mutually independent dummy variables were created (k = number of categories on each variables). By multiplying the appropriate vectors of the dummy variables, interaction terms which were supposed to have effects on the criterion variable were constructed. For each set of two variables with presumed interaction ($k1-1$) ($k2-1$) interaction terms were constructed ($k1$ = no. of categories of the first variable, and $k2$ = no. of categories of the second variable).

The total number of predictors used in this study, including main effects (continuous and categorical variables) and interactions (mainly categorical variables), was 78. Twenty-nine variables measured main effects and 49 variables estimated interaction effects.

RESULTS

Tables 1 through 4 show distributions of total time and registered time to doctorate by some of the independent variables. As these tables indicate, the greatest difference existed between time to doctorate on the different categories of source of support. The next highest difference involved postdoctoral plans.

TABLE 1. Mean Time to Doctorate By Primary Source of Support

		Time from Admission To Doctoral Degree		Registered Time	
	N	Mean	SD	Mean	SD
Own Earnings	909	10.82	3.53	8.61	3.28
Family Support	481	9.40	3.45	7.65	2.71
On Campus Earnings	1421	7.68	2.88	6.62	2.09
Loans	25	9.52	3.24	7.76	2.26
Fellowships/ Grants	1419	8.06	3.13	6.66	2.16
Total	4255	8.68	3.40	7.18	2.61

TABLE 2. Mean Time to Doctorate By Postdoctoral Plans

		Time from Admission To Doctoral Degree		Registered Time	
	N	Mean	SD	Mean	SD
Employment	3161	9.23	3.46	7.45	2.76
Study/Trainee	1094	7.11	2.67	6.40	1.93
Total	4255	8.68	3.40	7.18	2.61

TABLE 3. Mean Time to Doctorate By Number of Dependents

		Time from Admission To Doctoral Degree		Registered Time	
	N	Mean	SD	Mean	SD
None	2047	8.22	3.19	7.01	2.33
1	737	8.25	3.26	6.94	2.70
2	516	9.49	3.52	7.56	2.67
3	341	10.08	3.52	7.82	3.02
4	117	10.90	3.72	7.82	3.16
5	31	11.16	3.72	9.29	4.95
6	10	13.80	2.94	9.20	3.71
	456	Missing Data			
Total	3805	8.68	3.40	7.20	2.61

TABLE 4. Mean Time to Doctorate By Gender

		Time from Admission To Doctoral Degree		Registered Time	
	N	Mean	SD	Mean	SD
Female	1277	9.51	3.56	7.55	2.52
Male	2978	8.32	3.27	7.02	2.63
Total	4255	8.68	3.40	7.18	2.61

Number of dependents, field of study, and citizenship are also among the variables which show high difference in time to doctorate between their categories.

The results of the multiple regression analysis are summarized in Tables 5 and 6. Table 5 shows multiple regression coefficients, F ratios and probability of significance of F ratios (used to determine the inclusion of the variable in the equation) for the first model, which used total elapsed time as the criterion. Table 6 reports regression analysis results for the second model in which registered time was the criterion.

The order of entrance of the variables in the two models is not exactly the same. While source of support is the most important variable on the two models, the amount of the variance of the dependent variable explained by source of support is not the same in the two models. Among other variables, postdoctoral plans, number of dependents, field of doctorate, sex, citizenship, and some of the interactions are shown to be good predictors of time to doctorate.

DISCUSSION

To predict time to degree from the available personal, academic, and financial variables, 4,255 UCLA doctorate recipients from 1976 to 1985 were studied. A stepwise multiple regression analysis was employed to discover the most important predictors from the pool of 78 variables used in this study. Some of the variables used in this study were categorical variables, therefore for each of $k-1$ categories a vector of ones and zeros (dummy variables) was created. Two regression models were constructed. In the first model, total time to doctorate (registered + nonregistered) was used as the criterion, and in the second model the registered time was used as the criterion. Since the total time to doctorate was of prime concern, the main focus of this paper's discussion will be the first model.

As Table 5 indicates, the most important variable in predicting the total time to doctorate for all UCLA doctorate recipients (1976–1985) was the source of support during graduate school. One category of the source of support variable, i. e., own earnings, had the greatest predictive ability, accounting for about 12% of the variance of the dependent variable. The F ratio for entering this dummy variable into the regression equation is 467.5, which is significant far beyond 0.01. The regression data on this variable indicate that one can predict with a fair level of accuracy that a doctoral student who supports himself, and his family, through off-campus employment will take longer than the mean time to complete his doctorate. This is also shown in Table 1.

The second variable which adds a significant amount of variance to the equation and has excellent predictive ability is postdoctoral plan, which

TABLE 5. Multiple Regression Analysis with Total Elapsed Time as the Dependent Variable for Model I

Variable	Multiple R	Multiple R^2	Change in R^2	F Entering	P
Own Earnings	.340	.116	.116	467.5	0.000
Postdoctoral Plans	.395	.156	.040	329.4	0.000
Number of Dependents	.426	.182	.026	263.9	0.000
Sex	.463	.214	.032	242.9	0.000
Field of Study (physical sciences)	.478	.228	.014	210.8	0.000
Field of Study (life sciences)	.490	.240	.012	187.9	0.000
Citizenship by Field (Education)	.497	.247	.007	167.2	0.000
Age	.504	.254	.007	151.6	0.000
Baccalaureate from UC	.510	.250	.006	139.3	0.000
Citizenship	.516	.266	.006	129.1	0.000
Family Support	.520	.271	.005	120.2	0.000
Field of Study (humanities)	.525	.275	.004	112.5	0.000
Father's Education	.528	.279	.004	106.0	0.000
Citizenship by Field (social sciences)	.531	.282	.003	99.9	0.000
Field of Study (professional schls)	.536	.287	.005	95.3	0.000

TABLE 6. Multiple Regression Analysis with Total Registered Time as the Dependent Variable for Model II

Variable	Multiple R	Multiple R^2	Change in R^2	F Entering	P
Own Earnings	.283	.080	.080	311.6	0.000
Family Support	.309	.095	.015	188.3	0.000
Citizenship	.328	.107	.012	142.9	0.000
Postdoctoral Plans	.345	.119	.012	120.6	0.000
Citizenship By Field (physical sciences)	.357	.128	.009	104.2	0.000
Number of Dependents	.365	.133	.005	91.1	0.000
Sex	.370	.137	.004	80.7	0.000
Citizenship By Field (social sciences)	.375	.141	.004	73.0	0.000
Mother's Education	.380	.145	.004	66.9	0.000
Postdoctoral Status	.385	.148	.003	61.8	0.000
Citizenship By Field (Education)	.388	.150	.002	57.3	0.000
Field of Study (humanities)	.393	.154	.004	54.1	0.000
Baccalaureate UCLA	.396	.157	.003	50.9	0.000
Source of Support By Field	.399	.159	.002	48.1	0.000
Citizenship By Field (physical sciences)	.408	.166	.007	35.4	0.000

increased the multiple correlation by .055 and added about 4% to the predictive ability of the equation. Postdoctoral plan is categorical variable with two categories (1 = postdoctoral study/trainee, 0 = employment). As Table 2 shows, the average time to doctorate for those in the postdoctoral study/trainee category is significantly lower than the average time for those in the employment category (7.11 years for postdoctoral study/trainee vs. 9.23 for employment). This may be the result of a confounding of employment status during the doctorate with postdoctorate employment status. In many instances postdoctoral employment is a continuation of predoctoral employment. Many of those who specified employment after receipt of the doctorate were likely also employed while completing their doctorates. It is logical that they would take significantly longer to complete their degrees for the same reasons that those who support themselves off campus took longer than the mean to complete degrees.

The variable with the highest predictive validity after postdoctoral plan was the number of dependents. The *F* ration for including this variable into the design was 263.9, which is significant far beyond 0.01. As Table 3 indicates, as the number of dependents increased, total time to doctorate also increased systematically. There is a correlation of 0.243 between the two variables. Doctoral students who have larger families may have a great deal of moral support, but they also have to spend time with others that could be spent on their studies. In addition, they are also more likely to have to work to help support their families.

The next variable which entered the regression model was sex, which added more than 3% to the predictive ability of the equation (Table 5). The *F* ration indicating the significance of the contribution of this variable is 242.9, significant beyond 0.01. As Table 4 indicates, the men in this study took an average of 1.2 years less than the women to complete their doctorates. Most of this difference may be explained by field of doctorate. The percentage of men in fields such as physical science, with lower times to degrees, was higher than the percent of women; physical science was 88.0% men and 12.0% women. On the other hand, the percentage of women in the fields with longer times to doctorates was higher than men; for example, in education 51.8% of the doctoral recipients were women and 48.2% were men.

The next variable that added significant variance to the prediction was field of study, which added about 3% to the variance of the equation (Table 5). *F* ratios for including different levels of field of study were large and significant beyond the 0.01 level. The smallest average time to doctorate was 6.8 years in the physical sciences, and the longest average time was 11.0 years in education. This finding is consistent with the previous findings regarding the importance of the field of study on time to degree.

The interaction of citizenship by field had the next highest predictive validity

after field of study. This variable added about 0.007 to the multiple correlation and about 0.7% to the predictive variance of the equation (Table 5). While the contribution of this and additional variables into the equation may be statistically significant, the amount each of these contributed to the predictive ability of the equation did not justify increasing the list of variables. The first five variables were responsible for 24% of the variance in the equation. Entering the 73 other variables would have increased the predictability by only 7%.

After using those predictors with significant contribution, the multiple R was higher on the first model (total time), $R = 0.550$, than on the second model (registered time) $R = 0.408$.

Source of support was the variable with the highest predictive ability on both models (Tables 5 and 6). Doctoral students who had to support themselves (and perhaps their families) took more time to complete their degree than others. This difference is most evident on the first model, because the difference in the total times was mostly in the nonregistered time. Postdoctoral plans, number of dependents, and field of study are among the variables which also had highly significant contributions to both equations.

The results of this study suggest that there are many variables that effect the total time to doctorate. While some of these may be outside the control of graduate school administrators, it is clear that there are factors that can be manipulated to affect students' times to degrees. If for example, doctoral students are adequately supported by their universities, and they do not have to work off campus, this will have a direct impact on the speed with which they complete degrees.

LIMITATIONS OF THIS STUDY AND SUGGESTIONS FOR FUTURE RESEARCH

This study was limited to data collected on the National Research Council's Survey of Earned Doctorates. As a result, it suffers from all the limitations of research dependent on retrospective surveys. In addition, the survey instrument did not include many of the areas that have been identified as affecting students' time to degrees. Information regarding the doctoral candidacy period, choice of dissertation topic, and major professor's assistance in dissertation writing would be valuable information in any study dealing with doctoral degree completion. We would expect any follow-up study to include such variables.

This study was completed using only data relating to graduate study at UCLA, and the results may not be generalizable to the entire population of U.S. doctorates. However, it does provide a basis and a methodology which could be used on a broader and more representative sample of the doctorates produced by U.S. institutions. Cross-validation of this study using different populations would result in clearer definitions of the factors inhibiting degree completion.

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Received July 14, 1987