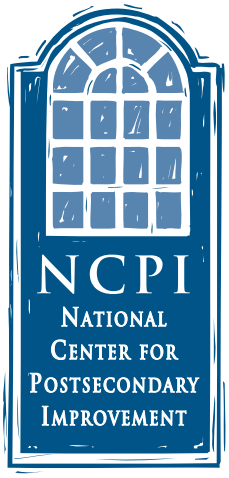

How Responsive is the Supply of Female College Graduates to Tuition and Payoff?

JOHN BISHOP

National Center for Postsecondary Improvement
Stanford University
School of Education
520 Galvez Mall, 508 CERAS
Stanford, CA 94305-3084

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Introduction

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 14-24 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 (Bureau of the Census 1948, 1990).

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 (e.g., 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?

Both time series and cross-section studies have found that higher tuition lowers college attendance. (Campbell and Siegel 1964, Bishop 1977, Jackson and Weathersby 1975, Leslie and Brinkman 1985, Kane 1995). What impact did the recent escalation of tuition charges having on college enrollment rates?

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 One, a simple model of the college attendance decision is developed, which incorporates most of the factors discussed above. Section Two presents the results of fitting the specification implied by the theory developed in

Section One 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 affecting instate tuition levels, to the proximity of public colleges, and to the 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 Three 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 slowed the growth of college enrollment, particularly of women between 20 and 35 years of age.

Section Four of the paper offers projections 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 U.S. 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 tuition grows at the same rate as wages, the enrollment equations forecast that female college attendance will grow 20 percent more rapidly than the Department of Education currently projects.

SECTION ONE: 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) $B_m - C_m = \boldsymbol{O}\ (W_c - W_n) - 4((1-U).75*W_n + T) + a_1A + u_1$

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

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

$\boldsymbol{O}$ 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 non-pecuniary 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) $B_n - C_n = a_0 + a'_1 A + a_2 \ln Y + a_3 E + a_4 X + u_2$

where Y is the real permanent income of the student's family,

E is the Schooling of the student's mother and father, and

X is the a vector of family and individual characteristics.

Combining pecuniary and nonpecuniary benefits and costs, we have:

3) $B\text{-}C = a_0 + (a_1 + a'_1)A + a_2 \ln Y + a_3 E + a_4 X + \Theta(W_c - W_n) - 4((1-U).75W_n + T) + u_1 + u_2$

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

Section Two: Cross-section Analysis of Project Talent Data

To estimate the response of enrollment demand to geographic variations in availability of colleges and cost of attendance, one must know the characteristics of local public colleges that the student is academically eligible to attend. This requires exact information on the location of the student's high school, which is not available in data sets like NLS Class of 1972 and High School and Beyond. Thus, for estimating response to price and availability, the Project Talent data used here is, despite its age, the best available data set. The study is longitudinal and consequently, a large battery of tests provide the measure of student achievement, the quality of the student's high school is measured directly, and the dependent variable is actual attendance rather than plans to attend. The large sample size allows the estimation of separate models for different income groups. It is national and thus has variation in critical variables such as payoff to college completed and the cost of attending college. 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. There are problems with the response rate for the Project Talent Sample, however; these problems are dealt with by assigning members of the special sample of non-respondents a weight of 20.

Models were estimated predicting the college enrollment of 29,141 young women who were juniors in high school in 1960.[1]

4) $P_i = + b_0 + b_1X_{i1} .... b_NX_{1N} + u$

where P_i takes on the value of 1 if the 'i' th individual attends college within two years of being first sampled in the spring of her junior year of high school and the value of 0 otherwise.

The most important determinant of college attendance is likely to be aptitude.

X_1 = Project Talent's academic aptitude composite minus the students score on the Math Information test and normalized to have a standard deviation of one. Hyp: $b_1 > 0$.

The social and economic status of the student's parents was represented by five variables:

X_2 = number of years of schooling of father. $X_2 = 11$. $o_2 = 3.0$. Hyp: $b_2 > 0$.

X_3 = difference between mother's and father's education. $X_3 = 0.0$. $o_3 = 1.2$. Hyp: $b_3 > 0$.

X_4 = permanent income proxy. An estimate of family income based on 10 questions about family income, the size and value of home, number of cars, and the ownership of various consumer durables. This variable was also used to stratify the sample. Hyp: $b_4 > 0$.

X_5 = father has white-collar occupation. $X_5 = .314$. Hyp: $b_5 > 0$.

X_6 = Project Talent's Socio-Economic Status Index—P*801. $X_6 = 98.2$, $o_6 = 10$.

There were two variables measuring the social status of the neighborhood in which the student went to high school.

X_7 = median years of schooling of men and women in the community. 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. $X_7 = 10.4$. $o_7 = 1.5$. Hyp: $b_7 > 0$.

X_8 = real median family income in hundreds of dollars. 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. X_8 = \$6120 o_8 = \$1460. It is expected that the sum of the standardized coefficients on these variables will be positive because the aspirations of a student's peers and the quality of the high school are a function of a community's status and resources.

Three variables were defined to capture the effects of frequently switching schools.

X_9 = Changed schools two or more times since entering the first grade (not counting promotions from one school to another). X_9 = .281. o_9 =.450. Changing schools disrupts the educational process, so: Hyp: $b_9 < 0$.

X_{10} = Changed schools five or more times since entering the first grade (not counting promotions from one school to another). X_{10} = .075. o_{10} =.263. Hyp: $b_{10} < 0$.

X_{11} = an index of the recency of the latest change of school. Changes "about one year ago" were coded 1, changes "about two years ago" were coded .5, "about three years ago" were coded .33, "about four years ago" were coded .25, and changes "about five or more years" ago are coded .1. More recent changes of school should have larger effects on college attendance. X_{11} =.185. o_{11} =.267. Hyp: $b_{11} < 0$.

Other background characteristics whose effects were estimated included the following:

X_{12} = index of student and parental involvement in religious activities.

X_{13} = number of siblings. X_{13} = 3.7. o_{13} = 2.2. Hyp: $b_{13} < 0$.

X_{14} = Black. X_{14} =.076.

X_{15} = % Black in high school.

X_{16} = residential high school. X_{16} = Hyp: $b_{16} > 0$.

The ten variables that characterized the availability of local colleges and the out-of-pocket costs of attendance were:

X_{17} = total costs (tuition + travel + room + board - savings at home) at the cheapest feasible college in hundreds of dollars deflated for the local cost of living. Hyp: $b_{17} < 0$.

X_{18} = 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 percent of the sample where a four-year college is the cheapest feasible college of any type $X_{18}=0$, Hyp: $b_{18} < 0$.

X_{19} = tuition at the cheapest feasible college in hundreds of dollars deflated for the local cost of living. The coefficient on tuition is expected to be negative because a) tuition is measured more accurately than the other components of minimum cost, b) the other public colleges of the state typically have the same tuition, c) tuition may have unique psychological effects on the student's planning.

X_{20} = distance to the cheapest feasible college.

X_{21} = Difference between the distance to a four-year college and the cheapest feasible college.

X_{22} = the proportion of a state's 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.

X_{23} = difference between admissions cutoff at a four-year college and the admissions cutoff at the cheapest college.

X_{24} = the cheapest feasible college is an away college. $X_{24} = .12$.

X_{25} = the cheapest feasible four-year college is an away college. $X_{25} = .39$.

X_{26} = 1.0 if the cheapest feasible college is a two-year extension campus of a four-year university without terminal vocational programs and 0 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 much smaller on extension campuses, so we expect b_{26} to be less than 0.

The variables which characterized the time costs of college attendance, $[(1-U).75*W_n]$, were:

X_{27} = foregone earnings index is the median yearly earnings of female clerical workers in the SMSA or county of residence deflated for the local cost of living.[2] The hourly wage has a mean of $0.89 per hour and a standard deviation of $0.14. There is no a priori expectation for the sign of b_{26}.

X_{28} = SMSA unemployment rate.

The two variables characterizing the payoff to college, $[\mathbf{O}(W_c-W_n)]$, were:

X_{29} = the difference in 1959 dollars between the income of college graduate and high school graduate women. It is defined separately for urban and rural parts of each state and is deflated by the cost of living in that area.

X_{30} = the earnings differential between college and noncollege occupations. It is measured in 1959 dollars deflated for the local cost of living. An average of full-time bookkeeper and secretary earnings was subtracted from an average of median full-time earnings of female elementary school teachers and medical and dental technicians. The local labor market is either the SMSA of residence or the non-SMSA portion of the state. Hyp: $b_1+b_2 > 0$ because higher monetary returns to college should attract more students.

It was anticipated that many of these variables would have different effects on young people from different economic backgrounds. Consequently, the model was fitted separately to data for five groups of high school juniors, each group defined by family income. Student aptitude had a powerful effect on college attendance in all income groups. A one standard deviation increase in aptitude raised the probability of college entrance by 13.5-14 percentage points in the low-, middle-, and high-income groups, and by 17.3 points in the lower-middle-income group and by 22 points in the upper-middle-income group.

Socio-Economic Status of the Student's Family

Students from poverty backgrounds had significantly lower college attendance rates (11.3 percent) than students from high-income backgrounds (58.3 percent). The first panel of Table 1A presents estimates of the impact of specific dimensions of socioeco-

Table 1A. Impact of Family and Neighborhood Characteristics on College Entrance Rates of Females in 1961

		Family Income Quintile				
	Mean	Low	Low Mid	Middle	High Mid	High
Percent Attending	(std. dev)	11.6%	22.4%	34.4%	45.9%	58.3%
Aptitude Test	0.0	.135***	.173***	.143***	.221***	.140***
	1.0	(16.24)	(28.27)	(22.22)	(23.25)	(14.57)
Parent's Education and Income						
Father's Schooling (Years)	11.44	.0104***	.0158***	.0490***	.0313***	.0391***
	(2.47)	(3.54)	(6.88)	(19.70)	(9.15)	(12.18)
Difference between Mother's and Father's Schooling	0.10	.012**	.0107**	.0501***	.0305***	.0302***
	(1.13)	(2.16)	(2.57)	(10.34)	(4.84)	(4.69)
Family Income-across strata (controls Ability only) ($'000s)		.0648	.0862	.0884	.0755	
Family Income--within strata (full set of controls)		.030***	-.010	-.017	.012	.031***
		(3.27)	(1.27)	(1.89)	(.96)	(4.30)
Father is White Collar Worker	.268	.098***	.035***	.047***	.078***	.160***
	(.443)	(4.45)	(2.84)	(4.04)	(5.10)	(8.90)
Socio-Economic Index	98.2	.011	.0047***	-.0012	.0001	.0011
	(10.0)	(.99)	(4.98)	(.81)	(.13)	(.82)
Neighborhood Characteristics						
Median Years of Schooling in neighborhood	10.45	-.0023	-.0005	.0234***	.0164***	-.0011
	(1.45)	(0.45)	(0.14)	(6.01)	(2.82)	(0.20)
Median Real Family Income in neighborhood ($'000s)	6.12	-.0033	-.0167***	-.0006	-.009	.0090*
	(1.24)	(.46)	(3.18)	(.13)	(1.48)	(1.67)
Changing Schools						
Changed 2 or more Times	.281	-.031**	.002	-.071***	-.078***	-.025
	(.450)	(2.13)	(.15)	(5.87)	(4.80)	(1.54)
Changed 5 or more Times	.075	-.040**	- .035**	-.081***	.022	-.032
	(.263)	(2.10)	(2.22)	(4.24)	(.86)	(1.39)
Recent Change (Inverse of Years since Last Chg.)	.185	-.028	-.050***	-.008	-.080***	-.099***
	(.267)	(1.26)	(2.85)	(.40)	(3.12)	(4.11)
Other Characteristics						
Religious Act.- Parents & Stud.	.945	.0056	.0276***	.0269***	.0132***	.0008
Very or Extremely Active	(1.60)	(1.41)	(9.60)	(9.48)	(3.41)	(.24)
Number of Children	3.37	-.0047**	-.0115***	-.0160***	-.0256***	-.0160***
	(1.93)	(2.22)	(6.06)	(6.69)	(7.39)	(4.38)
Student is Black	.056	.085***	.165***	.010	.316***	.389***
	(	(2.88)	(5.72)	(.26)	(4.04)	(3.81)
Proportion of HS Black	.067	.086**	-.031	.070	-.314***	-.570***
	(.21)	(2.45)	(.91)	(1.57)	(3.42)	(4.96)
Residential High School	.028	.185***	-.033	-.012	.144***	.107***
	(.166)	(6.08)	(1.31)	(.42)	(2.87)	(2.94)

Source: Analysis of Project Talent data on the college attendance rates in 1961 of high school Juniors in 1960. T statistics in parenthesis. * = p<.10 on a two tail test; ** = p<.05 on a two tail test and *** = P<.01 on a two tail test

nomic status (X_1 to X_6). Clearly, mother's education was the single most important family determinant of a young woman's college attendance. The difference between the mother and the father's education was statistically significant in all income strata and roughly equivalent in magnitude to the father's education variable. Holding occupation, family income, and father's schooling constant, four extra years of schooling for the mother increased attendance rates by 4.8 to 4.4 percentage points in poverty and lower-middle-income groups, by nearly 20 points in the middle income group, and by 12 points in the top two income groups. Holding family income and father's occupation constant, an increase in the father's education had almost no effect on his daughter's probability of attending college if the mother's education was not similarly raised.

The second most important family determinant of college attendance appears to have been father's occupation. A white-collar occupation increased a daughter's college attendance rate by 9.8 percentage points in the poverty strata, by 7.8 points in the high-mid strata, and by 16 points in the high-income strata.

The effect of a $1000 increase in the family's permanent income is reported in rows 4 and 5 of Table 1A. At a time when median family income was about $6000, a $1000 increase in family income represented a significant improvement in standard of living and ability to pay for college. When only ability is controlled (i.e. the overall effect of family SES is being calculated), attendance rates increased between 6.5 percentage points and 8.8 points per thousand-dollar increase in income. However, when aptitude, occupation, and parental education are controlled, the effect of family income on college attendance rates was much smaller (see row 5). This suggests that the taste and aspiration for college (proxied in this analysis by parental occupation and education) may be more important than ability to pay (proxied by the permanent income variable). A further implication of this finding is that aggregate trends in college attendance rates may be driven more by the increase in the number of parents with white-collar jobs and substantial schooling than by increases in real family income. If so, the slowdown in the growth of real family income after 1973 may not have significantly slowed the growth of college attendance. We will return to this subject in Section Three.

Neighborhood Effects

Males who grow up in high-income neighborhoods are more likely to attend college when ability and family background are controlled (Bishop 1977). Surprisingly, living in high-income neighborhoods had a negative effect on the college attendance rates of young women from poverty and lower-middle income families. Growing up in such a neighborhood did, however, increase the college attendance of young women from middle- and upper-income families (see lines 8 and 9 of Table 1A). A one standard

deviation increase in both median income ($1240) and median years of schooling (1.45 years) of the local community lowered the attendance rate of females from lower-middle-income families by 2.1 percentage points while increasing the attendance rates by 3.3 points in middle-income families and by 1-1.2 points in upper-income families.

Changing Schools

As hypothesized, frequent and recent school transfers reduce the probability of attending college. Nine of the fifteen coefficients that tested this hypothesis were significantly negative. Young women who changed schools 5 or more times before completing junior year (and whose most recent transfer was two years ago) were 6.0 to 15.6 percentage points less likely to go to college than youth who except for promotions changed schools 1 or fewer times.

Other Characteristics

Richard Freeman found that inner city youth who were active in a church were considerably more likely to be employed than similar youth not active. Religious activity was hypothesized to have positive effects on college attendance because it signals character traits such as achievement motivation and a taste for religiously oriented instruction. As predicted, religious activity is positively related to college attendance in all groups and significantly so in the three middle-income groups. Those who were extremely active in church, religious, or charitable organizations (and whose parents were active as well) were considerably more likely to attend college than those who were not members of these organizations or who were only "fairly active" in them.[3]

When socioeconomic status, aptitude test scores, and the racial composition of one's high school were controlled, black students were significantly more likely to attend college. For students from a poverty background, attending a predominantly black school increased college attendance rates by up to 8 percentage points. Colinearity between race and the racial composition of the high school is apparently causing problems in the two high-income groups.[4] Students attending residential high schools were more likely to attend college. We now turn to an examination of the effects of variables describing the cost and accessibility of college (X_{17} ... X_{26})·

Out-of-Pocket Costs of College Attendance

An examination of rows 1 through 3 of Table 1B reveals that the tuition and other out-of-pocket costs are a significant deterrent to college enrollment. Thirteen of the fifteen coefficients on dollar costs are negative and seven of these are statistically significant. The effect in 1961 of a general rise in tuition of $200 is reported in row 13. Such an

Table 1B. Impact of Monetary Costs and Payoffs on the Percent of Female High School Juniors That Attend College in 1961

		Family Income Quintile				
	Mean	Low	Low Mid	Middle	High Mid	High
Percent Attending	(std. dev)	11.6%	22.4%	34.4%	45.9%	58.3%
Out of Pocket Costs (in hundreds of 1960 dollars)						
Tuition + Room + Board +Travel-Cheapest College	4.40	-.0216***	-.0067	-.0365***	-.0060	-.0417***
	(2.30)	(3.52)	(1.48)	(8.16)	(.92)	(6.12)
Additional Costs of Cheapest 4 Yr. College	1.89	-.0046	-.0064**	-.0191***	-.0087*	.0054
	(2.18)	(1.07)	(2.21)	(6.12)	(1.75)	(1.00)
Instate Tuition at 4 Yr. Public College	2.25	-.0106*	-.0194***	.0030	-.0404***	.0234***
	(1.60)	(1.66)	(4.02)	(.66)	(5.92)	(3.15)
Distance to Cheapest College	20.8	-.0007	-.0028***	.00105	-.0022*	.0080***
	(29.7)	(.51)	(2.83)	(1.11)	(1.65)	(5.48)
Additional Distance to 4 Yr. College	24.8	-.0019*	-.0010	-.00063	-.0022*	.00098
	(39.8)	(1.87)	(1.24)	(.80)	(1.88)	(.70)
Admission Cutoff Proport. at Lowest Cost College	.59	-.005	.130***	.104***	.006	.020
	(.306)	(.16)	(5.80)	(4.55)	(.18)	(.62)
Difference between Admission Cutoff at 4 Yr. College	.223	.034	.176***	.045**	.087***	.140***
and Cheapest College	(.312)	(1.06)	(7.44)	(1.97)	(2.70)	(4.01)
Cheapest College is Away	.12	-.083	.132*	-.142*	-.028	-.338***
	(.32)	(.78)	(1.73)	(1.89)	(.26)	(3.03)
Cheapest 4Yr Col. is Away	.39	.171**	.079	.114*	.211**	-.109
	(.23)	(2.05)	(1.19)	(1.76)	(2.21)	(.96)
Cheapest College is Extension Campus	.203	.065***	-.005	-.035***	-.005	.039**
	(.402)	(4.47)	(.44)	(2.80)	(.29)	(2.17)
Time Costs						
Foregone Earnings (hundreds of dollars)	28.78	-.0009	.0037***	-.0038***	-.0063***	.0009
	(4.48)	(.58)	(2.97)	(3.06)	(3.51)	(.48)
SMSA Unemployment Rate	6.67%	.0040	.0044**	.0072***	.0187***	-.0067**
	(2.2%)	(1.50)	(2.22)	(3.43)	(6.26)	(2.24)
Payoff Costs						
Education Differential (hundreds of dollars)	21.20	-.0045***	-.0037***	.0036**	.0049***	-.0009
	(4.70)	(3.07)	(3.27)	(3.12)	(2.84)	(.50)
Occupational Differential (hundreds of dollars)	19.74	.0007	.0039***	.0035***	.0030**	.0035***
	(5.96)	(.68)	(4.89)	(4.36)	(2.54)	(4.76)
One Std. Dev. Inc. in Payoff		-.017	.006	.038	.041	.017
A $200 Reduction in Tuition Levels		.0644	.0522	.0670	.0928	.0366
R^2		.159	.202	.212	.330	.273
Number of Observations		3923	7742	9474	4283	4619

Source: Analysis of Project Talent data on the college attendance rates in 1961 of high school Juniors in 1960. T statistics in parenthesis. * = p<.05 on a one tail test; ** = p<.025 on a one tail test and *** = P<.005 on a one tail test.

increase is equivalent to an $800 increase at current price levels. Enrollment of the low-income group is predicted to drop by more than half. Attendance of the lower-middle-income group dropped by 23 percent and attendance of the middle- and upper-middle-income groups dropped by 20 percent. Only the high-income group had a small response—a 6 percent reduction.

The effects of reductions in travel, room, and board costs were also quite substantial. Establishing a four-year public college in a town (which lowered costs of attendance by roughly $471 in 1961) raised the proportion entering college by 6 or 7 percentage points.

Establishing a public two-year college in a town that previously had no public college also had a substantial impact on college entrance rates. If the new junior college had an open- door admissions policy, college entrance rates were predicted to rise by 4.3 percentage points. If the junior college had the same admissions policy as the public four-year colleges of the state, college entrance rates were predicted to rise by 3.0 percentage points. Since 1950, there has been a striking growth in the number of large cities with public two- and four-year colleges with generalized curriculums. During the twenty-year period from 1955 to 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 D.C., and many other cities. 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 between 1955 and 1970. The results presented in table 1 suggest that this improvement in the accessibility of public colleges provided a major stimulus to the explosive growth of female college attendance during the 1950s and 1960s.

Low-income groups had proportionately higher responses to changes in tuition. Elasticities of demand were -.56 in the poverty strata, -.21 to -.23 in the 3 middle-income strata and -.06 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.[5]

Time Costs of Attending College

High local clerical wages were hypothesized to have two counteracting effects on college attendance. High wage rates mean that the opportunity costs of college attendance are higher, but it also means that youth are more likely to be able to finance college attendance by part-time work. The opportunity cost effect appears to have predomi-

nated for middle- and upper-middle-income students. For these two groups, high wage rates lowered college entry rates. For young people from lower-middle-income backgrounds, high clerical wages raised college attendance rates, suggesting that greater availability of financing predominated for lower-middle-income students. Clerical earnings had no effect on college attendance rates of poverty and high-income students.

The other measure of the opportunity cost of a student's time was the unemployment rate. It has often been suggested that young people go to college in greater numbers when opportunities for getting a good job are poor. All but the highest income group seemed to respond to unemployment in this manner. The equations imply that a community with a 3 percentage point higher unemployment rate would have college entry rates that were 10 percent higher for low-income students, 6 percent higher for lower-middle- and middle-income students, and 12 percent higher for upper-middle-income students. These findings are consistent with time series evidence and with similar findings for college attendance of women over the age of 25 (Bishop and VanDyk, 1977).

The Monetary Payoff to College Attendance

The local college-high school earnings differential is a rather imperfect representation of the variable—the expected earnings payoff—suggested by theory. Two measures of the earnings payoff to college were used: the difference between the income of college and high school graduate women and the difference between the average median earnings of elementary school teachers and medical and dental technicians and the average for bookkeepers and secretaries. Six of the ten coefficients were significantly positive. Except for those coming from poverty families, coefficients were positive as hypothesized. The coefficients obtained in these models of female behavior were more consistently positive than those obtained for males.

A one standard deviation increase in both payoff measures raised attendance of both high- and lower-middle-income students by 3 percent, raised upper-middle-income students by 9 percent, raised middle-income students by 11 percent and lowered attendance rates of the low-income students by 15 percent (see row 12 of Table 1). Since most students come from middle- and high-income families, the overall impact was a 6.3 percent increase in enrollment. Considering the fact that estimating a response to payoff by comparing local areas with different rates of return necessarily underestimates the response to nationwide changes in payoff, these projected responses are fairly large.

Changes over time in the payoff to college averaged over the entire nation are likely to have larger effects on nationwide enrollment 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 affect 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.

SECTION THREE: TIME SERIES ANALYSIS: 1947-1989

Additional evidence on the role of tuition costs, the payoff to college, the capacity to pay, and test scores can be 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, 20-24, 25-29, and 30-34 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:

$$5)\ \frac{B - C}{.75*W_n} = \frac{O(W_c - W_n)}{.75*W_n} - \frac{4T}{.75*W_n} - 4(1-U) + (a_1+a'_1)A + a_2 \ln Y + a_3 E + a_4 X + u_1+u_2$$

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.[6] 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:

$$6)\ \log \frac{P_c}{1-P_c} = b_0 + b_1\frac{(W_c - W_n)}{.75*W_n} - b_2\frac{T}{.75*W_n} - b_3 U + b_4 A + b_5 \ln Y + b_6 E + b_7 X + v$$

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 18-24 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, 20-24, 25-29, and 30-34 year olds for most of the post-WWII period are given in the first eight rows of Table 2. The influence of a variable on the probability of attendance can be calculated by multiplying its coefficient by $P_t*(1-P_t)$. Effects of a variable expressed in percentage increases or decreases in enrollment can be approximated by multiplying the coefficient by $(1-P_t)*100$. For 1987, consequently, percentage effects on enrollment rates can be obtained by multiplying by 57 for 18 to19 year old women, by 77 for 20 to 24 year olds, by 92 for 25 to 30 year olds and by 94 for 30-34 year olds. The multiplier is 66 for ratio of BAs awarded to high school diplomas 4 to 9 years earlier and 78 for the college graduate share of 25-29 year olds. Table 3 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.

Consumption Demand and the Ability to Pay: The conventional way of representing outward shifts in the consumption demand and ability to pay for college is to employ real income per capita deflated by the personal consumption deflator.[7] The results of regression models employing real per capita income in this role (e.g., $a_3=0$ & $a_2>0$) are presented in the first row of each panel of Table 2.

The cross-section analysis found, however, that parental education is a more important determinant of college-going than parental education. This suggests that the trend increase in the schooling attainment of parents may be a more important cause of the upward trend in college enrollment than the increase in real incomes, at least for those under age 25 or 30. Consequently, an alternative specification was tried in which real income is replaced by an education index (defined as a simple sum of the proportion of adults with at least 12 years of schooling and the proportion of adults with at least 16 years of schooling taken from the March Current Population Survey). Results which employ this specification (e.g., $a_3>0$ & $a_2=0$) are presented in the second row of each panel of Table 2.

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. The substitution causes an increase in the coefficients on test scores and tuition and marginally lowers the fit of the model.

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

Table 2. College Attendance of Women

	Payoff / Foregone Earnings	Log Per Capita Income	Education Index (Age 25+)	Tuition / Foregone Earnings	Unemployment Rate Fem. 20-24	ITED	R2	RMSE	DW / obs
Logit of Enrollment Rate of 18 / 19 Yr Olds	.76***	1.18***	---	-5.60**	2.61***	.61***	.980	.071	1.63 / 41
	(.30)	(.13)		(2.55)	(.68)	(.16)			
1949-1989	.87***	---	1.60***	-9.79***	2.37***	.91***	.978	.075	1.51 / 41
	(.31)		(.19)	(2.78)	(.74)	(.18)			
Logit of Enrollment Rate of 20 / 24 Yr Olds	1.43***	2.09***	---	-14.01***	.96	.21	.983	.086	1.64 / 41
	(.27)	(.16)		(3.20)	(.83)	(.15)			
1949-1989	1.47***	---	2.45***	-16.41***	.64	.93***	.983	.088	1.60 / 41
	(.28)		(.19)	(3.37)	(..86)	(.14)			
Logit of Enrollment Rate of 25 / 29 Yr Olds	-.20	3.01***	---	-2.36	2.74**	.56**	.978	.110	1.82 / 35
	(.46)	(.34)		(5.26)	(1.24)	(.27)			
1955-1989	1.08**	---	2.66***	-9.66	-.30	1.65***	.973	.121	1.58 / 35
	(.51)		(.34)	(6.26)	(1.48)	(.21)			
Logit of Enrollment Rate of 30 / 34 Yr Olds	1.00**	3.97***	---	-22.28***	3.02**	.20	.987	.094	2.28 / 35
	(.49)	(.38)		(4.29)	(1.22)	(.34)			
1955-1989	3.68***	---	3.17	-41.76	1.16	1.28	.943	.197	.70 / 35
	(.86)		(2.06)	(11.82)	(2.60)	(1.39)			
Logit of Proportion of 25-29 yr olds with College Deg.	.53***	1.32***	---	---	---	.71***	.993	.041	1.95 / 31
	(.13)	(.08)			(.08)				
1957-1989									
Logit of Ratio of Bachelor Degrees to HS Grads	.89***	.62***	---	-2.70**	.40	.32***	.994	.023	1.22 / 36
	(.09)	(.05)		(1.33)	(.38)	(.04)			
4-9 yrs Before	.83***	---	.82***	-2.29*	-.24	.41***	.995	.022	1.41 / 36
1954-1989	(.09)		(.06)	(1.23)	(.38)	(.03)			

* 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+ years 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.

Table 3. Accounting for the Post War Growth of Female College Attendance

	Predicted Effects*			Academic	Unemp-	Actual
	Payoff	Real Income	Tuition	Achievement	loyment	Increase
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 ($\boldsymbol{b}_{TUITION}$= -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 Years 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.

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 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.[8] 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 standard deviations and the scores of seniors dropped .35 standard deviations or about 1.25 grade level equivalents. Comparable declines occurred throughout the country and for junior high school students as well.[9] 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.[10] 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 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 One 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 -3.69. This suggests that colinearity problems may upwardly bias the tuition coefficient in the model predicting enrollment of 20-24 year olds. Consequently, a new model was estimated which constrains the tuition coefficient to be equal to -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. 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 enrollment by 37 percent for 18-19 year old women and 44-78 percent for 20-24 year old women. 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 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.

Unemployment: It has often been hypothesized that recessions tend to cause additional students to attend college. Indeed when real per capita income represents demand growth, the unemployment rate of women 18-24 years old has a significant positive effect on enrollment in three of the four age groups. When, however, the schooling index for

Table 4. Projections of College Enrollment and Graduation Rates for Women Percentage Increases 1987 to 1997

	Projections by Dept. Education published in		Tuition Growth Relative to Wage Growth			Projected Effect on Enrollment			
	1989	1991	4% Faster	2% Faster	No Faster	Payoff	Real Income	Tuition	Test Scores
Enrollment Rate									
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%
Ratio BAs / HS Grads 4-9 yrs earlier	19%	39%	30%	34%	39%	22%	7%	-10%	5%
Number of BAs	0	17%	10%	12%	17%	--	--	--	--
College Grad. Share 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 thesame manner as the numbers in Table 3.

adults represents demand growth, the unemployment rate has positive effects on enrollment only for 18-19 year olds. The reason for this contrast is that recessions decrease income so while higher unemployment pushes enrollment up, the lowered income is tending to drag enrollment down. In the model predicting enrollment of 20-24, 25-29 and 30-34 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 2 presents an analysis of time series changes in the proportion of 25-29 year olds that 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 per capita income increased college completion rates. Table 3 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 25-29 year old age group.

Bachelors Degrees Awarded: The final panel of Table 2 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 BAs 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 coefficients on real per capita income and the education index are smaller because BAs are compared to high school diplomas, not to 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 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 to 9 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 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.

Section Four: Projections of Enrollment and Graduation Rates in 1997

Table 4 presents simulations of projected changes in enrollment and college graduation rates between 1987 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 2 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 Table 4. 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 that are the determinants of enrollment. The projections in Table 4 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). The forecasted changes in these variables between 1987 and 1997 are summarized in column 3 of Appendix Table B.

Appendix 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

This last assumption is quite important to the projection results, so the reasons for this assumption need explanation. It might be argued that recent increases in college completion rates will soon cause the college payoff to turn down, as occurred once before at the beginning of the 1970s. Bishop and Carter's (1990) 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 that 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 the 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, 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 18-29 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 A: Cross-Section Data

Data

The data base for the cross-section analysis includes 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 proximity 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 (1974) 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.[11] 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, state 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.

Individual Characteristics Used as Controls in the Cross-section Analysis

For reasons of space, not all of the individual and family characteristics which were controlled for were presented in Table 1. The additional controls were:

X_{30} = a dummy which equals 1 if the student is living in a two-parent family. $X_{30} = .78$. Hyp: $b_{30} > 0$.

X_{31} = student has won prizes in music. $X_{31} = .027$. Hyp: $b_{31} > 0$.

X_{32} = Yiddish or Hebrew spoken in home. $X_{32} = .066$. Hyp: $b_{32} > 0$.

X_{33} = eldest sibling. $X_{33} = .37$. Hyp: $b_{33} > 0$.

X_{34} = lives on a farm. $X_{34} = .082$. Hyp: $b_{34} < 0$.

Appendix B: 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 postwar 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 the 1963 to 1987 period was constructed from Katz and Murphy's (1991) tabulations of CPS data on the weekly earnings of young women classified by years of schooling.[12] 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 the *Digest of Educational Statistics: 1990*, Table 281 (NCES 1989a), and *Projections of Educational Statistics to 1981-82*, Table 45 (NCES 1972).

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 cannot be used because these tests are taken only by college-bound students and by a changing share of even this group. These tests were initially taken by highly select 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. A total of 35 variables were included in the model. Maximum likelihood programs that can estimate logistic models containing large numbers of variables for data sets of this size were not available at the time the analysis was conducted. Consequently, linear probability models had to be used. Logit models containing a smaller number of control variables produced similar findings (Bishop 1977).

2. Using 1300 hours as the estimate of study time and taking account of the lower wage rates received for part-time and summer jobs, the ratio of before-tax foregone earnings to yearly earnings of clerical workers is .50. The cost of lost work time is the after-tax wage rate. Applying a marginal tax rate of .20 reduces the ratio to .40.

3. A parallel analysis of male college attendance finds that religious activity also had a significant positive partial association with college attendance.

4. Taken at face value, the coefficients imply that, for young women from high- and upper-middle-income families, (a) holding aptitude and social status constant, Blacks were substantially more likely to attend college, but (b) attending a predominantly Black high school was associated with lower probabilities of college attendance.

5. 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. It is quite likely, however, that grant aid has smaller effects on college enrollment probabilities than equivalent reductions in tuition. Important decisions that 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 clear that expanded financial aid is a more efficient way of increasing college enrollment than low tuition levels. 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.

6. 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.

7. 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 that 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 it handles home ownership costs incorrectly. When median family income was experimentally substituted for real per capita income, the fit of the models deteriorated substantially.

8. Data on ITED trends was kindly provided by Robert A. Forsyth (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 (Farr and Fey 1982). Between 1958 and 1966 Minnesota high school juniors gained .39 SDs on the Minnesota Scholastic Aptitude Test (Swanson 1973). The periodic national standardizations of the ITED also exhibit an increase during the 1960s.

9. 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 1986; Waters 1981).

10. 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's (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's (1977) analysis of adult college attendance rates in 1970 obtained tuition elasticities of -.44 for husbands and -.58 for wives.

11. 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.

12. Katz and Murphy (1991). Kosters' (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 full-time 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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