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CAUSES AND
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Working Paper 92-20

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THE GROWTH OF FEMALE COLLEGE ATTENDANCE: CAUSES AND PROSPECTS

The postwar period has seen an explosion of college enrollment by women. In 1947 there were only 523,000 women enrolled in college. By 1988 that number was 13.5 times greater, a total of 7,166,000. The proportion of the 18/19 year old women attending college rose from 12.2 percent in 1947, to 34.6 percent in 1970 and 45.8 percent in 1988. Since the high school completion rate has risen during this period from 56 percent to 84 percent, proportions of high school graduates attending college rose somewhat more slowly than ratios of attendance to population. Nevertheless, proportions of 14 to 24 year old female high school graduates attending college nearly doubled from 14.1 percent in 1947 to 26.3 percent in 1970 and then expanded further to 36.8 percent in 1988.¹

What caused this enrollment explosion? Was it primarily a result of rising family incomes and the higher educational levels of the parents of more recent cohorts? Studies of male college attendance have found that enrollment rates respond to the salary differential between college and high school graduates (Freeman, 1975). Do women respond to the size of the college high school salary differential to the same degree men do? Did the payoff to college for women increase in the postwar period? If the answer to both of these questions is yes, the rise of female enrollment rates is in part a result of the social forces (eg. the women's movement) which opened up high paying occupations such as medicine, law and business to college educated women.

Cross section studies find that high school achievement has substantial impacts on college attendance. There have been substantial fluctuations in the test scores of students completing high school. What impact have these fluctuations had on college attendance and completion rates?

Attendance rates are higher when the commuting costs and tuition costs of college are low (Campbell and Siegel 1964, Bishop 1977, Bishop and Van Dyk 1977, Jackson and Weathersby 1975, McPherson 1978, Manski and Wise 1982, Leslie and Brinkman 1985). What impact did the creation of many new community colleges and public four year colleges in the nation's urban centers during the 1950s and 1960s have on the growth of female enrollment during that period? How has the recent escalation of tuition charges affected college enrollment in the 1980s?

This paper analyzes the response of female college attendance and completion rates to changes over time (and variations across labor markets) in the payoff to college and the cost of attendance and the preparation of

students for college. The robustness of the main findings will be checked by analyzing two very different data sets: cross section data on individuals and time series data on aggregate college enrollment and completion rates from 1949 to 1989. In Section 1, a simple model of the college attendance decision is developed which incorporates most of the factors discussed above. Section 2 presents the results of fitting the specification implied by the theory developed in Section I to cross-section data on the college attendance choices of 29,141 women who were high school juniors in 1960. Major findings of this analysis are that female college attendance is very responsive to public decisions effecting instate tuition levels and the proximity of public colleges and somewhat responsive to the magnitude of the local economic payoff to college.

The payoff to a women's college education has undergone a remarkable increase. In the early part of the post-war period most college educated women were teachers and most female high school graduates were clerical workers. Teachers were paid only 4 percent more than clerical workers in 1948. By 1970, however, teachers were being paid 59 percent more than clerical workers. The salaries of college educated women in other fields also grew more rapidly than clerical salaries. During the 1970s, however, the salary premium received by young college educated women fell slightly, but in 1980s it exploded again rising from 53 percent in 1980 to 79 percent in 1986/87.

The time series analysis presented in section 3 indicates that these increases in the payoff to college were important contributors to the postwar explosion of female college enrollment rates. Tuition levels have substantial negative effects and the recent tendency of tuition to rise more rapidly than high school graduate wages has depressed the growth of female college enrollment in college.

Section 4 of the paper offers a projection of enrollment and college graduation rates for 1997. During the 1980s the payoff to college grew significantly and tuition rose much more rapidly than ability to pay. If these trends continue, the US Department of Education's projection that between 1987 and 1997 enrollment rates will grow 10 percent for 18-19 year olds and 27 percent for 20-24 year olds will come true. If, however, the growth of public college tuition slows to only 2 percent above the rate of increase of wages, enrollment will grow at least 10 percent faster than the Department of Education projects. If the payoff stagnates at current levels, college attendance will grow less rapidly than the Department of Education's current projections.

I. THEORETICAL FRAMEWORK

The decision to attend college is assumed to be based on a rough calculation of benefits and costs. A young woman will attend college if the benefits of attending are greater than the costs. Benefits and costs are of two types--pecuniary and nonpecuniary. Let us begin by examining the pecuniary benefits and costs (B_m, C_m). Net monetary benefits may be written as:

$$1) \quad B_m - C_m = \theta(W_c - W_n) - 4((1-U).75*W_n + T) + a_1A + u_1$$

where W_n is the yearly earnings of female high school graduates working full time. Foregone earnings is assumed to be 75 percent of this figure.

W_c is the yearly earnings of female college graduates working full time.

θ is a multiplier that reflects the number of years the young woman plans to be in the labor force and the rate at which she and her parents discount the future

T is the direct costs of college attendance: Incremental room and board costs plus tuition at public colleges minus mean dollars of financial aid per student at public colleges.

$1-U$ is the probability of obtaining employment: 1 minus the expected unemployment rate.

A is a test measuring the academic achievement of the individual in high school. This variable influences the net benefits of college attendance because academic achievement in high school increases the likelihood of completing college, increases the earnings gain that results from completing college (Bishop 1991), reduces the study time necessary to get a given college grade and increases the probability of getting scholarships.

Attending college also generates nonpecuniary benefits and costs, $B_n - C_n$. The net nonpecuniary benefits of college are a function of tastes for college, parental income, the performance of the student in high school (A) and a multitude of other personal characteristics. They can be either positive or negative. The net non-pecuniary benefits received while attending college and after completion of college are represented by:

$$2) \quad B_n - C_n = a_0 + a'_1A + a_2\ln Y + a_3X + u_2$$

where Y is real permanent income of families or individuals

X is a vector of family and individual characteristics

Combining pecuniary and nonpecuniary benefits and costs, we have:

$$3) \quad B - C = \theta(W_c - W_n) - 4((1-U).75*W_n + T) + a_0 + (a_1 + a'_1)A + a_2\ln Y + a_3X + u_1 + u_2$$

The individual will chose to attend college if $B - C > 0$.

By assuming that $u_1 + u_2$ has a logistic distribution, the probability that the net benefits of the i^{th} person's college attendance are positive, may be written as a logistic function of $\hat{B}-\hat{C}$ the systematic elements of B-C:

$$4) \quad \text{Prob}(B-C > 0 | \hat{B}-\hat{C}) = \frac{1}{1 + e^{-(\hat{B}-\hat{C})}}$$

For estimating models of dichotomous choice at either the individual or aggregate level, the logistic specification has a considerable number of advantages. Unlike linear probability models and their aggregate counterparts, its predictions are bounded by the zero-one probability interval. Compared to a log-log or semi-log specification, the logit specification has the advantage that the elasticity of the response to a right hand side variable declines as the proportion attending increases. It also has the advantage of having comparable specifications for models of individual and aggregate behavior.

Relative to a probit specification, logit has the advantage of ease of interpretation. The elasticity of attendance with respect to a specific right hand side variable is easily obtained simply by multiplying the logit coefficient (e.g., b_4) by one minus the probability of attending, (that is $n_{c4} = b_4 (1-\hat{P}_c)$). The effect on the probability can be obtained by multiplying b_4 by $\hat{P}_c (1-\hat{P}_c)$.

II. CROSS SECTION ANALYSIS USING INDIVIDUAL DATA

The model used in our cross section analysis of the college entrance behavior of 29,141 young women is different from (6) in two respects. The following equation was fitted by maximum likelihood.

$$5) \quad \ln[P_i/(1-P_i)] = \Theta_0 + \Theta_1 X_{i1} \dots \Theta_n X_{in} + u$$

where $P_i =$ the probability that the "i" th individual attends college within two years of being first sampled in the spring of his junior year in high school.

$X_1 =$ total costs (tuition + travel + room + board - savings at home) at the cheapest feasible college deflated for the local cost of living. (Appendix A describes how this and other cost variables were constructed.) $\bar{X}_1 = \$445$ and $SD_1 = \$230$. $\Theta_1 < 0$.

$X_2 =$ tuition at the cheapest feasible college in hundreds of dollars deflated for the local cost of living. $\bar{X}_2 = \$224$. and $SD_2 = \$160$. Tuition's coefficient is expected to be negative because tuition is measured more accurately than the other components of minimum cost and

tuition may have unique psychological effects on the student's planning.

- X_3 = tuition at the public 4 year colleges in the state. $\bar{X}_3 = \$221$. and $SD_3 = \$102$. The total effect of a general reduction or increase in tuition is given by the sum of Θ_1 , Θ_2 , and Θ_3 . It is hypothesized that $\Theta_1 + \Theta_2 + \Theta_3 < 0$.
- X_4 = the proportion of the states' high school graduating class that is admissible at the cheapest feasible college. The effect of this variable should be close to zero in the highest ability quartile. It is expected to be positive in the other ability quartiles. $\bar{X}_4 = .588$ and $SD_4 = .306$.
- X_5 = 1.0 if the cheapest feasible college is a two-year extension campus of a four-year university without terminal vocational programs; and zero if the cheapest feasible college is either a four-year college or a two-year institution with terminal vocational programs. The variety of program offerings is smaller on extension campuses, so I expect Θ_5 to be less than 0. $\bar{X}_5 = .20$.
- X_6 = the additional cost of attending the cheapest four-year college over the cost of the cheapest feasible college of any type in hundreds of dollars deflated for the local cost of living. For the 42% of the sample where a four-year college is the cheapest feasible college of any type, $\bar{X}_6 = 0$. For the full sample, $\bar{X}_6 = \$189$ and $SD_6 = 218$.
- X_7 = the cheapest feasible college is an away college. Because of the way it interacts with Θ_1 , there is no a priori expectation about sign. $\bar{X}_7 = .12$.
- X_8 = social status of the neighborhood. It is expected to have a positive coefficient because of the aspirations of a student's peers and the quality of the high school are a function of a community's status and resources. It was defined as the real median family income. The neighborhood is defined as the census tracts immediately surrounding the high school in big cities, the town or village in suburbs and small cities, and the rural part of the country in communities with populations smaller than 2500. $\bar{X}_8 = \$6120$ & $SD_8 = \$1460$.
- X_9 = foregone earnings and is defined as three-quarters of the median yearly earnings of female clerical workers in the SMSA or country of residence deflated for the local cost of living. X_9

= \$2157 and $SD_9 = \$336$. There is no a priori expectation for the sign of Θ_9 .

X_{10} = the earnings differential between college and noncollege occupations and is measured in hundreds of 1959 dollars deflated for the cost of living. From an average of median full-time earnings of female elementary school teachers and medical and dental technicians was subtracted an average of full-time bookkeeper and secretaries earnings. The local labor market is either the SMSA of residence or the non-SMSA portion of the state. $\bar{X}_{10} = \$1980$ and $SD_{10} = \$596$. Θ_{10} should be positive because higher monetary returns to college should attract more students.

X_{11} = years of schooling of father. $\bar{X}_{11} = 11.0$, $SD_{11} = 2.5$. Hyp: $\Theta_{11} > 0$.

X_{12} = difference between mother's and father's education. $\bar{X}_{12} = 0.1$, $SD_{12} = 1.2$. Hyp: $\Theta_{12} > 0$.

X_{13} = permanent income proxy. An estimate of family income based on 10 questions about size and value of home, number of cars, and the ownership of various consumer durables. This variable was also used to stratify the sample.

X_{14} = number of siblings. $\bar{X}_{14} = 3.4$. $SD_{14} = 1.9$. Hyp: $\Theta_{14} < 0$.

X_{15} = an index of the frequency and recency of school changes. Frequent changes may reflect an unstable home environment. A change of schools cannot help but disrupt the educational process and the more recent the change the greater will be the effect on college attendance. The variable ranges from 0 to 1.44. $\bar{X}_{15} = .30$ & $SD_{15} = .34$. The coefficient on this variable is, therefore, expected to be negative.

X_{16} = Project Talents' academic aptitude composite minus the students score on the Math Information test. $\bar{X}_{16} = 469$ & $SD_{16} = 131$. Hyp: $\Theta_{16} > 0$.

This model was fitted separately to data for twenty groups of high school juniors, each group defined by ability and family income. Table 1 presents the weighted mean probability of entering college for each of these 20 groups. Student achievement/ability clearly has a major effect on college attendance rates. Holding family income constant, a one standard deviation achievement differential led to a 17.4 percentage point higher probability of attending college (see line 15 of Table 2).

For estimating response to price, the Project Talent data used here are better than any previously available. The large sample size allows the estimation of separate models for different income/ability groups. It is national and thus has variation in the most critical variable, tuition. Even its age is an advantage. Only limited amounts of scholarship aid were available at public institutions in 1961 when our sample was graduating from high school, so the difficulty of satisfactorily modeling the scholarship awarding process does not create serious problems. The method of handling the non-response problem present in Project Talent data is described in Appendix A.

RESULTS

This rather parsimonious logit model proved quite successful in explaining college entrance behavior. For within-strata models R^2 ranges between .538 and .072 and entropy reductions ranged between .298 and .034.² For predicting a zero-one variable in populations stratified on the two most important variables, this range is quite good. The entropy of the distribution before stratification was .633. The average conditional entropy of our models is .432. Thus the combined effect of stratifying by ability and income and the separate logit models is to reduce the uncertainty of a particular individual's choice by almost a third. The six background control variable ($X_{11} \dots X_{16}$) were almost always highly significant. The policy variables ($X_1 \dots X_7$) and the social and economic environment variables ($X_8 \dots X_{10}$) generally had the sign predicted a priori and were statistically significant in about half the strata. (A complete set of the estimated maximum likelihood parameters is available from the author on request.)

Table 2 presents results for a variety of environmental characteristics and policy instruments that effect enrollment in higher education. The impact of each variable or policy on the aggregate proportion of men and women entering college is presented in the first two columns. Their impact on women in specific ability groups or income strata are presented in columns 3 through 11.

The purpose of modeling college entrance is to make predictions about the response of groups to policy. The change in a group's attendance rate per unit change in X_j is obtained by calculating the change in probability for each member of the group and summing across the whole group: $dP/dX_j = \sum_{i=1}^N P_i (1-P_i)\Theta_j/N$. The change

in a group's attendance rate is necessarily smaller (10 to 25% lower in our data set) than the change in the probability of attendance predicted for a person with mean characteristics (i.e., $\hat{P}_i = \bar{P}$). Consequently, predicting the effect of a policy change on group behavior by evaluating logit coefficients at sample means will systematically overstate the expected impact.

Tuition

Examination of the first two columns reveals that the impacts of public policy on college attendance rates were quite large and that they tend to be larger for women than for men. Row 4 provides an estimate of the effect in 1961 of a general rise in tuition of \$200. Such an increase is equivalent to an \$800 increase at current price levels. Its effect is to lower female college attendance from roughly 32.9% to 24%, an 8.9 percentage point drop. From a higher base it lowered male college entrance rates by a smaller 5.7 percentage points. The female tuition elasticity of -.30 was twice the male tuition elasticity of -.15.

The other nine columns of Table 2 allow us to examine how the ability and family background of the student condition the impact of public policy. As was discovered in an earlier study of men (Bishop 1977), responsiveness to tuition seems to be especially large in the middle of the ability distribution and in the middle and bottom of the income distribution. The elasticity of enrollment with respect to tuition is -.77 in the lower middle ability quartile and -.44 in the upper middle ability quartile. Elasticities of demand were -.90 in the poverty strata, -.51 in the lower middle income strata and -.125 in the high income strata. The growth of need based grant and loan aid during the 1960s and 1970s lowered the price of college attendance for poverty and middle income students. Since these groups had particularly high price elasticities of demand, the enrollment expansion that resulted may have been particularly strong.²

Location and Characteristics of Colleges

The effect of reductions in travel, room, and board costs were also larger for women. Establishing a four year public college in a town (which lowered costs of attendance by roughly \$471 in 1961) is predicted to raise their aggregate rate of college entry by 6.7 percentage points.

As anticipated, having a nonselective public college in the community significantly increased college attendance rates of students from the middle of the ability/achievement distribution but only slightly (and

nonsignificantly) increased college attendance of those in the bottom quartile (see row 6). Surprisingly, it appears to have lowered college attendance by students in the top quartile of the ability range. Reducing selectivity had a much larger impact on enrollment rates of graduates from upper income backgrounds than from middle and low income backgrounds.

Establishing public two year colleges in towns that had no public college before also had a substantial impact on college attendance rate. If the junior college that is established has an open admissions policy, college entrance rates are predicted to rise by 4.3 percentage points. The number of large cities with public two and four year colleges with generalized curriculums grew dramatically in the post war period. During the twenty year period from 1955 and 1975 new public four year liberal arts colleges or universities were established in Albany, Atlanta, Baltimore, Boston, Buffalo, Cincinnati, Cleveland, Denver, Hartford, Houston, Milwaukee, New Haven, Pittsburgh, St. Louis, the suburbs of New York and Washington DC and many other cities. The highly selective City University of New York shifted to an open door admissions policy. The number of public two-year institutions in the United States grew from 295 in 1955 to 634 in 1970 and 865 in 1986. In the urban North the proportion of the population living in SMSAs served by a local public two-year college grew from .45 to .90. Most of these institutions had open door admissions policies. The improvement in the accessibility of public colleges and the lowering of admission standards contributed mightily to the explosive growth of female college attendance.

Cultural and Economic Climate

It is well established that when background and academic performance are held constant, growing up in a high income neighborhood increases the probability that young men attend college (Bishop 1977). Surprisingly, living in high income neighborhoods had, in 1961 anyway, the opposite impact on college attendance of women. A \$1000 (a 16%) increase in the median income of the local community lowered overall attendance rates by 0.7 percentage points. The reduction in attendance rates was statistically significant for students from the middle of the ability distribution and from low income families. The only exception to the generalization was young women from high income families, who were significantly more likely to go to college when they lived in high income communities.

The opportunity cost of the female student's time does not seem to have a consistent effect on college entrance rates. The sign of its coefficient (Θ_9) is negative in 9 of the subgroups and significantly so in three. The Θ_9 coefficient is positive in 11 subgroups. The five significantly positive coefficients are all in the middle of the ability distribution and the lower two-thirds of the income distribution. This result contrasts with the impact of foregone earnings on male college attendance where 15 of the subgroups were negative and seven were significantly so. There are three possible explanations for this contrast in results. For a large group of potential female students, lack of substantial financial contributions from parents may make the ability to earn your way through college by part-time work very important. A second explanation may be provided by the observation that in 1961 early marriage was one of the major alternatives to college attendance. Early marriage is likely to be more sensitive to male wages than female wages. The third possible explanation might be that because of variations across SMSA's in commitment to the labor force, median earnings of clerical workers unadjusted for weeks or hours worked may be a more imperfect proxy for female wage rates than the operative wage rate is for male wage rates.

Payoff to College

The local college-high school earnings differential is a rather imperfect representation of the variable--the expected earning payoff--suggested by theory. One might expect geographic variations in the expected earnings differential because an important source of information about this differential--direct observation of the wealthier life style associated with having been a college graduate--is local. Even if there were perfect knowledge, students preferring not to migrate would include the local differential in their calculation. The measure available for this study is the difference between the average median earnings of elementary school teachers and medical and dental technicians and the average for bookkeepers and secretaries. Coefficients were positive as hypothesized in 13 of the subgroups and significantly so in 10. While the coefficients obtained in these models of female behavior are more consistently positive than those obtained for males, the effects implied are nevertheless modest. Row 13 of the Table 2 presents the enrollment impact of a \$600. (one standard deviation) increase in the female payoff. This one third increase in the payoff proxy is predicted to increase female attendance rates by only 1.3 percentage. These small impacts suggest, that either future returns are not known

with any accuracy, are discounted at extremely high (> 50%) interest rates, or that local variations in the return do not affect the formation of expectations about the payoff to college. If one accepts either of the first two explanations, the current decline in the return to college cannot be expected to cause a large reduction in enrollment.

Changes over time in the payoff to college averaged over the entire nation are likely to have larger effects on nationwide enrollments rates than state to state variations in the payoff have on variations in state enrollment rates. The local payoff has a smaller effect because graduates can seek employment elsewhere if college level jobs available locally are poorly paid and because national media such as radio and television has a homogenizing effect on social norms and perceptions of the return to college. National changes in the payoff to college effect perceptions of the monetary benefit of college and social norms regarding whether women should aspire to college much more powerfully than local variations in these returns influence the perceptions and norms which prevail in a particular regional labor market. Consequently, analysis of aggregate time series data is necessary to understand the impact of changes in the payoff to college on female college attendance.

III. TIME SERIES ANALYSIS: 1947-1989

Additional evidence on the role of tuition costs, the payoff to college, the capacity to pay and test scores was obtained by analyzing the determinants of aggregate college enrollment rates during the last forty years.

The data on aggregate college enrollment rates of 18-19 and 20-24 year old women comes from the annual October Current Population Survey. In order to insure that the equation error has relatively constant variance over a forty year period, both sides of equation 1 were divided through by foregone earnings (.75*W_n) and equation 2 was reformulated as a model for the ratio of the nonpecuniary benefits to foregone earnings. The benefit cost calculation that determines college entrance then becomes:

$$4) \frac{B - C}{.75 * W_n} = \frac{\theta(W_c - W_n)}{.75 * W_n} - \frac{4T}{.75 * W_n} - 4(1-U) + (a_0 + a_1)A + a_2 \ln Y + a_3 X + u_1 + u_2$$

The growth path of female college enrollment was assumed to be logistic in form so the dependent variable was assumed to be the logit of the proportion of the group enrolled in college in October of the year.

The time path of the logit of the college enrollment rate of 18-19 year old women is presented in Figure 1.³ The college enrollment rate of 18-19 year old women grew very rapidly during the first two decades of the postwar period, then slowed down during the 1970s and has accelerated again during the 1980s. The model estimated was:

$$5) \ln \frac{P_c}{1-P_c} = b_0 + b_1 \frac{(W_t - W_t)}{.75 * W_n} - b_2 \frac{T}{.75 * W_n} - b_3 U + b_4 A + b_5 \ln Y + b_6 X + v$$

Real per capita personal income captures the rising consumption demand for higher education and improvements in the ability to pay. The unemployment variable is the average unemployment rate for 18 to 24 year old females. The definition, data source, means and standard deviations of the independent and dependent variables are provided in Appendix B.

Enrollment Rates

The results of fitting equation 5 to aggregate time series data on the logit of the enrollment to population ratio of 18-19 year olds and 20-24 year olds for the period 1949 to 1989 are given in the first four rows of Table 3. The influence of a variable on the probability of attendance can be calculated by multiplying its coefficient by $P_i * (1 - P_i)$. Effects of a variable expressed in percentage increases or decreases in enrollment can be approximated by multiplying the coefficient by $(1 - P_i) * 100$. For 1987, consequently, percentage effects can be obtained by multiplying by 57 for 18/19 year old women, by 77 for 20 to 24 year old women and by 66 for ratio of BAs awarded to high school diplomas 4 to 9 years earlier. Table 4 reports calculated percentage effects of historical changes in real income, tuition, test scores and the payoff to college for three different time periods-1949 to 1969, 1969 to 1979 and 1979 to 1989.

Test Scores: There is substantial cross section evidence that academic achievement in high school influences the probability of going to college. This suggests the hypothesis that time series fluctuations in achievement in high school influence aggregate rates of college attendance and completion. In particular one might hypothesize that the decline in achievement during the 1970s lowered college attendance and completion rates? If, however, colleges reacted to the decline in the quality of entering students by lowering admission and graduation standards, there might be no such tendency for college enrollment and graduation rates to decline

when aggregate achievement levels decline. These hypotheses can be tested by including a measure of achievement levels attained by the end of high school to the estimated model. The effect of fluctuations in test scores on college enrollment of the cohorts with low test scores is examined in rows 2, 4 and 5 of Table 3.

The achievement levels of students at the end of high school have varied a great deal over time. Mean scores for 11th and 12th grade students in Iowa are plotted in standard deviation units in Figure 1. During the 1950s and up to 1966 test scores were rising in Iowa and elsewhere around the nation.⁴ In 1966, however, the academic achievement of high school students stopped rising and began a decline that lasted about 13 years. On the ITED the composite scores of Iowa 9th graders dropped .283 Sds and the scores of seniors dropped .35 SDs or about 1.25 grade level equivalents. Comparable declines occurred throughout the country and for junior high school students as well.⁵ It appears that recent efforts to improve the quality and rigor of the curriculum have had an effect, as test scores are rising again. By 1988 Iowa 12th graders had recouped about three-quarters of their previous decline and eleventh graders had surpassed their 1965 record.

High school test score trends had significant effects on aggregate enrollment rates. The 30 percent of a standard deviation decline in test scores between 1969 and 1979 is estimated to have lowered enrollment of 18-19 year old women by 12 percent. The 30 percent of a standard deviation decline in the test scores of 20-24 year olds between 1971 and 1983 lowered enrollment of 20-24 year old women by 5 percent in the model presented in line 4 which freely estimates the tuition coefficient. The rise in test scores during the 1980s means that much of this loss has or will shortly be made up.

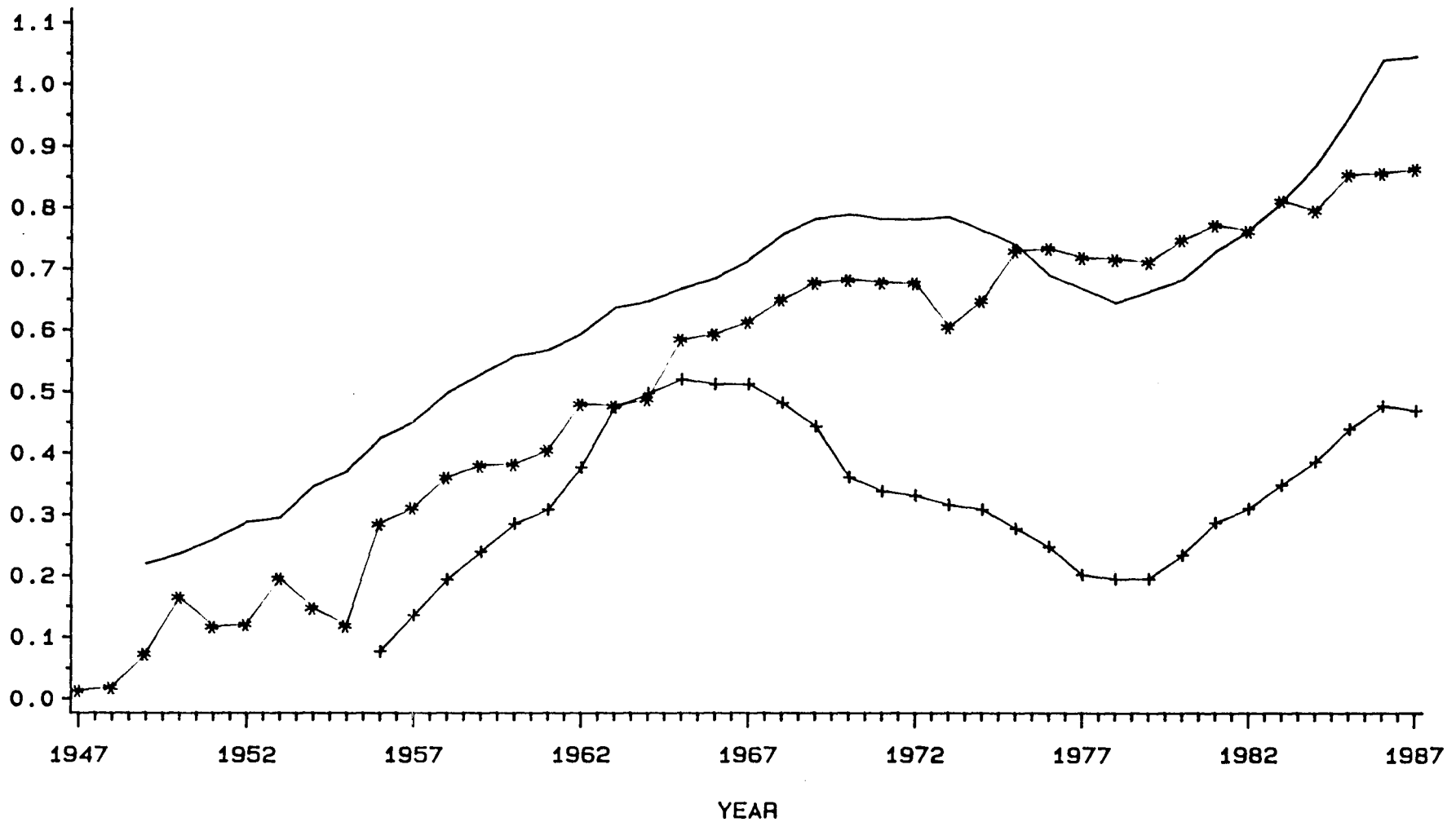
Cost of College: The cost variable is tuition at 4 and 2 year public colleges divided by estimated foregone earnings--the high school weekly wage times 39. This ratio was 7.2 percent in 1948-49, 6.5 percent in 1954-55, 9.0 percent in 1963-64 and 10.57 percent in 1972-73. It fell to 9.3 percent in 1979-80 and then increased to 12.5 percent in 1986-87 and 13.55 percent in 1988-89.

The coefficients on tuition generally range between -5.6 and -16.4. The implied elasticities of demand range from -.33 to -1.00. These elasticities are generally higher than those obtained in cross section studies.⁶

The coefficients on cost suggest that on a per dollar basis, a reduction in out-of-pocket current costs has a much larger impact on attendance than a change in the present discounted value of the difference between college and

THE PAYOFF TO COLLEGE AND ACADEMIC ACHIEVEMENT AND COLLEGE ENROLLMENT RATES

ITEDAV1



+++ ACHIEVEMENT OF JUNIORS AND SENIORS
 *** LOGIT OF COLLEGE ENROLL RATE OF WOMEN 18-19
 --- PAYOFF FOR WOMEN WITH 1-5 YRS OF EXPERIENCE

high school earning streams (even when discount rates on the order of .25 are used). This has also been found in cross section work (Bishop, 1977). The cross section results reported in section 1 can be translated into the time series specification by multiplying by 75 percent of the 1961 clerical wage. This calculation results in a tuition coefficient of -4.73.⁷ This suggests that colinearity problems may have upwardly biased the tuition coefficient in the model predicting enrollment of 20-24 year olds. Consequently, a new model was estimated which sets the tuition coefficient for 20-24 year olds to be equal to the tuition coefficient obtained for 18-19 year olds (-5.6). Estimating the model under this constraint, produces a smaller coefficient on payoff and a larger and now statistically significant coefficient on test scores. Panels 2 and 3 of Table 4 present alternative decompositions of enrollment growth of 20-24 year old women based on the constrained and unconstrained models.

The regressions imply that tuition's tendency to grow much more rapidly than wages has significantly depressed college enrollment. Between 1979 and 1989, public college tuition rose 47 percent more than ability to pay--the wages of recent female high school graduates. The results suggest that this increase in tuition lowered enrollment rates of 18-19 year old women by 16 percent and lowered enrollment of 20-24 year old women by 21 percent in the constrained model and by 52 percent in the unconstrained model. If public college tuition had not risen so substantially, there would have been a much stronger increase in college enrollment during the 1980s.

Payoff: The ratio of the college wage premium to foregone earnings was only 20 percent in 1947-48 but then rose steadily to 78 percent in 1969 before falling back to 64 percent in 1976-78. The wage premium then rose to 105 percent in 1986-87 (see figure 1). It was hypothesized that enrollment would respond to changes in the payoff with a lag so the analysis employed a three year lagged weighted average of this index.

College payoff has a large statistically significant impact on enrollment in all specifications. In the preferred specification where college payoff competes with test score trends, the large increase in the payoff ratio from .22 to .78 between 1949 and 1969 is estimated to have increased the enrollment of 18-19 year old women by 37 percent and the enrollment of 20-24 year old women by 44-78 percent. The decline of the college payoff during the 1970s lowered enrollment by 6 percent for 18-19 year old women and 8 to 14 percent for 20-24 year

old women. The recent rise of the college payoff is estimated to have increased the enrollment of 18-19 year old women by 22 percent and increased the enrollment of 20-24 year old women by 30-52 percent. Increases in the payoff to college have, thus, been one of the primary reasons why female college attendance has exploded.

Real Income: The variable which captures outward shifts in the consumption demand and ability to pay for college is real income per capita deflated by the personal consumption deflator.⁸ Increases in real incomes have also substantially increased college going rates. However, the deceleration of productivity growth after 1973 reduced the growth of real income and this has in turn contributed to the slowdown in the growth of college attendance in the 1970s and 1980s.

Unemployment: It has often been hypothesized that recessions tend to cause an increase in college enrollment. Both of the age groups studied have the hypothesized positive coefficient on the unemployment rate of women 18 to 24 years old but the coefficient is significant only for 18-19 year olds. A recession also lowers income and this makes college less affordable. This has counteracting effects. In the model predicting enrollment of 20-24 year olds, the reduction in real income produced by a recession lowered enrollment more than the rise in unemployment increased it. For 18-19 year olds the two effects would roughly cancel each other, if they operated simultaneously. The unemployment effect is assumed to operate with no lag, however, so enrollment rates are predicted to increase during recessions. Income effects operate with some lag and kick in during the recovery thus depressing enrollment during the upswing that follows a recession.

College Completion of 25-29 Year Olds

The third panel of Table 3 presents an analysis of time series changes in the proportion of 25-29 year olds who have 16 or more years of schooling. Since some of these individuals entered college as much as twelve years earlier, the economic environment was characterized by lagged averages stretching twelve years back. In order to make the hypothesis tests as clean as possible, there was no experimentation with the lag structure. Lagged averages of tuition had no significant effect on the proportion of the cohort completing college, so the variable was dropped from the model.

The impacts of payoff and real income on college completion rates were remarkably similar to their impacts on the enrollment of 18-19 year olds. Rising percapita income increased college completion rates. Table

4 suggests that the growing payoff to college education of women stimulated a 20 percent increase in college completion rates between 1957 and 1969, only a 4 percent increase during the 1970s and then a 16 percent increase during the 1980s.

The test score variable was an average of ITED test scores when the members of the cohort were high school juniors and seniors. The coefficient on test scores is quite large and comparable to the coefficient in the model predicting the enrollment rate of 18-19 year olds. The test score gains of the 1950s and early 1960s contributed to the growth of college completion rates in the 60s and 70s. These effects then reversed in the 1980s. The 23 percent of a standard deviation decline in test scores of 15-19 year olds between 1969 and 1979 produced, a decade later, an 11 percent reduction in the number of college graduates in the 25 to 29 year old age group.

Bachelors Degrees Awarded

The final panel of Table 3 presents an analysis of time series changes in the number of bachelors degrees that colleges report awarding to women. The dependent variable was the logit of the ratio of BA's awarded to women in a given year to the average number of high school diplomas awarded to women 4 to 9 years previously. The lagged weighted average of high school diplomas was used because many BA recipients are substantially older than the 21-22 year old norm. The test score variable was a lagged average of ITED test results using weights identical to those used in constructing the estimate of the average number of high school diplomas awarded. The tuition and payoff variables were unweighted averages of the values for the previous 5 years.

The results are quite similar to those obtained in the enrollment rate models. Contrary to the previous panel but consistent with the enrollment rate results, tuition had significant negative impacts on the award of BAs to women. The coefficient on real per capita income is smaller because BAs are compared to high school diplomas not the number of 25-29 year old women. The coefficient on test scores is highly significant but somewhat smaller than in the enrollment models, probably, because of the base of the ratio is high school graduates rather than the age cohort. It implies that the test score decline reduced the number of BAs awarded in the early 1980s by 7 percent. The results also imply that the increase in the ratio of tuition to ability to pay

during the 1980s lowered the number of BAs awarded in 1989 by 6 percent. Clearly it has been the rising payoff to college that has that has been primarily responsible for the 32 percent increase during the 1980s in the ratio of BAs awarded to high school diplomas awarded 4 to 9 years earlier.

V. PROJECTIONS OF ENROLLMENT AND GRADUATION RATES IN 1997

Table 5 presents simulations of projected changes in enrollment and college graduation rates between 1989 and 1997. For purposes of comparison, the Department of Education's 1989 and 1991 projections are presented in the first two columns of the table. The projections presented in columns 3, 4 and 5 are based on the models presented in Table 3 rows 2, 5, 6 and 7. The predicted effects of the assumed trends in payoff, real income and test scores are given in columns 6 through 9 of the Table 5. The preferred enrollment model for 20-24 year old women imposes a tuition coefficient of -5.6 on the equation. Projections based on these structural models can be no better than the projections of the right hand side variables which are the determinants of enrollment. The forecasted changes in the independent variables between 1987 and 1997 are summarized in column 3 of Appendix Table B. The projections in Table 5 are based on the following assumptions: no change in the unemployment rate, a slow 1.1 percent per year increase in real per capita income from 1989 to 1997, an increase of .01318 standard deviations per year in high school test scores and continued increase in the payoff to college at the rate that prevailed from 1979 to 1989 (.04469 per year).

This last assumption is quite important to the projection results, so the reasons for this assumption need explication. It might be argued to the contrary that recent increases in college completion rates will soon cause a decline in the college payoff as occurred once before at the beginning of the 1970s. Bishop and Carter's (1991) examination of the balance between the projected supply and demand for college graduates in the 1990s predicts, to the contrary, that college graduates are likely to remain in short supply. The college graduate labor force exploded in the 1970s because the cohort entering the labor force in the 1970s was both abnormally large and had college completion rates that were nearly double those of just two decades earlier. The cohort entering the labor force in the 1990s, by contrast, is abnormally small and is projected to have college completion rates that are only 50 percent greater than the previous generation. When this fact is combined with projected increases

in the number of college graduates retiring from the labor force, the result is a slowdown in rate of growth of the supply of college graduate workers during the 1990s.

Bishop and Carter also projected demand for college graduates. Regression based forecasts of occupational shares predict that occupations requiring a college degree will grow in the 1990s at approximately the same rates that prevailed in the 1980s. Bishop's (1992) update of the occupational projections reached the same basic conclusions. If these occupational projections are correct, the wage premium for college graduates is likely to continue to grow in the 1990s.

The projections are sensitive to the assumed behavior of tuition. Between 1979 and 1989 tuition grew 4 percent per year more rapidly than the wages of females who recently graduated from high school. Column 2 presents a forecast which assumes that this will continue from 1990 to 1997. This assumption results in a projection of enrollment growth that is very close to the projections made by the Department of Education in 1991. If the rate of growth of tuition slows to only 2 percent faster than wages, enrollment growth is projected to be 12 percent greater than Department of Education's 1991 forecasts for 18-19 year old women and 14 percent greater for 20-24 year old women. If tuition rises no faster than wage rates, enrollment is projected to exceed Department of Education forecasts by 19 percent for 18-19 year old women and by 29 percent for 20-24 year old women (see column 5).

These projections should be taken with a grain of salt, however, for two reasons. First, despite the small standard errors on the coefficients on payoff, tuition and test score variables, their magnitudes are sensitive to changes in specification and in the time period used to estimate the model. Second, enrollment rates are also sensitive to assumptions about the future path of tuition and payoff. These variables are particularly difficult to forecast accurately, so errors in forecasting these variables may cause projections to be wide of the mark. If, for example, the payoff to college were to stabilize at current levels rather than increasing secularly and tuition continued to grow 4 percent faster than wage rates, the model forecasts that enrollment and graduation rates would stabilize at 1990 levels and enrollment and degrees awarded would fall by more than 7 percent (due to the decline in the size of the 18-24 year old age cohort). Department of Education projections of enrollment would be too high by a significant margin. The projections described in Table 4 might best be seen as "what if"

simulations of the consequences of alternative public policies regarding the funding and pricing of higher education and alternative scenarios for trends in the payoff to college.

Summary

Time series and cross section analyses tell a consistent story about the determinants of college attendance and completion by young women. In both analyses, higher family incomes, higher local unemployment rates and higher test scores increase college attendance and completion rates. The decline in test scores during the 1970s is one of the reasons why college enrollment and completion rates stagnated and fell slightly during the 1970s. Enrollment and completion is also very sensitive to tuition costs and to anticipated labor market benefits of a college degree. In both analyses, a given decrease in tuition had a substantially larger (7 to 10 times greater in the analysis of 1949 to 1989 time series data) effect on enrollment and completion than an equal (in dollars per year) increase in the payoff to college. This means that increases in the number of college students and graduates can be generated much more cheaply by lowering public college tuition than by paying higher wage rates to graduates.

If other things had remained constant, the rapid increase in the college payoff during the 1980s might well have produced an exploding supply of college graduate workers sufficient to halt the continued growth of the college wage premium. Other things did not remain constant, however: test scores of college age cohorts remained below the peaks achieved at the beginning of the 1970s, tuition rose much more rapidly than ability to pay, and the size of the college age cohort fell. These influences partially offset the positive effects of high college wage premiums on college enrollment and degrees awarded. The result was substantial increases in enrollment and graduation rates but stagnation in numbers of full time students and degrees awarded. The 18 to 29 year old cohort which accounts for the bulk of students and BAs awarded will remain small during the 1990s, so despite substantial projected increases in college completion rates, the share of the work force with a college degree is likely to grow only modestly. Demand for college graduates has been projected to continue growing rapidly, so it appears the labor market for college graduates will continue to be much stronger than the labor market for high school graduates.

APPENDIX ON CROSS-SECTION DATA

Data

The data base for the cross-section analysis is 29,141 females who were high-school juniors in 1960 and for whom information was obtained in one of the two Project Talent follow-up efforts. Over 95 percent of our sample are in the Project Talent 5 percent stratified random sample of the nation's high schools, so the juniors originally contacted in 1960 are broadly representative of the total population of juniors (Flanagan [101]). The proportion of these juniors who responded to one of the questionnaires mailed in 1962 and 1966 was only 53 percent, however. More intensive follow-up procedures were used for a 5 percent sample of the mail-questionnaire non-respondents.

A comparison of the two samples reveals that responding to a mail questionnaire is positively related to college attendance. Controlling for family background, the college-attendance rate of the non-respondent sample was two-thirds that of the respondent sample. Probability of responding to the mailed questionnaire is not solely a function of college attendance, however, so an unweighted model will yield biased estimates of many of the crucial parameters. Manski and Lerman (1976) have shown that the solution to this statistical problem is to give each observation in the intensive follow-up sample of mail-questionnaire non-respondents a weight of 20.

Selection of the College That Represents the College Availability Environment

The college used to represent a student's college availability was required to meet the following five conditions:

1. The college had to provide a broad range of programs. Therefore Bible schools, seminaries, and business, engineering, and teachers colleges were excluded.
2. The college had to admit women.
3. The college could not be so selective that it accepted less than 20 percent of the high-school graduating class of the state in which it was located.
4. A denominational college had to be of the same religion-Catholic, Jewish, or Protestant-as the student. There is a very strong tendency for students to avoid denominational colleges. As a result, in 1967 only 2.9 percent of the freshmen at Catholic colleges were Protestant and only 7.7 percent of the freshmen at Protestant colleges were Catholic.
5. In the South, a college generally had to be of the same race as the student. The only exception to this was that if the number of black students at a predominantly white college was either greater than 15 or a higher proportion of the student body than .10 times the black proportion of the state's population, that college was considered biracial. By this very liberal criterion, no white colleges were biracial in Alabama, Georgia, Mississippi, and South Carolina. There were one each in Arkansas and Florida, Seven or eight in Louisiana and

North Carolina, 10 out of 38 in Tennessee, and 39 out of 90 in Texas.

Within the set of colleges defined by the above five conditions, the college that was assumed to be "most attractive" was the one that was least costly to attend. Cost was defined to include travel and incremental room and board costs. A computer program was written so that the 29,141 students in 1500 high schools selected the cheapest college meeting the five requirements described above from the pool of over 2000 possible colleges. Use of the minimum-cost criterion is justified by the fact that the college least costly to attend is the one least likely to be impossible to finance. When financing out-of-pocket costs is not a constraint, the cheapest college will still rank high by other criteria. For the 86 percent of the sample whose minimum-cost college was within commuting distance, the mean distance to the college was 10.8 miles. The physical closeness of the college no doubt increased its salience. Medsker and Trent (1972) found that in towns with a junior college, almost three-quarters of those who went to college attended the local junior college (i.e., the minimum-cost college). Low cost and physical proximity need be dominant considerations for only some of the students, however, for many others will focus on the same college simply because that is where most of their friends are attending. Lower expected pecuniary and nonpecuniary benefits may in specific instances outweigh advantages of low costs, but for students near the margin on the decision to attend or not to attend, this will happen only infrequently. If one of these students is admissible at the low-cost public college of a state, a lowering of that college's expenditures per student or a rise in tuition at higher-cost private colleges is not likely to dissuade the student altogether from attending college. Hopkins [14] found that when tuition and proximity were held constant, a state's college-attendance rates were not related to per student expenditures in the public and private colleges of that state.

This constrained selection of the cheapest form of college attendance usually results in a local public college representing the college-availability environment. Using the approach described above, the primary determinants of the costs of college attendance turn out to be the level of in-state tuition, the distance from the student's high school to the nearest public institution, and whether a student lives in a political jurisdiction with access to a low-tuition junior college.⁹

Except for a variable describing the extra costs of a four-year college, the extra distance of a four year college and the relative admission selecting of a four year college, only the cheapest college's characteristics enter the model.

Cost-of-Living Index: Food at home and comprehensive cost-of living indexes were developed for each state and some of the major SMSAs from data in Lamale and Stroz [1960] and Brackett [1963, 1967]. Where 1960 data were unavailable, 1966 data were used. Price indexes for SMSAs not included in these studies were predicted by an FHA housing-cost index, stat and city sales tax rates, and dummies for subregion. The 1966 study made regional estimates for nonmetropolitan areas, and these were averaged with the local SMSA indexes to produce an index number for each state.

APPENDIX ON TIME SERIES DATA

Economic Payoff to College Completion for Females

Data on incomes of women classified by education are not available for the whole period, so an occupational wage ratio was used to characterize the payoff during the early part of the post war period. The base of the occupational wage ratio is the median yearly wage and salary income of full time full year female clerical workers. For the early years for which this series is not available, it is extrapolated back by the median wage and salary income of all female clerical workers. Prior to 1961 the college wage was a weighted geometric average of four Endicott Survey starting salaries (weight = .44), and the average salary of public school teachers (weight = .56) (Lindquist, various years). After 1961 nursing salaries (weight = .106) and assistant professor salaries (weight = .042) were spliced into the series with Endicott and teacher weights correspondingly reduced.

The teacher salary used was a weighted average of elementary and secondary school teacher wages received by men and women. For most of the period the Endicott surveys did not report women's starting salary offers separately. While the resulting index tends to be dominated by offers made to men, the weights assigned to the college majors for which salary information is available did reflect the distribution of women by major. Wage rates not specific to women were used because no comparable series on the wages of college trained women was available. Between 1969 and 1975 separate information was available on the starting salaries of female college graduates. During this period starting salary offers to women were improving relative to those of men. This index was constructed up through 1975.

A payoff variable for 1963 to 1987 period was constructed from Katz and Murphy's tabulations of CPS data on the weekly earnings of young women classified by years of schooling.¹⁰ The variable was defined as the weekly wages of female college graduates with 1 to 5 years of experience times 52 minus the weekly wages of female high school graduates with 1 to 5 years of experience times 52 all divided by an estimate of the foregone earnings--the weekly wage of high school graduates with 1 to 5 years experience multiplied by 39.

The payoff variable used in the regressions splices together these two series: the college payoff ratio available from 1963 to 1989 and the occupational wage ratio variable available for 1947 to 1963. An average of the two series was used for 1963 to 1975, the period during which two series overlap.

Tuition Costs

For the period 1947-1971 tuition charges for attending public colleges were measured for each state and then averaged using state populations as weights. This was spliced to the mean public college tuition data for 1972 to 1990 reported in U.S Department of Education, Digest of Educational Statistics: 1990, Table 281. and Projections of Educational Statistics to 1981-82, Table 45, National Center of Education Statistics.

For the 1972 to 1989 period, foregone earnings is estimated to be equal to 39 times the weekly wages of female high school graduates with 1-5 years of work experience (Katz and Murphy 1990). A time series for the 1947 to 1972 period was constructed by splicing the mean clerical earnings index used to construct the payoff

variable.

The variable employed in the enrollment rate models is an unweighted average of the current value and one year lag of the tuition ratio. A lagged average was used because it was hypothesized that perceptions of the cost of college would not immediately respond to changes in actual tuition levels and because averaging reduces measurement error.

Test Scores While Cohort was in High School

The variable used to characterize achievement at the end of high school was the mean scores for the age group on the Iowa Test of Educational Development (ITED) when they were 11th and 12th graders all measured in standard deviation units. Data on SAT and ACT tests can not be used because these tests are taken only by college bound students and by a changing share of even this group. These tests were taken initially by highly selected groups of high school students and only more recently by more representative samples of college bound students. Consequently, trends in scores on these tests are biased by the decreasing selectivity of those who took the test. ITED data for the state of Iowa is used because about 95 percent of the public and private schools in the state of Iowa regularly participated in the testing program.

ENDNOTES

1. Bureau of the Census, "School Enrollment--Social and Economic Characteristics of Student: October 1988 and 1987," Current Population Reports, Series P-20, No. 443, April 1990 and "Educational Attainment of the Civilian Population: April 1947," Current Population Reports, Series P-20, No. 15., May 1948.
2. The marginal subsidy cost of an extra student--the per-student subsidy of instructional cost plus the difference between the price paid and the marginal revenue--is inversely related to the elasticity of demand. If the offer of a \$200. grant has the same effect on enrollment decisions as a \$200 reduction in tuition, shifting public subsidy of higher education to financial aid is a more efficient way of stimulating enrollment increases. The results imply that a million dollars spent lowering the general level of tuition in 1961 for new female high school graduates and providing the staff to teach them, would have produced 609 new students. A million dollars made available to students of all abilities from each of the two lower income groups would in 1961 have produced 869 female students from poverty backgrounds and 745 from lower middle class backgrounds. It is quite likely, however, that grant aid has smaller effects on college enrollment probabilities than equivalent reductions in tuition. Important decisions which influence college access are made in middle school and the early years of high school. A state policy of low tuition and many accessible colleges is likely to have larger effects on these decisions than the uncertain prospect of need based financial aid to attend expensive geographically remote colleges. Consequently, it is not surprising that a number of studies have found that dollar for dollar, grant aid has a smaller effect on attendance than tuition reductions. Lee Hansen (1984) argues that the expansion of student aid between 1972 and 1980 did not result in students from low income backgrounds becoming a larger proportion of college students.
3. In order to place the logit on the same scale as the other variables plotted in Figure 1, the variable that is plotted is one-half the logit plus one.
4. Data on ITED trends was kindly provided by Robert A. Forsyth (personnel communication) "Achievement Trends for the Iowa Tests of Educational Development in Iowa: 1942-1985," Iowa City:Iowa Testing Programs, 1987. Other tests that have been administered for long spans of time to stable test-taking populations also exhibit a positive trend during this period (Roger Farr and Leo Fey, 1982). Between 1958 and 1966 Minnesota high school juniors gained .39 Sds on the Minnesota Scholastic Aptitude Test (Edward Swanson,1973) The periodic national standardizations of the ITED also exhibit an increase during the 1960s.
5. From peak to trough the decline for seniors was .38 SDs on the SAT and .32 SDs on the ACT. For 11th graders it was .28 SDs in the Illinois decade study, .24 SDs on the Preliminary Scholastic Aptitude Test and .22 SDs on the California Achievement Test. The scores of 9th and 10th graders declined .42 SDs on the Metropolitan Achievement Tests. Koretz, Daniel, et. al. Trends in Educational Achievement.

Washington: Congressional Budget Office, 1986 and Brian K. Waters, The Test Score Decline: A Review and Annotated Bibliography, Technical Memorandum 81-2, Directorate for Accession Policy, Office of the Secretary of Defense, April, 1981.

6. Hopkins (1974) obtained a public college tuition elasticity of -.10 for aggregate enrollment. At public college tuition of \$200 in the early 1960s, the regressions in Corazzini et al (1972) imply an elasticity of aggregate enrollment to a simultaneous change of all public college tuition of -.20. Bishop (1977) analysis of male college entry rates found tuition elasticities of -.39 for those from a poverty background and -.08 for those with high income parents. Bishop and Van Dyk (1977) analysis of adult college attendance rates in 1970 obtained tuition elasticities of -.44 for husbands and -.58 for wives.

7. In the cross section analysis a \$100. increase in tuition at all public institutions lowered the proportion of juniors enrolling in college by .04436 at a time when .329 of juniors were attending. The logit coefficient for an aggregate model necessary to produce an equivalent change is $-.04436 / (.329 * .671) = -.2009$. In 1961 the foregone earnings variable ($.39 * \text{weekly wage for high school graduates with 1-5 years of experience}$) was \$2356. Consequently, if the tuition variable in the aggregate model is normalized by foregone earnings, the coefficient of the aggregate model that produces this change would need to be $-.2009 * (\$2356 / \$100) = -4.73$.

8. Real income per capita grew 2.27 percent per year during the 1950s and 1960s, 2.23 percent per year in the 1970s and 1.6 percent per year during the 1980s. Real income per capita deflated by the personal consumption deflator is a better measure of ability to pay than alternatives like median family income for three reasons. Increasing numbers of students are not receiving support from their parents and the number of children per family is falling. Per capita income handles these problems. Secondly, most dependent students come from upper middle income families which are better represented by mean income than by median family income. Finally, the personal consumption deflator is a better deflator than the Consumer Price Index for Urban Consumers. The CPI-U tends to exaggerate inflation because it is a fixed weight index and because home ownership costs were incorrectly measured for many years. When median family income was experimentally substituted for real percapita income, the fit of the models deteriorated substantially. Bishop (1992) presents results obtained when an index constructed from CPS data on the proportion of adults with at least 12 and at least 16 years of schooling is substituted for real percapita income. The substitution causes an increase in the coefficients on test scores and tuition and marginally lowers the fit of the model.

9. In 1961, many publicly supported institutions charged lower fees to students who applied from within the district that provided financial support. Schools of this type were the municipal universities of Kansas, Kentucky, Ohio, Nebraska and New York and public junior colleges in Arizona, Colorado, Florida, Idaho, Illinois, Iowa,

Maryland, Massachusetts, Michigan, Minnesota, Missouri, Nebraska, Oregon, Texas, and Wyoming. In some states the in-out district price differential was small-\$40 or so in Iowa-but in others, Illinois and Maryland for instance, it was between \$200 and \$300.

10. Lawrence Katz and Kevin Murphy, "Changes in Relative Wages, 1963-1987: Supply and Demand Factors," 1991. Koster's (1991) data on hourly wage rates from the May CPS through 1988 was used to update the series to 1988. Estimates of changes in relative wage ratios between 1988 and 1989 were based on weekly wages of fulltime workers by occupation from January issues of Employment and Earnings. Trends for college graduates were approximated by professional and managerial workers and trends for high school graduates were approximated by clerical workers and sales workers in retail and personal service industries.

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Table B**Means and Standard Deviations of
Variables in the Time Series Analysis**

	Mean	Standard Deviation	Change Projected 1987-97
Logit of:			
Enrollment Rate of 18/19 Year Olds	-.891	.500	
Enrollment Rate of 20-24 Year Olds	-1.988	.666	
College Graduate Share for 25-29 Yr Olds	-1.736	.476	
Ratio of BAs to HS Diplomas	-1.049	.302	
 Independent Variables			
Payoff: 3 Year Average	.655	.229	.404
5 Year Average	.684	.182	.373
12 Year Average	.633	.174	.425
Real Income: 3 Year Average	2.021	.259	.151
5 Year Average	2.029	.232	.181
12 Year Average	1.982	.225	.191
Tuition Ratio: 2 Year Average	.093	.018	.061
5 Year Average	.092	.014	.054
Test Score: 18/19 Year Olds	.070	.161	.147
20-24 Year Olds	.026	.162	.235
25-29 Year Olds	.053	.169	.206
BA recipients	.051	.151	.254
Unemployment Rate of 18-24 Year olds	.101	.025	.000

Table 1
Probability of a Woman Entering College in 1961
by Ability and Family Income

Family Income	Ability Percentile				All Abilities
	Top Quartile	Second Quartile	Third Quartile	Bottom Quartile	
High	.810	.501	.361	.387	.583
High-Middle	.760	.412	.219	.167	.459
Middle	.610	.319	.132	.240	.344
Low-Middle	.511	.192	.130	.106	.224
Poverty	.358	.140	.085	.056	.116
All Incomes	.640	.310	.157	.167	.329

Table 2
 Changes in the Percent of a Community's Female High School Juniors Entering College
 Resulting from Selected Changes in Public Policy or Environment

	<u>Men</u>	<u>Women</u>	<u>Achievement/Ability Quartiles</u>				<u>Family Income</u>				
	Total	Total	Top	2nd	3rd	Bot	High	HighMid	Middle	LowMid	Poverty
Percent Entering College Higher Education Policies	40	33	64	31	16	17	58	46	34	23	12
1) College in center rather than the outskirts of a city with a 6-mile radius ^b	.6*	1.0*	1.2*	1.5*	.2	.8*	.9*	.3	1.6*	.5*	1.2*
2) 4-year public college established in town with none before ^e	4.2*	6.7*	9.2*	6.7*	.4	9.4*	-6.3*	4.2*	10.5*	12.4*	1.9
3) Transforming an extension campus into a community college ^e	4.6*	-.7	1.2	0	-4.3*	-.3	-6.3*	2.8	1.6	.4	-5.8*
4) Tuition at all public colleges raised \$200	-5.7*	-8.9*	-7.1*	-12.1*	-10.8*	-5.9*	-6.5*	-7.7*	-9.2*	-10.1*	-9.3*
5) Tuition at 4-year public colleges raised \$200 while 2 year tuition remains constant ^f	-1.2*	-5.7*	-3.8*	-7.4*	-6.1*	-5.5*	-.6*	-2.6	-8.8*	-6.5*	-4.8*
6) Open admission replaces a 50 percent cutoff	3.8	2.6*	-4.5*	6.6*	6.1*	2.9	6.4*	3.5	1.2	2.0	1.9
7) 2-year community college established in town with none before ^e	1.4	3.0	6.2	2.9	-4.2	5.9	-8.4	-.8	4.1	11.8	-2.3
8) 2-year community college with open admissions in town with none before ^e	3.3	4.3	4.0	6.2	-1.1	7.4	-5.2	1.0	4.7	12.8	-1.3
9) Move to a neighborhood with \$1000 higher mean family income	1.6*	-.7*	.1	-1.0*	-3.0*	.8	1.4*	-.7	1.4	-3.2	-2.4

10) Have a family with \$1000 higher income ^d	2.7	2.7	4.7	3.2	1.6	1.3	-	-	-	-	-
11) Have one more sibling	-1.5*	-1.5*	-2.4*	-2.0*	-1.8*	0.0	-2.2*	-2.7*	-1.2*	-1.5*	-5*
12) Foregone earnings higher by \$200	-.5*	.2	-1.0*	.6	1.8*	-.4	-.1	-1.1	-.3	1.2	.6
13) Future earning difference higher by \$600 a year (one SD)	1.3*	1.3*	1.8*	1.6*	.7	1.0+	3.6*	2.1*	.3	1.3	.3
14) Both parents one more year of schooling	-	3.3*	3.9*	3.8*	2.2*	3.0*	4.0*	3.5*	4.6*	2.1*	1.5*
15) Academic Aptitude (one SD)	-	17.4	-	-	-	-	17.0	24.5	14.7	17.4	13.2

Notes: The hypothesis tests reported in this table are for the weighted average of the logit coefficients where the weights are those that produce the estimate of the change in proportion attending for a whole quartile or stratum (i.e., for a combination of groups).

$$\frac{dP}{dX_{jt}} / \sigma_{jk} = \frac{\sum w_{jk} \theta_{jkt}}{(\sum w_{jk}^2 \sigma_{jk}^2)^{.5}}$$
 where the summations are over k, which indexes the 20 subgroups. σ_{jk} is the variance of the coefficient on the jth variable in the kth subgroup. The t tests are one tail for lines 1-6, 11, 13 and 15 and two tail for line 14 and 16. Lines 7-10 are not tested because they are combinations of coefficients. *indicates significance at .01 level. + indicates significance at the .05 level.

Table 3
College Attendance of Women

	Payoff/ Foregone Earnings	Log Per Capita Income	Tuition/ Foregone Earnings	Unemploy Rate Fem. 20-24	Test Score	R2	RMSE	DW/obs
Logit of the Enrollment Rate of 18-19 Year Olds 1949-1989	1.65*** (.22)	1.04*** (.14)	-10.36*** (2.60)	2.00*** (.78)	----	.973	.083	1.21/41
	.76*** (.30)	1.18*** (.13)	-5.60** (2.55)	2.61*** (.68)	.61*** (.16)	.980	.071	1.63/41
Logit of the Enrollment Rate of 20/24 Yr Olds 1949-1989	1.65*** (.24)	2.17*** (.15)	-16.44*** (2.75)	.69 (.82)	----	.983	.087	1.59/41
	1.44*** (.27)	2.09*** (.16)	-14.13*** (3.20)	.95 (.83)	.20 (.15)	.983	.086	1.72/41
	.82*** (.16)	1.91*** (.16)	-5.60 ---	1.66* (.85)	.42*** (.15)	.980	.093	1.35/41
Logit of Proportion of 25-29 yr olds with College Degree 1957-1989	.60*** (.16)	1.33*** (.09)	---	---	.60*** (.08)	.989	.043	1.92/29
Logit of the Ratio of BAs to HS Grads 4 to 9 Yrs Before 1954-1989	.89*** (.09)	.62*** (.05)	-2.72** (1.33)	.40 (.38)	.32*** (.05)	.994	.023	1.22/36

* p<.05 on a one tail test

** p<.025 on a one tail test

*** P<.005 on a one tail test

Standard errors are in parentheses under the coefficient. Dependent variables: Data on college enrollment and completion rates is from various issues of the Current Population Reports, Series P20. The number of high school diplomas and bachelors degree are from table 89, and 200, Digest of Educational Statistics and Douglas Adkins (1975). In the enrollment models the real income and payoff variables are weighted averages with weights of .4 on year t, .33 on year t-1 and .27 on year t-2. For the models predicting the proportion with 16+ yrs of schooling at age 25-29, the real income and payoff variables are ten year trailing averages lagged 1 year. The test score variable is an average of ITED test scores when members of the cohort were juniors and seniors in high school. In the college graduation to high school graduate ratio models, the payoff and tuition variables are unweighted averages for t-1, t-2, t-3, t-4 and t-5. The test score for the graduation rate model is a weighted average with 21 yr. olds having a weight of .5 and 22 to 26 yr. olds having weights of .1 each. The third model estimated for the enrollment of 20-24 year olds imposed a coefficient of -5.6 on the tuition variable. This value was selected because both the cross section analysis and the time series analysis of 18-19 year olds obtained this value.

Table 4
Accounting for the Post War Growth
of Female College Attendance

	Predicted Effects*					Actual Increase
	Payoff	Real Income	Tuition	Acad. Achiev.	Unemp.	
College Attendance of 18-19 Yr. Olds						
1949-69	37%	46%	-10%	26%	0%	153%
1969-79	-6%	17%	0%	-12%	0%	4%
1979-89	22%	12%	-16%	10%	-3%	23%
College Attendance of 20-24 Yr. Olds (free estimate)						
1949-69	78%	92%	-28%	9%	0%	350%
1969-79	-14%	40%	-1%	-3%	-3%	28%
1979-89	52%	27%	-52%	1%	-1%	37%
College Attendance of 20-24 Yr. Olds ($b_{TUITION} = -5.6$)						
1949-69	44%	84%	-11%	18%	-1%	350%
1969-79	-8%	36%	-1%	-5%	-5%	28%
1979-89	30%	25%	-21%	2%	-2%	37%
College Completion of 25-29 Yr. Olds						
1957-69	20%	30%	0%	10%	0%	71%
1969-79	4%	29%	0%	13%	0%	60%
1979-89	16%	17%	0%	-11%	0%	12%
Ratio of BA's to HS Grads 4 to 9 Yrs. Earlier						
1954-69	33%	17%	-4%	10%	1%	64%
1969-79	-5%	11%	-1%	-1%	1%	6%
1979-89	27%	9%	-6%	-1%	0%	32%

* Calculated from Table 2 by multiplying an X variable's coefficient times $(1-P_t)$ times $(X_{t+10}-X_t)$, the change in the X variable over the sub-period. The sum of the effects of the five variables do not equal the actual percentage increases reported in column 6 because the effects interact in a multiplicative way, the functional form is not linear and there are random errors in the model.

Table 5
Projections of College Enrollment and Graduation Rates for Women
Percentage Increases 1987 to 1997

<u>published in</u>	Projections by Dept. Education		Tuition Growth Relative to Wage Growth			Projected Effect on Enrollment				
	4% 1989	2% 1991	No Faster	Payoff Faster	Payoff Faster	Real Tuition	Test Inc.	Scores		
<u>Enrollment Rate</u>										
18-19 Year Olds	9.6%	10%	13%	22%	29%	17%	10%	-19%	5%	
20-24 Year Olds ($b_{TUITION} = -5.6$)	13%	27%	29%	43%	56%	27%	23%	-28%	8%	
<u>Ratio BAs/HS Grads</u>										
4-9 yrs earlier	19%	39%	30%	34%	39%	22%	7%	-10%	5%	
Number of BAs	0	17%	10%	12%	17%	--	--	--	--	
<u>College Grad. Share</u>										
of 25-29 Yr olds	----	---	49%	49%	49%	20%	20%	--	10%	

Source: The projections made by the Department of Education were presented in Projections of Education Statistics to 2000 (1989) and Projections of Education Statistics to 2002 (Dec. 1991), Table A1.3 and Table 28. My projections assume that between 1989 and 1997 the contemporaneous measures of high school test scores grow at .01318 SDs per year, real percapita income grows at 1.1 percent per year and the ratio of the payoff to foregone earnings grows at .04469 per year. Between 1979 and 1989 tuition grew 4 percent per year more rapidly than the wages of females who recently graduated from high school. The third column of the table presents the baseline projection which assumes that tuition will grow 4% more rapidly than the wages rates of women who have recently graduated from high school. The fourth and fifth columns present projections for the less likely scenario that tuition will grow only 2 percent more rapidly than wages and that the two grow at the same rate. Columns six through nine of the table present the forecasted impact of payoff, real income, tuition and test scores on the growth of college enrollment and completion rates for the most likely scenario of tuition growing 4 percent per year faster than wage rates. It was calculated in the same manner as the numbers in Table 4.