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ABSTRACT

This study analyzed 13 national datasets and evaluated their utility for addressing policy questions concerning college faculty availability (such as minority hiring, affirmative action, supply and demand in specific disciplines) and the overproduction of Ph.D.s. Each dataset was evaluated for its utility in modeling faculty availability. Also documented were the types of assumptions which need to be addressed in building models based on these datasets. Every national survey instrument related to faculty was reviewed, along with information about the data element dictionary, the value labels for categorical variables, the sample size, the population size, error estimates and weighting procedures. Analysis of the datasets suggests that, while many important policy questions may be studied with the data, it is not currently possible to complete the critical cross-tabulation of gender within ethnicity by rank within tenure status by discipline at the institution level. It is recommended that the Integrated Postsecondary Education Data System expand its survey to include a table on full-time instructional, research and service faculty. The table should be broken out by gender within ethnicity by rank within tenure status by discipline clusters. (Contains 55 references.) (DM)

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"Developing Benchmarks for Faculty Hiring"

1997 AIR Forum Paper Presentation
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This paper was presented at the Thirty-Seventh Annual Forum of the Association for Institutional Research held in Orlando, Florida, May 18-21, 1997. This paper was reviewed by the AIR Forum Publications Committee and was judged to be of high quality and of interest to others concerned with the research of higher education. It has therefore been selected to be included in the ERIC Collection of Forum Papers.

**Jean Endo
Editor
AIR Forum Publications**

"Developing Benchmarks for Faculty Hiring"

ABSTRACT

This paper analyzes 13 national datasets about faculty and evaluates their utility for addressing policy questions about faculty availability and the overproduction of Ph.D.s. This work was funded by an NSF-NCES-AIR Research Fellowship for 1996-97. While it is important to review several of the complex econometric approaches and their assumptions about Ph.D. production, the primary purpose of this research is to document specific datasets which may be used for different types of models. A basic pipeline model is presented which demonstrates how several 1993 datasets may be used to conduct more complicated analyses.

Introduction

How many minority and female faculty in a specific discipline are available in the national pool for a new hire?

Is a department producing too many Ph.D.s?

These two campus-level, policy questions demonstrate the need for data on benchmarks for faculty hiring. Faculty availability data are at the heart of required affirmative action reports for institutions that receive federal funding (Milam, 1995b). While the climate for affirmative action has changed dramatically in California and other states, a parallel debate about faculty availability is taking place at the national level in response to alarms about the overproduction of Ph.D.s (Geiger, 1997; Massy and Goldman, 1995; SRS Professional Society Workshops, 1995a, 1995b, 1996).

This paper analyzes the national datasets about faculty and evaluates their utility for addressing policy questions about faculty availability. This work was funded by an NSF-NCES-AIR Research Fellowship for 1996-97. While it is important to review several of the complex econometric approaches and their assumptions about Ph.D. production, the primary purpose of this research is to document specific datasets which may be used for different types of models. A basic pipeline model is presented which demonstrates how several 1993 datasets may be used to conduct more complicated analyses.

Literature Review

Discussion of faculty availability is informed by five distinct literature bases:

(1) Scholarship about affirmative action and the pipeline of women and minority faculty in higher education (Bereman and Scott, 1991; Clark and Corcoran, 1986; Cunningham and

Hemmeter, 1992; Ethington, 1988; Hallock, 1994; Hanna, 1988; Harvey and Valadez, 1994; Lie et al., 1994; Opp and Smith, 1994; Reynolds, 1992; Rodriguez, 1994; Schroeder and Mynatt, 1993; Smith, 1994; Tack and Patitu, 1992; and Washington and Harvey, 1989).

(2) Documentation of availability data on women and minorities in higher education (Gill, 1992; Milam, 1995a, 1995b; NEBHA, WICHE, and SREB, 1994; Texas Higher Education Coordinating Board, 1992; and Vander Maerdt, 1989).

(3) A labor economics approach to understanding the supply and demand for faculty in the disciplines, particularly science and engineering (Atkinson, 1990; Committee on Science, Engineering, and Public Policy, 1995; Geiger, 1997; Leslie and Oaxaca, 1990; Massy and Goldman, 1995; McGuire and Price, 1989; Science and Engineering Indicators, 1996; SRS Professional Society Workshops, 1995a, 1995b, 1996; Syverson, 1997; Syverson and Forster, 1985).

(4) Other surveys and research about the nature of higher education faculty, including data about rank, tenure status, activity, workload, productivity, program rankings, research, and retirement (Tang and Chamberlain, 1997; Lozier and Dooris, 1989, 1991; National Research Council, 1995; National Center for Education Statistics, 1996a, 1996b).

(5) Scholarship about the Ph.D. process, including time to degree, mentoring, and post-doctoral programs (Bowen and Rudenstine, 1992; Bowen and Sosa, 1989; Stricker, 1994).

Each of these approaches offers different assumptions for consideration in developing models of faculty availability. The pipeline scholarship suggests that the entrance of women and minorities into the faculty depends on the climate and nature/tier of the graduate institution, effective mentoring, and faculty diversity for role models, among other factors. Availability research uses survey data to calculate utilization rates and predict shortages using models based

on simple, descriptive statistics. The research of Massy and Goldman (1995) on The Production and Utilization of Science and Engineering Doctorates in the United States, the Committee on Science, Engineering, and Public Policy's (1995) work Reshaping the Graduate Education of Scientists and Engineers, and NSF's Science and Engineering Indicators - 1996 chapter on "Higher Education in Science and Engineering" are examples of econometric approaches which make complex assumptions about matriculation rates, faculty rank transitions, retirement rates, and departmental activity based on undergraduate enrollment, budgets, and sponsored research funding to estimate the long-term equilibrium of supply and demand. Numerous other efforts focus on understanding topics such as changing patterns in the faculty ranks, tenure status, and the greying of the professoriate. These shifts in demographics can be incorporated into complex models that, for example, account for the growth of non-tenure track positions and the increased use of part-time faculty. Finally, the literature on the Ph.D. process informs models with assumptions about the percent of graduates entering academe, the increase in post-doctoral appointments, unemployment, underemployment, and the segmentation of tiers and types of institutions.

Several sets of assumptions emerge from the literature which need to be addressed by policy makers, if only to state whether they are accounted for and whether a particular faculty availability model is therefore limited in its implications. These may be grouped by their effect on data about graduate students, Ph.D. recipients, post-doctoral appointments, new assistant professors, and other faculty.

Graduate students

Assumptions need to be made about the effect of the number of bachelor and master's degrees on doctoral student supply, the relationship of the master's to the doctorate, breakouts by

gender and ethnicity, age, retention, and completion rates. Example questions: How valuable is master's enrollment in predicting supply for Ph.D. programs? What is the impact of funding patterns by field and type of institution on completion? Based on undergraduate and master's enrollments, how many Ph.D. students will be enrolled in five years?

Ph.D. recipients

Complex models require that assumptions be made about time to degree, matriculation and graduation rates, gender, ethnicity, age, field of specialization/dissertation topics, the effect of different tiers of institutions on marketability, and the percent of recipients entering academe. Example questions: How will the percent of students entering academe vary by field, funding, and tier of institution? Are too many Ph.D. students being produced to meet the demand of academe, government, and industry?

Post-doctoral appointments

Assumptions need to be made about the growth of post-doctoral appointments and their effect on obtaining positions in academe? Example questions: What percentage of Ph.D. recipients by field go into post-docs? Are post-doc appointments taken because tenure track positions are unavailable or because the nature of the discipline requires advanced study?

New assistant professors

Assumptions need to be made about the number of new tenure track, assistant professor slots. This requires complex assumptions about faculty turnover, rank transitions, retirements, etc. Massy and Goldman (1995) suggest that the demand for new hires is driven positively by undergraduate enrollments in a department and departmental budgets and negatively by the amount of sponsored research. Other assumptions need to be made about whether retiring faculty are replaced with tenure track positions or part-time and non-tenure track faculty.

Example questions: What is the effect of declining tenure track appointments and the increased use of restricted faculty on Ph.D. demand? How many new faculty are hired each year in a specific discipline?

Other faculty

Assumptions about faculty turnover, rank transitions, retirement planning, and the effect of early retirement policies need to be taken into account. Increased interdisciplinary work, the feminization of some disciplines, the dissolution of tenure, collective bargaining, and other factors also influence the demand for new faculty hires. Example questions: How has the lifting of mandatory retirement and the greying of the tenured professoriate helped push tenure track positions into non-tenure track? Is most of the growth of women and minorities at the non-tenure track level? Has the use of part-time faculty for undergraduate instruction limited the need for full-time faculty altogether? What is the effect of faculty workload policies on the number of faculty needed in a department?

In evaluating different datasets, it is important to acknowledge the implicit assumptions and limitations of the data as they impact modeling about the faculty pipeline.

Methodology

The primary purpose of this research is to (1) evaluate each national dataset for its utility in modeling faculty availability and (2) document the types of assumptions need to be addressed in building models based on these datasets. An extensive review was performed of the literature bases detailed above and of related documentation on NSF, NRC, NCES, and other agencies' web sites. This review led to the construction of a critical table (or cross-tab or pivot table) which illustrates the lowest level of aggregation necessary for modeling.

This critical cross-tab includes the faculty variables rank within tenure status by gender within ethnicity. The data need to be completed for the lowest taxonomy of a discipline for a single institution. (See table #1 below).

Table #1: Critical cross-tab at lowest level of aggregation

Institution: Carnegie: Control: Department: Discipline:		
	Ethnicity	
	Male	Female
Tenured		
Professor		
Assoc Prof		
Asst. Prof		
Instructor		
Lecturer		
Tenure Track		
Professor		
Assoc Prof		
Asst. Prof		
Instructor		
Lecturer		
Non-Tenure Track		
Professor		
Assoc Prof		
Asst. Prof		
Instructor		
Lecturer		
# Post-Docs		
# Ph.D.s Awarded		

In the institutional research literature on peer review, the standard categorical variables for institutional comparisons are Carnegie classification and control. Some peer comparison

In the institutional research literature on peer review, the standard categorical variables for institutional comparisons are Carnegie classification and control. Some peer comparison models document additional information about location, enrollment size (broken out by undergraduate and graduate), part-time enrollment percentage, and full- and part-time faculty size. Traditionally, peer selection and comparison models use variables from NCES IPEDS reports, the College Board, John Minter Associates, and other sources. The combination of Carnegie classification and control is consistent throughout the institutional research literature for segmenting institutional types. It is assumed that data will vary with Carnegie classification and that Carnegie types provide an adequate proxy for institutional infrastructure.

Massy and Goldman (1995) expand this schema for their model. They do a factor analysis on fifteen variables available in the NSF CASPAR system and group institutions based on their factor loadings. Their variables include the number of faculty, sponsored research and development dollars, full-time and part-time science and engineering personnel, science and engineering post-doctoral fellows, doctoral degrees (broken out by U.S. and foreign), masters degrees, bachelors degrees, expenditures for research equipment, and total graduate students in science and engineering (full and part-time).

In addition to the literature and web review, numerous interviews were conducted in person, writing, and by telephone with staff from various higher agencies and higher education associations about their experience with and research on faculty data. These agencies included the National Science Foundation (NSF), the National Center for Education Statistics (NCES), the American Association of University Professors (AAUP), the Rand Corporation, Quantum Research Corporation (QRC), Pinkerton Computer Corporation, the U.S. Department of Education, the Council of Graduate Schools (CGS), the National Research Council (NRC), and

the National Academy of Sciences (NAS). Many of these people participated in the NSF-sponsored SRS Professional Societies Workshop series that met in 1995 and 1996. The author is grateful for the assistance and guidance which these discussions provided during the course of the research and for the availability of the proceedings on the NSF SRS web site.

The following persons were contacted and interviewed about the faculty datasets: Ernst Benjamin, AAUP; Sam Bettinger, Pinkerton; Joan Burrelli, NSF; Lawrence Burton, NSF; Michael Cohen, NCES; Valerie Martin Conley, NCES; Charles A. Goldman, RAND; Mary Golladay, NSF; Theresa Grimes, QRC; Linda Hardy, NSF; Susan Hill, NSF; Steve Hunt, U.S. Dept. of Education; Linda Parker, NSF; Carolyn Shettle, NSF; Peter Syverson, CGS; Veerle Van Meel, QRC; Jim Voytuk, NAS; Julie Wood, NRC; and Linda Zembler, NCES.

Datasets

The critical question in evaluating each dataset is whether it offers the necessary level of aggregation in the cross-tab of rank within tenure status by gender within ethnicity at the discipline level by institution. Every national survey instrument related to faculty (as currently constructed and evolved over time) was reviewed, along with information about the data element dictionary, the value labels for categorical variables, the sample size, the population size, error estimates, and weighting procedures.

Other questions which are important to the evaluation include: How are the data made available to researchers? In what format and at what degree of aggregation are they available? How easy is it to aggregate, sort, group, and filter the data to produce the cross-tab of interest? Are there sufficient numbers in the cells at the lowest level (particularly women and minorities) to produce the cross-tab? What disciplinary taxonomy is used? Are the data normalized? Is it

possible to merge the data with other datasets? How have the data been analyzed by other researchers or agencies and what publications have been produced based on the results?

(1) NSF-NIH Survey of Graduate Students and Postdoctorates in Science and Engineering (GSS)

This survey has been conducted by the National Science Foundation in cooperation with the National Institutes of Health since 1972. 1994 data are the most current available. This survey "compiles a factual base for assessing shifts in graduate enrollment and the relationship between patterns of financial support for graduate students. It provides the only nationally representative data bank on sources of support of graduate science and engineering (S&E) students and their enrollment characteristics, and on S&E postdoctoral appointments" (Guide to the Data Files, 1997, <http://www.nsf.gov/sbe/srs/gss/dug/parta.htm>). Data are collected by full and part-time students by gender within ethnicity and by funding source, and for other "nonfaculty doctoral research staff."

Some critical variables have changed over the years, but the survey offers consistent data about enrollment of science and engineering graduate students at the program or departmental level. For several years in the 1980's, a sample of institutions was used. Information about faculty, including rank, tenure, appointments, and departures were included in the 1983 and 1984 surveys. According the Quantum Research Corporation staff, "NSF was not pleased with the quality of the faculty data that could be collected through the Graduate Student Survey -- it reflected only departments that had graduate programs; it did not satisfactorily deal with such problems as split appointments, etc. As a result the data were never published and were dropped from the survey during the next OMB clearance cycle. As a result, the data is not available for the public" (Van Meel, 1997).

The entire universe of graduate programs in S&E is surveyed. In 1994, data on 11,425 departments at 604 institutions were collected, with a 96% response rate. Numerous tables of the data are available on the web, as are public use data files in AASCII format. While no SAS programs are publicly available to read the files, the record layout is documented and the same data are available in CASPAR by institution and discipline.

CASPAR (Computer-Aided Science Policy Analysis and Research) is a software tool designed developed by the National Science Foundation (NSF) and Quantum Research Corporation (QRC) to make data from NSF, NCES, and other surveys available to researchers and policy analysts. The CASPAR CD-Rom may be purchased from Quantum or downloaded free over the Internet (approximately 600 megabytes). While the CASPAR software fails to take advantage of the Windows environment, with practice it becomes a useful tool. When creating spreadsheet or SAS card formatted datasets with SAS read programs, limitations are placed on the number of observations which can be saved, requiring that multiple files be saved. Data by institution may be merged seamlessly within CASPAR by FICE code. Files created with CASPAR can include institutional attributes such as FICE code in order to merge files within SAS other software.

The disciplinary taxonomy is unique to the GSS and includes an exhaustive breakout on health fields. A lookup table is available on CASPAR which rolls the 79 disciplines in the GSS 30 of the 49 CASPAR discipline clusters. The CASPAR discipline taxonomy, while thorough, discards some important disciplinary distinctions. While data on psychology, economics, anthropology, geography, political science, public administration, linguistics, sociology, and other social sciences programs are included in the survey, the S&E purpose of the instrument does not gather comparable data on other disciplines. Post-doctoral data for these disciplines and

for S&E post-docs outside of academe (such as at national labs) must be estimated from the NSF Survey of Doctorate Recipients and the NRC Survey of Earned Doctorates.

For the critical cross-tab table, the GSS can be used to complete the data on gender within ethnicity for S&E post-doctorates in academe, but only for 30 of the 49 CASPAR discipline clusters. If the CASPAR taxonomy is adopted for the model, crosswalks must be in place for every other dataset.

(2) NRC Survey of Earned Doctorates (SED)

The SED is collected by the National Research Council's Office of Scientific and Engineering Personnel and is available in the NSF Doctorate Records File for all persons receiving doctorates in the United States since 1957, with limited data on doctorate recipients from 1920-1956. The survey does not include professional degrees such as the M.D. Of 39,754 new doctorates in 1993, there was a 95% response rate, with the survey usually considered a requirement of graduation paperwork. Records for non-respondents are created from commencement lists and other sources.

The three digit taxonomy of disciplines used for the SED continues to evolve and is the most exhaustive of any of the surveys reviewed, with 330 distinct specialties. Specialty data are collected for each degree earned, the dissertation topic, field of intended postdoctoral study, and expected field of work. In addition to complete demographic data, the SED collects data on time to degree, financial support, and post-graduation plans. Aggregate data are available on CASPAR for academic years 1965-66 through 1994-95 at the institution level, but only for the 49 CASPAR discipline clusters. No public use file comparable to the GSS file is available because of the need to protect confidentiality, but researchers can obtain permission from NSF to access the microdata under controlled conditions.

Numerous tables from the data are available on the web and in annual publications from NRC and NSF such as Science and Engineering Degrees, Science and Engineering Indicators, and Women, Minorities, and Persons with Disabilities in Science and Engineering. The SED data on time to degree are an invaluable resource, although the survey does not account for periods of stop-out or part-time study. The data on post-doctoral plans are useful for analysis, but these are intentions, not reality. NSF staff report a significant discrepancy between intention to pursue a post-doc as reported in the SED and actually having done a post-doc as reported in the Survey of Doctorate Recipients (SDR). Similarly, the data on whether graduates plan to enter academe, government, or the private sector are useful, especially with the exhaustive specialty breakout. According to NSF staff, the SDR is a more accurate predictor than the SED for estimating what percentage of Ph.D. recipients are likely to complete a post-doc.

For the critical cross-tab table, the SED provides a breakout of gender within race for doctoral recipients by institution at the lowest disciplinary taxonomy.

(3) NSF Survey of Doctorate Recipients (SDR)

The SDR collects data about doctoral recipients who receive their doctorates in the United States. A longitudinal survey, new doctoral recipients are added each cycle and individuals over age 75 are dropped. The sample is drawn from the Doctorate Records File of the SED, with a sampling rate of approximately 1 to 12 and fifty thousand individuals surveyed in 1993. In 1993, the sample was expanded to include doctoral recipients in the humanities. Data from the survey are weighted to the census population estimates. The most recent data available are for 1995.

In addition to demographic data not collected in the SED, the SDR collects data about employment, occupation, postdoctoral status, primary and secondary work activities, salary,

sector of employment, and years of professional experience. Numerous reports based on the SDR are available on the web in HTML, PDF, and Excel formats and are published in print by NSF. The data element dictionary is available on the web and includes extensive technical notes and cross-tabs of responses to each variable in the 1993 and 1995 files. The survey also collects data on rank, tenure status, full-time/part-time status, occupation, and Carnegie classification of institution.

The Science and Engineering Data System (SESTAT) was developed to provide research access to the three survey files maintained by NSF - the SDR, the National Survey of Recent College Graduates (NSRCG), and the National Survey of College Graduates (NSCG). The individual or combined data files may be used for analysis of the engineering and science workforce. No public use files or CASPAR aggregate datasets of the SDR are available because of the need to protect confidentiality, but researchers can obtain permission from NSF to access SESTAT data under controlled conditions and on the web. Immediate access to public use versions of the NSCG and SCG files is available on the web with a simple online application form.

A problem of the SDR is that information about current employment is collected in major occupational codes. These lose the fine level of detail available in the SED. Field of degree is used extensively in some reports as if it were comparable to field of employment. NSF staff recognize that this assumption is erroneous and that many Ph.D.s work outside of their field of graduate degree.

The crosswalk to CASPAR and other disciplinary taxonomies is simplistic, given the broad nature of the occupation codes. Another problem of the SDR which has been raised by NSF staff and in the online proceedings of the SRS Professional Societies Workshop series is

that the survey, because it is based on the SED, excludes persons with professional degrees in the medical sciences, yet it surveys Ph.D.s working in this area. The data on medical sciences are, therefore, incomplete, unless persons have for example received both the Ph.D. and the M.D.

A caveat of the SDR is that it is a sample, where the GSS and SED are of the entire universe of institutions and Ph.D. recipients. The SDR data are weighted to census population estimates, using the occupation codes. This weighting may be suspect, not because of the sampling techniques, but because the census data on occupations are themselves a sample (the long census form) and because census estimates may not be the best predictors of the higher education faculty population. The survey is stratified at many levels in two phases: "For the 1993 SDR, the sample for the new cohort (1992-93 graduates) was selected as an independent supplement to the older cohort sample. The new cohort sample was selected using stratified simple random sampling, with comparable sampling rates and stratum definitions as those of the Phase 2 older cohort sample" (NSF, 1997, <http://srsstats.sbe.nsf.gov/TECHINFO.HTML>). Despite the complex stratification, it is necessary to evaluate the validity of the population estimates for postsecondary faculty in comparison to the IPEDS S or SA.

For the critical cross-tab, the SDR provides breakouts of gender within race and rank within tenure for a sample of S&E higher education faculty, but only for the 29 postsecondary occupation codes. An example of the limitations of this taxonomy may be seen in the occupation codes for the group "Life and Related Sciences," which has only four occupation codes:

- 282710 Postsecondary teachers - Agriculture
- 282730 Postsecondary teachers - Biological scientists
- 282870 Postsecondary teachers - Medical science
- 282970 Other postsecondary teachers - Natural sciences

A crosswalk must be used between CASPAR and the SDR, losing most of the fine levels of aggregation built into the other surveys. The SDR does allow for estimates of post-doctoral data not included in the GSS. It is possible to estimate the percentage of Ph.D. recipients entering post-docs by occupation and field of degree. The longitudinal component of the SDR collects age-related data useful for modeling faculty retirement and longitudinal data useful for modeling rank transitions. Since the SDR is only a sample, it is not appropriate to gather data at the institutional level. If SDR data are to be used in the critical cross-tab, then it is necessary to aggregate the data up to a combination of Carnegie classification and control. Without FICE code data, additional variables for institutional segmentation such as done by Massy and Goldman (1995) are not available.

(4) National Survey of Recent College Graduates (NSRCG)

This survey gathers data about people who obtained a bachelor's or master's degree in science and engineering since 1990. The National Survey of College Graduates (NSCG) gathers comparable data on persons who obtained at least a bachelor's degree prior to 1990. Both surveys were designed to be similar to the SDR. Approximately 25,785 students in 273 institutions were surveyed in 1993. There was a 99% school response rate in stage one, in which a sample of institutions provided lists of graduates. Data were collected using computer-assisted telephone interviewing, with an 86% response rate. Of the institutions included in the sample, "196 produced so many of the nation's S&E graduates that they were selected with certainty. From the remaining institutions, 79 institutions were selected using systematic, probability-proportional-to-size sampling, after sorting the file by ethnic status, region, public/private status, and presence of agriculture" (NSF, 1997, <http://srsstats.sbe.nsf.gov/TECHINFO.HTML>).

This survey should not be confused with the Recent College Graduates survey conducted by NCES. The NCES survey has been conducted since 1976. According to survey documents on the web, in 1993 NCES established a longitudinal survey of graduating college seniors which was supposed to replace the RCG Study. Baccalaureate and Beyond is supposed to follow an "oversample of graduating seniors from the National Postsecondary Student Aid Study." The NCES version of the RCG was designed to "determine how many graduates become eligible or qualified to teach for the first time and how many were employed as teachers in the year following graduation, by teaching" and "to examine the relationship between courses taken, student achievement, and occupational outcomes" (NCES, 1997, <http://www.ed.gov/NCES/surveys/rcg.html#overview>).

Like the SDR, the occupation field data related to faculty in the NSRCG are reported for 29 post-secondary occupations, and then only for persons with S&E degrees. The technical notes about the survey explain that "individuals do not always know the precise definitions of occupations that are used by experts in the field and may thus select occupational fields that are technically incorrect" (Science and Engineering Work Force, 1997, <http://x.nsf.gov:80/sbe/srs/survey2.htm>). According to NSF staff, the use of occupation codes was simplified between the 1993 and 1995 surveys.

For the critical cross-tab, the NSRCG provides gender within race data for the 29 post-secondary occupations by general type of academic institution. Since the survey is designed to reach new graduates and age data are collected, the results allow researchers to study the new faculty population in institutions which do not require the doctorate. Since it is a sample, institutional data are not appropriate and it is necessary to aggregate the cross-tab data to the general type of educational institution where faculty are employed. Carnegie, control, rank, and

tenure data are not available. In addition, the NSRCG is a sample, with results weighted to census estimates that may not be adequate for documenting the faculty population in higher education.

(5) National Survey of College Graduates (NSCG)

This survey gathers data about persons who stated on the long form for the 1990 Census that they held a bachelor's degree or above. Approximately 214,643 of the 4,728,000 people who completed the Decennial Census Long Form were selected. A self-administered mail survey was sent in 1993, with a response rate of 80%. Like the NSRCG, the data on faculty are collected for the 29 postsecondary occupations and the weighting is done to census estimates. The NSCG differs in that it collects data regardless of whether the degree was in an S&E field. The survey sample was stratified used demographic characteristics, highest degree achieved, occupation, and gender.

For the critical cross-tab, the NSCG provides a breakout of gender within race for the 29 post-secondary occupations by general type of educational institution. The data on age and other demographic and work-related variables may be useful in assumptions and models about comprehensive, liberal arts, and two-year institutions where the Ph.D. is not required. Carnegie, control, rank, and tenure data are not available.

(6) NCES IPEDS survey of Earned Degrees (C)

The Integrated Postsecondary Education Data System (IPEDS) Completions Survey is an annual NCES survey of all accredited two and four-year institutions. No weighting techniques are used, since the entire population is surveyed at the school level. Response rates range from 85% to 96%, with data on non-responding institutions imputed from previous year's data. Out of

the universe of 6,948 institutions included in the early release of 1995-96 data, a total of 5,762 completed the survey for a response rate of 82.9%.

Data from 1966 through 1994 are available on CASPAR at the institution level, using a crosswalk between the 1990 CIP code disciplines reported in the survey to the CASPAR taxonomy. The raw data for 1995-96, rolled up to the two digit CIP code level, are also available for downloading from the NCES IPEDS web site. The 1994 data are available on the IPEDS CD-Rom. Aggregate degree data are offered by the IPEDS Interactive Database Search site (most current 1993). Data are also available through the NCES National Data Resource Center, which was established to "enable state education personnel, education researchers, and others to obtain special statistical tabulations and analyses of data sets maintained by NCES" (NCES, 1997, <http://www.ed.gov/pubs/ncesprograms/elementary/others/ndrc.html>). The Pinkerton Computer Corporation is contracted to provide data services. NDRC has files for IPEDS, the National Postsecondary Student Aid Study, and the National Study of Postsecondary Faculty. NDRC is the logical source for completions data at the six digit CIP code level by institution.

For the critical cross-tab, the completions survey documents the number of doctoral graduates by gender within race by CIP code. The data on masters degrees may be useful for some models of doctoral enrollment demand and for predicting faculty supply for two-year colleges which do not require the Ph.D.

(7) NCES IPEDS survey of Faculty Salaries (SA)

The IPEDS Faculty Salary Survey collects data on full-time, instructional faculty, with breakouts by gender within rank within tenure, broken out by contract length for each institution. Data from 1971 through 1995 are available in CASPAR, though the calculation of the average, all-ranks salary differs from that of AAUP. The data are also available for download at the

NCES IPEDS web site (1996-97 most current), on the IPEDS CD-Rom (1994 most current), and in the Interactive IPEDS Database search site (1993).

Basic institutional identifiers such as Carnegie classification and control collected in the IPEDS Institutional Characteristics survey are also listed in the datasets. There is no disciplinary breakout. 8,868 institutions were included in the universe in 1995, with an 85.5% response rate.

It is important to note that the SA includes only full-time instructional faculty. It does not include faculty whose duties are 50% or more in research, service, or administration. For this reason, the SA is the best estimate of the total full-time faculty teaching population. Historical SA data are useful for tracking the growth of non-tenure track positions by type of institution. The SA is comparable to the AAUP faculty survey in the collection of salary and benefits expenditures and can be substituted for AAUP in the calculation of average salaries by rank, which converts twelve month contracts to nine month.

For the critical cross-tab, the SA provides aggregate data on gender within rank within tenure at the institutional level. The IPEDS SA and S may be used as population estimates of faculty totals by Carnegie classification and control and can serve as a validity check for other estimates of the total, full-time, instructional faculty population.

(8) NCES IPEDS Fall Staff survey (S) and the EEO-6 survey

In 1993, the IPEDS Fall Staff survey replaced the EEO-6 survey administered by the Equal Employment Opportunity Commission. Prior to this, both surveys collected data on higher education full- and part-time faculty and staff biennially in odd-numbered years. The 1993 IPEDS S included all institutions covered by the combination of both surveys, with 8,861 postsecondary schools, including 3,670 institutions of higher education with accreditation

recognized by the U.S. Department of Education. The response rate for 1993 was 87%, with data imputed for missing schools based on previous submissions.

IPEDS data are available for download at the web site (1995 most current), on the IPEDS CD-Rom (1993), and at the Interactive IPEDS Database search site (1993). As in the IPEDS SA, Carnegie classification and control are collected as institutional identifiers and there is no disciplinary breakout.

The bulk of the IPEDS S is devoted to data on the broad occupational categories developed by the EEOC for affirmative action reporting, with breakouts by gender within ethnicity for specified salary ranges for each category. Data are collected on part-time employees, including part-time faculty (with teaching, research, and service combined). A table of data similar to the IPEDS SA is collected, with full-time faculty data on rank within tenure, but expanded to gender within ethnicity. The survey combines all teaching, research, and service faculty and offers the opportunity to calculate the number of research and service faculty by subtracting the number of instructional faculty reported in the SA. Another table of information about new hires is collected, broken out for full-time faculty by gender and ethnicity. Unfortunately, this is not further broken out by tenure status or rank. These data on hiring reflect the only national data source on the number of new faculty hired by specific institutions.

For the critical cross-tab, the IPEDS S provides aggregate data by gender within ethnicity by rank within tenure, but only at the institution level. The survey provides the best estimate of the total full- and part-time faculty population. The data on new hires is useful in predicting an annual growth rate by institution and therefore of the stratum of Carnegie classification and control.

(9) CUPA National Faculty Salary Survey

The annual National Faculty Salary Survey by Discipline and Rank in Public Four-Year Colleges and Universities has been administered by the College and University Personnel Association (CUPA) since 1982. The survey collects data on the number and salaries of faculty by clusters of CIP code-level disciplines. A total of 357 institutions completed the survey for 1996-97, many of them members of the American Association of State Colleges and Universities (AASCU). The data are broken out by gender and rank within discipline, with minimum, maximum, and average salaries for full-time, instructional faculty. Only data that fit into the survey's unique combinations of CIP code taxonomy are collected, so the results may not be used as an estimate of the total faculty population by discipline at the participating institutions.

The survey is administered by Richard D. Howe at Appalachian State University and analyzed by the University of Oklahoma institutional research staff, which also administers the Oklahoma Faculty Salary Survey. A data book on the CUPA survey is published each year and participating institutions may purchase customized studies with special data tabulations for \$250, without institutional identifiers. There is no collection of data by ethnicity or tenure status. Data are collected for new assistant professors as a subset of the assistant professor data. These are potentially useful for estimating the number of new assistant professor hires by discipline and are used to document benchmarks of the salary marketplace.

For the critical cross-tab, the CUPA survey provides data by gender within rank for clusters of CIP code disciplines. The sample size does not permit extrapolation for non-AASCU institutions. The data on new assistant professors is useful in making assumptions about the number of new hires by discipline, though these are not qualified by whether they are tenure-track or restricted positions.

(10) Oklahoma Faculty Salary Survey

The annual Oklahoma Faculty Salary Survey is comparable to the CUPA survey, but is expanded to all CIP codes used by participating institutions and includes data on ethnicity. Like the CUPA, the Oklahoma survey is limited to a relatively small number (84 in 1996-97) of AASCU and NASULGC (National Association of State Universities and Land Grant Colleges) institutions and collects data only on full-time, instructional faculty. A subset of 30 institutions is analyzed by the University of Alabama for the Southern University Group (SUG).

Data are collected for gender, ethnicity, and rank, with a breakout for new assistant professors identical to that of the CUPA survey. In order to be listed in the print reports which aggregate data by discipline, a CIP code must be used by more than a few institutions. If there is no match, the data are rolled into the other (99) version of the four digit CIP code and then to the (01) version of the CIP.

Electronic data are provided to participating institutions, allowing institutional research offices to weight the data to match their own profile of disciplines. Reports on faculty salaries by CIP code are published regularly by the University of Oklahoma's institutional research office. Depending upon the office's workload, the additional data on ethnicity are reported in occasional years. Oklahoma will produce special data tabulations without institutional identifiers for a fee.

For the critical cross-tab, the Oklahoma survey provides data on gender within ethnicity by rank at the CIP code discipline level, but only for a relatively small, somewhat homogeneous sample of institutions.

(11) National Survey of Postsecondary Faculty (NSOPF)

The NSOPF was conducted in 1988 and in 1993 by NCES, with support from NSF and the National Endowment for the Humanities. In 1993, institutional and faculty versions of the survey were used. A department chair survey was administered in 1988. The 1993 NSOPF was administered by the National Opinion Research Center (NORC) at the University of Chicago.

NSOPF is the primary survey of faculty activities, demographics, and attitudes. A two stage sampling procedure was used for the faculty questionnaire. First, 974 institutions were contacted, of which 817 agreed to participate. These institutions provided lists of faculty by discipline. Disciplinary data were recorded in order to over-sample four NEH disciplines. The sampling rate was also increased for full-time women and minorities. From the lists, samples with a measure of size of 41.5 faculty (41 or 42) per institution were developed, stratified by Carnegie classification and control. Most public and private research universities and most public doctoral universities were included (with certainty) in the sample. A total of 25,780 surveys were completed for a response rate of 86.6%.

In analyzing the NSOPF data for 1988 and 1993, anomalies were detected in the number of part-time and health science faculty. The initial Data Analysis System (DAS) and analyses were revised and re-released after it was determined that the survey was not adequately administered to medical school faculty and that the weights of part-time faculty were incorrect due to problems in the institutional lists. The part-time issue has been corrected, but NSOPF still under-reports health science faculty. While data on discipline were collected with 149 possible fields, the sample was not stratified by discipline. For this reason and because of the problems with health sciences, the data should not be interpreted by discipline. Even analysis by clusters of disciplines is suspect.

The NSOPF data are available for study in a data analysis system (DAS) on CD-Rom from NCES. The CD also includes data on most other non-IPEDS surveys administered through NCES. The Window-based software allows filtered, two dimensional cross-tabs. Two versions of the software are provided, one for regular tables and one that produces correlation matrices for further analysis in SAS or SPSS. The software produces a tab delimited text file with information on weights, Ns, and standard errors. Microdata are available for controlled use under licensing agreements with NCES. In addition, the National Data Resource Center is able to produce data tables from the NSOPF if the required analysis cannot be easily obtained with the DAS.

Several reports of the NSOPF data are now available, including Faculty and Instructional Staff: Who Are They and What Do They Do? and Institutional Policies and Practices Regarding Faculty in Higher Education. A Methodology Report is forthcoming in the Summer of 1997. The report Women and Minority Faculty in Science and Engineering is being prepared by staff of the Pelavin Research Institute (1997) and will also be distributed soon. This is the only report of its kind focused on science and engineering faculty in higher education. Other analyses conducted by NSF on science and engineering faculty are limited in their scope to the SESTAT occupation codes. Basic information about the survey is also available at the NCES web site.

It is important to note that the definition of faculty used for the NSOPF differs from that of the IPEDS S and SA. The institutional lists included full-time, part-time, permanent, temporary, instructional faculty and staff, along with non-instructional faculty. This is an important source of information on part-time and temporary staff. The reader must be careful, though, in interpreting tables of NSOPF data to ensure that the correct faculty definition is used.

In weighting the sample to the population, NORC first weighted the respondents by institutional type to the lists from institutions (approximately 500,000 faculty names). These data were then weighted again by institution to 17 strata of Carnegie classification and control and the total faculty population as documented in the IPEDS S. The number of strata is uneven because there are no public, religious institutions.

For the critical cross-tab, the faculty questionnaire provides data on gender within ethnicity by rank within tenure. Unfortunately, the data need to be aggregated by Carnegie and control and the data on disciplines are not usable because they were not stratified in the sample.

The institutional survey contains additional data about instructional and non-instructional faculty hires, retirements, and downsizing. Totals of instructional and non-instructional tenured and tenure track faculty are collected for Fall 1991 and Fall 1992 by institution. The number of faculty considered for and granted tenure are also documented. These types of data are extremely valuable in making assumptions about faculty mobility

(12) UCLA HERI Faculty Survey

The Faculty Survey administered by the Higher Education Research Institute (HERI) of the University of California - Los Angeles is very similar to the NSOPF in its focus on faculty demographics, activities, and attitudes. The survey was most recently administered in 1995, with 384 institutions and 33,986 respondents, for an overall response rate of 42%. Faculty, for the purpose of the survey, are defined broadly. Depending upon whom institutions chose to sample, the survey includes employees who teach undergraduates, full-time administrators, full-time researchers, and faculty who teach only at the graduate level.

This survey is an invitational sample and HERI charges institutions a fee based on the number of faculty surveyed, similar to the administration of the UCLA CIRP Freshmen survey.

The publication The American College Teacher: National Norms for the 1995-96 HERI Faculty Survey is sent to participating institutions and is available for purchase from HERI. HERI sends a standard set of cross-tabs of the data to institutions and will prepare additional analysis of data for a fee.

"National Norms" were developed based on the portion of respondents who code themselves as undergraduate teaching faculty. The norms included all institutions which surveyed a minimum percentage of their faculty population, as determined from analysis of IPEDS reports. The list of participating institutions was examined "using a 23 cell stratification based on institutional type, selectivity, and control" (Sax et al, 1996, p. 1). The sample was supplemented with 21 randomly selected institutions for the cells with low Ns and the participation of 22 additional institutions was supplemented with funding from the Corporation for National Service.

For the critical cross-tab, the HERI faculty questionnaire provides data on gender within ethnicity by rank within tenure status by Carnegie classification and control. Data on discipline are not collected. Also, the instrument does not permit coding as non-tenure track, only if and when tenure was awarded.

(13) Doctoral Program Rankings - 1995

The National Research Council (NRC) collected data on faculty as part of its doctoral program rankings project in 1982 and 1995. The 1980 data were used by Massy and Goldman (1995) to calculate the base number of faculty by discipline. For the 1995 study, the NRC gathered data on 41 fields selected because of three factors: the number of Ph.D.s produced nationally, the number of programs training Ph.D.s within a particular field, and the average number of Ph.D.s produced per program.

Based on reports from Institutional Coordinators (ICs) who provided information about their programs, 3,634 research-doctorate programs at 274 U.S. universities were targeted. Of these, 105 were private and 169 public. "This sample represents about 35 percent more programs than the number included in the 1982 study. Taken together, these programs involved about 78,000 faculty members and trained about 90 percent of the total number of Ph.D.s produced in these fields between 1986 and 1992. Of the 228 institutions in the 1982 study, 214 participated in this one and many added more programs for review" (National Research Council, 1997, <http://www.nap.edu/readingroom/books/researchdoc/summary.html>).

Data on specific faculty were taken from "various sources of information," including the Doctorate Records File of SED data. Using the combination of IC reports and faculty survey instruments, data were gathered about program ratings, Ph.D. recipients, women and minority enrollment and degree patterns, and the number of faculty.

In addition to the book Research-Doctorate Programs in the United States: Continuity and Change, various documents and Excel spreadsheets are available on the web. A CD-Rom of the data will be available in a few weeks, according to Jim Voytuk at the National Academy of Sciences. Voytuk believes that since there was a "Greater number of programs and fields for the 1995 study than was used in 1982" it is possible to "use the data to project overproduction" (Voytuk, 1997).

For the critical cross-tab, it is possible to document a portion of the number of higher education faculty, but only for the 41 targeted programs and only for the 214 institutions which participated. Information on gender, ethnicity, and tenure status is not collected.

Results

The analysis of the datasets suggests that, while many important policy questions may be studied with the data, it is not possible to complete the critical cross-tabulation of gender within ethnicity by rank within tenure status by discipline at the institution level. With every data source, there are inherent limitations in the instrument, the sampling, or the coding.

In order to merge the different datasets, it is necessary to adopt the CASPAR disciplinary taxonomy. If the Survey of Doctorate Recipients (SDR) data are to be used, and these are the best source of data on non-S&E post-docs and the percent of doctorate recipients entering academe, the 49 disciplines in the CASPAR taxonomy must be rolled up to the 29 postsecondary census occupations. This is unfortunate, given the fine level of disciplinary detail built into some of the surveys, particularly the Survey of Earned Doctorates (SED).

No single dataset is capable of addressing the myriad of policy questions about faculty availability at the required level of aggregation. On the surface, the NSOPF seems closest. However, the lack of stratification by discipline and the problems in sampling health science faculty are significant drawbacks to the survey's utility for this purpose. Many one- and two-dimensional tables may be created with the thirteen datasets which are of great importance to policy makers. Complex models of faculty availability for affirmative action and for understanding Ph.D. production require weighting and assumptions based on different datasets.

It is possible to create a model of faculty availability which incorporates the best of what scholars can learn from several of the surveys. The components of such a model would include:

Ph.D. Recipients

The universe of doctoral graduates is available by gender within ethnicity at the institution level in the SED and the IPEDS C. The various SED and IPEDS C taxonomies are already crosswalked to CASPAR. These need to be normalized to the 29 postsecondary occupation census codes used in SESTAT.

Using the SED, the percent of Ph.D. recipients entering academe may be estimated by gender within race, occupation code, and by Carnegie and control. The validity of the estimates needs to be examined against data from the SED.

The percent entering S&E post-doctoral programs in academe may be estimated by gender within ethnicity and by discipline using the GSS. The discipline data must be rolled up to the CASPAR taxonomy and then to the 29 occupation codes. The SDR may be used to estimate the percentage of graduates entering post-docs outside of academe in national labs and industry. The SDR and the NSOPF may also be used to estimate the percentage of graduates entering post-docs in non-S&E disciplines.

Faculty

The SDR, NSRCG, and NSCG datasets may be used to generate estimates of faculty numbers by gender within ethnicity by occupation code and type of institution (control and Carnegie for the SDR, type of educational institution for the other two SESTAT datasets). These need to be evaluated against data obtained with the Oklahoma survey for public research and doctoral institution percentages.

The SESTAT data are weighted against census estimates for the entire U.S. population. The weights need to be recalculated using the IPEDS S to estimate the total number of full-time

and part-time, instructional and research faculty positions in higher education by occupation, broken out by general type of educational institution.

Rates for faculty transitions should be calculated by occupation code, gender, ethnicity, rank, tenure, and institutional type from the SDR. These also need to be calculated by rank, tenure, and institutional type from the NSOPF faculty questionnaire. Rates for faculty retirement and attrition may be estimated by occupation code and institutional type from the SDR and by institutional type from the NSOPF institutional questionnaire. Rates for new faculty hires may be calculated by institutional type from the IPEDS S, the NSOPF institutional questionnaire, and perhaps the CUPA and Oklahoma surveys. Of these rates, only those taken from the SDR and the IPEDS S allow breakout by gender within ethnicity.

The Massy and Goldman (1995) study predicts faculty mobility and new hires based on complex econometric models about undergraduate enrollment (faculty productivity), research expenditures, departmental budgets, and differences by institutional segmentation. It is possible to use the results of rate of growth in faculty positions by each of the ten disciplines which are calculated in the study to project faculty demand.

Conclusions

It is clear that a massive research effort is underway at the national level to collect data about faculty. These thirteen datasets address many policy issues. Unfortunately, there are problems in using each of them for complex modeling for faculty availability and Ph.D. production studies. Should one of the data elements in the cross-tabs should be eliminated? What is the appropriate level of aggregation? Each level represents a necessary assumption, albeit one of many. This analysis shows that the disciplinary crosswalk must be rolled up to the

29 postsecondary census occupation codes in order to use the SDR. Rank and tenure data are critical to calculating projections for new assistant professor and non-tenure track hires. If the gender or ethnicity variables are discarded, the utility of the model for affirmative action and faculty pipeline research is greatly diminished. Since institutional data are not available across each of the key datasets, the combination of Carnegie classification and control is essential to differentiating segments of institutions.

If scholars, researchers, and practitioners agree that the critical cross-tab detailed in this paper is essential to policy analyses about affirmative action and Ph.D. production, then an additional survey instrument should be proposed to NSF and/or NCES. As part of the IPEDS Technical Panel which met in May, 1997, the author suggested that the IPEDS S survey be expanded to include a table on full-time instructional, research, and service faculty. The table would be broken out by gender within ethnicity by rank within tenure status by discipline clusters. Conceivably, the table could aggregate all disciplines into ten or simply collect data on different disciplines in different years. At ten disciplines a year, over a five year cycle, data could be collected on all 49 CASPAR discipline clusters. Mary Golladay and NSF staff have worked for many years to get interest in a faculty survey at the S&E department level comparable to the GSS. It would be unfortunate, though, if this were limited to only S&E disciplines.

The Professional Societies Workshop series sponsored by NSF's Division of Science Resources Studies has brought agency and association personnel together in frank discussions of the utility and limitations of these instruments and datasets and the implications for policy research. Several disciplinary associations conduct their own surveys of Ph.D. recipients and

faculty and are perhaps the best prepared to understand discipline-specific tensions of supply and demand. These insights need to be incorporated into the assumptions of these complex models.

Several additional research projects are currently underway. According to Ernst Benjamin of AAUP, the Sloan Foundation is funding an effort by Jack H. Schuster of the Claremont Graduate School and others to examine and develop the kind of complex econometric models studied by Massy and Goldman (1995). The Mellon Foundation is funding a longitudinal study being conducted by the University of California at Berkeley by Maresi Nerad and Joe Cerny entitled "The Ph.D. Ten Years Later Study." According to Peter Syverson of CGS, the objectives of the longitudinal study are to (1) determine career paths; (2) understand reasons for choosing career paths; and (3) understand employment patterns of women and minority doctoral recipients.

Except for the longitudinal study, each of these models shares the limitations of the existing datasets and must by nature make many kinds of assumptions. The Massy and Goldman study, interesting as it is for its explanation of departmental activity in predicting faculty demand, is flawed by its use of the 1980 NRC doctoral rankings data. A model is presented in this paper which uses the best of the national datasets, but it makes many levels of assumptions which are subject to error. No model for understanding faculty availability or supply and demand will be credible unless an effort is made to survey the entire faculty population at the discipline level. No amount of careful sampling techniques, complex stratification, and weighting methodologies will substitute.

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