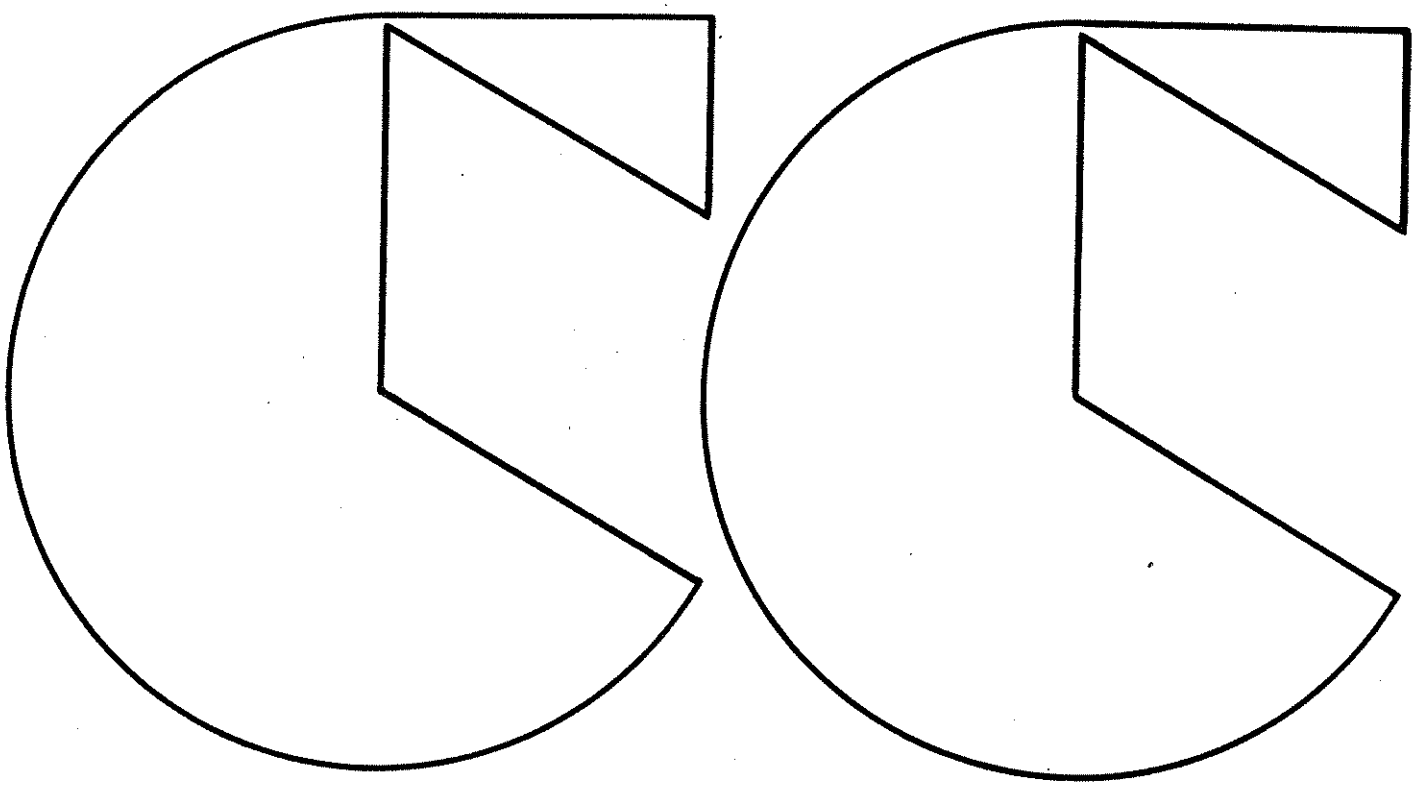
Preserving a Lost Generation: Policies to Assure a Steady Flow of Young Scholars Until the Year 2000

A Report for the Carnegie Council on Policy Studies in Higher Education

Project on Quantitative Policy Analysis Models
of Demand and Supply in Higher Education

October, 1978



PRESERVING A LOST GENERATION:

POLICIES TO ASSURE A STEADY FLOW OF YOUNG SCHOLARS

UNTIL THE YEAR 2000

A Report and Recommendations*

October, 1978

Carnegie Council on Policy Studies
in Higher Education

Project on Quantitative Policy Analysis Models
of Demand and Supply in Higher Education

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*The recommendations contained in this report are those of the principal investigators of this project, and do not necessarily reflect the views of the Carnegie Council.

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ABSTRACT

If no radical changes occur over the next ten years in the aggregate relationships among college-age cohort sizes, rates of college-going, and ratios of doctoral faculty to students, the mid-1980's and mid-1990's will see precipitous, but probably temporary, declines in the demand for new Ph.D. faculty. Without the implementation of policies designed to offset such cyclical fluctuations, the evolution of the academic age structure will mirror the history of changes in the size of student cohorts, and will have serious consequences for academic research and teaching. It is in both the national interest and the interest of individual institutions to assure a moderate but steady flow of young doctorate scholars into academia, and the initiatives for suitable programs should come from both levels. On the national level, we recommend that steps be taken immediately to lay the groundwork for a Junior Scholars Program that would go into effect in the mid-1980's. This program should be self-liquidating, in the sense that it should provide no more research positions than can be turned into teaching positions after the demographic troughs have been passed. On the institutional level, we recommend that early retirement programs be introduced to fit projected changes in age structure and teaching demand. At both levels, in order for these programs to be smooth demographically-generated fluctuations in the hiring of young doctoral scholars, the timing of implementation should be an important consideration in the planning process. This report spells out these recommendations in more detail, and outlines the consequences, in terms of faculty demography and program costs, of these and alternative programs.

I. Introduction

The Baby Boom of the late 1940's and early 1950's is now producing and will continue to produce important changes in American society. Equally important, but less dramatic, is the decline in population growth rates that followed the Boom. The U.S. educational establishment responded with amazing flexibility to the Baby Boom. Faculty were found as higher education began producing its own labor supply at a more and more rapid rate. Faculty hiring was such that by 1976, over half of U.S. doctoral faculty had been hired during the preceding fifteen years.

The mechanisms that allowed U.S. higher education to respond so successfully to growth are not the same as those necessary to respond to the slowing or end of growth in the academic sector. In a time of rapid growth the definition of priorities seems a less pressing problem because even less favored alternatives can grow, if at a slower rate, than more favored ones. As growth slows, it becomes more and more evident that administration involves the allocation of scarce resources. The battle for resources in education can easily degenerate into a war of all against all: public against private, men against women, young against old, scientists against humanists. Yet the strength of U.S. higher education is unlikely to be enhanced by victory of any side in any of these battles. The strength of U.S. higher education is its diversity and its ability to change.

The question that we examine in this report is how to maintain a steady flow of highly qualified younger scholars into research and scholarship when demographically-driven market forces would result in a very small academic demand for such scholars. We feel that such steady inflow of younger scholars is important for the vitality of U.S. higher education, and especially for the ability of U.S. science to maintain its internationally pre-eminent place. Older faculty may well be better teachers and expositers of research findings. Young investigators may make some "mistakes" and follow more wrong leads, but they also bring enthusiasm and energy to their pursuit of knowledge. They are important to older faculty, as well. As mentees, they are valued collaborators, bringing a singleness of purpose that often becomes attenuated as, with increasing reputation, older investigators find that they must devote more time to administration and public service.

In the absence of programs directed toward insuring a steady flow of young investigators, we are likely to see the Baby Bust reflected in an exaggerated way in the demand for new faculty in academia. From its peak in 1980 to its trough in 1986, new hiring of doctorates will fall by over 50%. This means that unless doctorate supply drops very rapidly indeed, a very small proportion of new doctorates can expect to get academic jobs. And would we want the market to work fully in any case? The 1980's will probably see a decline in real academic salaries, as well as employment opportunities. Furthermore, the chances of obtaining tenure, even for those who obtain academic employment, will be lower than they were in the 1960's and 1970's. This will mean that a Ph.D. in the 1980's will have to be more qualified than his 1960's counterpart to obtain employment and tenure. There may well be considerable bitterness resulting from justifiably adverse intergenerational comparisons. "Who are they to judge?" the young will be tempted to say: "They got the best jobs when the best jobs were easy to get. We have to be twice as good as they were to obtain even an assistant professorship". Although it has often been said that academic collegiality is a myth, it may not even be that by the end of the 1980's.

Academia will have changed, too, in the age structure of the allocation of work. Currently, young faculty spend relatively more of their time in research than do older faculty. As faculty age, more time is spent in administration and service. If the amount of faculty time devoted to teaching and research is to remain constant, more older faculty will have to devote more time to these activities as academic age increases. There will be many fewer junior faculty to lighten the teaching burden of senior faculty. It is possible that junior faculty might simply be required to teach more courses. Research, which would become a residual activity, would shrink even more. The process by which basic research is translated into scientific advance is not well understood. However, an academic enterprise in which half as many young faculty did twice as much teaching could not help but result in a considerably smaller amount of research, with considerable consequence for U.S. science.

A final justification for our focus on achieving a steady flow of young faculty is the screening function of junior faculty positions. The lifetime productivity of a new Ph.D. is a very difficult thing to forecast. Every

department chairman and personnel committee may have a view about the best predictors of creative and lasting scholarship, but such prediction is certainly not perfect. When fewer and fewer people can be hired, the predictors chosen are likely to become more and more conservative. The young Ph.D. who has two published articles in addition to his thesis is likely to be chosen over the young Ph.D. who has an interesting area of research with a longer gestation period. "Mistakes", after all, are much more costly when they can be spread over fewer people. But, in fact, the research with the longer gestation period may be more productive in the long run. The bias toward rapidly productive research that is likely to become evident in the 1980's may not be best for producing either faculty that are good colleagues for one another or faculty that are good researchers over a long period of time. Basic research is conducted, in large part, by a small number of doctorate-producing universities. Programs are needed that will allow them to take some "long shots" in the hiring of young scholars. The larger the pool, the more likely that the best scholars will be found in it. In fact, to the extent that good research results from the existence of a "critical mass" of scholars, it is likely that up to some point, the fraction of good scholars will be larger, the larger the pool.

The program that we propose focuses on a narrow population--junior faculty and new Ph.D.'s in the approximately one hundred leading doctoral-granting institutions in the country. In particular, we are concerned about faculty in the sciences because these are the fields where youth seems especially important to creativity, and creativity seems so important to a reasonable rate of production of basic research. A substantial demographically-generated decline in academic hiring of doctoral scientific faculty would result in a "lost generation" of talented scientific manpower. The non-academic sector may step into the gap and become a more prominent producer of important basic research. But it would be impossible, for one or maybe two decades, for the universities to fulfill their role as the "home of science." A decade is long enough to lose many talented scientists in basic research and too short to completely reorient the institutional structure in which universities are now responsible for the production of much basic research in this country.

In this report, we propose a Junior Scholar Program (JSP), which sat-

isfies two objectives. First, it ensures that a minimal level of academic (i.e., teaching or JSP) jobs will be available to each cohort of new Ph.D.'s. Second, it is designed so that those who participate in the JSP can eventually be absorbed into jobs as teaching faculty. The program thus assures generational continuity in academia while at the same time it temporarily decouples the demand for junior scholars from the demand for teaching faculty. We also discuss briefly other alternatives, such as early retirement and a program of subsidized sabbaticals which can achieve the same level of new hiring.

The problem of arguing for the JSP is that we propose a future program for a group for which oversupply seems imminent. At the same time, we want academia to continue to be sensitive to market signals. We do not want our program of support for Junior Scholars to go the way of the farm program--where the subsidy program blends into the institutional wallpaper, as though it had always been there and would always continue to be. The timing of the program is crucial. It should be there when needed and should disappear when demographic forces would indicate a return to a normal level of demand for young faculty.

It now seems evident that the low rate of change in enrollments generated by the Baby Bust will continue well into the 1990's. We propose here a self-liquidating Junior Scholars Program for the 1980's. If the country settles down to a "steady state" of zero population growth, the scientific manpower policy questions of the 1990's will be much harder. We shall have to ask whether we wish to establish academic positions for junior scholars who can probably never be absorbed into teaching positions, given current faculty/student ratios. Alternatively, we may want to encourage early retirement of the faculty bulge that resulted from hiring in the 1960's, so that some steady level of faculty hiring may be achieved more rapidly than if demographic forces simply worked themselves out.

In the following sections, we shall first outline the baseline projections of demand for faculty in a demographic model. These are projections of future demand in the absence of policy intervention. We shall then describe the timing and magnitude of a Junior Scholar Program that will partially offset the cyclical fluctuations in faculty demand. Finally, we shall discuss alternative programs that might achieve the same results, but at higher cost.

II. The Baseline: Academic Demand for Ph.D.'s to the Year 2000*

Our baseline simulation of the age and size of faculty presents a picture of faculty in the 1990's that looks very different from that of faculty today. The number of faculty under age 40 will have declined by over 40%. The total number of faculty in 1995 will be 10% lower than it was fifteen years earlier. This will have occurred in a system that prior to 1980 was accustomed to growing at 2% per year. Young faculty will have half as many younger colleagues and many more of those colleagues will leave academic employment before attaining tenure.

It is difficult to imagine the sociological structure of faculty in the 1990's. With fewer job openings, mobility of faculty would be much lower. Whether faculty will feel devoted to their institution or trapped in it depends in part on the ability of institutions to adjust to the new demographic picture. Yet it is also necessary to recognize that there are things that go on in academia that should not be tied to demographic change. It would be a mistake to cut back research because there were fewer students to teach. One can imagine a vicious downward cycle where students choose not to go to graduate school because of the scarcity of jobs for Ph.D.'s, where professors do less research because there are fewer students to work with them and where undergraduates are discouraged when they find themselves taught by a disillusioned gerontocracy. It is already clear that the number of Ph.D.'s is responsive to the job market. The power and excitement generated by the growth of academia in the late 1950's and early 1960's should not have to collapse like a house of cards.

Our baseline model is essentially a demographic one, similar in spirit to that of Allan Cartter (3). There is a given faculty/student ratio and a given ratio of doctoral to total faculty. Thus, demand for doctoral faculty depends on the numbers of students who go to four year colleges or universities. New hiring depends on the number of retirements and the change in enrollments. Figure 1 shows the change in the number of 18-year-olds from

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*A description of the simulation model which generated the estimates of Ph.D. faculty size is found in Technical Report No. 4 of this Project. All the Technical Reports of the Project are described briefly in Appendix B.

1976 to 2000 based on the Census P-25 projections of population, which appeared in 1977.* Births are known through 1976. Thereafter, projections are used. The 1973 series of Census projections are shown in part to allow for comparison with Cartter's projections of faculty demand, which used the 1973 series, and also to illustrate the fairly large extent of over-estimation of the number of eighteen year olds predicted by the census for the years in which births were not yet known. Demographically-based estimates of demand can only be as good as the projections on which they are based.

We can see that the number of eighteen year olds increases to 1979. It then declines until 1986 with the largest drop occurring in 1984. There are small increases in the number of eighteen year olds until 1989, but then the size of the cohort plummets and remains low at least until 1993, when, depending on which series you believe, it either continues to decline in size for three more years (Series III) or it picks up immediately.

To go from the size of the eighteen year old cohort to the number of enrollments requires assumptions about the porportion of a cohort that goes to high school, the proportion that continues on to a four-year institution, and continuation rates for those enrolled in college. We have simply adopted Cartter's assumptions.

The change-in-enrollment series, which is very similar to the eighteen-year-old series, is shown in Figure 2.** We then assume that the faculty-student ratio is seventeen-to-one and that 50% of new faculty hold doctorates. These assumptions give us our faculty demand series, and hence the demand for new hires, which is shown in Figure 3. For the period 1995-2000 we predict faculty demand under two assumptions. The first is that Series III is followed. The second is that the eighteen-year-old cohort stays constant after 1995, which is an even more pessimistic projection than that of the Census. We project new doctorate faculty demand under both assumptions. Demand for new faculty does not depend on enrollments alone. It also depends on the rates of attrition and retirement for junior and senior faculty, and on the tenure ratio, which

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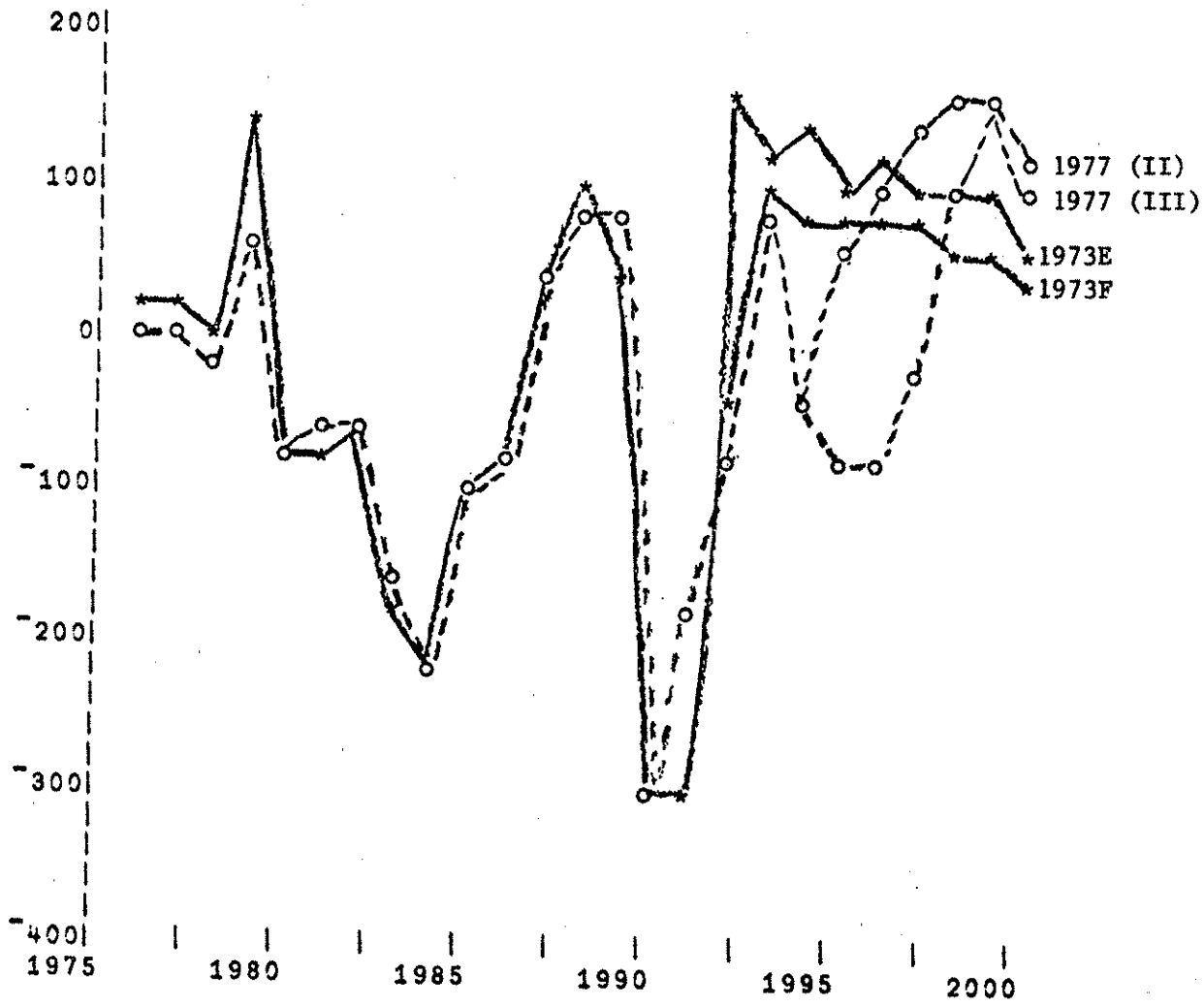
* Tables presenting the data displayed in the graphs are found in Appendix A.

** To put these changes in perspective, we note that the average annual change in FTE enrollment in four-year institutions from 1962 to 1967 was 296,600; the corresponding annual growth rate was 8.6 percent.

Figure 1:

CENSUS PROJECTIONS OF THE YEARLY CHANGE
IN THE NUMBER OF 18-YEAR OLDS:1976-2000
(in thousands)



* - 1973 Census Projections

o - 1977 Census Projections

Source: See Appendix Table A-1

Figure 2:

CHANGES IN FTE ENROLLMENTS 1976-2000: CENSUS-BASED PROJECTIONS
(in thousands)

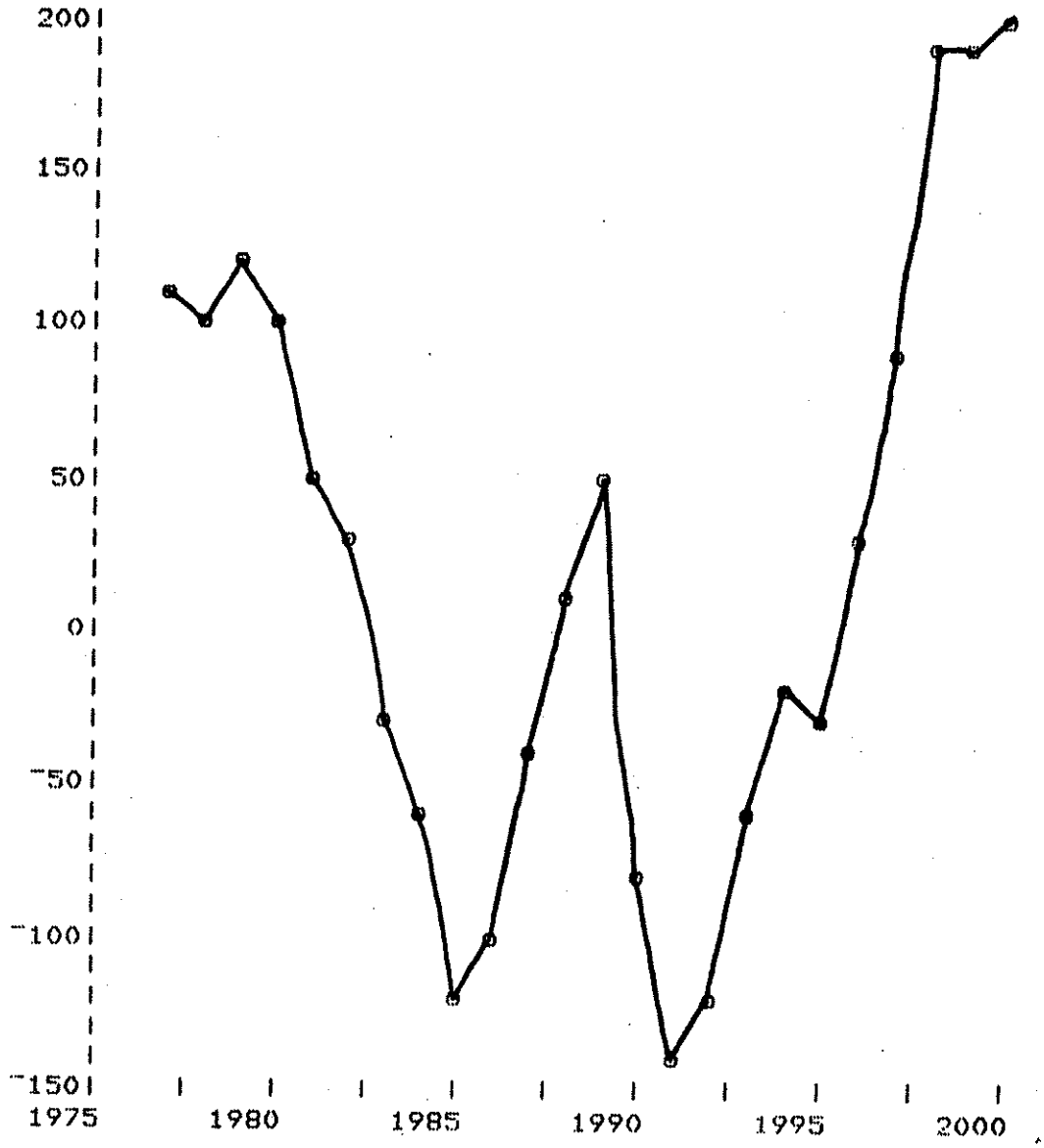
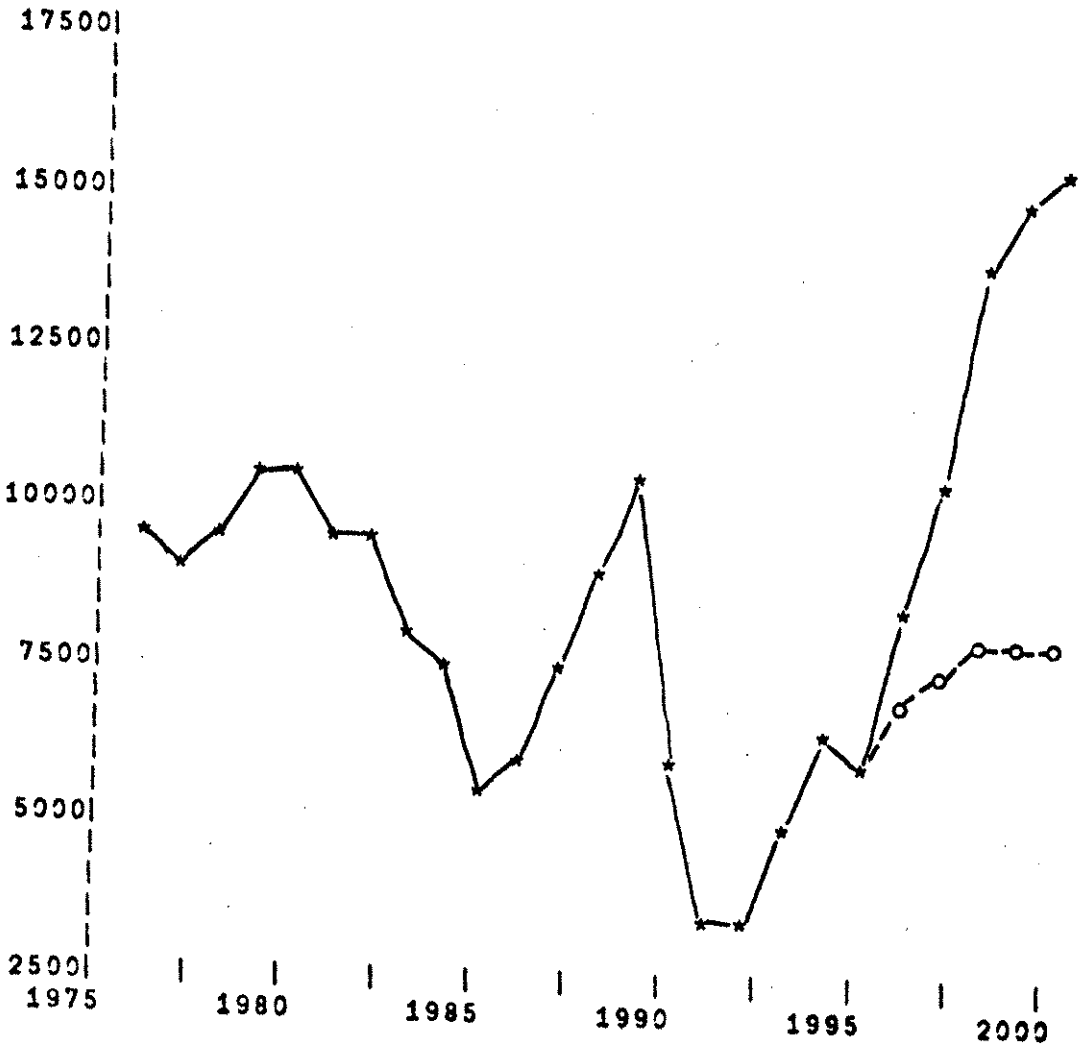


Figure 3

BASELINE PROJECTIONS OF DOCTORATE HIRES

1976-2000

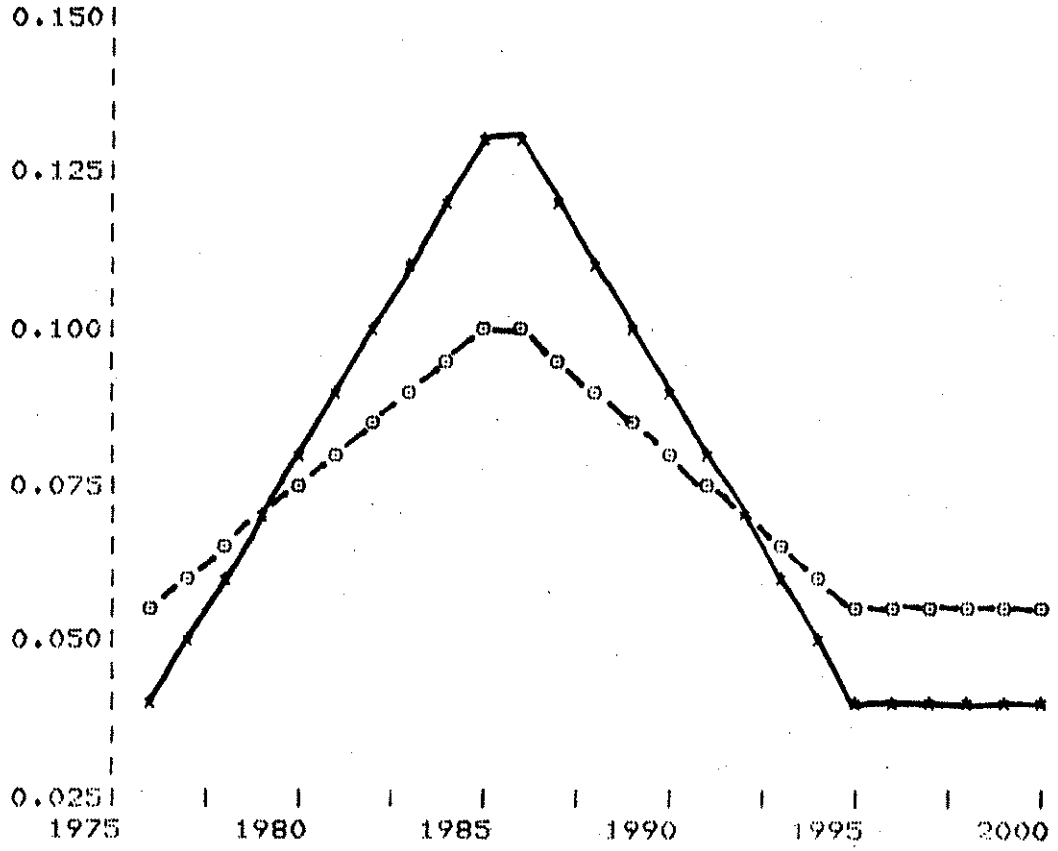


* - Census Series III

o - Zero Enrollment Growth After 1995

Figure 4

BASELINE PROJECTIONS OF ATTRITION RATES

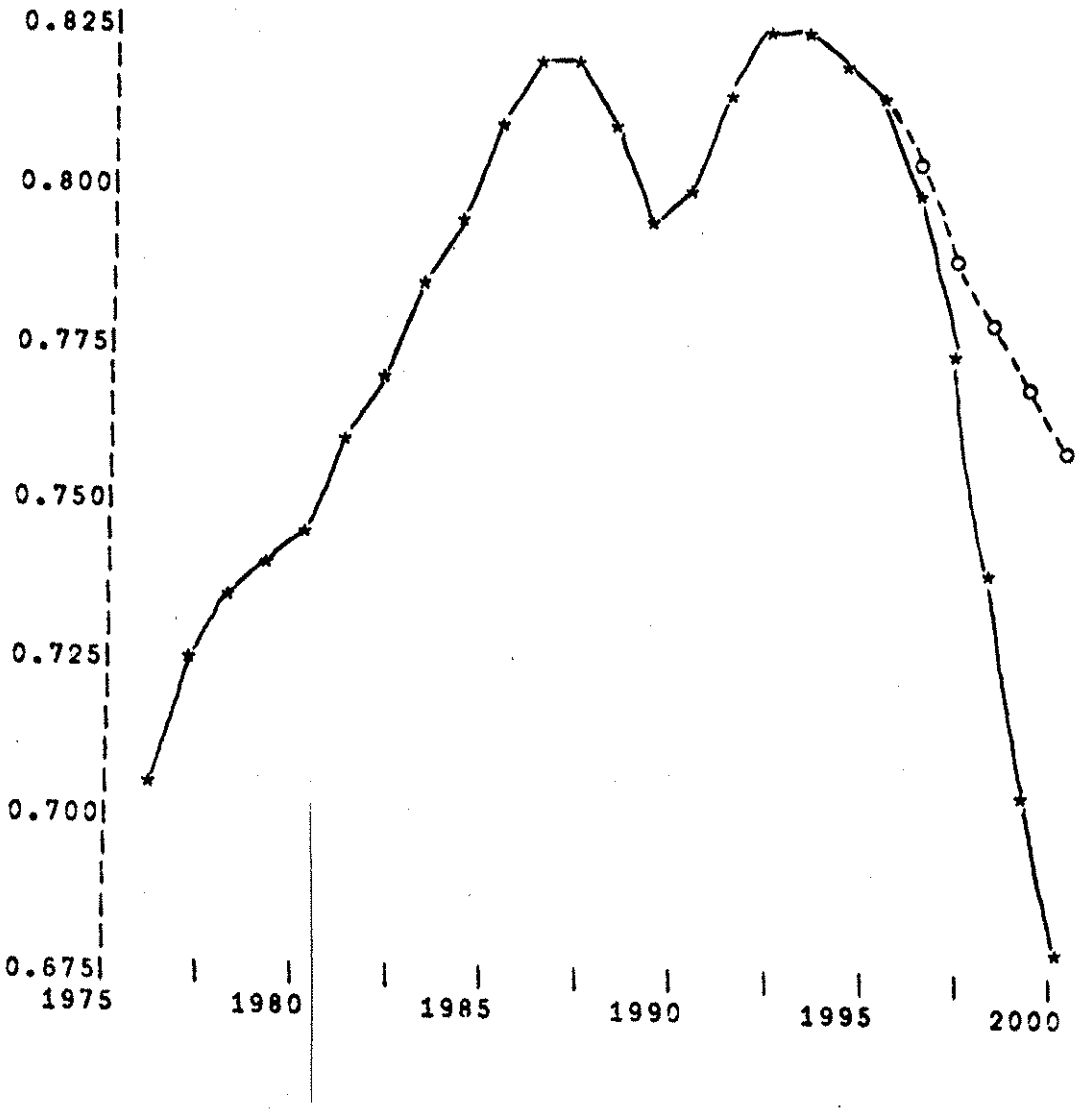


o- Projected Tenured Attrition Rates x 10

* - Projected Non-tenured Attrition Rates

Figure 5

BASELINE PROJECTIONS OF THE TENURE RATIO
AMONG DOCTORATE FACULTY: 1976-2000



* - Based on Census Series III

o - Zero Enrollment Growth After 1995

Figure 6

BASELINE PROJECTIONS OF THE FRACTION OF
DOCTORATE FACULTY UNDER THE AGE OF 40
1976-2000

* - Based on Census Series III

o - Zero Enrollment Growth after 1995

determines the number of faculty that are exposed to the different attrition rates. We assume that attrition rates rise until 1986 and decline thereafter. Attrition rates for tenured faculty rise from .5% to 1% and then decline back to .5% in 1994. Attrition rates for junior faculty rise from 4% to 13% and then decline back to 4% in 1994. The series for attrition rates is shown in Figure 4.

The tenure ratio depends on two things: the number of new hires in recent years and the time that it takes junior faculty to attain tenure.* The longer it takes junior faculty to become tenured, the higher the chance that they will leave academia because of the force of attrition. Far more important than the time to tenure, however, is the new hiring series. From 1980 to 1985, new doctoral hiring declines by 47%. This results in a rise in the tenure ratio, even though the time to tenure rises as enrollments decline. The tenure ratio rises from 70% in 1976 to 82% in 1986 and then stays quite high until the late 1990's. The path of the tenure ratio over time is shown in Figure 5. As a result of the same forces, the proportion of the faculty under forty, shown in Figure 6, falls from 44% in 1976 to 23% in 1995, when it begins to rise again.

Finally, our model takes into account the change in the laws affecting mandatory retirement for tenured faculty. The median age at retirement rises from 66.3 years in 1976 to 69.1 years in 1981 and stays constant at that level thereafter. This change has a relatively small impact on new hiring in the 1980's because a relatively small proportion of faculty are in their 60's. The impact will be much greater in the 1990's when 19% of doctorate faculty will be over age 60, as compared to 6% in 1976. The age distribution of total doctoral faculty for selected years is shown in Table 1.

Before proceeding to discuss policies that can lessen the effect of demographic change on new doctoral hiring, it is worth discussing qualitatively the assumptions that underlie the model, and the sensitivity of the results to these assumptions. We have tried to be pessimistic in our assumptions. In particular, we have assumed that even in the face of an oversupply of Ph.D.'s, faculty/student ratios will not rise and that the share of doctorates in total faculty will remain constant. This assumption was made in part because of a somewhat surprising result found by the ACE Higher Education Panel(2) that doc-

*A discussion of the change in time to tenure and its response to market conditions is found in Technical Reports No. 2 and No. 3.

Table 1

TOTAL FACULTY

AGE DISTRIBUTION

YEAR		≤30	≤35	≤40	≤45	≤50	≤55	≤60	≤65	≤70	*MEDIAN AGE*	*ATTRITION RATE*
1976	1	0.063	0.243	0.437	0.612	0.754	0.860	0.936	0.986	1.000	41.7	0.014
	2	0.063	0.243	0.437	0.612	0.754	0.860	0.936	0.986	1.000	41.7	0.014
1981	1	0.067	0.193	0.352	0.533	0.686	0.824	0.924	0.986	1.000	44.1	0.033
	2	0.067	0.193	0.352	0.533	0.686	0.824	0.924	0.986	1.000	44.1	0.033
1986	1	0.042	0.142	0.259	0.417	0.589	0.749	0.888	0.978	1.000	47.3	0.041
	2	0.042	0.142	0.259	0.417	0.589	0.749	0.888	0.978	1.000	47.3	0.041
1990	1	0.059	0.152	0.258	0.384	0.546	0.714	0.862	0.974	1.000	48.6	0.039
	2	0.059	0.152	0.258	0.384	0.546	0.714	0.862	0.974	1.000	48.6	0.039
1995	1	0.044	0.136	0.231	0.341	0.463	0.632	0.810	0.954	1.000	51.2	0.033
	2	0.044	0.136	0.231	0.341	0.463	0.632	0.810	0.954	1.000	51.2	0.033
2009	1	0.102	0.246	0.353	0.453	0.549	0.660	0.809	0.949	1.000	47.4	0.035
	2	0.064	0.179	0.285	0.389	0.495	0.620	0.786	0.943	1.000	50.2	0.037

torates were about 50% of faculty in four-year institutions of higher education and that most departments did not wish to increase the share of doctorates in their total faculty. Our guess is that this reflects a bi-modal distribution in which research-oriented universities have almost all their faculty with doctorates, and are satisfied with this state of affairs, and teaching-oriented institutions have a considerably smaller share of doctorates, and are also satisfied. The share of doctorates in total faculty could change if the enrollment declines in the 1980's resulted in the closing of relatively more teaching-oriented institutions than research-oriented institutions. In this report, however, we are looking at higher education at the aggregate level and it seems unlikely that such selective attrition will have a large effect on the share of doctorates in total faculty.

The faculty/student ratio could also rise if the demand for faculty is responsive to changes in real faculty salaries. After rising in the 1960's, real faculty salaries fell in the early 1970's and have remained fairly constant since. If they fall in the 1980's, the result could be a rising faculty/student ratio. On the other hand, real costs of other educational inputs, such as energy, will probably rise, so that if institutional budgets do not increase we may simply observe a relatively smaller share of budgets being spent on faculty. If faculty/student ratios rise, however, the new hiring picture would be considerably brighter.

Finally, although we present quantitative estimates of the magnitude of enrollment change and adjustment of doctoral teaching staff to such change, it is the qualitative aspect of these magnitudes that has dictated the types of policy that we propose. In particular, we doubt that faculty demand will respond fully to every change in demographically generated demand. Nor do we feel that adjustment is totally controlled by demography. Wage adjustment may also become important. There are lags everywhere in the structure of decision making in higher education, which may well result in higher valleys and lower peaks even if no counter-cyclical policy is pursued. In addition, prophets of gloom in academic labor markets hope never to see their prophecies realized, and usually they aren't. However, given the way that academic markets have responded to demographic change in the past, our baseline projections are the best that we can make of what will happen in the absence of counter-cyclical policy.*

*Here and elsewhere in this report we use the term counter-cyclical to describe policies whose aim is to smooth demographically-generated fluctuations in new doctoral hiring.

III. A Junior Scholar Program

We have chosen as the objective of our proposed program the maintenance of a "reasonable" level of hiring of new doctorates into the academic sector. By "reasonable" we mean that only enough junior scholar positions should be created to employ those who can eventually be absorbed into teaching positions in academia. We take as "given" the present level of post-doctoral research support. These positions are in addition to those post-doctoral positions currently funded. The way that the program would work would be to provide research employment to new Ph.D.'s during the demographically-generated troughs in academic hiring, and then to feed those junior scholars back into teaching jobs when academic hiring picked up. We present estimates of the magnitude and cost of three programs which differ, first, in the enrollment baseline that is used to estimate the demand for new faculty, and, second, in the level of academic demand for new Ph.D.'s which is to be maintained. We also present, as a contrast, the Atkinson-Baratz program, which inspired our more "finely tuned" programs. The programs are the following:

1. CBE7500 Program: This uses the census based enrollment estimates, and demand for new Ph.D.'s is maintained at 7,500 through the year 2000.

2. ZEG5900 Program: This assumes zero enrollment growth in the 1990's; Ph.D. demand is maintained at 7,500 in the 1980's and at 5,900 in the 1990's. The 5,900 level allows the program to liquidate itself by the year 2000.

3. ZEG7000 Program. This program is the same as ZEG5900 except that new Ph.D. demand is maintained at 7,000 during the 1990's. As a result, the program cannot be liquidated by the year 2000.

4. A-B Program. This program, similar to that suggested by Richard Atkinson and Morton Baratz, provides 1,000 five-year post-doctoral fellowships beginning in 1979 and continuing through 1995.

Three counter-cyclical junior scholar programs

In general, all three programs work in a similar manner. Instead of immediately receiving teaching appointments, new Ph.D.'s are given Junior Scholar Fellowships. The number and duration of the fellowships is determined so that

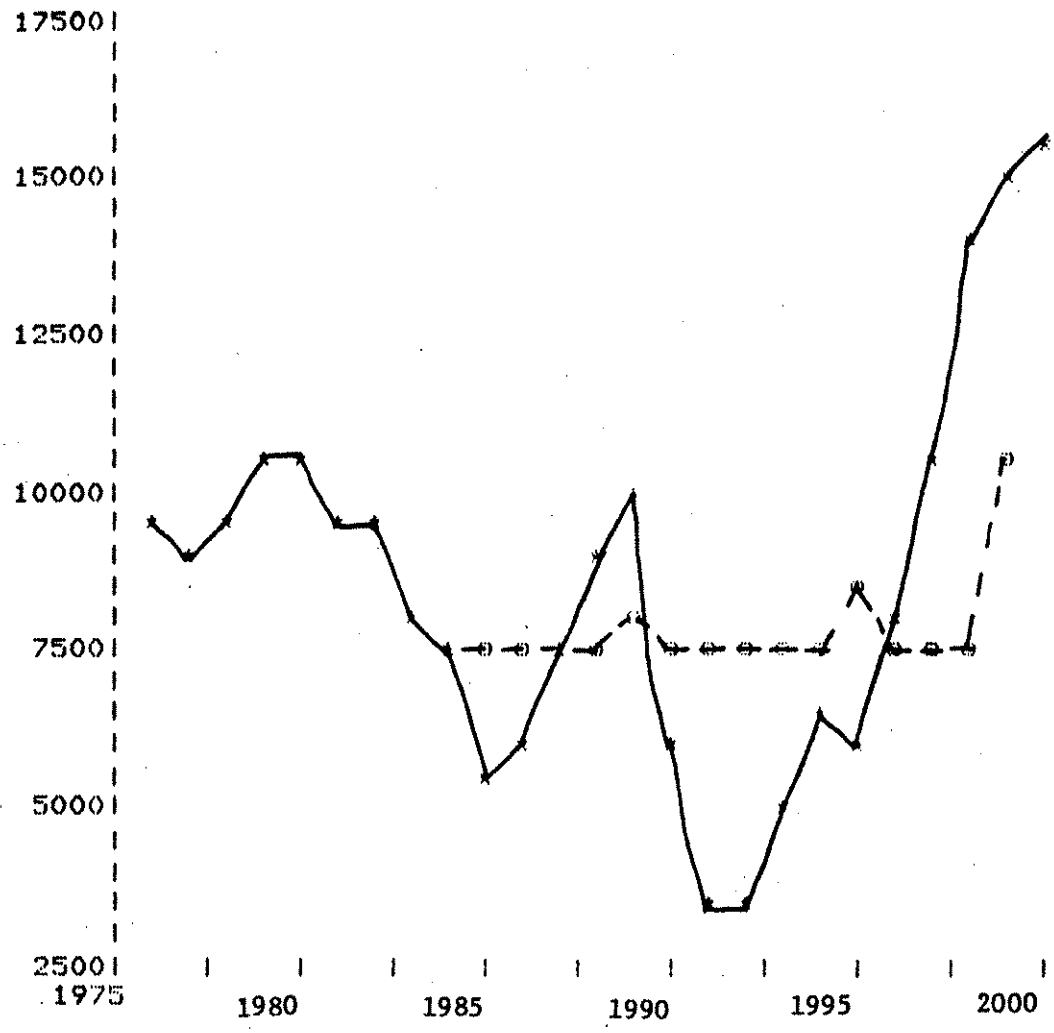
total placements of new Ph.D.'s remains at some pre-determined level. The level is determined in such a way that all fellows (less normal attrition) can receive teaching appointments during the next five years (with the exception of ZEG7000 Program, where the level of demand during the 1990's is maintained at 7,000, as opposed to 7,700 during the 1980's, so that the program will liquidate itself shortly after the year 2000).

Figure 7 displays the paths of new hiring and of total Ph.D. placements given the census-based enrollment estimates and a program that sustains total new Ph.D. placements at 7,500. A feeling for the order of magnitude of this program can be obtained from a comparison with postdoctoral plans of new doctorates in 1977. Excluding professional schools, 9,517 new doctorates planned immediate employment in an educational institution and an additional 5,119 planned to pursue postdoctoral study. We expect that educational employment of new Ph.D.'s will peak at close to 11,000 in 1980, but by 1985 this figure will have fallen to 5,700. During its countercyclical implementation in 1984-87, the CBE7500 program would increase from 300 junior scholars in 1984 to 3,769 junior scholars in 1986. In its final year, 1987, there would be 2,262 junior scholars, all of whom could be absorbed when academic hiring rises back to around 10,000 in 1988.

Unfortunately, the high level of demand will probably not last, and the JSP must be re-implemented in 1990 with 1,650 junior scholars who would receive three and four year fellowships. In order to maintain demand for new Ph.D.'s during the trough of 1991-92 and the slow pick-up before 1996, it is necessary to make a choice between having more junior scholars with shorter-term fellowships and feeding them back into teaching more rapidly, or giving the same number of scholars longer-term fellowships and hiring more Ph.D.'s directly into academia. For purposes of illustration, we have chosen a program that implies the first alternative. It has the expositional advantage of being simple to present. It also has the administrative advantage or being easier to "tune" in the sense that the number of short-term fellowships can be adjusted relatively rapidly to perceived changes in demand. The second alternative should be seriously considered, however, because it may well be preferable on career and organizational grounds. Longer fellowships may result in young scholars looking more favorably on research that has a longer gestation period. Of course, it would also give the

Figure 7

PLACEMENTS OF NEW DOCTORATES WITHOUT A JUNIOR SCHOLAR PROGRAM AND WITH THE CBE7500 PROGRAM



(——) Baseline level of hiring (no J.S.P.)

(----) Placements of new doctorates under CBE7500

Source: Table A-7

younger scholar more time to produce a "track record" of publications. Having chosen to examine the first alternative, however, we find that the program would be at its peak in 1995 and would involve close to 15,000 scholars, when no new Ph.D.'s would be hired into teaching positions. (At this point the entire demand for new Ph.D. faculty would be filled by ex-junior scholars.) New demand will pick up in the last years of the 1990's, and all junior scholars would have academic positions by the year 2000. Further, no new junior scholars would be appointed after 1996.

The Census-based estimates give what we feel are somewhat optimistic projections for the number of children, not yet born, who will be in the 18-21 year-old cohort by 1996. The zero enrollment growth (ZEG) assumption is that births remain at their present levels and do not pick up. During the 1980's the JSP is identical to that under the census-based estimates. For the 1990's, we present two different programs. ZEG5900 liquidates itself by the year 2000 but in order to do so requires that placements of new doctorates fall to as low as 5900. ZEG7000 maintains new doctoral placements close to 7000 but, given the level of academic demand, must continue after the year 2000. Placements under each program are shown in Figures 8 and 9, respectively. At its largest, ZEG7000 involves close to 11,000 scholars, while ZEG5900 involves less than half as many. The reason that both programs are smaller at their maximum than CBE7500 is that a lower level of total demand for Ph.D.'s is being projected.

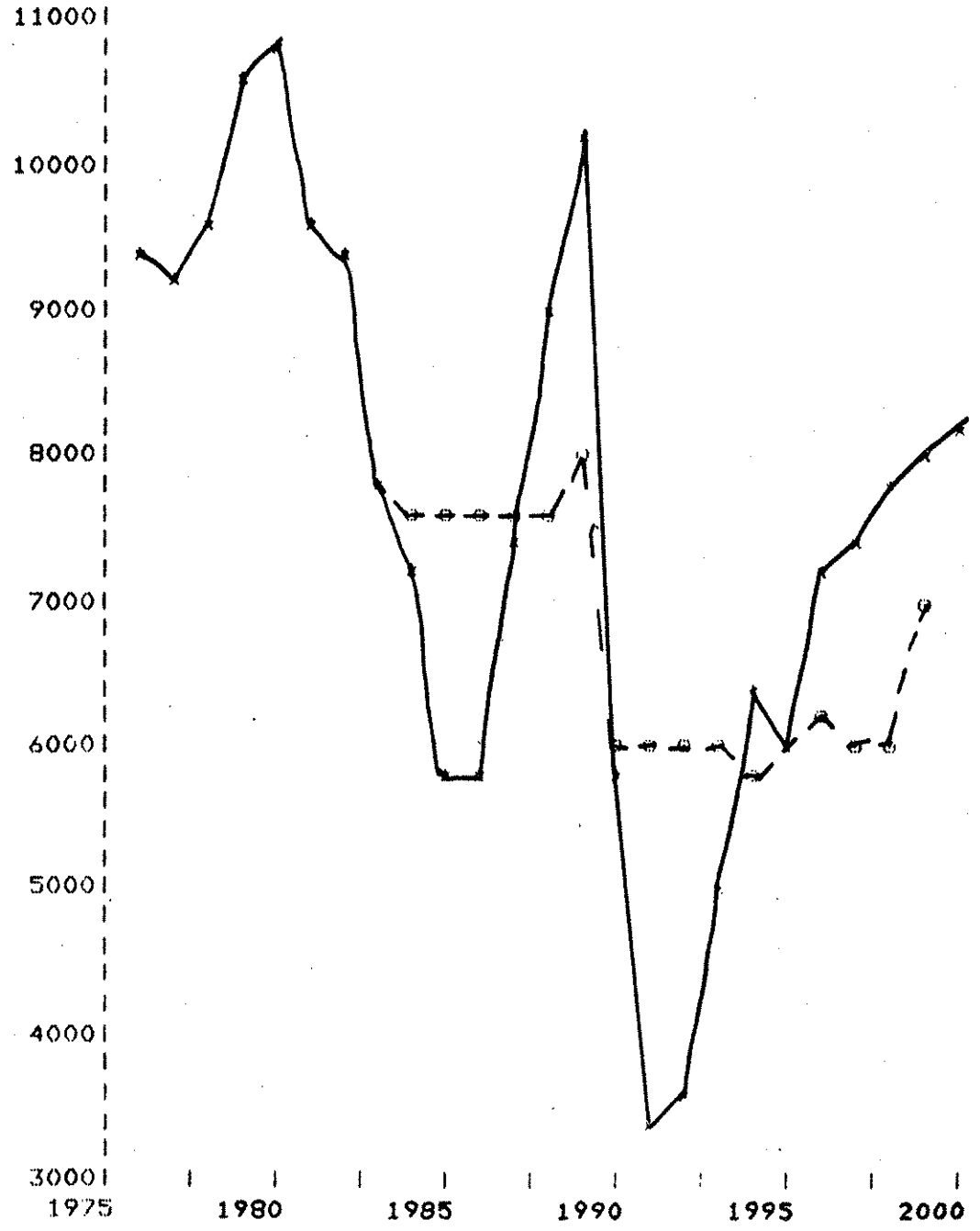
The Atkinson-Baratz Program

This plan, as described by Morton Baratz in a recent issue of Academe (June, 1978) and attributed to Richard Atkinson, Director of the National Science Foundation, would provide

> 1000 research professorships and at least as many new postdoctoral fellowships. The professorships would be awarded for five years, renewable for five more, to distinguished scholars who would devote all their time to scholarly work; their current teaching positions would be filled by junior scholars, all eligible for permanent tenure at the end of a probationary period. The post-doctoral fellows, who might be assigned to research institutes or centers, would also receive initial five-year appointments, and would be called upon to teach as well as carry on scholarship. (Academe, June 1978, p. 0.)

Figure 8

PLACEMENTS OF NEW DOCTORATES WITHOUT A JUNIOR SCHOLAR PROGRAM AND UNDER ZEG5900



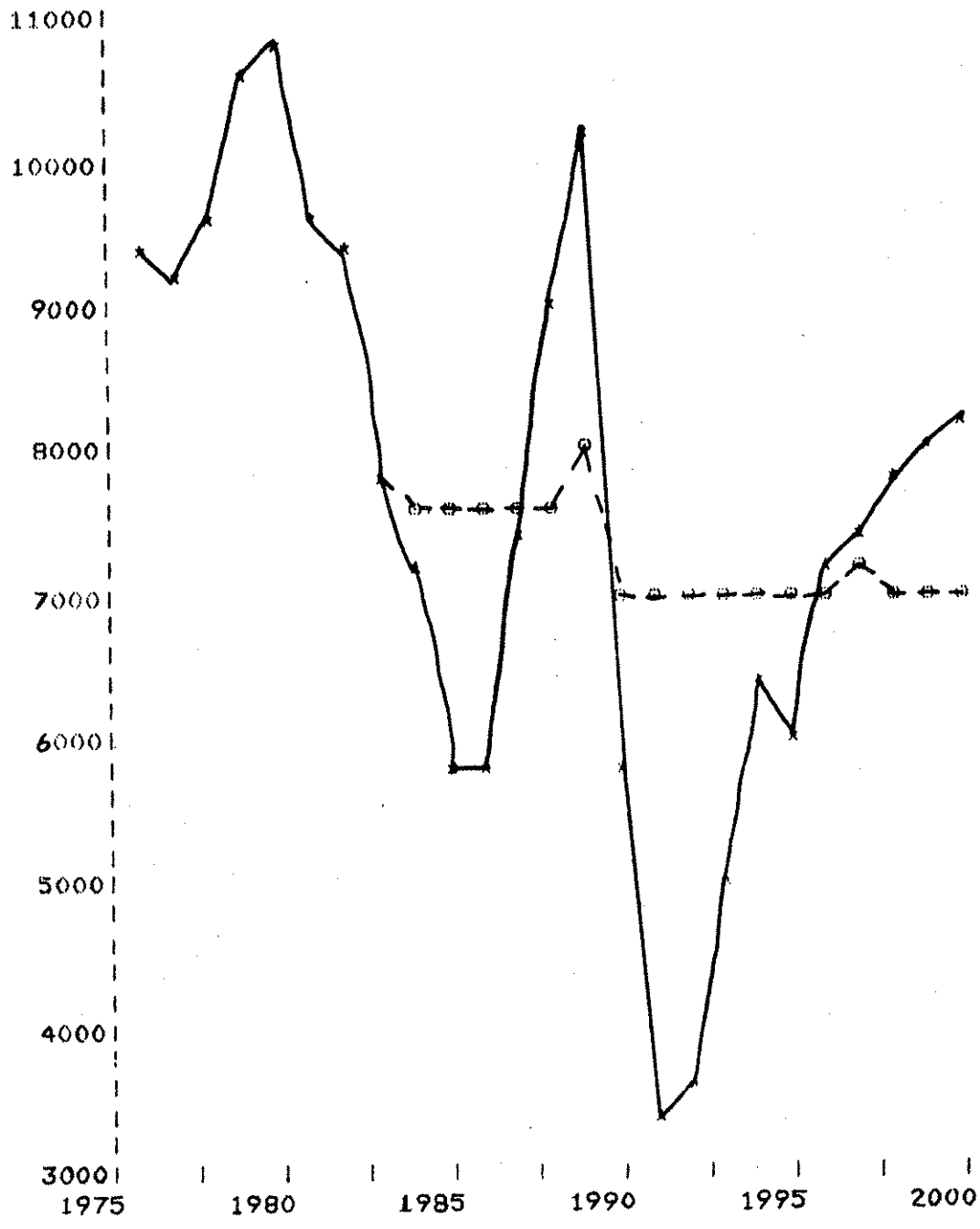
(———) Baseline level of hiring (No J.S.P.)

(-----) Placements of new doctorates under the ZEG5900

Source: See Table A-6

Figure 9

PLACEMENTS OF NEW DOCTORATES WITHOUT A JUNIOR SCHOLAR PROGRAM AND UNDER ZEG7000

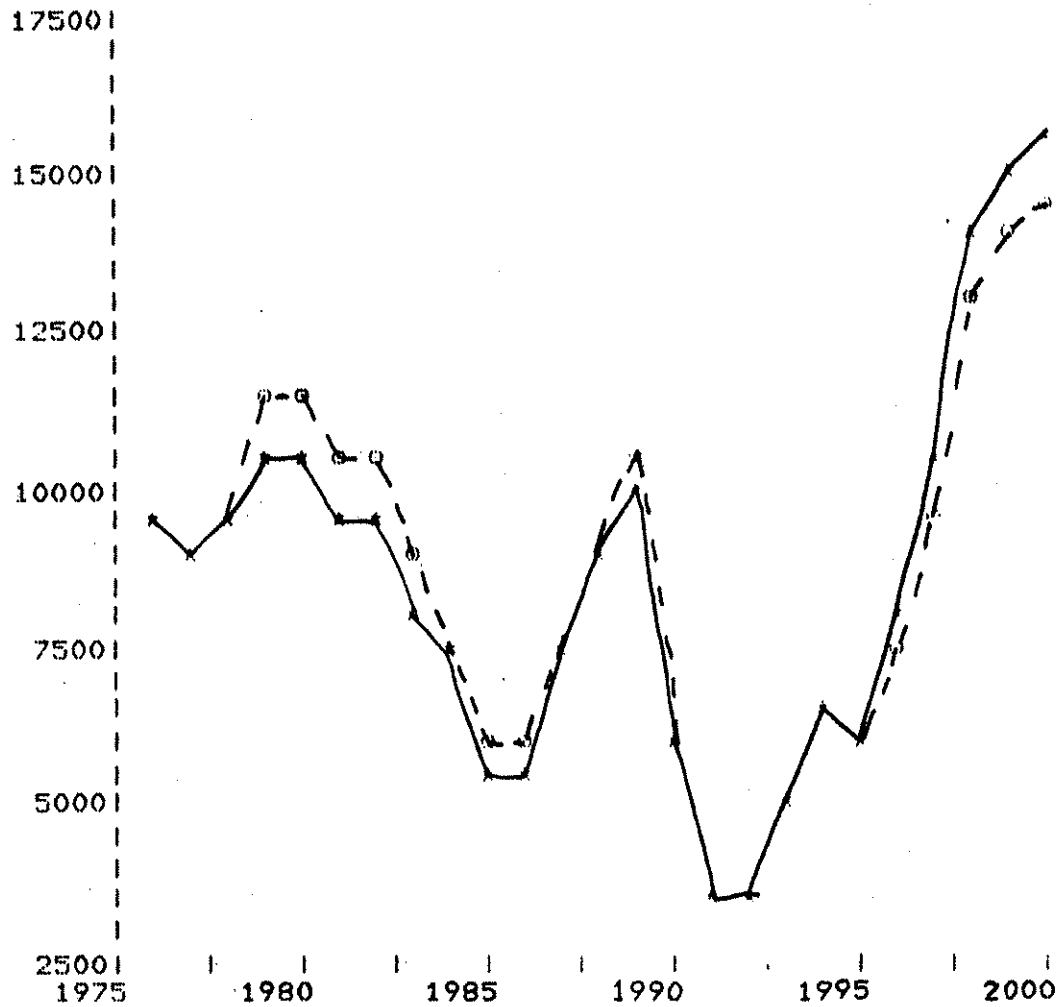


(———) Baseline level of hiring (no J.S.P.)
(- - - - -) Placements of new Doctorates under the ZEG7000

Source: See Table A-5

Figure 10:

PLACEMENTS OF NEW DOCTORATES WITHOUT A JUNIOR SCHOLAR PROGRAM AND UNDER THE ATKINSON-BARATZ PROPOSAL ASSUMING CENSUS-BASED ENROLLMENTS



(———) Baseline level of hiring (No J.S.P.)

(-----) Placements of new doctorates under the A-B Program

Source: See Table A-8

We present a variation of this plan, in which 1,000 new positions of five year duration are created, in part to illustrate the importance of timing to the effectiveness of these sorts of programs. We begin the A-B program in 1979. The effect on doctorate placements is shown in Figure 10. It is clear that, more often than not, the program would be pro-cyclical. It would create additional jobs in the early 1980's, when demand for new doctorates will be close to its peak. After the first five years, it would have practically no effect, since for every 1,000 scholars taken into the program, 1,000 minus attrition from the program would be released into the market. The program could be improved by postponing its implementation until the mid-'80's. After the initial impact, however, it would have very little effect. The argument for it is stronger on intellectual grounds than on the grounds of its effectiveness as a manpower program; it frees young scholars to devote their time primarily to research. The Junior Scholar Programs also serve this purpose but are more finely tuned to manpower needs, as well.

Details and Choices Related to Implementation of the Countercyclical Program

In Section III, we have been concerned primarily with the magnitude of the Junior Scholar Programs. In the appendix tables that correspond to the figures, possible term structures of awards are shown. We assumed that no award should be for less than two years or for more than four. The term structures can be altered, just so long as the totals come out the same.

We have avoided the prickly questions of who should get the awards. It may be argued that a steady flow of young researchers is more important to the vitality of the sciences, especially the natural sciences, than to the humanities and arts. The calculations above are for Ph.D.'s in all fields; were it decided to have Junior Scholar Programs in only selected fields, the total size of the program could be smaller and still achieve the desired outcome in those fields. Our feeling, however, is that a continuous age structure is important in all fields.

There is a clear need for more research to forecast the demand for new doctoral faculty on a field-by-field basis. Changes in enrollment demand, for example, may not have an impact on all fields at the same time or of the same magnitude. Such research is best done in careful consultation with, for example,

professional organizations in the individual fields. The actual selection of individuals for the Junior Scholar Fellowships could be carried out through a national competition judged by panels of experts within each field.

A further question relates to the institutional allocation of the awards. Our view is that they should be limited to, say, 100 research-oriented institutions. The "critical mass" argument for the establishment of such a program is defeated if the scholars are spread too thinly. Further this is quite frankly a program to preserve the quality of research in U.S. higher education, and high-quality research occurs primarily at research-oriented institutions. Even when the extent of the program is limited to 100 institutions, the size of all three programs is such that it is quite likely that an efficient way of implementing the program would be to limit it to particular fields in particular institutions. The justification for this sort of limitation is again that of creating a critical mass of talented young scholars.

IV. Alternative Programs that Would Achieve Similar Manpower Objectives

In this Report, we recommend the Junior Scholar Program primarily because it seems the simplest and most direct way to achieve the objective of obtaining a steady flow of young Ph.D.'s into academic jobs. There are, however, other ways of achieving the same objective more indirectly and, as discussed below, at greater cost. Two examples of such policies are early retirement and a program of government-funded sabbaticals. Both create vacancies that can be filled by young scholars and both perhaps have the advantage over the Junior Scholar Program that they can be incorporated within existing institutional structures.

Junior scholars, however, are cheap. We would expect that they would be paid salaries equivalent to assistant professors. Sabbaticals and early retirement require the "buying off" of staff whose compensation is relatively high, in addition to paying the young scholar.

Early retirement. This option has been discussed extensively by Jenny (4) and Patton, et al (5), and we shall not discuss it at great length here. We estimate that in 1986, about 22.5 thousand doctoral faculty will be over the age of 60. This estimate results from our assumption of a "mild response" to the extension of the age of mandatory retirement. We assume that the median age of retirement rises from 66.3 years in 1976 to 69.1 years in 1982. This means that over half the eligible doctoral faculty continue to retire before age 70. Were there to be a marked increase in the rate of inflation, which would erode retirement benefits, it might be the case that fewer people than we estimate would retire before age 70. Were this the case, early retirement might be needed in addition to a JSP simply to offset the decline in new hiring that will result from the change in the age of mandatory retirement. In either case, what early retirement would do is to free places sooner. Given the new legislation affecting mandatory retirement, however, it is not clear that enough faculty members could be convinced to retire early. Thus, in addition to its expense, early retirement lacks the reliability of timing that makes the JSP attractive and, unless carefully implemented, may encourage more productive faculty to retire early while less productive faculty remain until the age of mandatory retirement.

Government funded leaves. Under this sort of a program, the government would pick up the cost of leaves for faculty members on the condition that: 1) the leave constitute a net addition to the number of leaves or sabbaticals that the institutions themselves would otherwise have funded, and 2) the institution hire new junior faculty to replace the faculty who would be on government-funded leave. The funding of the leaves could be phased out when attrition and growth of enrollments in the institutions allowed for the regular teaching employment of the younger faculty members. Again, the timing and magnitude of such a program is shown by the same figures as the figures for the JSP. For example, under all the programs, 12,132 scholar-years of sabbaticals would be required during the period from 1984 to 1988. This is the same number as the total number of scholar-years provided under the JSP.

There are two sorts of objections to this program. First, since faculty on leave would typically be more experienced than junior scholars, it would be more expensive to pick up their salaries than the salaries of new Ph.D.'s. Second, it would have to be policed, in the sense that the government would have to be assured that the leaves it was providing were in addition to the number of leaves that would ordinarily have been given by the institution and that the additional young faculty were being hired. Since it is difficult to say how many young faculty any one institution would hire under normal circumstances, the concept of additional young faculty is not well-defined. Further, since many institutions do not grant sabbatical leaves as a "right" but rather as a privilege, and many institutions do not have a regular sabbatical leave policy at all, it would be hard to assure the administering agency that leaves given under the program were a net addition to leaves that would have been given otherwise. Similar problems, however, have been encountered with other emergency manpower programs and have not prevented their implementation.

It can be argued in favor of the program that it could easily be put into place within the existing institutional structure. Further, imaginative use of such leaves might encourage university-industry exchange in some fields and thus encourage higher rates of voluntary attrition.

A variation on the Junior Scholar Program. The version of the Junior Scholar Program that we have discussed envisages the appointment of junior scholars to essentially full-time research positions, although some involvement

in teaching, especially at the graduate level, would typically be desirable. One could also consider appointments that combined teaching and research in more equal proportions, say half and half. Unless the federal government were explicitly to subsidize university teaching, such a program would require joint federal and institutional financing of these appointments. This would further complicate the process of matching junior scholars, selected through a nationwide competition, with the needs of particular institutions, since the latter would involve both teaching and research. Such a program might also lead to increased pressure to allocate federal funds in response to institutional and regional needs, with less emphasis on selecting junior scholars with the highest research potential.

V. Costs of the Junior Scholar Programs and of Alternative Programs

We shall assume that junior scholars are paid compensation equivalent to that of assistant professors of comparable experience. The AAUP estimates this figure for a faculty member under age 30 at $15,800 (1). The cost of the Junior Scholar Program, then, depends on the number of awards and their term structure. The term structure of the different programs is presented in Tables A-5 through A-8 in Appendix A. The annual cost, in 1977 dollars, is given in Table 2 under the assumption of no real salary increment over time, as well as under the assumption of a 2% real salary increment for each year that an individual is in the program.

Table 3 shows total and average annual costs of the programs. The average cost of all three programs in the 1980's is $31.95 million, or 32.69 million with the 2% real compensation increase. In the 1990's, the average costs for all the programs are higher. CBE7500 costs $133.8 million with no real salary increase and $136.7 million with a 2% increase. The corresponding costs for ZEG5900 are 49.3 million and 50.2 million, and for ZEG7000 are 138.7 million and 142.1 million, respectively. A feeling for the order of magnitude of these costs can be given by comparing them to basic research expenditure for universities and colleges in 1976, which was $524 million. The largest program, then, would be equal to 27% of basic research expenditures in 1976. The smallest program would be equal to 8% of basic research expenditures by colleges and universities in 1976.

To compare these costs to those of early retirement or of government-funded sabbaticals requires careful specification of the alternatives, which, in the case of early retirement, has been done by Jenny (4) and by Patton et al (5). A simple example of a way to make the cost calculations, however, can be presented. Early retirement is attractive because it frees up salary lines of more expensive older professors that can then be used to pay less expensive younger professors. For example, consider a full professor who is receiving a salary of $25,000, of which he pays 5% into a retirement fund and the university pays an additional 15% of his salary into the fund. Suppose, in an extreme case,

Table 2: Annual Costs of the Junior Scholar Programs
(in millions of dollars)

	All Programs					
	With zero compensation increase			With 2% compensation increase		
1984	4.7			4.7		
1985	33.7			33.7		
1986	59.6			60.3		
1987	58.0			59.8		
1988	35.7			37.6		
1989	0			0		
	CBE7500	ZEG5900	ZEG7000	CBE 7500	ZEG5900	ZEG7000
1990	26.1	1.4	17.1	26.1	1.4	17.1
1991	89.8	41.6	72.4	90.3	42.5	72.8
1992	148.5	77.6	123.1	150.7	78.4	124.8
1993	183.8	90.5	149.3	188.2	92.2	152.9
1994	199.9	80.1	155.2	205.6	81.7	159.6
1995	233.9	81.5	170.9	237.0	82.2	173.2
1996	217.7	66.0	163.9	222.0	67.5	169.3
1997	169.8	40.7	156.9	175.7	42.1	160.9
1998	68.6	13.6	144.6	71.9	14.2	146.8
1999	0	0	128.4	0	0	131.6
2000	0	0	107.4	0	0	112.0

Table 3 : Program Costs

Average Annual Costs (in millions of dollars)

	With zero compensation increase			2% compensation increase		
Period	CBE7500	ZEG 5900	ZEG7000	CBE7500	ZEG900	ZEG7000
1984-89	31.2	31.2	31.2	32.7	32.7	32.7
1990-99	133.8	49.3	138.9	136.7	50.2	142.1
1984-99	95.6	42.8	98.8	97.7	43.6	101.1

Total Costs (in million of dollars)

1984-89	191.7	191.7	191.7	196.2	196.2	196.2
1990-99	1338.1	493.1	1389.2	1367.5	502.2	1420.9
1984-99	1529.8	684.8	1580.9	1563.7	698.4	1617.1

that he were to vacate his position early and not collect his annuity until the usual age of retirement, while the institution continued paying his contribution and its own to the retirement fund, from which he would receive benefits at the normal level when he reached the normal retirement age. The resulting salary saving of $23,750 could finance about 1.3 assistant professors per year, whose gross annual compensation (salary plus institutional pension contribution) was $18,170 per FTE. This example is extreme, however, because there would be no financial incentive for the faculty member to retire early. On the other hand, if he were to be paid 80% of his salary upon early retirement, the resulting salary saving would be only $3,750 per year, and 1/5 of an FTE assistant professor could be financed with this amount. Finally, alternatively, it can be calculated that in order to hire half an FTE assistant professor per year, the most that the early retiree could be paid would be 59% of his previous salary, or $14,665. It must be remembered, however, that the salary saving is achieved only during the years of early retirement. It should be noted that the older the faculty in a particular institution are and the more highly paid they are relative to assistant professors, the more attractive early retirement should be to an institution as a way of increasing spaces for young faculty.

We can ask what the magnitude of early retirement would have to be to result in the same FTE man-years as the JSP in the 1980's. Column 1 of Table 4 shows how many FTE Junior Scholars will be needed in each of the years 1984-1988. If each early retirement were to free one-half FTE assistant professorship per year, then the equivalent numbers of early-retirement years would be double the above figures, and are shown in Column 2 of Table 4 . There is no unique retirement schedule that would produce at least this sequence; an example of one such schedule is shown in Table 5 .

For each of six age-cohorts, this table shows what percentage of the cohort would retire one year early, two years early, etc. This schedule also has the property that in 1988 there would be an excess of 628 retirees, and in 1989 an excess of 2,675 retireees, unless one could call large numbers of faculty in the youngest two cohorts back to active service. Unfortunately, unless such recall to active service were feasible, no schedule of early retirement could match the JSP program without an excess of retirees in some

Table 4

Year	FTE Junior scholars	Equivalent number of retirees
1984	300	600
1985	2,130	4,260
1986	3,769	7,538
1987	3,671	7,342
1988	2,262	4,524

Table 5

Cohort age in 1984	Total number	Percent retiring early by 1 yr.	2 yrs.	3 yrs.	4 yrs.
66	1,841	33			
65	2,061	100			
64	2,224	1	99		
63	2,190		100		
62	2,477			100	
61	2,808			72	23

years.

These figures illustrate an important point: highly variable shares of successive cohorts would be needed to obtain the "cyclical smoothing" that we view as one of the objectives of the JSP. It is hard to imagine an early retirement program that could be considered "fair" in the sense that the same opportunities would be available to all, that would result in 33% of a cohort retiring one year, and 100% retiring the next. Early retirement is an attractive option, however, in part because as described above, it is costless. Young faculty FTE's are essentially "bought" by the difference between the cost of the annuity and the salary saving that results from replacing a higher paid teacher by a lower paid one. Not enough is known as yet about the response of faculty to early retirement options. It is quite possible that a good program that would be less costly than the JSP would be some combination of a smaller scale of JSP and an early retirement option.

The costs of a funded sabbaticals program depends, of course, on the salaries of the people participating in the program. If they were junior faculty, the cost would be very similar to that of the JSP. If, however, half of the participants were senior faculty, the program could easily become a third to a half again more expensive than the JSP in any given year.

VI. Conclusions and Recommendations

Provided that no radical changes occur over the next ten years in the aggregate relationships among college-age cohort sizes, rates of college-going and ratios of doctoral faculty to students, the late 1980's will see a precipitious decline in the demand for new Ph.D. faculty. In the absence of policies designed to offset such decline, the academic age structure will mirror the history of changes in size of student cohorts. As time passes, the median age of faculty will rise and the share of young faculty in total faculty decline. It may be overly alarming to speak of a "lost generation" of young faculty, but the change in academic age structure cannot help but have serious implications for both teaching and research in academia. Since the handwriting on the wall is there for all to see, it should be clear that now is the time to design policies to avert the negative effects of such changes.

It is in both the national interest and the interest of individual institutions to assure a reasonable flow of young doctorate scholars into academia, and the initiatives for programs should come from both levels. Institutional initiatives are necessary in order to take into account the diversity in age structure and teaching demand that already exists both among colleges and universities and, within them, among departments. National initiatives are necessary so as to assure a satisfactory level of research by younger scholars nationwide.

On the national level, we recommend that steps be taken immediately to lay the groundwork for a Junior Scholar Program that would go into effect in the mid-1980's. The objective of the Junior Scholar Program would be to assure a reasonable flow of young researchers into academia during those periods in the 1980's and 1990's when demographically generated demand for teaching is in decline. At the same time, this program should be self-liquidating. That is, it should provide no more research positions than can turned into teaching positions after the demographic trough is passed. The groundwork involves detailed study of individual disciplines in order to elucidate mechanisms to select and match scholars and institutions so as to satisfy national needs. Such groundwork is best carried out through careful consultation with

those intimately acquainted with the structure of research in their fields.

On the institutional level, we recommend that early retirement programs that are designed to fit projected changes in age structure and teaching demand be instituted. At the same time, institutions should realise that the impact of early retirement is greatest when it is first implemented. Thus, the timing of implementation should be an important consideration in the planning process.

Finally, we recommend that timely monitoring of flows of doctorate manpower be continued and that data on flows into and out out of institutions of higher education be collected. The exact magnitude of the programs should depend sensitively on the magnitude of these flows. Without timely data, it will be very difficult to implement policy in an economical manner.

The demographic forces that will affect the academic labor market in the next 20 years are not going to go away. In ways that have been described in other Carnegie Council reports, American higher education is adjusting and will have to continue to learn to adjust to what is at best, the "steady state." At the same time, our colleges and universities do much more than teach students. In particular, they employ and train the researchers who produce technical change from which future generations benefit. This research function should not fall victim to the decline of the teaching function. While new institutional arrangements are developed so that teaching and research can be less dependent on one another, programs are needed to support research by young doctorate scholars so that the academic age structure in the late 1980's and 1990's may be reasonably uniform, despite fluctuations of student cohort size. A combination of foresightful institutional planning and national support of young scholars can achieve this objective.

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APPENDIX A:

TABLES

Table A-1

CENSUS PROJECTIONS OF THE NUMBER OF 18-YEAR OLDS
1975-2000
(IN THOUSANDS)

	NUMBER IN EACH YEAR				*CHANGE BETWEEN YEARS*			
	1973 *CENSUS PROJECTIONS*		1977 *CENSUS PROJECTIONS*		1973 *CENSUS PROJECTIONS*		1977 *CENSUS PROJECTIONS*	
YEAR	*SERIES E*	*SERIES F*	*SERIES II*	*SERIES III*	*SERIES E*	*SERIES F*	*SERIES II*	*SERIES III*
1975		4168		4245				
1976		4187		4254		19		9
1977		4204		4244		17		-10
1978		4207		4229		3		-15
1979		4344		4292		137		63
1980		4254		4211		-90		-81
1981		4182		4145		-72		-66
1982		4120		4087		-62		-58
1983		3945		3917		-175		-170
1984		3728		3703		-217		-214
1985		3625		3604		-103		-99
1986		3550		3521		-75		-83
1987		3597		3567		47		46
1988		3690		3653		93		86
1989		3735		3733		45		80
1990		3437		3426		-298		-307
1991		3143		3240		-294		-186
1992	3296	3108		3168	153	-35		-72
1993	3423	3198		3247	127	90		79
1994	3567	3282		3199	144	84		-48
1995	3668	3353	3262	3115	101	71	63	-84
1996	3783	3440	3359	3043	115	87	97	-72
1997	3892	3510	3491	3027	109	70	132	-16
1998	3982	3567	3652	3133	90	57	161	106
1999	4073	3624	3806	3301	91	57	154	168
2000	4140	3663	3911	3426	67	39	105	125

SOURCES:U.S. CENSUS, 'PROJECTIONS OF THE POPULATION OF THE U.S.: 1972-2000,' SERIES P-25, NO. 493, TABLE 2; U.S. CENSUS, 'PROJECTIONS OF THE POPULATION OF THE U.S.: 1977-2050,' SERIES P-25, NO. 704 (JULY 1977), TABLE 2.

Table A-2

PROJECTIONS OF FTE DEGREE-CREDIT ENROLLMENTS USING 1977 CENSUS PROJECTIONS (IN THOUSANDS)

YEAR	NUMBER AGE 18	UG FIRST ENROL.	UG 4-YEAR ENROL.	GRADUATE + PROFESSIONAL	TOTAL FTE ENROLLMENTS	CARTTER (1973)
1976	4227	1700	4899	875	5774	5702
1977	4244	1724	5012	867	5879	5814
1978	4229	1745	5115	868	5983	5936
1979	4292	1797	5233	870	6103	6083
1980	4211	1789	5322	885	6207	6217
1981	4145	1782	5358	901	6259	6297
1982	4087	1778	5378	913	6291	6333
1983	3917	1724	5323	938	6261	6300
1984	3703	1648	5224	979	6203	6244
1985	3604	1620	5106	981	6087	6129
1986	3521	1597	4993	990	5983	6017
1987	3567	1632	4953	992	5945	5982
1988	3653	1683	4984	975	5959	6002
1989	3733	1731	5051	962	6013	6036
1990	3426	1600	5006	928	5934	5982
1991	3240	1520	4876	919	5795	
1992	3168	1494	4756	923	5679	
1993	3247	1538	4680	935	5615	
1994	3199	1522	4662	935	5597	
1995	3262	1556	4651	911	5562	
1996	3359	1604	4710	884	5594	
1997	3491	1669	4807	873	5680	
1998	3652	1754	4992	873	5865	
1999	3806	1827	5178	881	6059	
2000	3911	1883	5374	887	6261	

SOURCES:

1. *NUMBER OF 18-YEAR OLDS: U.S. CENSUS, 'PROJECTIONS OF THE POPULATION OF THE U.S.: 1977-2050,' SERIES P-25, NO. 704 (JULY 1977), TABLE 2.*
2. *UNDERGRADUATE FIRST-YEAR AND TOTAL FTE ENROLLMENTS: CALCULATIONS OF THE AUTHOR; BASED ON CARTTER [1976], CHAPTER 4.*
3. *PROJECTED ENROLLMENTS OF GRADUATE STUDENTS: CARTTER [1976], TABLE 5-8.*
4. *CARTTER'S PROJECTION OF FTE ENROLLMENTS: CARTTER [1976], TABLE 5-8.*

Table A-3

BASELINE DEMOGRAPHIC PROJECTIONS OF U.S. DOCTORATE FACULTY: 1976-2000

	DOCTORATE HIRES		*TENURE RATIO*		*FACULTY UNDER 40*	
YEAR	(1)	(2)	(1)	(2)	(1)	(2)
1976	9327		0.703		0.437	
1977	9231		0.723			
1978	9671		0.734			
1979	10693		0.741			
1980	10749		0.747		0.369	
1981	9523		0.760			
1982	9316		0.771			
1983	7816		0.784			
1984	7260		0.796			
1985	5708		0.810		0.276	
1986	5771		0.820			
1987	7410		0.818			
1988	8943		0.808			
1989	10262		0.795			
1990	5907		0.801		0.250	
1991	3452		0.817			
1992	3628		0.825			
1993	5100		0.825			
1994	6462		0.819			
1995	5940		0.814		0.231	
1996	8303	7229	0.798	0.803		
1997	10468	7548	0.775	0.791		
1998	14142	7796	0.740	0.780		
1999	14950	8022	0.707	0.768		
2000	15700	8235	0.678	0.758	0.353	0.285

NOTES:

1. *BOTH BASELINE PROJECTIONS ASSUME A CONSTANT FACULTY-STUDENT RATIO, HOWEVER THEY DIFFER IN THEIR ASSUMPTIONS ON THE SIZE OF THE COLLEGE-AGE POPULATION AFTER 1995. BASELINE 1 ASSUMES THAT CURRENT CENSUS PROJECTIONS OF THIS GROUP WILL HOLD. BASELINE 2 IS MORE PESSIMISTIC; HERE WE ASSUME A LEVELING-OFF OF THE SIZE OF THE COLLEGE POPULATION AFTER 1995.*

Table A-4

ASSUMPTIONS OF THE BASELINE PROJECTIONS

YEAR	CHANGE IN DOC. FACULTY DEMAND[1] (1)	(2)	TENURED QUIT RATE[2]	NON-TEN. QUIT RATE[2]	MEDIAN AGE AT RET.[3]	MEDIAN TIME TO TENURE[4]
1976	4230	4230	0.005	0.040	66.3	4.7
1977	3521	3521	0.006	0.050	66.3	4.9
1978	3481	3481	0.006	0.060	66.7	5.1
1979	4005	4005	0.007	0.070	67.1	5.1
1980	3457	3457	0.007	0.080	67.6	5.0
1981	1739	1739	0.008	0.090	68.6	4.9
1982	1081	1081	0.008	0.100	69.1	5.0
1983	-998	-998	0.009	0.110	69.1	5.4
1984	-1951	-1951	0.009	0.120	69.1	5.8
1985	-3868	-3868	0.010	0.130	69.1	6.4
1986	-3475	-3475	0.010	0.130	69.1	6.6
1987	-1264	-1264	0.009	0.120	69.1	7.1
1988	465	465	0.009	0.110	69.1	7.1
1989	1795	1795	0.008	0.100	69.1	6.3
1990	-2638	-2638	0.008	0.090	69.1	5.8
1991	-4620	-4620	0.007	0.080	69.1	5.7
1992	-3894	-3894	0.007	0.070	69.1	6.7
1993	-2120	-2120	0.006	0.060	69.1	6.5
1994	-619	-619	0.006	0.050	69.1	6.2
1995	-1160	-1160	0.005	0.040	69.1	6.0
1996	1074	0	0.005	0.040	69.1	6.0
1997	2871	0	0.005	0.040	69.1	6.0
1998	6166	0	0.005	0.040	69.1	6.0
1999	6475	0	0.005	0.040	69.1	6.0
2000	6750	0	0.005	0.040	69.1	6.0

NOTES:

1. BOTH FACULTY DEMAND SERIES ASSUME THAT THE DOCTORATE-FACULTY/STUDENT RATIO REMAINS CONSTANT FROM 1976 TO 2000. THEY DIFFER, HOWEVER IN THEIR ASSUMPTIONS ON ENROLLMENTS AFTER 1995. THE FIRST SERIES USES 1977 CENSUS PROJECTIONS OF 18-YEAR OLDS AFTER 1995, WHILE THE SECOND ASSUMES SIMPLY THAT ENROLLMENTS WILL STAY CONSTANT AFTER 1995.
2. THE QUIT RATES REPORTED ABOVE ARE THOSE IMPLIED BY THE AGE-SPECIFIC RATES IN EACH YEAR AND THE 1975 AGE DISTRIBUTION. THE OBSERVED AGGREGATED QUIT RATES WILL DIFFER SOMEWHAT FROM THE ABOVE SINCE THE TENURED AND NON-TENURED AGE DISTRIBUTIONS CHANGE OVER THE PROJECTION PERIOD.
3. THE MEDIAN AGE OF RETIREMENT GIVEN FOR EACH YEAR IS THE AGE IMPLIED BY A STEADY-STATE AGE DISTRIBUTION AND THAT YEAR'S AGE-SPECIFIC RETIREMENT RATES
4. LIKEWISE, THE MEDIAN AGE TO TENURE IN EACH YEAR IS THE AGE THAT WOULD BE OBSERVED WITH A STEADY-STATE AGE DISTRIBUTION. AS A RESULT, IT DIFFERS FROM THE OBSERVED MEDIAN AGE TO TENURE OVER THE COURSE OF THE PROJECTION PERIOD.

Table A-5. Projected Evolution of Doctorate Placement under ZEG7000

YEAR	(1) NEW AWARDS	(2) NUMBER OF SCHOLARS	(3) EX-SCHOLARS HIRED	(4) NON-SCHOLARS HIRED	(5) TOTAL HIRES (3)+(4)	(6) PLACEMENTS (1)+(4)
1978	0	0	0	9633	9633	9633
1979	0	0	0	10642	10642	10642
1980	0	0	0	10698	10698	10698
1981	0	0	0	9488	9488	9488
1982	0	0	0	9294	9294	9294
1983	0	0	0	7790	7790	7790
1984	300	300	0	7197	7197	7497
1985	1850	2130	0	5609	5609	7459
1986	1780	3769	0	5661	5661	7441
1987	140	3671	0	7315	7315	7455
1988	0	2262	1273	7579	8852	7579
1989	0	0	2262	7892	10154	7892
1990	1080	1080	0	5756	5756	6836
1991	3550	4585	0	3293	3293	6843
1992	3370	7789	0	3495	3495	6865
1993	2380	9451	489	4548	5037	6928
1994	2670	9824	2106	4337	6443	7007
1995	5930	10816	4835	1092	5927	7022
1996	0	10375	219	6961	7180	6961
1997	4190	9930	4513	2980	7494	7170
1998	4110	9152	4780	2933	7713	7043
1999	1100	8125	1977	5935	7911	7035
2000	0	6800	1179	6938	8116	6938

NUMBER OF JUNIOR SCHOLAR AWARDS
BY TENURE OF THE AWARD

YEAR	1-YEAR	2-YEAR	3-YEAR	4-YEAR	5-YEAR	TOTAL
1978	0	0	0	0	0	0
1979	0	0	0	0	0	0
1980	0	0	0	0	0	0
1981	0	0	0	0	0	0
1982	0	0	0	0	0	0
1983	0	0	0	0	0	0
1984	0	0	0	300	0	300
1985	0	0	0	1850	0	1850
1986	0	1100	680	0	0	1780
1987	0	140	0	0	0	140
1988	0	0	0	0	0	0
1989	0	0	0	0	0	0
1990	0	0	530	550	0	1080
1991	0	0	1730	1820	0	3550
1992	0	0	3370	0	0	3370
1993	0	0	230	2150	0	2380
1994	0	0	1530	1140	0	2670
1995	0	1060	3870	1000	0	5930
1996	0	0	0	0	0	0
1997	0	1060	1230	1900	0	4190
1998	0	0	4110	0	0	4110
1999	0	1100	0	0	0	1100
2000	0	0	0	0	0	0

NOTES:

1. WITH THIS PROGRAM PLACEMENTS DURING 1984-87 ARE KEPT AT ABOUT 7700, WHILE PLACEMENTS DURING 1990-98 ARE ALLOWED TO FALL TO 7000 A YEAR. AS A RESULT, THE PROGRAM DOES NOT LIQUIDATE ITSELF UNTIL AFTER 2000.

Table A-6

Projected Evolution of Doctorate Placement Under ZEG5900

YEAR	(1) NEW AWARDS	(2) NUMBER OF SCHOLARS	(3) EX-SCHOLARS HIRED	(4) NON-SCHOLARS HIRED	(5) TOTAL HIRES (3)+(4)	(6) PLACEMENTS (1)+(4)
1978	0	0	0	9671	9671	9671
1979	0	0	0	10693	10693	10693
1980	0	0	0	10749	10749	10749
1981	0	0	0	9523	9523	9523
1982	0	0	0	9316	9316	9316
1983	0	0	0	7816	7816	7816
1984	300	300	0	7260	7260	7560
1985	1850	2130	0	5708	5708	7558
1986	1780	3769	0	5771	5771	7551
1987	140	3671	0	7410	7410	7550
1988	0	2262	1273	7669	8943	7669
1989	0	0	2262	7985	10247	7985
1990	90	90	0	5848	5848	5938
1991	2550	2636	0	3396	3396	5946
1992	2460	4915	86	3496	3582	5956
1993	1900	5727	962	4104	5065	6004
1994	1550	5069	2113	4320	6433	5870
1995	1830	5158	1669	4240	5909	6070
1996	900	4177	1811	5378	7189	6278
1997	0	2577	1544	5953	7497	5953
1998	0	862	1696	6042	7738	6042
1999	0	0	862	7095	7958	7095
2000	0	0	0	8169	8169	8169

NUMBER OF JUNIOR SCHOLAR AWARDS
BY TENURE OF THE AWARD

YEAR	1-YEAR	2-YEAR	3-YEAR	4-YEAR	5-YEAR	TOTAL
1978	0	0	0	0	0	0
1979	0	0	0	0	0	0
1980	0	0	0	0	0	0
1981	0	0	0	0	0	0
1982	0	0	0	0	0	0
1983	0	0	0	0	0	0
1984	0	0	0	300		300
1985	0	0	0	1850	0	1850
1986	0	1100	680	0	0	1780
1987	0	140	0	0	0	140
1988	0	0	0		0	0
1989	0	0	0	0	0	0
1990	0	90	0	0	0	90
1991	0	1000	1550	0	0	2550
1992	0	690	1770		0	2460
1993	0	0	1900	0	0	1900
1994	0	0	1550	0	0	1550
1995		60	1770	0	0	1830
1996	0	0	900	0	0	900
1997	0	0	0	0	0	0
1998	0	0	0	0	0	0
1999	0	0	0	0	0	0
2000	0	0	0	0	0	0

Notes:

1. With this program placements during 1984-87 are kept at about 7,700, while placements during 1990-1998 are allowed to fall to about 6,000 a year. This way, the program liquidates itself by the year 2000.

Table A-7
Projected Evolution of Doctorate Placement Under CBE7500

YEAR	(1) NEW AWARDS	(2) NUMBER OF SCHOLARS	(3) EX-SCHOLARS HIRED	(4) NON-SCHOLARS HIRED	(5) TOTAL HIRES (3)+(4)	(6) PLACEMENTS (1)+(4)
1978	0	0	0	9671	9671	9671
1979	0	0	0	10693	10693	10693
1980	0	0	0	10749	10749	10749
1981	0	0	0	9523	9523	9523
1982	0	0	0	9316	9316	9316
1983	0	0	0	7816	7816	7816
1984	300	300	0	7260	7260	7560
1985	1850	2130	0	5708	5708	7558
1986	1780	3769	0	5771	5771	7551
1987	140	3671	0	7410	7410	7550
1988	0	2262	1273	7669	8943	7669
1989	0	0	2262	7985	10247	7985
1990	1650	1650	0	5848	5848	7498
1991	4100	5682	0	3396	3396	7496
1992	3920	9398	0	3582	3582	7502
1993	3200	11633	692	4374	5066	7574
1994	4010	12651	2761	3672	6433	7682
1995	8393	14806	5906	0	5906	8393
1996	2950	13776	3747	4481	8229	7431
1997	0	10748	2798	7574	10372	7574
1998	0	4340	6315	7715	14029	7715
1999	0	0	4340	10464	14804	10464
2000	0	0	0	15533	15533	15533

NUMBER OF JUNIOR SCHOLAR AWARDS
BY TENURE OF THE AWARD

YEAR	1-YEAR	2-YEAR	3-YEAR	4-YEAR	5-YEAR	TOTAL
1978	0	0	0	0	0	0
1979	0	0	0	0	0	0
1980	0	0	0	0	0	0
1981	0	0	0	0	0	0
1982	0	0	0	0	0	0
1983	0	0	0	0	0	0
1984	0	0	0	300	0	300
1985	0	0	0	1850	0	1850
1986	0	1100	680	0	0	1780
1987	0	140	0	0	0	140
1988	0	0	0	0	0	0
1989	0	0	0	0	0	0
1990	0	0	750	900	0	1650
1991	0	0	0	4100	0	4100
1992	0	2020	1900	0	0	3920
1993	0	590	2610	0	0	3200
1994	0	1090	2920	0	0	4010
1995	193	0	6590	1610	0	8393
1996	0	0	2950	0	0	2950
1997	0	0	0	0	0	0
1998	0	0	0	0	0	0
1999	0	0	0	0	0	0
2000	0	0	0	0	0	0

NOTES:

1. In 1995 we projected that 193 more fellows would be released from the program than could be hired in academia, these fellows were given special 1-year extensions, and entered academia in 1996.

Table A-8 Projected Evolution of Doctorate Placement

Assuming Baseline 1 and Atkinson-Baratz Young Scholars Program

YEAR	(1) NEW AWARDS	(2) NUMBER OF SCHOLARS	(3) EX-SCHOLARS HIRED	(4) NON-SCHOLARS HIRED	(5) TOTAL HIRES (3)+(4)	(6) PLACEMENTS (1)+(4)
1978	0	0	0	9671	9671	9671
1979	1000	1000	0	10693	10693	11693
1980	1000	1960	0	10749	10749	11749
1981	1000	2873	0	9523	9523	10523
1982	1000	3730	0	9316	9316	10316
1983	1000	4526	0	7816	7816	8816
1984	1000	4481	824	6436	7260	7436
1985	1000	4436	807	4873	5680	5873
1986	1000	4411	790	4925	5716	5925
1987	1000	4416	778	6559	7337	7559
1988	1000	4443	774	8085	8859	9085
1989	1000	4483	778	9393	10170	10393
1990	1000	4528	790	5021	5811	6021
1991	1000	4573	807	2550	3357	3550
1992	1000	4619	824	2716	3540	3716
1993	1000	4665	841	4179	5020	5179
1994	1000	4711	859	5534	6393	6534
1995	1000	4758	877	5008	5884	6008
1996	0	3786	895	7350	8245	7350
1997	0	2820	909	9499	10408	9499
1998	0	1864	918	13161	14079	13161
1999	0	923	923	13963	14886	13963
2000	0	0	923	14712	15635	14712

NUMBER OF JUNIOR SCHOLAR AWARDS
BY TENURE OF THE AWARD

YEAR	1-YEAR	2-YEAR	3-YEAR	4-YEAR	5-YEAR	TOTAL
1978	0	0	0	0	0	0
1979	0	0	0	0	1000	1000
1980	0	0	0	0	1000	1000
1981	0	0	0	0	1000	1000
1982	0	0	0	0	1000	1000
1983	0	0	0	0	1000	1000
1984	0	0	0	0	1000	1000
1985	0	0	0	0	1000	1000
1986	0	0	0	0	1000	1000
1987	0	0	0	0	1000	1000
1988	0	0	0	0	1000	1000
1989	0	0	0	0	1000	1000
1990	0	0	0	0	1000	1000
1991	0	0	0	0	1000	1000
1992	0	0	0	0	1000	1000
1993	0	0	0	0	1000	1000
1994	0	0	0	0	1000	1000
1995	0	0	0	0	1000	1000
1996	0	0	0	0	0	0
1997	0	0	0	0	0	0
1998	0	0	0	0	0	0
1999	0	0	0	0	0	0
2000	0	0	0	0	0	0

APPENDIX B:

Summaries of Related Technical Reports Issued Under the Project on Quantitative Policy Analysis Models of Demand and Supply in Higher Education

to be lower than non-academic salaries because academic employment will be more certain. Other things equal, we would also expect higher tenure ratios in fields in which there is greater non-academic demand.

Although tenure may be used as a competitive weapon, it is a two-edged sword. From the point of view of the academic employer, tenure acts as a constraint on labor force adjustment in the face of changing enrollment demand. In particular, when enrollment becomes stable it limits the institution 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. The institution will be 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 will the institution have. When enrollments are growing, this apparent loss of flexibility is less, since the faculty can grow as well, and a high rate of new hiring can provide that growth.

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 particular types 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.

We use a statistical model to estimate the behavior of the tenure rate, which we define 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 de-

to be lower than non-academic salaries because academic employment will be more certain. Other things equal, we would also expect higher tenure ratios in fields in which there is greater non-academic demand.

Although tenure may be used as a competitive weapon, it is a two-edged sword. From the point of view of the academic employer, tenure acts as a constraint on labor force adjustment in the face of changing enrollment demand. In particular, when enrollment becomes stable it limits the institution 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. The institution will be 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 will the institution have. When enrollments are growing, this apparent loss of flexibility is less, since the faculty can grow as well, and a high rate of new hiring can provide that growth.

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cision 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. 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, one would expect that a faculty member would have a greater chance of being given tenure than if he had been non-tenured in the early 1950's, at the same age.

To briefly summarize the most important results: 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 institution 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.

These results are based upon an analysis of data from the 1973 ACE Survey of Teaching Faculty, using a conditional logit model. This statistical model is analogous to an analysis-of-variance model, and was developed specifically for this application.

2. 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, Technical Report No. 3, C.V. Kuh, July 1977.

This report describes the results of the tenure rate estimation model that was discussed in Technical Report No. 2, using data obtained from the 1975 Survey of Teaching Faculty sponsored by the Carnegie Council on Policy Studies in Higher Education. Qualitatively, the results are similar to those found using data from the 1973 ACE Survey for the years that are covered by both surveys.

There is a rapid fall in the median time to tenure during the 1960's when there was the most rapid increase in enrollments. Quantitatively, however, the median times to tenure estimated from the 1975 data are lower than those estimated from the 1973 data for earlier years (1950-1968). More specifically:

1. For all types and control of institution, median times to tenure fell rapidly from 1961 until the late 1960's. Thereafter, they rose slowly through 1973, for universities and private colleges, and levelled off for public colleges. Generally, the median time to tenure is longer in private than in public institutions. This same pattern is found in broad fields. We also find that the median time to tenure is longer in the physical and biological sciences than in the humanities and social sciences.

2. We investigated possible explanations for the fact that lower median times to tenure for earlier years were estimated from the 1975 Survey than from the 1973 Survey. Although the main differences between the two samples were the size of the 1975 Survey and the inclusion in it of relatively more low-quality institutions, these differences do not appear to explain the systematic differences in the estimates from the two samples. Rather, it appears that the differences result from systematic differences of the incidence of tenure for the older cohorts. At any age, the older cohorts in the 1975 sample are more likely to be tenured than the older cohorts in the 1973 sample. We think that this may be due to selective attrition of untenured older faculty. Careful examination of this hypothesis, however, can only be done with other data, such as those from the NAS-NRC comprehensive roster, to obtain direct evidence of movements into and out of academia

3. U.S. Doctorate Faculty after the Boom: Demographic Projections to 1995, Technical Report No. 4, L. Fernandez. October 1978.

The academic labor market during the next quarter-century promises to be chronically depressed. All indicators point to a slowing down and eventual contraction in total enrollments at four-year institutions, a reversal of the rapid growth in the 1960's that led to a 138% expansion in full-time faculty between 1960 and 1970. In 1973, 72% of undergraduate enrollments at four-year colleges and universities were 18 to 21 years old. Census projections show that by 1985, the number of people in this prime college-attending age bracket will have fallen back to the 1973 level. Although the percentage of this group attending college has been steadily increasing, projections by Cartter that assume a continuation of this trend show at most a 12% increase in enrollments between 1973 and 1985. Already, graduate enrollments are leveling off in the face of an estimated 33,000 Ph.D.'s competing for only 9,000 new junior faculty positions in 1975.

From the historical record of the academic labor market, the current disequilibrium can be expected to lead to an increased flow of experienced faculty to non-academic employment and to a fall in the rates of promotion to tenure. Projections, then, obtained by simply extrapolating the current percentages of junior faculty receiving tenure or the fraction of faculty leaving university employment (which we will refer to as "academic quits") can be expected to show a more severe aging and "tenuring-in" of faculty (i.e., an increase in the fraction of faculty with tenure) and a more depressed level of hiring for new doctorates than will probably occur. In addition, the age composition of the faculty can be expected to influence the rate of retirements and the level of inter-institutional movement, as older faculty tend to move less and certainly retire in larger numbers. Correcting for each of these effects in a piece-meal fashion is not a good way to provide accurate forecasts of labor market conditions or faculty characteristics (such as its age distribution). It is precisely accurate numbers that are needed to answer such questions as: When faculty-student ratios fall, what is the level of increase in attrition of experienced faculty required to keep hiring unchanged? How many positions are "freed" if faculty begin to retire at earlier ages (voluntarily or not)? By how much, given the

present pools of qualified women and minorities, will affirmative action programs in hiring and promotion change the sex and race competition of academia? Which is the best policy for slowing any increase in the tenure ratio: early retirement plans or tenure quotas (remembering the faculty denied tenure can always leave academia rather than look for another appointment)? How much of an error is likely to result from assuming that the proportion of the faculty promoted, retiring, etc., is independent of the age distribution? This report takes a "demographic approach," and follows each age group (or "cohort") from its entry into academia until the end of our projection period in 2000, making extensive use of the simple identity relating the number F(i,t) of faculty of age i in year t, the fraction a(i,t) of people of age i leaving academia between year t and t+1, the number H(i,t) of newly hired faculty during year t who are i years old (hired both to replace those who leave and to allow for expansion), to the number F(i+1, t+1) of faculty in year t+1 who are i+1 years old can be expressed as:

$$F(i+1,\ t+1) = (1-a(i,t))F(i,t) + H(i,t)$$

In order to construct the series F(i,t), starting from a certain date, we hypothesize values for the two sets of parameters a(i,t) and H(i,t), and project the series F(i,t) conditional on these hypotheses. Our strategy has been to construct alternative projections of junior faculty hiring, the tenure ratio, and the age structure of the total faculty, corresponding to alternative hypotheses about the level of total faculty demanded by colleges, the age-specific rates of retirement and of leaving academia for non-academic jobs, and the age-specific rates at which faculty are given tenure. We also explore the sensitivity of our projections to changes in these hypotheses.

The accuracy of such projections is considerably improved by also controlling for the type of institution each faculty member is employed at and whether he is working full-time or part-time. To avoid unnecessary complications, in this paper we have chosen to restrict our attention to full-time doctorate faculty at four-year institutions. As a result, what we term "non-academic employment" includes employment in two-year colleges, and what we term "hires of new doctoral graduates" includes non-doctorate faculty who obtain a doctorate after starting their academic careers.

The projections presented in this paper reveal the following patterns in the evolution of the age structure of doctorate faculty and the creation of new junior faculty positions:

(1) Under all of our projections, the level of hiring increases during the seventies and then declines during the eighties, bottoming out in 1985-86. The most "optimistic" projection of doctorate hiring for the period 1976-1995 is 155,000 people, or an average of 7,750 people a year. (In contrast, Cartter projected that between 1976 and 1990 there would be 568,000 new doctorates conferred.)

(2) Although changes in the rate of retirement and out-migration and changes in the faculty-student ratio have sizable <u>percentage</u> effects on the number of new junior faculty positions available, <u>absolute</u> changes are small because the level of hiring is going to be very low during the rest of this century. Increasing the non-tenured attrition rate leads to modest increases in hiring, but has very little impact on the tenure ratio or the age distribution; it reveals itself to be simply a "revolving door" policy. Increasing the tenured attrition rate is much more effective at keeping the tenure ratio low. Unfortunately, it is not clear how institutions can change their attrition rates without encouraging the most gifted faculty to leave first.

(3) Early retirement turns out to be disappointing. At most 1000 new junior faculty positions are created in any year by earlier retirement of the senior faculty. In addition, because early retirement has a quick "once and for all" impact on hiring, in order to have the most effective counter-cyclical impact on hiring it seems best to <u>delay</u> its implementation until the middle 1980's or even 1990.

(4) There is a continuous aging of faculty in every projection. By 1995 the median age of the doctorate faculty has increased by 8 to 11 years over its value of 41.7 in 1975. The percentage of faculty over the age of 50 increases from the current 24.6% to between 51.2% and 57.8%. Even when early retirement is assumed to have been instituted, the percentage of faculty in 1995 over the age of 50 is projected to be almost double its current level.

The report is divided into five sections. The first section examines the effect of variations in the growth of enrollments. The second looks at the results of allowing the rate of promotion to fluctuate with excess demand (supply) of faculty, while the third examines the results of increasing the level of out-migration from academia by tenured and non-tenured faculty. We next examine the impact of the current elimination of mandatory retirement and impact of programs which encourage faculty to retire earlier. The fifth section focuses on doctorate women and their future representation in academia. We end by summarizing our results and noting the extensions required of our methods and data to address the list of questions we discussed above. The appendices provide a careful derivation of our projection equations and a listing of the data we used to construct our probabilities.

4. Field Disaggregated Analysis and Projections of Graduate Enrollment and Higher Degree Production, C. von Rothkirch, October, 1978

Since the end of the 1960s, when the booming growth of Higher Education in general and its graduate sector in particular was reduced to moderate annual increases or even decreases, much effort has been made to analyze these dynamics and find reliable projections of likely future developments. The threat of growing unemployment among Ph.D.'s, in particular, has caused researchers in universities and other agencies to develop models for analyzing, forecasting, and evaluating policy for the academic labor market.

By far the majority of existing models is represented by so-called fixed-coefficient models in which model functions are reduced to time series of coefficients evaluated by relating graduate enrollment to B.A. degree numbers and Ph.D. degree numbers to graduate enrollment, respectively. Analyzing the dynamics of these coefficients provides information about the development of the 'Ph.D. production process'. Projections of future degree numbers can be obtained by means of coefficient extrapolation.

A few approaches are based upon the assumption that student enrollment and completion decisions can be theoretically and empirically explained by influencing factors. Response models of the graduate sector, for example, may combine the endogenous variables of first year graduate enrollment, faculty salaries, and number of Ph.D.'s with each other and with several exogenous variables representing the number of recently graduated B.A.'s, research and development spending, output of Ph.D.-intensive industries, salaries of alternative careers, and fellowship support.

Enlarging a fixed-coefficient model, Cartter recently used a market response model to explain first year graduate enrollment by means of three influencing factors. In addition to the number of recently graduated B.A.'s, he used two other variables reflecting "R & D demand for scientists" and "the number of Junior academic position openings."

Nearly all existing models of graduate higher education are too crude with respect to their level of aggregation. They neglect that student enrollment and degree completion behavior is considerably different in distinct academic fields. Every bachelor, for example, who considers

studying at the graduate level, faces a twofold decision. First he has to make up his mind whether to enroll or not; then he has to choose a field of study.

Disaggregation with respect to academic fields is especially necessary if a model is used for the evaluation of policies and the analysis of policy impacts. Present conditions, as well as likely future developments in the academic labor market, are not the same in all fields. Market adjustment policies based only on global analyses might improve one part of the market but impair another.

In this paper, a further step is taken toward a comprehensive, field-disaggregated analysis of the academic labor market. Using NCES data for first-year graduate enrollment and higher degrees awarded in distinct fields, the fixed-coefficient model used by Cartter in 1975 is enlarged and disaggregated into a model of the supply of master's as well as doctor's degrees in 19 different academic fields. Trend comparison and extrapolation are used in the analysis. No hypotheses about graduate students' behaviour are presumed. The results not only indicate that behaviour-explaining models must be constructed on a field-disaggregated level, but yield also plausible rationales concerning the factors influencing student decisions.

In the global enrollment and degree data we see that the majority of B.A. graduates still enroll in graduate or professional schools. More and more of those who enroll, however, do not aspire to the doctorate but are content with a lower level degree.

This shift clearly indicates the students' responsiveness to changing job possibilities and prospects. The field-disaggregated analysis also supports the global findings. Since the beginning of the 1970s, traditionally academic fields, such as English, foreign languages, mathematics, and social sciences, as well as research-oriented fields, such as engineering and physical sciences, experienced a steady and strong decrease of shares of graduate enrollment. In contrast, graduate enrollment in professionally oriented fields, like, for example, architecture, business administration, computer science, and public administration, increased continuously above the average.

If these trends last in the near future, higher degree production in the 1980s will be considerably different from traditional patterns. The share of Ph.D. production in engineering, mathematics, physical sciences, arts, letters, and social sciences, which totalled more than one-half of all Ph.D.'s awarded before 1971, will decrease to less than one-third in 1983 and thereafter.

But the economically-based hypothesis of market responsiveness cannot explain all recent changes. In agriculture, biological sciences, and education, for example, graduate enrollment as well as higher degrees awarded are still increasing, in spite of bad job prospects in these fields inside and outside academia. This development indicates that there are also noneconomic factors, such as concern for the physical and social environment, that influence educational and career decisions. This hypothesis, too, of course, needs to be tested by means of a disaggregated model.