Access to Public Higher Education, 1976 to 1994

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Abstract

This study expands on earlier research on student demand theory by examining the relationship between tuition prices, state grants, and public college enrollment in the 50 states from 1976 to 1994. Emphasis is placed on differences in enrollment behavior among Asian American, Black, Hispanic, and White students, as well as between college sectors.

The results of this analysis are used to establish policy recommendations for states to improve equality of access to public higher education in this country.

Introduction

Policy makers have long been concerned that the cost of higher education may create a barrier to entry for students wanting to attend college. In 1947, President Truman's Commission on Higher Education sounded an alarm concerning equality of access for all students to the nation's colleges and universities:

> By allowing the opportunity for higher education to depend so largely on the individual's economic status, we are not only denying to millions of young people the chance in life to which they are entitled; we are also depriving the nation of a vast amount of potential leadership and potential social competence which it sorely needs. (quoted in Mumper, 1996, p. xv)

The federal government did not become a major player in helping to ensure equal opportunity for postsecondary education until the reauthorization of the Higher Education Act in 1972, which implemented the Basic Educational Opportunity Grant program (later renamed Pell Grants).[1] Unlike the federal government, however, the states have long played a role through direct subsidy of public colleges and universities, dating back to the federal Morrill Act in 1862 and the founding of many of this country's great land-grant universities. These subsidies historically have kept public tuition rates relatively low for all students.

The impact of state policy on enrollment in public higher education is critical. Clotfelter (1991) notes that

> It would be impossible to gain a fair impression of U.S. public policy to encourage college attendance without considering the role of the states. State policies directly affect the demand for undergraduate places in two ways — through their institutional support of public institutions and through state student aid programs. (p. 113)

The level of institutional support of public institutions helps to determine the tuition paid by students; the higher the support provided by the state, the lower generally is the tuition paid by all students. State programs award financial aid (the greatest portion based on need) to individual students which can be used at a public college or university within the state, and in some instances, private colleges and out-of-state institutions.

The last two decades have been a turbulent period for college tuition prices. Table 1 presents the annual real increase in tuition charges at public and private institutions, as well as the annual change in median family incomes for three different periods over the last two decades. In the latter half of

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[1] Earlier federal support for higher education, such as the G.I. Bill (1944), and the National Defense Education Act (1958), did not have access to higher education as a primary goal. While the Higher Education Act of 1965 did create the Educational Opportunity Grant program, it was not funded at a level that had much impact on higher education until the 1972 reauthorization.

Table 1: Annual Changes in Undergraduate Tuition Prices at Colleges and Universities, and Changes in Incomes

	Public College Tuition		Private College Tuition		
Period	4-Year	2-Year	4-Year	2-Year	Median 4-Person Family Income
1976 - 1980	–3.1%	–1.6%	–0.8%	0.7%	–1.2%
1980 - 1990	4.3%	3.2%	5.0%	4.1%	1.0%
1990 - 1994	6.1%	6.6%	3.1%	2.3%	0.4%
1976 - 1994	3.0%	2.8%	3.2%	2.9%	0.2%

Note: All changes in constant (1994) dollars. Public tuition is for resident students, and includes all mandatory fees (excluding room and board).

Source: Author's calculations from National Center for Education Statistics, 1995, Table 306, and U.S. Bureau of the Census, 1996.

the 1970s, tuition prices at both public and 4-year private institutions fell in real terms, as tuition increases did not keep pace with the double-digit inflation of this period. In the 1980s, real prices rose in all sectors, but at a faster rate in private colleges. While the 1990s have seen a slowing of the rate of growth of private college tuitions, the rate at public colleges has increased, with both occurring while incomes in the country stagnated and the gap between rich and poor families has widened.[2]

In 1994, 81% of all undergraduate students were enrolled in public institutions. Given the magnitude of public college and university tuition increases, a relevant policy concern is whether future students will be able to enroll in public higher education at the rates achieved in recent periods. Most studies that have examined students' demand for higher education have reached the same basic conclusion: tuition prices (either the "sticker price" or net of financial aid) are inversely related to the probability of enrolling in college, *ceteris paribus*. As tuition rates increase we would expect fewer students to enroll in college. A related question is whether these increasing tuition prices impact students of varying characteristics (such as race) differently.

To address this policy issue, this study analyzes how public tuition prices and financial aid expenditures in the fifty states relate to undergraduate enrollment rates. Using data from 1976 to 1994, this study addresses the following questions:

1. To what extent do differing tuition levels and financial aid spending relate to the public undergraduate enrollment rate in each state?
2. Do these tuition and financial aid effects differ for students of different races and in different public college sectors?

While most studies focus on the behavior of individuals in making college enrollment decisions, this study examines what role state policy plays in helping to determine the level of access to college enjoyed by students from different racial groups.

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2 See Kane (1994) and Hearn, Griswold, and Marine (1996) for some explanations of the reasons for the large public college tuition increases in the 1990s. The consensus opinion is that the increase has been driven by the slowdown in state funding for public higher education.

The answers to these questions will benefit those state policy makers responsible for tuition charges and financial aid expenditures. If the impact of rising prices does differ from group to group, states need to adapt their policies to ensure the goal of equality of access to public higher education.

Methods

Description of Data

Data on public college enrollment, tuition prices, state financial aid expenditures, and unemployment were used to address the questions in this study.[3] Public college enrollment data were obtained from the Integrated Postsecondary Education Data System (IPEDS) surveys, tabulated by the National Center for Education Statistics. Tuition prices were collected from an annual survey conducted by the Washington State Higher Education Coordinating Board (1996) and data on state need-based grant expenditures are from an annual survey conducted by the National Association of State Scholarship and Grant Programs (1994). State population data (used for calculating enrollment rates) and unemployment rates (used as a control variable) were obtained from various on-line files and publications of the U.S. Bureau of the Census and U.S. Bureau of Labor Statistics, respectively.

Table 2 provides descriptive statistics on the public college and university enrollment rates of all undergraduates used in this study. Means and standard deviations are presented both unweighted and weighted by the square root of the 18 to 24 population in each state in the 1990 census. Public college enrollment rates for each racial group are shown as a percentage of the 18 to 24 population in each state, and are shown for all public institutions, 4-year colleges and universities only, and community colleges only.[4] College enrollment rates are defined as:

$$\left(\frac{E_{ijt}}{P_{ijt}}\right) \times 100 \qquad (1)$$

where E_{ijt} = the number of undergraduate students enrolled in state i of race j in year t

P_{ijt} = the 18 to 24 population in state i of race j in year t.

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[3] Since attending college can be a substitute for entering the workforce, many researchers have hypothesized that unemployment is positively associated with college enrollment, i.e., as employment possibilities lessen, individuals are more likely to enter college. A countervailing force is that fewer employment possibilities mean that students and their families have fewer resources for financing a college education. See for example Ahlburg, McPherson, and Schapiro (1994), Blakemore and Low (1983), Corazzini, Dugan, and Grabowski (1972), and Jackson (1988).

[4] Because of large standard errors in the estimates of Native American populations by state provided by the Census Bureau, separate models will not be fitted for this group. Their enrollment (and the enrollment of foreign students) are included in the all races numbers shown in Table 2.

One issue that needs to be addressed in calculating public college enrollment rates is the percentage of students who are residents of the state in which they attend college. Not all students attend college in their home state, as prestigious private colleges tend to attract students from across the country (as do a handful of public universities). Most public colleges, because of large tuition surcharges for out-of-state students, and their missions as state-supported institutions, tend to be more heavily populated with in-state students, however. The NCES collects data on the state of residence (before attending college) of first-time freshman students only, in certain years, and not by race. From these data, however, it can be determined that 91% of all first-time freshman in public colleges and

Table 2: Descriptive Statistics of Public Enrollment Rates for All Undergraduates, Even Years 1976 to 1994

Measure (in percentage points)	Unweighted Mean (SD)	Weighted* Mean (SD)	Minimum	Maximum
Total public enrollment rate, all races	31.68 (9.23)	31.38 (9.06)	16.16	65.50
Total public enrollment rate, Asian American	38.40 (14.28)	40.69 (14.85)	8.15	83.09
Total public enrollment rate, Black	24.39 (9.53)	24.30 (9.15)	5.10	65.85
Total public enrollment rate, Hispanic	15.13 (6.75)	15.77 (6.61)	1.65	36.41
Total public enrollment rate, White	33.61 (10.88)	33.69 (10.81)	14.84	68.75
Public 4-year enrollment rate, all races,	18.50 (6.51)	16.79 (5.57)	8.80	46.90
Public 4-year enrollment rate, Asian American	23.80 (9.08)	23.63 (8.53)	6.07	74.28
Public 4-year enrollment rate, Black	13.74 (7.61)	12.08 (6.02)	1.23	54.01
Public 4-year enrollment rate, Hispanic	8.20 (4.63)	7.69 (4.08)	0.91	27.61
Public 4-year enrollment rate, White	19.69 (7.53)	18.01 (6.23)	7.20	55.40
Public community college enrollment rate, all races	13.37 (8.33)	14.67 (8.66)	0.97	43.11
Public community college enrollment rate, Asian American	14.82 (10.67)	17.16 (11.62)	0.53	63.83
Public community college enrollment rate, Black	10.80 (7.97)	12.28 (8.56)	0.16	41.34
Public community college enrollment rate, Hispanic	7.03 (5.25)	8.13 (5.49)	0.14	26.08
Public community college enrollment rate, White	14.13 (9.27)	15.76 (9.93)	1.19	46.29

* Values weighted by the square root of the 18 to 24 population in each state in the 1990 census.

universities were in-state students, as compared to 61% of those in private institutions (author's calculations from IPEDS data). Thus, the vast majority of public college students do come from the state in which the institution is located. In addition, these rates within each state have been fairly constant over time. Other researchers facing this issue in similar studies have come to similar conclusions (see for example Blakemore & Low, 1983; Rouse, 1994).

Another issue with this methodology is the age cohort chosen as the denominator of the enrollment rate calculation. The 18 to 24 age cohort was chosen for this study in order to be consistent and compare results with most earlier student demand studies, which expressed enrollment rates as a percentage of the 18 to 24 population. There is a good deal of evidence, however, that many students are delaying college entry, causing the average age of undergraduates to increase in recent years. Unfortunately, the IPEDS surveys contain information on the age of first-time freshmen students only, so it is impossible to tell the age distribution of all undergraduates who are included in the numerator. Another study conducted by this author compared the results of this methodology using both the 18 to 24 age cohort, and a cohort of 18 to 34 year-olds in the denominator. The effects were consistent with those found here no matter which age cohort was used (Heller, 1997a).

Table 3 presents descriptive statistics of the key question and control variables used in this study.

Table 3: Descriptive Statistics of State-Level Question and Control Variables, Even Years 1976 to 1994

Variable and Measurement Unit	Unweighted Mean (SD)	Weighted* Mean (SD)	Minimum	Maximum
Question Variables				
Resident community college tuition (thousands of 1994 $)	1.00 (0.43)	0.99 (0.46)	0.00	2.46
Resident comprehensive university tuition (thousands of 1994 $)	1.68 (0.64)	1.72 (0.67)	0.39	3.89
Resident flagship university tuition (thousands of 1994 $)	2.13 (0.94)	2.18 (0.94)	0.66	6.67
State need-based grant spending per 18-24 year-old (hundreds of 1994 $)	0.44 (0.54)	0.54 (0.63)	0.00	3.80
Control Variables				
Annual unemployment rate, age 16+, all races (percentage points)	6.68 (2.09)	6.83 (2.04)	2.20	15.50
Annual unemployment rate, age 16+, Black (percentage points)	13.64 (4.54)	13.80 (4.53)	4.58	33.3
Annual unemployment rate, age 16+, Hispanic (percentage points)	10.03 (3.92)	10.06 (3.70)	1.10	28.90
Annual unemployment rate, age 16+, White (percentage points)	5.87 (1.96)	5.92 (1.91)	2.10	14.70

* Values weighted by the square root of the 18 to 24 population in each state in the 1990 census.

Analytic Approach

Most of the previous research on these questions has used either cross-sectional *or* time-series methodologies to address these issues. Many cross-sectional studies examine how recent high school graduates behave in the face of various postsecondary options. Researchers use multivariate analysis on datasets such as the High School and Beyond survey to measure the impact of tuition and aid on individual students' decisions to attend college or not. These analyses measure how much of the college-going decision is based on price, as compared to other factors.

An alternate methodology is time-series analysis. Time-series studies examine changes over time in the aggregate enrollment of students (e.g., in the entire U.S. or in individual states or institutions). These studies relate changes in enrollment to tuition changes during the given period.

Each approach has advantages and limitations. While cross-sectional studies often have large sample sizes, and therefore much statistical power to examine subsets of data (e.g., racial or income categories), they commonly measure tuition sensitivity at a single point in time. In addition, they usually measure only the tuition sensitivity of first-time enrollees in college. Time-series analyses measure how enrollment changes in response to different tuition prices in multiple years, but often are unable to track changes in the choices of individual students or groups of students. The analysis here combines both cross-sectional *and* time-series econometric techniques to take advantage of the strengths of each to address these questions.

Datasets that combine both cross-sectional and time-series observations can be described as using "panel data." The panel used here is composed of enrollment, population, tuition, and financial aid expenditure data for the 50 states (the cross-section) during the period from 1976 to 1994 (the time-series).

Many student demand studies assume a perfectly elastic supply, i.e., public institutions will accommodate any and all students who wish to enroll (and meet the minimum admissions requirements). If a state or institution restricted enrollment through some rationing system, then the enrollment rate during that period may reflect not just the demand of students, but also the restricted supply. One way to overcome this limitation would be to gather data on the number of applicants (not just enrollees) to every public institution over the last twenty years. These data are not easily available, however, without surveying over 1,500 public institutions and gathering the data retrospectively. Absent the ability to do this, however, this study must share the same supply assumptions, with the understanding that the results of this study could be affected by the states and years in which the supply of public higher education were restricted.[5]

Model Used in This Study

Panel data generally are analyzed using either fixed-effects or random-effects models. Kennedy (1992) recommends that

> If the data exhaust the population (say observations on all firms producing automobiles), then the fixed effects approach, which produces results conditional on the units in the data set, is reasonable. If the data are a drawing of observations from

[5] With notable exceptions (i.e., California in the early 1990s), there are very few examples of states that explicitly have reduced the number of seats available in public institution as a matter of public policy.

> a large population (say a thousand individuals in a city many times that size), and we wish to draw inferences regarding other members of that population, the fixed effects model is no longer reasonable; in this context, use of the random effects model has the advantage that it saves a lot of degrees of freedom. (p. 222)

The IPEDS data are in fact a census of all college enrollment in the country, so the fixed-effects approach is appropriate. The state fixed effects in the model result in a shift of the intercept of the regression line for each state (and year) away from the mean intercept across all the units of observation, thus controlling for the unobserved, unique characteristics of each state not captured by the question or control variables. For example, states in the northeastern part of the U.S. have a longer history and larger supply of private higher education than do states in other regions of the country. Thus, all other things being equal, we would expect the northeastern states to have lower public college enrollment rates because more students are attending private institutions, and to have a higher level of federal financial aid flowing into them, because of higher tuition prices. These regional effects will be captured through inclusion of year by region interactions.

The fixed-effects model fitted in this study can be specified as:

$$r_{it} = \beta_0 + \beta_1 c_{it} + \beta_2 a_{it} + \beta_3 j_{it} + \mu_i + \phi_{dt} + \rho\varepsilon_{it-1} + \upsilon_{it} \qquad (2)$$

where r_{it} = Enrollment rate in state *i* in year *t* (number enrolled divided by the 18 to 24 population in the state)

c_{it} = Vector of tuition prices in state *i* in year *t*

a_{it} = State need-based grant expenditures (per 18 to 24 population) in state *i* in year *t*

j_{it} = Unemployment rate in state *i* in year *t*

μ_i = State fixed effects

ϕ_{dt} = Year effects, which are allowed to vary by census region *d*

ρ = a parameter, rho, representing the strength of the influence of the previous period

ε_{it-1} = error component for state *i* in year *t–1*

υ_{it} = random disturbance for state *i* in year *t*

A 3 X 5 matrix of 15 models were fitted with the first dimension being the college sector (all public institutions, 4-year only, and community colleges only), and the second dimension being the racial/ethnic group (all races, Asian American, Black, Hispanic, and White students). Since enrollment counts by race are available from the IPEDS data only in even years through 1990, ten years of data were used for fitting the models for each racial group.[6]

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[6] Potentially twelve years of data could be used, because enrollment by race were collected every year beginning in 1990, so data from 1991 and 1993 could also be used. However, time-series models generally require that the

A key issue with Equation 2 is the estimation of the parameter ρ, or rho. If rho is zero, i.e., there is no autocorrelation, then the error terms for each state are not correlated, and Equation 2 becomes a standard fixed-effects model. First-order autocorrelation can be detected through calculation of the Durbin-Watson statistic. Bhargava, Franzini, & Narendranathan (1982) generalized the Durbin-Watson test for use with panel data:

$$d_p = \frac{\sum_{i=1}^{I}\sum_{t=2}^{T}\left(\tilde{u}_{it} - \tilde{u}_{it-1}\right)^2}{\sum_{i=1}^{I}\sum_{t=1}^{T}\left(\tilde{u}_{it}\right)^2} \qquad (3)$$

where $\tilde{u}_{it}$ = the OLS residuals from estimating the fixed-effects model in Equation 2

Bhargava, Franzini, and Narendranathan provide tables for testing the significance of the null hypothesis at the 5% level that rho = 0, i.e., no autocorrelation exists.

Fifteen fixed-effects models of undergraduate enrollment were fitted as described earlier in order to calculate the value of d_p for each. The values ranged from 0.50 to 1.08, all of which fall well below the cutoff point for rejection of the null hypothesis that rho = 0.[7] Thus, statistical methods that take this autocorrelation into account were used for fitting the models described here.

General estimating equation models (GEE), as developed by Liang and Zeger (1986), were used to estimate the fixed-effects model shown in Equation 2. GEE models are a form of general linear models for use with panel data that allow the specification of the particular covariance structure, including autocorrelation, for the dataset, so that the heteroscedasticity assumptions in ordinary least squares regression can be relaxed in estimating standard errors. For the models fit in this study, first-order autocorrelation was found and thus a first-order autocorrelative covariance structure was specified.

Results

Before presenting the results of fitting the fixed-effects models, a few points need to be made:

1. As described in the previous section, the enrollment rates are expressed in percentage points, and tuition amounts are in thousands of 1994 dollars. Thus, a coefficient of -2.0 on one of the tuition measures should be interpreted as indicating a drop in enrollment of two percentage points for every $1,000 increase in tuition.
2. The tuition prices used in these models include the community college tuition and the comprehensive university tuition in each state for each year, obtained from the Washington State Higher Education Coordinating Board (1996). Flagship university tuition prices tend to be highly correlated with those of comprehensive universities in each state, so that including both 4-year prices in models introduces problems of collinearity. In addition, the majority of students who attend 4-

time periods be evenly spaced, so the models used in this study will include only the even years from 1976 to 1994.

7 The cutoff point for rejection of the null hypothesis of no autocorrelation is for values below approximately 1.75 or greater than approximately 2.0 for a panel dataset of these dimensions and number of regressors.

year institutions in each state attend comprehensive universities, so it is reasonable to assume that the tuition level there is the price "signal" to which the majority of students respond.[8]

3. State financial aid spending is expressed in hundreds of 1994 dollars for every 18 to 24 year-old in the state. A coefficient of 1.0 would indicate that a $100 increase in grant spending (per 18-24 year-old) is related to an enrollment increase of one percentage point.
4. Unemployment rates are expressed in percentage points, so that a coefficient of 1.0 would indicate that a one percentage point increase in unemployment is related to an enrollment increase of one percentage point.

In fitting GEE models, McCullagh & Nelder (1989) propose the use of the deviance statistic as a measure of goodness of fit. For normally-distributed models, the deviance statistic *D* is the sum of squares residual, calculated in ordinary least squares regression. By building a set of nested models, beginning with a baseline model including only the state fixed effects, year effects, and intercept, and sequentially adding each predictor, you can measure the reduction achieved in the deviance statistic at each step. The amount of the reduction can be compared with the total deviance for the baseline model to calculate a pseudo r-squared statistic, R_p^2, for each model. If a model achieved a "perfect" fit, the value of D_n would be zero, and R_p^2 would be 1.0. Thus, the pseudo r-squared statistic ranges between zero and one and can be calculated for each successive model in a sequence of nested models, to determine the explanatory power of the predictor or set of predictors most recently added.

The R_p^2 statistics estimated for most of the models in this study tend to be low in comparison to those found in many cross-sectional studies. This is because much of the within-state variation in enrollment rates is absorbed by the state fixed effects and the year effects. Thus, the R_p^2 statistics estimated here represent the incremental explanatory power of the question and control predictors beyond the state and year effects.

Enrollment in All Public Institutions

The fixed-effects model was fit first for the enrollment of undergraduate students in all public institutions, both 4-year and community colleges combined, for the even years from 1976 to 1994. The results are shown in Table 4. As can be seen from the R_p^2 statistic, the explanatory power of the models range from a low of explaining 4.7% of the variation in enrollment rates for students of all races (beyond the fixed state and year effects), to a high of almost 16% for Asian Americans.

The effects that are significantly different from zero are all in the direction that one would expect. For all races, enrollment rates are related to community college tuition prices, state grant spending, and unemployment rates. For example, a $1,000 increase in community college prices is associated with an overall drop in enrollment rates of 2.08 percentage points. Similarly, an increase in grant spending of $100 per 18-24 year-old in the state is related to an enrollment rate increase of 1.26 percentage points. An increase in unemployment of one percentage point is related to an increase in enrollment of 0.19 percentage points.

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8 This formulation is used by other researchers, including Kane (1995) and Rouse (1994). The models were also fit using lagged tuition prices, but no improvement in the models' explanatory power and no substantive changes to coefficients were found. This is likely because of the strong correlation in year-to-year tuition prices in each sector.

Table 4: Coefficients (Standard Errors) of Models for All Undergraduates

	All Races	Asian Americans	Blacks	Hispanics	Whites
Community College Tuition	-2.081** (0.752)	-18.033** (2.953)	-2.613* (1.070)	-5.564** (0.983)	-1.780* (0.719)
Comp. Univ. Tuition	-0.713 (0.467)	5.337** (1.802)	0.481 (0.611)	0.305 (0.529)	-1.529** (0.453)
State Grants per 18-24 Year-old	1.264** (0.467)	4.266** (1.614)	2.495** (0.629)	1.253* (0.510)	0.971* (0.457)
Unemployment Rate	0.185** (0.064)	0.804* (0.335)	0.117* (0.040)	0.079* (0.038)	0.109~ (0.065)
# of observations	489	489	489	489	489
R_p^2	.047	.159	.122	.069	.053

~ = p≤.10, * = p≤05, ** = p≤.01

In comparing the effects of tuition changes across racial groups, one can see that the results are generally in the expected direction, but with important differences in effect sizes among the groups. Asian Americans had a very high level of sensitivity to community college tuition levels; a $1,000 tuition increase there is related to a drop in the enrollment rate of Asian Americans in all public institutions of over 18 points, an effect difficult to compare with previous studies given the dearth of quantitative research on the enrollment behavior of this group.[9] Interestingly, overall Asian American enrollment responds *positively* to increases in prices at 4-year institutions. While this effect appears counter-intuitive, it should be noted that what is being examined here is the enrollment of Asian Americans in *all* public institutions, 2-year and 4-year, so that one should not conclude that rising prices in 4-year institutions cause Asian Americans to enroll there in greater numbers. The relevance of this effect can be more clearly seen when enrollment in each sector is examined separately (described below).

The other three groups respond to price increases at community colleges as would be expected, with a drop in their overall public enrollment rates. Hispanic students show the next highest price sensitivity, with their enrollment dropping over five percentage points in response to a $1,000 increase in community college prices. Only White students enroll in lower numbers in response to increases in the tuition rates at 4-year comprehensive institutions. This may indicate that to Blacks and Hispanics, the price "signal" they are responding to in the marketplace is that being sent by community colleges. The greater sensitivity to community college prices on the part of Hispanics (which is significantly different from that of the other three groups) could in part be due to the fact that this is the sector that has traditionally served the Hispanic population.[10]

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9 One issue that needs to be mentioned at this point is that "Asian Americans" as a group encompasses a wide range of national origins. For example, the college-going behavior of first generation Southeast Asians may be very different from that of third generation Chinese and Japanese Americans. Unfortunately, the broad racial categorization schema used in the IPEDS surveys limits the ability to analyze the behavior of these smaller, national groups. The same limitation holds for the other racial groups also, i.e., Cuban Americans in southern Florida may have different college-going patterns than Mexican Americans in California.

10 Tests of differences in parameter estimates were conducted at a level of p≤.05.

The enrollment of all four races responds positively to increases in state grant spending, with Asian American and Black students having the strongest response. With the exception of a comparison of the parameter estimates of Hispanics and Whites, all the other comparisons find that the effects are statistically different from one another.

The enrollment of Asian Americans, Blacks, and Hispanics responds positively to increases in unemployment, confirming much of the literature described earlier that found that decreasing employment possibilities tend to make college a more attractive option for some. Only Asian Americans had an enrollment response statistically different from the other groups; the responses of the three others were within a close range. White enrollment appears to respond in a similar fashion, but the results found here are only marginally different from a zero, or null, effect.

Enrollment in 4-Year Institutions

Turning now to look at each sector individually, Table 5 presents the results for enrollment in 4-year institutions. Looking at each sector separately allows you to examine the cross-price sensitivities, i.e., how a price change in one sector affects enrollment in the other. The first important characteristic of this set of models is that their explanatory power is less than that of the models of enrollment behavior in all public institutions. In fact, tuition prices, state aid, and unemployment explain little of the within-state variation in enrollment of students of all races combined and Hispanics alone during this period. For the other groups, these factors help to explain 6% or less of the variation in enrollment. Even though two of the variables in the model of all race enrollment are jointly significant (comprehensive university tuition and state grant spending), their overall contribution to the explanatory power of the model (beyond the state and year effects) is close to zero.

While few of the effects are significantly different from zero, the direction of the effects are what one would expect. Increases in community college prices are related to higher levels of enrollment in 4-year institutions. This is not surprising, as one would expect increases in the price in one sector to push students into the other (the cross-price response). Conversely, increases in comprehensive university prices tend to decrease enrollment in that sector, an effect that is significantly different from

Table 5: Coefficients (Standard Errors) of Models for 4-Year Institutions

	All Races	Asian Americans	Blacks	Hispanics	Whites
Community College Tuition	0.045 (0.316)	1.056 (1.598)	0.501 (0.664)	0.171 (0.617)	0.410 (0.254)
Comp. Univ. Tuition	-0.525** (0.195)	1.096 (0.976)	0.077 (0.379)	-0.417 (0.331)	-0.639** (0.159)
State Grants per 18-24 Year-old	0.935** (0.198)	1.043 (0.874)	0.669~ (0.391)	0.432 (0.320)	0.566** (0.162)
Unemployment Rate	0.018 (0.026)	0.266 (0.181)	0.031 (0.025)	-0.012 (0.024)	-0.025 (0.022)
# of observations	489	489	489	489	489
R_p^2	†	.053	.026	†	.005

~ = p≤.10, * = p≤05, ** = p≤.01

† = less than .001

zero for all races combined and for White students. Recall that the total public enrollment of Asian Americans exhibited a large (and significant) *positive* enrollment response to price at 4-year institutions, as shown in Table 4. In examining enrollment of this group at 4-year institutions only, this counterintuitive effect is no longer significantly different from zero.

While all races combined and White students as a group respond positively to increases in state grants (but at rates lower than for public enrollment as a whole), none of the groups appear to be affected by economic conditions. Evidently, decreasing employment possibilities (as indicated by higher unemployment rates) do not seem to make attending a 4-year institution more attractive for any of these groups.

Enrollment in Community Colleges

Table 6 presents the results of fitting these models for enrollment in community colleges. As one would expect, increases in community college tuition levels are related to a decrease in enrollment rates for all groups, with the response to a $1,000 increase ranging from a drop of 14 points for Asian Americans to approximately two points for all races combined, and for Blacks and Whites individually. Cross-price responses are in the expected direction — an increase in tuition at 4-year comprehensive universities is associated with an enrollment increase in community colleges — for Asian Americans, Blacks, and Hispanics, though for the latter two groups the effect is not significantly different from zero.

Table 6: Coefficients (Standard Errors) of Models for Community Colleges

	All Races	Asian Americans	Blacks	Hispanics	Whites
Community College Tuition	-2.082** (0.576)	-14.220** (2.251)	-2.001** (0.634)	-5.716** (0.957)	-2.037** (0.537)
Comp. Univ. Tuition	-0.181 (0.356)	4.036** (1.239)	0.396 (0.361)	0.765 (0.510)	-0.887** (0.337)
State Grants per 18-24 Year-old	0.260 (0.359)	-0.136 (1.205)	1.300** (0.380)	0.733 (0.495)	0.350 (0.342)
Unemployment Rate	0.165** (0.048)	0.570** (0.208)	0.086** (0.022)	0.087* (0.036)	0.128** (0.048)
# of observations	482	482	482	482	482
R_p^2	.073	.204	.082	.202	.062

~ = p≤.10, * = p≤05, ** = p≤.01

An interesting effect is that the enrollment of Whites in community colleges is *negatively* associated with an increase in the price in the 4-year sector. In other words, higher prices at 4-year institutions serve to depress enrollment in community colleges. One possible explanation for this is that White students, even those attending community colleges, may be receiving their price signal at least partially from 4-year institutions. This could be because of their greater knowledge of prices in the 4-year sector (relative to the other groups), or possibly because they see community colleges as a stepping stone to eventual attainment of a bachelor's degree. If this latter explanation is true, then an increase in price at 4-year institutions may dissuade Whites from even beginning the quest for a bachelor's degree by starting in a community college.

Within community colleges, Blacks are the only group responding to changes in state grant spending. All five groups, however, respond to changes in economic conditions. As employment possibilities lessen, all are more likely to enroll in community colleges as an alternative to entering the workforce, with Asian Americans having the largest response, followed by Whites.

The explanatory power of the models of community college enrollment are much greater than those of enrollment at 4-year institutions. This indicates that enrollment at 2-year institutions is more sensitive to the joint effects of price, state grants, and economic conditions than is enrollment in the other sector.

Discussion

The results of this study confirm the existence of a downward sloping demand curve for public higher education. Within states and for most groups, enrollment tends to respond negatively to higher tuition prices, *ceteris paribus*.

Leslie & Brinkman (1988) conducted a comprehensive analysis of the literature on student demand. They calculated a student price response coefficient (SPRC) for each study. The SPRC is defined as the

change in the college participation rate of 18 to 24 year-olds for every $100 increase in tuition prices (in 1982-1983 dollars). They found that

> the mean price response is about 0.7 percentage points. That is, for every $100 increase in tuition price — given 1982-1983 average weighted higher education prices of $3,420 for tuition and room and board — one would expect an 18-24-year-old participation *rate* drop of about three-quarters of a percentage point. (p. 188)

They went on to note that

> Since the national higher education participation rate was about 0.33 in 1982, U.S. enrollments would decline by about 2.1 percent for each $100 price. (p. 189)

Another analysis examined later student demand studies and found the results to be consistent with those found by Leslie and Brinkman (Heller, 1997b). [11]

To compare Leslie and Brinkman's findings to those of this study, an adjustment must be made to the $100 price increase they used in order to reflect the effects of inflation since then (tuition prices are expressed in 1994 dollars in this study). Adjusting that price to take into account increases in public college tuition costs since then would bring the 1982-1983 increase of $100 to $160 in 1994-1995. The parameter estimates found in this study can then be converted from a tuition change of $1,000 (the standard unit for all tuition measures) to ones based on a $160 tuition change, in order to compare the effect on enrollment with that found by Leslie and Brinkman.

Table 7 shows the expected enrollment effects for a $160 increase in tuition. The mean enrollment rate for each category and coefficient for the $1,000 increase are shown, taken from Tables 2 and 4 through 6. The coefficient is then converted to reflect a $160 tuition increase (i.e, multiplied by 16%), and the enrollment effect for that increase is calculated. As can be seen, for all public institutions, the SPRC ranges from -0.28 for White students to -2.89 for Asian Americans (as compared to Leslie's and Brinkman's estimate of -0.70 for all students). The estimated enrollment effect ranges from a decrease of 0.8 percent for White students to a decrease of 7.1 percent for Asian American students (compared to Leslie's and Brinkman's estimate of a decrease of 2.1 percent, again for all students). The projected enrollment effects at 4-year institutions are less, while the effects at community colleges are greater.

[11] The authors noted that this effect is probably overstated, as most of the studies examined the enrollment only of first-time freshman students. One would expect upperclass students to be less price responsive, because they already have invested in a portion of their postsecondary education and have fewer semesters of tuition left to pay to attain the benefits of a college diploma.

Table 7: Enrollment Effects Adjusted for a $160 Tuition Change

Group	Mean Enrollment Rate	Coefficient for $1,000 Increase	Coefficient for $160 Increase (SPRC)	Enrollment Effect for $160 Increase
	I. All Institutions — Response to Community College Tuition			
All Races	31.38	-2.08**	-0.33	-1.1%
Asian Americans	40.69	-18.03**	-2.89	-7.1%
Blacks	24.30	-2.61*	-0.42	-1.7%
Hispanics	15.77	-5.56**	-0.89	-5.6%
Whites	33.69	-1.78*	-0.28	-0.8%
	II. 4-Year Institutions — Response to Comp. University Tuition			
All Races	16.79	-0.53**	-0.08	-0.5%
Asian Americans	23.63	1.10	0.18	0.7%
Blacks	12.08	0.08	0.01	0.1%
Hispanics	7.69	-0.42	-0.07	-0.9%
Whites	18.01	-0.64**	-0.10	-0.6%
	III. Community Colleges — Response to Comm. College Tuition			
All Races	14.67	-2.08**	-0.33	-2.3%
Asian Americans	17.16	-14.22**	-2.28	-13.3%
Blacks	12.28	-2.00**	-0.32	-2.6%
Hispanics	8.13	-5.72**	-0.91	-11.2%
Whites	15.76	-2.04**	-0.33	-2.1%

~ = p≤.10, * = p≤05, ** = p≤.01

Leslie and Brinkman developed their estimated SPRC and enrollment effects based on a wide range of studies that used many different methodologies and covered students in different sectors of higher education. From their overall estimate of an enrollment decrease of 2.1 percent (for a $100 tuition increase), they concluded that the enrollment effect size for all public colleges should be slightly larger (-2.1 to -2.4 percent, p. 132). The equivalent enrollment effect size here is smaller, a decrease of1.1 percent (for students of all races). This difference could be reflective of a change in the relative tuition sensitivity of overall public enrollment since the studies reviewed by Leslie and Brinkman were conducted.

When looking at the two public sectors separately, Leslie and Brinkman estimated an enrollment effect of -1.8 to -2.1 percent for 4-year institutions, and -2.7 percent for community colleges (p. 132). The equivalent effects here are -0.5 percent and -2.3 percent respectively. In both cases, as with overall public enrollment, students' tuition sensitivities appear to have decreased from what Leslie and Brinkman found, though the decrease is less for community college students.

One possible reason for the decrease in the tuition sensitivity of public college students is the change in the college earnings premium. During the two decades covered by this study, the wage

premium earned by those who attended college compared to those who did not grew substantially. Clearly, even if nothing else had changed in the ensuing time period, students likely understood the newfound importance of a college education in the labor markets. Thus, they are more likely to suffer tuition increases than are their predecessors a generation or more earlier.

Another issue that could affect the findings described here is the change in private college prices during this time period. As described in Table 1, tuition increases in public institutions were less than those in their private counterparts in the 1980s, but were greater in the 1990s. Overall during this time period, however, constant dollar tuition increases in all sectors (public or private, 2-year or 4-year) averaged approximately 3% nationally. However, if the price of public colleges and universities relative to private institutions rose or fell in certain states, this could have an impact on the results described here. Because the cost of private colleges was not included in the models (other than as captured by the state fixed effects), it is difficult to judge its impact on these results.[12]

The findings of this study can be summarized as follows:

- Increases in tuition lead to declines in public enrollment, *ceteris paribus*, with community college students much more responsive than those in 4-year institutions (whose responsiveness was not statistically significant for most groups).
- Decreases in state grant spending lead to declines in enrollment, with the effect largest among community college students.
- Blacks are slightly more sensitive to tuition increases than White students, with Hispanics more sensitive than Blacks. Asian American students, however, exhibit the largest enrollment response to tuition increases.
- In general, the enrollment of members of the three minority groups responds more to changes in state grant spending than does that of White students.

[12] The difficulty with modeling private college prices is that the main source, the IPEDS data, are highly unreliable. While it would be possible to verify the tuition data for the over 2,000 private institutions in the country for a single year, the effort to do this retrospectively for 10 years of data was deemed unworthy relative to the expected modest gain in the improvement of the explanatory power of the models.

Implications for Public Policy

Tuition Setting Authority

Responsibility for setting of tuition prices at public colleges and universities varies from state to state. Lenth (1993) reviewed the fifty states to determine which organizations had the authority to set tuition levels. This authority is dispersed among state legislatures, state higher education coordinating or governing boards, college or university systems, and individual institutions. Thus, the audience of "policy makers" involved in tuition decisions is diverse and far-reaching. The constituencies that these groups respond to are equally disparate; in some states, tuition levels are established by state policy makers responsible for oversight of the state's entire system of public higher education; in others, the decision is made by those who are accountable only to a single institution.

This distinction is an important one, for the structure of public higher education governance can substantially affect access to and choice in public higher education. For example, entities that control tuition (and financial aid) policies for only a single institution may implement tuition pricing strategies that maximize institutional interests while working against the broader societal goals with respect to access and choice. Statewide governing or coordinating boards that have tuition-setting responsibility for all sectors of public higher education can more easily balance policies in each to ensure that goals of equality of opportunity remain at the forefront of state policy.

Coordination of tuition policies across different sectors is important because of the cross-sector price effects described in this study. For at least some groups of students, tuition prices in the 4-year sector can affect enrollment in community colleges, and vice versa. For example, the enrollment of Asian American students in community colleges is positively related to tuition prices in 4-year institutions. In other words, as 4-year prices rise, students are more likely to enroll in community college. Thus, there is a compelling public interest that tuition policies be coordinated among sectors (and even individual institutions) so as to ensure that access and choice goals are achieved.

Linking Tuition and Financial Aid Policy

As described earlier, public tuition levels had historically been kept low relative to private college prices (and family incomes), largely in recognition of the societal benefits of public higher education. In the last two decades, however, a number of higher education analysts have argued that while low prices may promote equity in access and choice, they do not promote efficiency. As the college wage premium has increased, they argue, more and more of the benefits to attending college accrue to the individual, rather than to society. Public tuition levels should be increased so that students bear more of the cost of their education, with offsetting awards of financial aid for those who cannot afford to pay the higher prices. This policy has become known as the "high tuition/high aid" policy, and was described recently by Hearn, Griswold, and Marine (1996):

> The argument is that the causes of both educational efficiency and equal educational opportunity would be better served by raising tuition in the public sector to something more closely approximating the actual institutional costs of education less the social returns derived from the public investment. By removing a "blanket" public subsidy to all students regardless of need or susceptibility to financial incentives (i.e., by doing away with low or no tuition) and putting in its place a subsidy explicitly targeted on students with need, the rationalization approach promises the rewards of both greater equity and greater efficiency. To assure equity the savings to be derived from tuition rises could be devoted to providing much more aid to needy, deserving students. (p. 244)

This policy seeks to capture the consumer surplus of those middle- and upper-income students who would (and could) pay a higher price and thus are the primary beneficiaries of this "blanket subsidy."

The high tuition/high aid strategy requires linkages between tuition increases and state grant spending (and/or financial aid awards by institutions). Yet Lenth (1993), in his review of these linkages in the 50 states, found that only half the states had explicit policies whereby tuition increases would be offset by increases in grant awards to needy students. Of these 25 states, only 15 have sizable state grant programs, and in only one (New York) is the state grant program a need-based entitlement. In the other 49 states, no matter what the expressed policy with respect to meeting the financial aid requirements of needy students, the reality is that the state grant programs are funded at the whim of each state legislature and executive branch. The same fiscal pressures that cause states to cut back on their appropriations to public institutions, which often result in increased tuition prices, can also affect spending on state financial aid.

In order to test the effectiveness of linking tuition increases with increases in state grant spending, one can use the results from this study to simulate the impact on enrollment for a variety of changes in tuition and state grant spending. For example, the enrollment effects of a $160 increase in tuition were demonstrated in Table 7 in order to compare the findings here with those of Leslie & Brinkman (1988). $160 represented approximately a 12.3% increase in the national median community college tuition price in 1994. To test how much increases in state grant spending can help to offset the impact of tuition increases, the enrollment effect of a similar increase in grant spending per 18 to 24 year old was modeled.[13] The results are shown in Table 8.

For students of all races in all public institutions, the net effect of the tuition and state grant increase would be an enrollment gain of 0.8%. Asian American and Hispanic students would see a decrease in their enrollment, while Blacks and Whites would see an increase. All groups in 4-year institutions would see a net enrollment gain (largely due to the low level of response to tuition increases at comprehensive universities), while all groups except Blacks would seen an enrollment drop in community colleges, with the decline greatest for Asian American and Hispanic students.

One way to help ameliorate the disparate effects among the racial groups seen here would be to target financial aid at those groups, such as Asian Americans and Hispanics in community colleges, who appear to be most impacted by tuition increases. However, in today's political and judicial climate that is largely hostile to race-based affirmative action — witness the *Hopwood v. State of Texas* and *Podberesky v. University of Maryland* federal court cases, the University of California Regents' decision to abandon affirmative action throughout the university, and Proposition 209 in California — it is unlikely that any

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[13] The national median grant spending in 1994 was $41.30 per 18 to 24 year old; a 12.3% increase would be $5.08. At this point, some observers might question why you would not model the same *dollar* (as opposed to percentage) increase in both tuition and grants, under the supposition that if tuition went up $100, you would want to ensure that needy students get a $100 increase in state grants. The fact is that some of the increase in tuition costs would be covered by other forms of aid, such as Pell Grants, loans, work study, and institutional aid. Modeling the same percentage increase seeks to ensure that the student is proportionally no worse off than the position she found herself in before the tuition increase.

state will be willing to move forward in this arena. Nevertheless, policy makers need to be aware of the disparate impact of tuition and financial aid policies and attempt to craft programs that target those groups who are most affected.

Table 8: Combined Enrollment Effects of Increases in Tuition and State Grant Spending

Group	Enrollment Effect for $160 Tuition Increase*	Enrollment Effect for $5.08 Grant Increase (per 18 to 24 Year Old)	Combined Enrollment Effect
	I. All Institutions — Response to Community College Tuition		
All Races	-1.1%	1.9%	0.8%
Asian Americans	-7.1%	4.9%	-2.2%
Blacks	-1.7%	4.8%	3.1%
Hispanics	-5.6%	3.7%	-1.9%
Whites	-0.8%	1.3%	0.5%
	II. 4-Year Institutions — Response to Comp. University Tuition		
All Races	-0.5%	2.6%	2.1%
Asian Americans	0.7%	2.0%	2.7%
Blacks	0.1%	2.6%	2.7%
Hispanics	-0.9%	2.6%	1.7%
Whites	-0.6%	1.5%	0.9%
	III. Community Colleges — Response to Comm. College Tuition		
All Races	-2.3%	0.8%	-1.5%
Asian Americans	-13.3%	-0.4%	-13.7%
Blacks	-2.6%	4.9%	2.3%
Hispanics	-11.2%	4.2%	-7.0%
Whites	-2.1%	1.0%	-1.1%

* From Table 7

Even if states and institutions are unable to explicitly target financial aid to members of particular racial groups, there are still some steps that they can take to help lessen the disparate impacts shown Table 8. There is much evidence that poor and minority students are less knowledgeable about the existence of state, federal, and institutional financial aid, as well as how to negotiate the process of applying for it. They are susceptible to being influenced only by the "high tuition" portion of the high tuition/high aid policy. States and institutions should develop or expand programs that seek to educate these potential students about the existence of financial aid programs and the mechanisms of applying for grants, loans, and other forms of aid, as well as about the college application process in general. This

education should take place not just during the senior year in high school, but much earlier when students and their families first begin to formulate their postsecondary plans.[14]

There are many examples of successful programs of this type throughout the country, though they do not reach nearly all the students who could benefit from them. Community-based programs, such as Dollars for Scholars (1996), seek not just to award grants to needy students but also to help students negotiate the financial aid application process and begin thinking about college at an early age. In Boston, the Higher Education Information Center, a non-profit resource center funded by loan guarantors, colleges and universities, and state and federal education agencies, provides

> academic, financial aid and career information and counseling to Massachusetts residents of all ages and backgrounds. The Center also conducts education awareness programs in middle schools, high schools and community agencies serving youth and adult populations throughout the Boston area. (Higher Education Information Center, 1997)

The federal Department of Education's TRIO programs provide early intervention mechanisms to inform students from under-represented groups about the college application process and financial aid.

Conclusion

While policy makers have to balance a number of issues that affect access and choice in public higher education, the information in this study helps to inform the debate concerning the impact of changes in tuition prices and state grant spending. While the tuition effects shown here tend to be somewhat less than those shown by earlier research, policy makers need to be aware of how the effects may differ for students of different racial groups and for different sectors of public higher education.

In times of budget constraints, there are no easy choices for higher education policy makers. Most analysts agree that the "golden age" of expansion of public higher education has come to a halt, and more and more, public institutions have to battle with other constituencies for scarce resources. Breneman (1997) reported that state support for public higher education fell from 14 percent of total state budgets to 12.5 percent during the first half of the 1990s, citing "prisons, elementary and secondary education, Medicaid, and welfare" (p. B4) as just some of the programs receiving higher funding priority. Continuing strain on appropriations for public higher education institutions will only serve to put ongoing pressure on students and their families for the financing of their postsecondary education. Recent proposals by the Clinton administration to scale back or eliminate entirely the State Student Incentive Grant program may encourage states to cut back on their own state grant programs.

Notwithstanding the current state of affairs, those groups responsible for setting public tuition prices and state grant spending should take note of the evidence presented in this study. These findings are an important extension of the previous body of student demand studies because:

- The results here demonstrate tuition and aid effects over a long period of time, not restricted to the effects in a single year represented by many cross-sectional studies. This timeframe includes enrollment in the late 1980s and early 1990s, a period not yet analyzed by the majority of the existing student demand studies (including ones conducted after those reviewed by Leslie & Brinkman, 1988).
- Effects on the enrollment of all students, not just beginning students, were shown.

[14] See Mumper (1996), O'Brien (1992), and Orfield (1992) for information on the relationship between race, income, and knowledge of financial aid.

- Differences in effects between students in community colleges and 4-year institutions were demonstrated.
- The effects of tuition and state grants on students of different races were demonstrated.

The differences in the findings across these various groups can help to inform policy makers responsible for ensuring equality of educational opportunity.

References

Ahlburg, D., McPherson, M. S., & Schapiro, M. O. (1994). *Predicting Higher Education Enrollment in the United States: An Evaluation of Different Modeling Approaches*. Williamstown, MA: Williams Project on the Economics of Higher Education Discussion Paper #26.

Bhargava, A., Franzini, L., & Narendranathan, W. (1982). Serial Correlation and the Fixed Effects Model. *Review of Economic Studies 49*, 533-549.

Blakemore, A. E., & Low, S. A. (1983). Scholarship Policy and Race-Sex Differences in the Demand for Higher Education. *Economic Inquiry 21*, 504-519.

Breneman, D. W. (1997, March 7). The "Privatization" of Public Universities: a Mistake or a Model for the Future? *The Chronicle of Higher Education*, pp. B4.

Clotfelter, C. T. (1991). Financial Aid and Public Policy. In C. T. Clotfelter, R. G. Ehrenberg, M. Getz, & J. J. Siegfried (Eds.), *Economic Challenges in Higher Education*. Chicago: University of Chicago Press.

Corazzini, A. J., Dugan, D., & Grabowski, H. G. (1972). Determinants and Distributional Aspects of Enrollment in U.S. Higher Education. *Journal of Human Resources 7(1)*, 39-59.

Dollars for Scholars. (1996). Dollars for Scholars [World Wide Web site]. Minneapolis.

Hearn, J. C., Griswold, C. P., & Marine, G. M. (1996). Region, Resources, and Reason: A Contextual Analysis of State Tuition and Student-Aid Policies. *Research in Higher Education 37(3)*, 241-278.

Heller, D. E. (1997a). *Access to Public Higher Education, 1976 to 1994: New Evidence From an Analysis of the States*. Unpublished dissertation, Harvard University, Cambridge, MA.

Heller, D. E. (1997b). Student Price Response in Higher Education: An Update to Leslie and Brinkman. *Journal of Higher Education 68(6)*.

Higher Education Information Center. (1997). Higher Education Information Center [World Wide Web site]. Boston.

Jackson, G. A. (1988). Did College Choice Change During the Seventies? *Economics of Education Review 7(1)*, 15-27.

Kane, T. J. (1994). *The Causes and Consequences of Recent Public Tuition Increases (Draft)*. Cambridge, MA: Monograph, Kennedy School of Government.

Kane, T. J. (1995). *Rising Public College Tuition and College Entry: How Well Do Public Subsidies Promote Access to College?* Cambridge, MA: National Bureau of Economic Research, Working Paper Series #5164.

Kennedy, P. (1992). *A Guide to Econometrics*. Cambridge, MA: The MIT Press.

Lenth, C. S. (1993). *The Tuition Dilemma*. Denver: State Higher Education Executive Officers Association.

Leslie, L. L., & Brinkman, P. T. (1988). *The Economic Value of Higher Education*. Washington: American Council on Education.

Liang, K.-Y., & Zeger, S. L. (1986). Longitudinal Data Analysis Using Generalized Linear Models. *Biometrika 73(1)*, 13-22.

McCullagh, P., & Nelder, J. A. (1989). *Generalized Linear Models*. London: Chapman and Hall.

Mumper, M. (1996). *Removing College Price Barriers: What Government Has Done and Why It Hasn't Worked*. Albany, NY: State University of New York Press.

National Association of State Scholarship and Grant Programs. (Various years). *NASSGP Annual Survey Report*. Harrisburg, PA: Author.

National Center for Education Statistics. (1995). *Digest of Education Statistics 1995*. Washington: Author.

O'Brien, P. M. (1992). *Enrollment in Higher Education: The Role of Information About College Costs and Financial Aid*. Unpublished qualifying paper, Harvard University, Cambridge, MA.

Orfield, G. (1992). Money, Equity, and College Access. *Harvard Educational Review, 62*(3), 337-372.

Rouse, C. E. (1994). What to Do after High School: The Two-Year versus Four-Year College Enrollment Decision. In R. G. Ehrenberg (Ed.), *Contemporary Policy Issues in Education* (pp. 59-88). Ithaca, NY: ILR Press.

U.S. Bureau of the Census. (1996). Median Income for 4-Person Families, by State [On-line data file]. Washington.

Washington State Higher Education Coordinating Board. (1996). *1995-96 Tuition and Fee Rates: A National Comparison*. Olympia, WA.