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FEMALE COLLEGE
ATTENDANCE:
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.

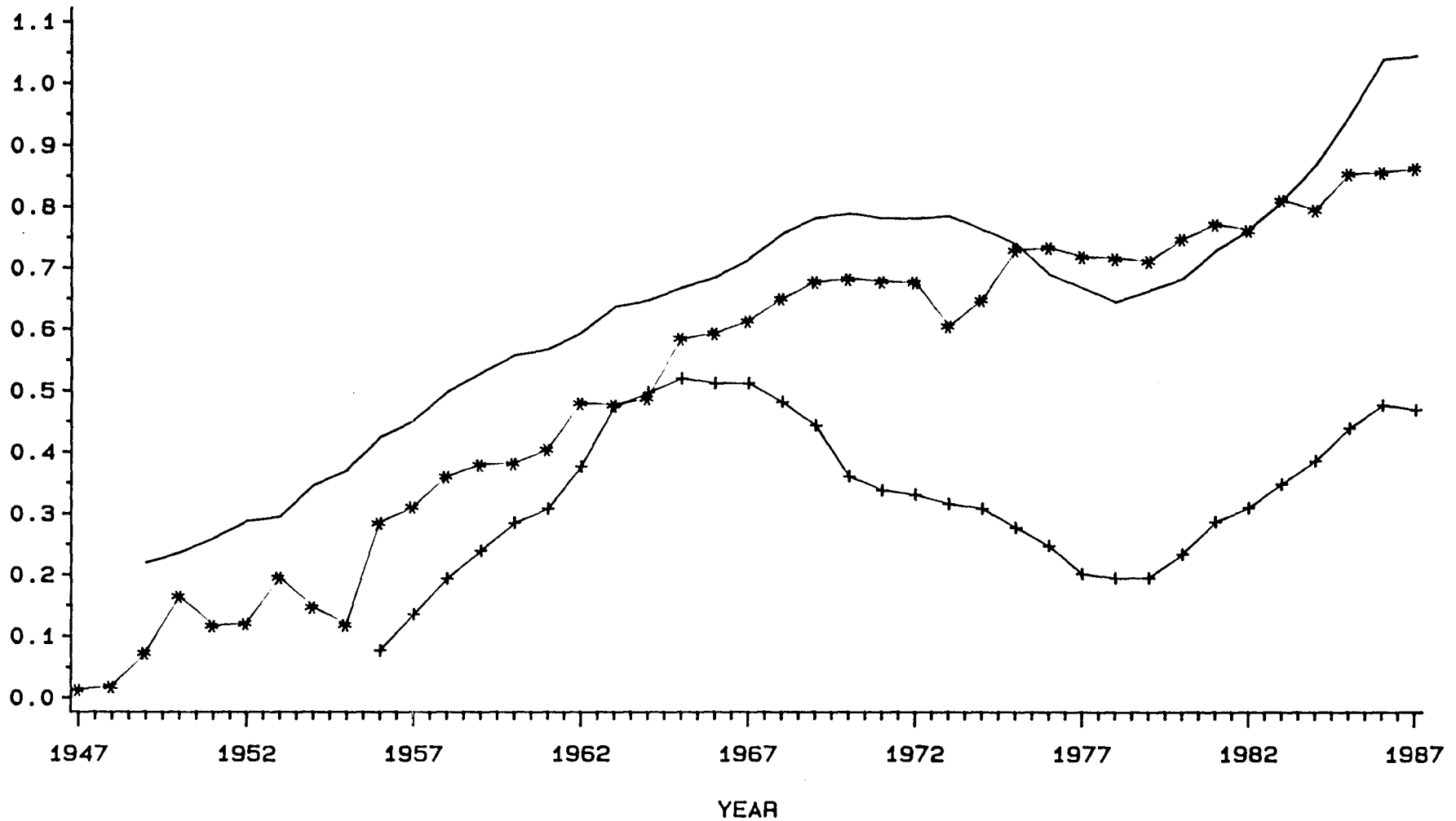
Cost of College: The cost variable is tuition at 4 and 2 year public colleges divided by estimated foregone earnings--the high school weekly wage times 39. This ratio was 7.2 percent in 1948-49, 6.5 percent in 1954-55, 9.0 percent in 1963-64 and 10.57 percent in 1972-73. It fell to 9.3 percent in 1979-80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

