ON ANALYZING AND PREDICTING ENROLLMENTS AND COSTS IN HIGHER EDUCATION

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This paper is a preliminary report on a study of enrollment and financial statistics in higher education that has been sponsored in part by the Carnegie Commission on Higher Education. The purpose of the study is to analyze statistically certain trends in higher education and to assess the effects of factors such as the Vietnam war, the G.I. Bills, and the increased holding power of the high schools. The statistical models which have been used in analyzing the data are described in detail and compared with other models which have been used in the past. This report also contains a discussion of current trends in higher education, some predictions of future demands on higher education, and some long-term projections of enrollments and costs.

The colleges and universities have grown at an almost incredible rate throughout the last decade. This growth is attributable in part to the growth of the college-going age group as an aftermath of the post-World War II baby boom; in particular, the population in the 18-21 age group has risen by almost 60% from 1958 to 1968. During the same ten-year period the high schools have cut their drop-out rate; over 75% of the young people are graduating from high school today as compared with only 65% ten years ago. Also, an increasing proportion of the high school graduates go on to college--approximately 60% at the present time as compared with slightly over 50% only ten years ago.

As a result enrollments in colleges and universities have soared. Despite the negative effects of the Vietnam war, undergraduate enrollment has more than doubled during the last decade. Graduate enrollments have risen even more rapidly, doubling in the last 7 years, tripling in only 12 years. The total opening fall degree-credit enrollment in institutions of higher education in 1968 was 6.9 million students as compared with 3.2 million only ten years ago, an increase of over 110% in ten years.

With the high schools continually reducing their drop-out rates and with an increasingly higher percentage of high school graduates going on to college, institutions of higher education are being asked to serve an ever-broadening segment of the population. Nevertheless, the yearly retention rates for college students have remained virtually unchanged at a surprisingly high level for the last 20 years, contradicting the popular notion that college work is so demanding that only the most able survive the first year.

These conclusions suggest that on the whole the higher educational system in this country is continually adjusting to accommodate an increasingly larger segment of the population. The notion that a college education is something to be reserved for only the more academically talented students appears to be eroding with time in almost the same way that the corresponding notion about high school education did 30 or 40 years ago.

Before the methodology used in this study is discussed, let us turn to some projections of future demands to be placed upon higher education. The table below shows how much time the institutions of higher education will have to increase their capacities by 50% (100%) in various categories according to the projections given in this paper. It also shows how long it has taken to increase their capacities by 50% (100%) in the past.

According to the projections given in this report, total opening fall degree-credit enrollment will continue to rise at a rate of about one-half million students per year for the next ten years. Then total enrollment should begin to level off and remain rather stable throughout the 1980's at around 12½ million students with a very slight decline beginning perhaps in 1982 or 1983.

No one seems to doubt that the demands upon higher education will continue to rise at a rapid rate for some time, but there is considerable reason to doubt that colleges and universities can continue to meet these demands as they have in the past. In particular, with the current financial plight of the private institutions due to spiraling costs and tuition rates, these institutions are apparently being priced out of the market and may fast be approaching the limit of their capabilities insofar as further increases in enrollment are concerned. The public institutions are also having to cut back on some of their programs as state legislators and governors react to rocketing costs and student disruptions on campus with substantial budget cuts. Also, recent cuts in research support by various government agencies may already have seriously affected future growth at the graduate level. Nevertheless, on the basis of past performance, it's hard to discount the capability of the colleges and universities to meet these demands, despite the mounting financial crisis in higher education.

As a partial indication of the methodology used

	Projected Number of Years to Increase by 50% (100%)	Number of Years Needed in the Past	1968 Level
Undergraduate enrollment	9 (40)	5 (9)	6,131,000
Graduate enrollment	4 (7)	5 (7)	797,000
Total enrollment	8 (26)	5 (9)	6,928,000
Bachelor's and first-professional degrees	7 (27)	5 (12)	667,000
Master's degrees	4 (7)	3 (6)	177,000
Doctor's degrees	5 (8)	4 (7)	23,000
Expenditures	4 (8)	4 (6)	$20.6 billion

in this study, the analysis of the undergraduate enrollment data will be briefly discussed. In assessing the growth of undergraduate enrollment, it seemed reasonable to compare the number of undergraduate students in each year with the number of high school graduates over the past several years. This led us to consider the "undergraduate enrollment rates"

$$r_t = U_t / \Sigma_{k=0}^3 H_{t-k}$$

for each sex, where U_t denotes the opening fall undergraduate degree-credit enrollment during year t and H_t is the number of high school graduates during year t. These enrollment rates for women have been increasing consistently since World War II at a rate of about 1% per year, whereas the enrollment rates for men have fluctuated in a rather wild manner, with dips coinciding with high draft calls and bulges with the return of large numbers of veterans to civilian life. The basic assumption in analyzing male undergraduate enrollment is that, if one first accounts for the wartime effects upon under-

graduate enrollment, the enrollment rates r_t for men can be suitably approximated by a logistic growth curve

$$\rho(t) = \gamma / [1 + e^{-(\alpha + \beta t)}].$$

This led us to use the nonlinear regression model

$$U_t = \rho(t) \Sigma_{k=0}^3 H_{t-k} + \beta_2 VII_t + \beta_3 VK_t + \beta_4 VV_t + \beta_5 DK_t + \beta_6 DV_t + e_t$$

where VII_t, VK_t, and VV_t denote the numbers of veterans attending institutions of higher education from World War II, the Korean War, and the Vietnam conflict respectively; and DK_t and DV_t denote the number of draftees in service for the Korean and Vietnam conflicts respectively. The analysis of the data for the years 1947-68 yields estimates of the underlying growth rate $\rho(t)$ as well as assessments of the effects of the wars upon enrollments. The projections of undergraduate enrollment are obtained by combining extrapolations of the estimated growth curve with projections of high school graduates and estimates of the post-Vietnam effects upon enrollment based upon the Korean War experience.