Discussion Paper No. 4

Williams Project on the Economics of Higher Education
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Measuring the Effects of Federal Student Aid:

An Assessment of Some Methodological and Empirical Problems

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May 1990
DP-4

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final draft May 1990

The authors wish to thank Michael P. O'Malley, Diedre Goodwin, and Mary Skinner for excellent research assistance.

EXECUTIVE SUMMARY

Certainly no aspect of the evaluation of federal student aid has attracted more attention than the question of its impact on enrollment levels and patterns. Although it is important to note that affecting enrollment is not the whole justification for student aid, the aim of promoting the enrollment of targeted groups has been central to the case for federal student aid throughout its history. Despite quite substantial empirical efforts, the issue of the size - and even the existence - of these enrollment effects remains unsettled.

This paper reviews the major studies of enrollment effects of aid briefly and offers some new econometric evidence on the enrollment/aid relationship. We give special attention to the seeming conflict between empirical findings based on cross-section econometric results which tend to find large effects of aid and the actual historical experience in which these effects are not readily discernible in the aggregate data. Our new results go some distance toward reconciling these various findings. A properly controlled econometric analysis of time-series data for white students shows significant effects of aid on enrollment for students from low-income families.

Specifically, our results indicate that increases in net cost over time lead to decreases in enrollment rates for low-income students. The magnitude of the coefficient on net cost implies that for lower-income students a $100 net cost increase, expressed in 1982-83 dollars, results in a 1.6 percent decline in enrollment for that income group. A consensus in the literature is that a $100 increase in net cost reduces enrollment rates by 1.8 percent. Our result is broadly consistent with typical cross-section findings.

Our finding that the time-series and cross-section results for low-income white students are reasonably consistent is an important first step in resolving a longstanding controversy in the literature. These results derive from the fact that we have systematically related changes in net cost to changes in enrollment, rather than simply looking at enrollment levels at two points in time. It is important to appreciate that these findings for low-income students would be obscured in an analysis that aggregated over income groups, since our evidence suggests (in line with the findings of cross-section studies) that the behavior of these income groups is quite different.

Our main findings for low-income students survive more detailed analysis. When we broke down our enrollment and cost measures into separate variables for public institutions and for private institutions, we found evidence of a negative net cost effect for low-income students attending private institutions; for public institutions the net cost variable had a negative coefficient but was statistically insignificant.

We went on to break down net cost into its two components of sticker price and the subsidy value of student aid. For the combined public-private sample, we found an expected negative and significant coefficient on sticker price among low-income white students; the aid effect was positive, as expected, but insignificant. The point estimates of these two effects were virtually identical, suggesting that students responded equally to price cuts or aid increases. When public and private enrollment were considered separately, all the variables had the expected signs, with the aid and price variables in the private enrollment equation being significant. Point estimates of the aid and price effects in the private equation once again indicate highly similar magnitudes.

In sum, a more careful analysis of the time-series data has raised serious doubts about the hypothesis that federal student aid has failed to significantly affect enrollment patterns in U.S. higher education over the past two decades. Our assessment indicates that time-series evidence on the enrollment behavior of low-income white students is quite consistent with the many econometric estimates of aid effects in the literature. While further analysis seems warranted, it is nonetheless clear that policy makers must carefully consider potential enrollment effects when determining student aid policy.

I. Introduction

Certainly no aspect of the evaluation of federal student aid has attracted more attention than the question of its impact on enrollment levels and patterns. Although it is important to note that affecting enrollment is not the whole justification for student aid, the aim of promoting the enrollment of targeted groups has been central to the case for federal student aid throughout its history.[1] Despite quite substantial empirical efforts, the issue of the size - and even the existence - of these enrollment effects remains unsettled.

This paper provides a critical review of the major studies of enrollment effects of aid. We give special attention to the seeming conflict between empirical findings based on cross-section econometric results which tend to find large effects of aid and the actual historical experience in which these effects are not readily discernible in the aggregate data.

The issue of enrollment effects has several aspects. The main focus has traditionally been on "access", interpreted as the effect of student aid on postsecondary enrollment of disadvantaged groups, without reference to the kind of postsecondary education they obtain. A second focus is "choice" - the effect of aid availability on the range of postsecondary alternatives available to and chosen by disadvantaged students. Usually expanded choice is equated with improved enrollment prospects for disadvantaged students at more costly private colleges and universities. A distinction is also sometimes drawn between the effect of aid on students' initial decision to enroll in a postsecondary institution and their tendency to "persist" through the completion of a program or degree.

Commentators have noted that evidence on these various dimensions of aid's influence on student behavior could have important implications for policy. Jensen (1983) and St. John and Byce (1982) emphasize the sharp reversal in trend in federal student aid appropriations in the early Reagan years. After more than a decade of expanded funding, real spending on most student aid programs was either capped or significantly reduced in 1981 and 1982, intensifying interest in the possible behavioral impacts of such sharp changes in spending.

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1 A broader framework of goals for federal student aid is suggested in McPherson (1988).

Schwartz (1986) points to the considerable fluctuations in the income targeting of federal student aid over the 1965-1984 period. The Higher Education Act of 1965 initiated relatively small scale programs that were at first targeted fairly closely on lower income groups.[2] Starting in the 1970's, funding increases substantially expanded the amounts of support available to lower income students from these programs, but changes in the programs during the 1970's also increased significantly the share of federal student aid funds for which middle income students were eligible. As St. John and Byce (1982) show, the distribution of student aid funds had moved substantially toward the middle class in the period following the passage of the Middle Income Student Assistance Act in 1978. This trend toward broadened aid eligibility reversed with the budget cutting initiatives of the early 1980's, which had the effect of targeting available funds more heavily on lower income students. Schwartz (1986) argues that knowledge of the behavioral effects of aid on students from various income groups is needed to assess the impact of changes in the distribution of aid across income classes.

An additional persistent policy concern has been the effectiveness of aid in increasing the participation of minority students in higher education. St. John and Noel1 (1988) report evidence that the enrollment rate of 18-to-24-year old blacks increased from the early to the late 1970's as student aid funding expanded, but had reached a plateau by 1978 at a level well below white enrollment rates. Analysis of the responses of students from different racial and ethnic backgrounds to student aid offers is important in assessing the effectiveness of federal student aid spending as a device for expanding minority participation in higher education.

Finally, in reviewing reasons for interest in studying the effects of aid on student behavior, we should note a concern with persistence through, and graduation from, college. Although it is quite possible that even abbreviated stays in college that do not result in degrees are productive for students and society, it would plainly be worrisome if an important effect of student aid were to encourage students to enroll in college and then drop out. St. John, Kirshstein and Noel1 (1988) are among several authors who have recently attempted to isolate the influence of aid of varying types

[2]From the outset, the guaranteed student loan program had broader income eligibility criteria than grant and work study programs.

on student decisions to persist in college.

Attempts to measure the impact of aid on these varied aspects of student behavior fall into two basic classes, econometric studies and "trend" or "before and after" studies.[3] "Before and after" studies compare enrollment levels or patterns over a period during which federal student aid policies changed significantly, attributing changes in observed outcomes to the changed policies. Such studies are vulnerable to the criticism that factors other than aid policies which may have changed over the same period may be responsible for the observed outcome. Despite this serious flaw, studies of this kind are sometimes quite influential, because they are relatively easy to understand and because they do link up visibly with the most obvious purpose of the federal programs: to have a noticeable effect on real-world behavior of students.[4]

The econometric alternative to "before and after" studies is to build a statistical model of the processes that generate the historical outcomes, estimate the parameters of the model, and use those parameter estimates to "simulate" the effect of changes in federal policy. These models attempt to control for factors that simple "before and after" studies leave out, although no model can escape the risk that important variables are left out or poorly measured, or that the model specifies the relationships among the variables incorrectly.

In principle, one should be able to reconcile the findings of these two kinds of studies: given adequate historical data, it should be possible to use the parameters of a correctly specified econometric model to trace out the historical data used in "before and after" studies. In practice, the two approaches have not seemed easy to reconcile: the econometric studies lead us to expect substantial effects of changes in aid policy on observed student behavior, but such effects have not been seen to emerge clearly in many studies of aggregate historical data.

The principal aim of this paper is to pursue the task of reconciling historical and econometric

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[3] A third source of information is study of student survey responses to questions about how their educational decisions are made - in particular about the effect of aid. These studies can't be viewed as providing "hard" evidence, partly because students, as aid recipients, are likely to be inclined to exaggerate its impact, but more importantly because students probably in many cases cannot reliably tell how they would have behaved had aid not been available to them.

[4] The most widely cited of the "before and after" studies of federal student aid is Hansen (1983). A comprehensive survey is included in Leslie and Brinkman (1988).

data more thoroughly than has been done before. We first review, in Section II, the various approaches to measuring aid effects that have been employed in the literature, and discuss some of their strengths and limitations. Section III reviews some of the principal empirical findings from the econometric literature on aid. Section IV describes existing studies of historical trends in enrollment and aid patterns, and thus poses the problem of the apparent inconsistency between econometric predictions and historical reality. In Section V, we turn to some newly developed data to pursue this historical versus econometric contrast in more depth, and to offer our assessment of how it should be reconciled. Finally, Section VI discusses improvements in econometric testing.

II. Types of studies and their problems

Although differing in many ways, most econometric studies of enrollment share a background of common theoretical assumptions. They assume, most fundamentally, that the data under examination reveal information about students' demand for education rather than decisions about institutions' enrollment supply. They generally assume, that is, that if more students with given characteristics (income, academic record, and so on) seek higher education of a particular kind, that added demand will be met without any change in institutions' prices, admission standards, student aid policies or quality. They usually assume, further, that any increase (decrease) in the aid funds available to an institution from external sources (such as the federal government) will be completely passed through into reductions (increases) in the net cost facing prospective students, rather than being absorbed by the institution through higher (lower) fees or less (more) aid provided from the institutions' own funds.

These are problematic assumptions, more so in some econometric studies than others.[5] Even if econometric estimates manage to escape contamination from the confounding of supply with demand effects, it remains critical, as developed further below, to allow for supply effects in applying the findings to historical trends, where supply effects clearly do play a role.

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5 These assumptions of perfectly elastic supply are most troubling in econometric studies that rely on aggregate data, such as state cross-sections or national time series. They are least worrying in studies of the behavior of individual students.

Student aid is assumed in these demand models to affect student behavior through affecting the net price (to the student and his or her family) of educational alternatives. Microeconomic theory carries implications for how students should respond to various factors that may change their net cost of education. Other things equal, a fully informed student should have the same reaction to a $100 grant as to a $100 reduction in tuition - both reduce the net cost equally. If, as evidence suggests (Hearn (1980)), students are better informed about tuition levels than about aid availability, the tuition decrease should have a relatively larger effect.

The analysis of student loans is somewhat more complicated. Typical student loans offer their recipients two things: (1) access to a credit market which would otherwise not be available owing to difficulties in establishing credit-worthiness and (2) subsidies in the form of below market interest charges and direct government payment of interest. For fully informed student borrowers, the impact of the second factor on behavior should be just the same as a grant or a tuition reduction of equal value (that value being determined as the present discounted value of the stream of subsidy payments evaluated at an appropriate market interest rate). The first factor should increase the behavioral effect of the loan beyond that amount.[6] A subsidized loan, that is, should in theory have a smaller effect on behavior than a grant with the same face value, but a larger effect than a grant which equals the value of the loan subsidy -- all this assuming that students and their parents are able to figure out what's going on.

In fact, as we shall see, empirical studies have in any event had relatively little success in distinguishing the impact of different sources of reduction in net cost.

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[6] A third form of aid, besides grants and loans, is "college work-study", the provision to students of jobs (typically on campus) at governmentally subsidized wages. If the students receiving these jobs would otherwise get similar jobs at similar wages, the subsidy payment is really being made to the school, and should have no enrollment effect. To the extent that students avoid unemployment or receive higher wages because of the subsidy, there should be demand effects. Because college work-study has been a relatively unimportant federal program in dollar terms, it is in any event ignored here. It should be noted that a number of studies indicate that being employed for a limited number of hours in an on-campus job while in school tends to encourage persistence in college, apparently by increasing the students' commitment to and integration with the institution. This phenomenon is apparently independent of the "net cost" considerations this chapter focuses on. See Newman (1985).

A final set of theoretical issues concerns distinguishing the question of whether to enroll in college (the "access" question) from the question of where to enroll ("choice"). It's helpful conceptually (although not necessarily accurate psychologically) to sort the college choice decision into two parts. The student first ranks all the schooling alternatives available to her - taking into account price, aid availability, quality, and so on - and then compares the best of those educational alternatives with the alternative of not continuing in school at all. A change in aid policies would affect the net cost to the student of (at least) some of the educational alternatives and therefore may affect which school is ranked highest among educational alternatives. If the top ranked choice changes or if it stays the same but the net cost of that choice is changed by the change in aid policy, then the decision about whether or not to go on to school may also change.

It follows that the change in student behavior produced by changes in aid policy is likely to be sensitive to how the policy change affects the net cost of different alternatives. Thus a policy change whose main effect is to increase the aid at alternatives previously ranked low by potential students may affect choice while having little effect on access (principally changing the destinations of students who were college bound anyway), while a change which reduces net costs at all institutions without affecting relative prices may promote access without affecting choice. The actual targeting of aid among institution types is likely to have an important influence on its effects, and these are not easy to sort out.

III. Findings: a summary of the literature

A great many studies over the years have attempted to estimate the impact of price or net cost of education on students' postsecondary education decisions.[7] A minority of those studies have tried to measure specifically the effect of student aid on enrollment decisions, with the rest focusing on the impact of tuition price.[8] Although the studies differ widely in data sources and estimation

[7] A number of able surveys of this literature exist. A recent one, which provides references to many of its predecessors, is Leslie and Brinkman (1987).

8 Again, Leslie and Brinkman (1988) provides a helpful review of the literature.

techniques, they tend to agree on two main points. First, student decisions to enroll in college respond positively, and non-trivially, to price cuts or aid increases. Second, decisions about where to attend school also respond non-trivially to changes in the relative prices of schooling alternatives.

Rather than providing still another review of this large and complex literature, it may be more enlightening to review one exemplary study in some depth, elaborating the discussion with evidence from other studies and literature reviews. The study to be focused on is that by Charles Manski and David Wise.[9] This study is similar in basic approach to several other studies of individual student behavior, which rely on evidence concerning student characteristics and choices from large scale surveys of young high school graduates.

A. Access

The Manski-Wise analysis proceeds in several steps. Starting from data for a sample of 1972 high school graduates, the authors first construct for each student a "choice set" of institutions to which the student could be admitted, that set depending on the student's academic performance and geographic location. The authors then perform an analysis estimating the amount of aid any given student would have been offered at each institution in his or her choice set.[10] The final step, given knowledge of the characteristics of these young people and of the academic institutions and the non-schooling alternatives available to them, is to estimate a statistical model that best explains the choices these young people actually made among schooling and non-schooling alternatives.

More specifically, the authors develop in this last step an equation which indicates the probability that a person with given characteristics (income, race, academic background, and so on) will select a school with particular characteristics (price, aid offer, quality, and so on). The maximum-likelihood parameter estimates of this multinomial logit model are chosen to yield a

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[9] Manski and Wise (1983).

[10] The National Longitudinal Survey of the High School Class of 1972 does not contain good information on the aid offers students actually did or might have received from institutions in their choice set which they did not attend. The imputations Manski and Wise developed were derived from an equation relating the aid offers students actually received at institutions they attended to such characteristics of the students as their academic achievements and parents' incomes and of the institutions as their tuition and type (4-year or 2-year).

predicted enrollment pattern which matches the actual outcomes as closely as possible. This equation can then be used to estimate how actual enrollment patterns would differ if some of these student or institutional characteristics were to change - if, for example, incomes or SAT scores rose, or if institutional costs rose.

In particular, the authors were able to simulate the effects of changes in student aid policy on enrollment patterns. They used their model to estimate how 1979 enrollment patterns would differ depending on whether the Pell grant program was or was not available to students. Specifically, the estimated model was used to forecast a student's response to changes in the cost of enrolling at different schools. The sample of students was weighted to match the national population of 1979 high school seniors and predictions were made for Pell awards during the 1979-80 academic year. Enrollment impacts of the program were then computed and compared with the hypothetical situation in which 1979 conditions are preserved but there is no Pell program. Their main finding was that the Pell grant program "should have" had a substantial effect on "access". By their estimate, the Pell grant program left enrollments 21% higher than they would have been without Pell, with the increases heavily concentrated at two-year colleges and among students from lower income families. The predicted response by income group varies greatly: there is a 59% enrollment increase for low-income students, a 12% increase for middle-income students, and only a 3% increase for upper-income students.

As with most econometric studies, a detailed look at the Manski-Wise results exposes some puzzles. The large enrollment effect they find at two-year colleges stems from the fact that they find that two-year enrollments respond much more strongly to aid increases than to price cuts. They do not find anything comparable to this result for other types of schools, nor is the finding replicated in other studies. Moreover, as noted above, theory suggests that grant increases should have a smaller effect than price cuts, because they are harder to learn about. If the aid effect at two-year colleges is set equal to the effect of price changes of the same magnitude, the effect of the Pell program on total enrollment drops to six percent.

On the other hand, the effect of the Pell program on four-year college enrollments in the Manski-wise study is puzzlingly small (virtually zero). Other studies, notably those by J. B. Schwartz,

find substantial effects of public grants on four-year college enrollment.[11] It may be that a technical feature of the Manski-Wise estimation procedure produces an underestimate of the enrollment effect at four-year colleges.[12]

Several key features of the Manski-Wise findings on the access effects of Pell grants are corroborated by other studies. Leslie and Brinkman (1988) identified six studies in addition to Manski and Wise that contained useful estimates of the effects of grant aid on enrollment levels.[13] While differing widely in data sources and estimation techniques, the studies all find substantial effects of grant aid on enrollment levels, and find those effects to be stronger among lower-income students. Jensen (1983), in a survey of the literature outside the discipline of economics, similarly concludes that there is strong evidence of positive effects of financial aid on access to college, especially among students from relatively disadvantaged backgrounds. Hauptman and McLaughlin (1988), in summarizing the econometric literature, agree that enrollments rise in response to additional aid availability and that lower-income students are more influenced by aid than are students from more affluent families.

Estimates developed by Leslie and Brinkman from their analysis of the seven econometric studies suggest that the Pell program as it existed at the end of the 1970's should have raised lower income enrollment by between 20 and 40%, implying an increase in total enrollment of roughly 10 to 20 percent. They point out that these results indicate that roughly 500,000 to 1 million low-income students and approximately 400,000 middle-income students are enrolled in college because of grant aid. The mid-point of the total of these figures is slightly over 1 million students, approximately 16% of all full-time students.

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[11] Schwartz (1985) and (1986).

[12] Their simulation technique requires the assumption that the availability of Pell grants will not induce any increase in applications to four year colleges; the only effect allowed for is increased enrollment among students who (without Pells) apply to and are admitted to at least one four year school but do not enroll. Since, in their sample, about 65 percent of the eligible population never are accepted for admission at a four year college, this assumption sharply limits the possible effect they could have found.

[13] The six studies are Berne (1980), Blakemore and Low (1985), Carlson (1975), Crawford (1966), Carroll et a1.(1977), and Jackson (1978).

Further econometric support for this finding is provided by the many studies that estimate the effect of tuition variations on enrollment behavior. Although changes in grant awards may have somewhat different effects on enrollments from tuition changes that have equivalent effects on net price, the size of those effects and their variation across income classes should be similar. It is therefore reassuring to note that most studies of enrollment demand find significant positive effects of tuition reductions on enrollment levels, and find that the enrollment effects (in percentage terms) are larger for lower-income students.[14] Leslie and Brinkman (1987) find that a consensus of the studies they survey puts the effects of a price cut of $100 (1982-83 academic year dollars) on national enrollment of 18-24 year-olds at about 1.8 percent. On the assumption that a price cut has equal effect with a grant increase of the same magnitude, the Pell program as it existed in 1979 should have boosted total enrollment by roughly 10 to 15 percent, compared to what enrollments would have been in that year without the program.[15] This is roughly comparable to estimates like those of Manski and Wise that try to measure the effect of grant aid directly.

Perhaps the most important limitation of the Manski-Wise effort and most of the other studies discussed so far lies in their reliance on data that predate the major expansion in federal student aid beginning in the early 1970's.[16] Thus, the Manski-Wise effort to simulate the effects of Pell relies on estimates of student responsiveness to student aid grants available in 1972, under award programs that differed significantly in structure and sources from the Pell program. Within the last several years, a data set (High School and Beyond) based on a survey of 1980 high school graduates has become available from the federal government. Although relatively few econometric studies of enrollment behavior based on these data are yet complete, findings that are available suggest that

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[14] See Leslie and Brinkman (1987) for a comprehensive survey. For an analytically oriented survey that examines the relation between income levels and price responsiveness of enrollment, see McPherson (1978).

[15] This assumes an average Pell award of about $1000 1979 dollars per recipient and that about half of freshmen should have been eligible for Pell under 1979 rules. Manski and Wise (1983), p. 21, estimate an eligibility rate of around 2/3rds and an average award of slightly below $1000.

[16] All but one of the econometric studies of access discussed by Leslie and Brinkman (see footnote 13 above) rely on data from 1972 or earlier. The first year in which students received awards from the Pell (BEOG) program was 1974.

results from these data will be broadly similar to earlier results. Schwartz (1986), for example, has reported on a study examining the effects of grants and loans on enrollment at four-year colleges. He found that about 21 percent of low-income enrollment at four-year colleges was accounted for by Pell, and smaller percentages of higher-income enrollments; results that are broadly consistent with other findings reported here. St. John and Noel1 (1988), using High School and Beyond along with the National Longitudinal Survey of the High School Class of 1972, also found that financial aid had a positive impact on enrollment decisions, with scholarships and grants having the largest effect among aid packages for minority applicants.

B. Choice

Empirical findings about the effects of grants on "choice" - the decision about where to enroll in college - are much more unsettled than the "access" findings. Part of the reason is that there has been less agreement in the literature about precisely what questions should be studied. Several studies have adopted the perspective of the individual institution, asking to what degree students with particular characteristics may be influenced in choosing that institution by varying the amount or kinds of aid they are offered. These studies, in effect, attempt to help institutions measure the effectiveness of student aid as a marketing or recruiting tool.

Other studies have instead been concerned with the responsiveness of national enrollment patterns to changes in the relative prices of different schooling alternatives, with student aid viewed as one source of relative price variation. Still other studies have been concerned to ask how big an impact the actual patterns of student aid we observe nationally have had on the enrollment destinations of students.

It is important to recognize that each of these types of study is very different from the others. It is conceivable, for example, that differences in aid offers might have a big influence on which school was chosen from within a particular broad class of schools, but very little influence on what broad class of school was chosen. To take a Chicago example, perhaps aid offers make a big difference on students' choice between Loyola and Depaul, or between Chicago and Northwestern, but almost no influence on the choice between a Catholic comprehensive university and a secular

research university. It's apparent that the outcome of any choice study may be extremely sensitive to just how the alternatives facing students are specified and that attempts to generalize from disparate studies are quite hazardous.

There is also a major difference between asking how responsive students are to relative price changes and asking how large an impact the national aid distribution has on choice. The latter question combines the issue of student responsiveness with the issue of how large an effect the aid pattern has on relative prices (the latter being essentially a supply rather than a demand side question).

Despite these complications, some generalizations do emerge. Institutionally oriented studies tend to show that substantial differences in aid offers can be effective in attracting students. These studies rely on data reporting the relative amounts of aid offered by a particular institution along with other institutions to which a sample of students were admitted. The usual finding is that the attractiveness of the aid package significantly affects student destinations.[17]

Tierney (1980) examined the choices made by Pennsylvania students who were admitted to schools that differed substantially in cost. Tierney had available data files with exceptionally good information on the costs (including aid) facing students at these institutions and on the students' personal and academic characteristics. His studies too show significant responsiveness of choice to relative prices: as differences in tuition between public and private institutions increased, the probability of matriculating at a public institution rose. However, as private institutions offer more grants and scholarships relative to public institutions, the probability of matriculating at a private institution rises.

In summarizing the literature, Jensen (1983) states that financial aid has a substantial influence on institutional choice for students who are accepted by two or more colleges. Leslie and Brinkman (1988) conclude that student aid is an effective way of changing net price differentials among competing institutions -all else equal, an institution can increase its enrollment share by offering more aid. Manski and Wise (1983) also find that college financial aid offers could play an

[17]See, for example, Ehrenberg and Sherman (1984) for a study of Cornell.

important role in affecting choice among schools. However, in terms of the specific effect of the Pell program on institutional choice, Leslie and Brinkman report that there is less agreement in the literature. Of critical importance is the effect of federal student aid on institutional behavior. Specifically, do institutions raise tuitions in response to increases in federal student aid? This question is returned to below.

IV. History: does reality look like what the studies suggest?

These econometric findings create an expectation that it should be possible to detect effects of changing student aid policy in the national time series data. In this section, we examine evidence on historical trends in pricing, student aid, and enrollment in U. S. higher education, in order to compare these historical data with the econometric evidence.

The econometric evidence suggests that student decisions about whether to enroll and where to enroll are influenced in the expected directions and by significant amounts by changes in the net costs of schooling and of different schooling options. At the same time, federal student aid policies have changed sufficiently over the past two decades in both their magnitude and targeting that they should have had some discernible impact on the relative prices facing undergraduate students.

However, actually tracing these influences is complicated for several reasons. First, changes in federal student aid policy are blended in the time series data with other forces affecting net costs facing students. Changes in tuition rates and in schools' own expenditures on student aid grants have also been important influences on net costs in recent decades, and both theory and econometric evidence tell us that it is these net costs of attendance that influence student behavior. Second, the distribution of federal student aid among income classes has itself fluctuated considerably in recent years. It is sometimes suggested that federal student aid has been a force consistently lowering the net costs of attendance for lower income students compared to others; but in some years, especially at the end of the 1970's, substantial federal aid went to middle and upper middle income students, complicating the picture substantially. Finally, and related, the mix of federal student aid between grants and loans has changed substantially over time. According to data presented in Gillespie and Carlson (1983) and Lewis (1988), the share of federal loans was only about 60 percent of the total

grant and loan volume in 1975, 62 percent in 1979, and had risen to 71% in 1985.[18] Judgments about the relative impact of grants and loans on student behavior should therefore importantly color one's expectations about the influence of federal student aid on enrollment patterns.

A final and quite significant complication is that fully adequate data on aid distributions over time simply don't exist in any consistent series. Data are particularly weak for the period before 1974, when the advent of the Basic Grant program made the need for collection of student aid data more obvious. Before that time, we have only partial and episodic information. After 1974, the managers of the American Freshman survey began to include a series of detailed questions on the sources and amounts of financial assistance received by surveyed freshmen. These responses provide a fairly complete picture for freshmen of their own perceptions of how their education is being financed. It is necessary to be cautious about interpreting these numbers, since students may be unclear not only about the amount but especially about the form (grant vs. loan) and source (federal government vs. state government vs. institution) of the aid they receive." Despite these limitations, however, the American Freshman data, which are used extensively below, provide a helpful baseline for years after 1974 which does not exist for earlier years.

A. Federal aid over time

Table 1 presents data from the College Board showing the overall magnitudes of federal student aid, expressed in constant dollars, for selected years since 1963. Trends for the 1970's and 1980's are dominated by so-called "specially directed aid", funds provided to veterans and to children

[18]The shift toward loans is more dramatic when social security and the GI Bill are included. In 1975, new guaranteed loans were about 21% of total federal grants and loans, in 1979 they were 42%, and by 1985 they had risen to 63%.

[19]The survey is also forced to rely on self-reported family incomes. This survey is administered by institutions that elect to participate, and the setting in which it is administered may vary among institutions. The sample of institutions is therefore self-selected rather than random (institutions are only included in the sample if they survey a large fraction of their freshmen), and underrepresents two year colleges substantially. Proprietary institutions, mostly vocational/technical institutions, are not
included.

of social security recipients attending college. Although it makes sense to label each of these programs "student aid", since awards are contingent on college attendance, neither was designed principally with higher education in mind, and neither fits the model of need-based student aid. Both programs were very large in the mid-1970's, and have dwindled to almost nothing in the 1980's.[20]

When these programs are put aside, the "generally available" student aid programs administered by the Office (later Department) of Education predominate. The so-called "campus-based" programs (National Defense [later Direct] Student Loans, College-Work Study, and Supplemental Educational Opportunity Grants) have not grown much since their inception in the mid-1960's, with the result that the Guaranteed Student Loan Program (now called Stafford loans) and the Basic Educational Opportunity (later Pell) Grant program have gradually become the main sources of federal student aid.

The period 1965-85 can in fact be usefully divided into three subperiods. From 1965 to 1973, a fairly modest total of federal "generally available" aid was divided between GSL and the campus-based programs. From 1973-1980, the federal aid budget grew rapidly, with expenditures on Pell roughly keeping pace with growing numbers of dollars lent through GSL. After 1981, GSL growth has continued to be substantial, while real growth has essentially stopped in the Pell grant and the campus-based programs.

This changing mix and level of federal aid must be seen against a background of changing tuition prices in higher education. Figure 1 shows the course of real tuition at public four-year colleges and private universities for selected years from 1963/64 through 1985/86. Here again three rough periods suggest themselves: from 1965 to the early 1970's tuitions rose relative to the price level; from the early 1970's until around 1980 they fell behind the rapid inflation of those years, and from 1980 to the present they have been rising rapidly compared to inflation, especially in private higher education. Thus, the overall tendency has been for tuition to rise most rapidly in periods

[20]The social security benefit to college students was phased out as part of the budget reconciliation process in 1981. The reduction in GI Bill spending results both from changes in the program and from reductions in numbers of young veterans following the end of the Vietnam war.

when federal student aid has grown slowly or declined, while slow growth in tuition has coincided with periods of rapid increase in federal student aid.

A more focused picture of trends in the level and distribution of generally available aid can be derived from the American Freshman Survey. The tables and figures that follow focus on a limited subgroup of American undergraduates: young (ages 18-24), full-time freshmen in residence at traditional two-and four-year colleges. This subgroup has always been an important target of the federal student aid programs and has the advantage of providing a fairly well defined universe for comparisons over time.[21]

The distribution of federal aid among income classes of students has by no means been constant over time. The Middle Income Student Assistance Act of 1978 increased the grant and loan money available to higher income students - effects which have been gradually reversed in the 1980's. There has also been a real contraction in federal grant money for the lowest income students in the 1980's.

Student opportunities throughout this period were affected not just by changes in federal student aid policies but by changes in schools' tuition charges and in aid available from non-federal sources as well. At private four-year colleges, this non-federal aid is especially important, amounting in some years to more than a third of the subsidy value of student aid available to low income freshmen.[22] Moreover, it is not only low income students who benefit from non-federal grant aid. At many private institutions, students with incomes between $10,000 and $20,000 dollars receive almost as much non-federal grant aid per student as the lowest income group. It is also clear that the amount of non-federal aid going to more affluent students (partly in the form of merit grants) has been rising in recent years.

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[21]The specially directed aid programs (principally GI Bill and Social Security) do not appear importantly in these data, apparently for two reasons. First, much of this money probably went to students outside the subsample reported here, which is limited to first-time, full-time freshman resident dependent students ages 24 and below. Second, many students who were recipients of either Social Security survivor benefits or of GI Bill assistance may not have reported it as student aid.

[22]The subsidy value calculation is discussed below.

Although no summary measure can be fully adequate, it is helpful to boil down the changes in tuition and in various forms of aid to a manageable index. One way of doing this is to estimate the subsidy value of the aid received by a particular subclass of students, recognizing that the subsidy value of a loan is less than that of a grant. Per student subsidies are computed here by combining all sources of aid, and putting the subsidy value of a federal loan at half the amount lent. These numbers can be combined with estimates of the cost of attendance (including books and room and board as well as tuition) to come up with an estimate of the net cost of attending college. Figure 2 reports these net cost figures for students of different income levels (in 1978 dollars) at public and private institutions.

It is very important to stress that these net cost figures are influenced by factors other than federal aid. At public institutions, the principal contribution to changes in the net cost of education is change in the cost of attendance. This is especially true of the period since 1979, where that factor accounts for more than 80 percent of the change in net cost, except in the lowest income group. At private institutions, changes in non-federal aid were more important than federal aid in bringing costs down in the 1970's, while increases in cost of attendance have been the predominant cost raising factor for most income groups in the 1980's. In general, changes in federal student aid policy play a non-trivial but far from dominant role in producing variations over time in the net costs to students of attending college.

Figure 2 shows that for students at both public and private institutions, and at all income levels, net costs for the 1970's and 1980's have followed a similar U-shaped pattern. Costs in general fell for all groups of students in the latter part of the 1970's and rose in the 1980's, and in general the dollar amounts of cost change for different groups were roughly similar. For lower- and middle-income students, the cost increase in the 1980's is caused partly by the shift from grants to loans in federal student aid. The overall result is that the student aid system has not succeeded in insulating needier students from changes in the costs of college that affect more affluent students.

To the degree that net costs influence student enrollment decisions, what do these trends lead us to expect to find in the enrollment data that we turn to next? Several points deserve emphasis.

1. It is very important to stress that the basic pattern of net cost trends

is very similar for different income groups and at different types of institution. All groups tended to benefit from cost reductions in the 1970's and to suffer from cost increases in the 1980's. There is no reason to think federal student aid would have produced strong differentials among enrollment patterns of different groups of schools and students over this period.

2. Still, we should expect to find some detectable influence on the enrollment patterns of the lowest-income group of students through this period, both absolutely and compared to other groups. This is so for two reasons.

   a) Lower-income students on the whole experienced a larger percentage reduction in costs in the late 1970's, and a larger percentage increase in costs in the 19803, than other groups.

   b) The econometric evidence implies that lower-income students are more sensitive to price changes of given magnitude than are more affluent students.

   We thus should expect to see a relative increase in low-income students' participation rates in the late 1970's and a relative decline in the 1980's.

B. Enrollment patterns over time[23]

It is useful to divide the historical data on enrollment effects of student aid into three periods: that before 1974, preceding the introduction of the Basic Grants program; that from 1974-1980, when federal funding for student aid grew sharply in real terms; and that following 1980, when federal student aid funding failed to keep pace with inflation.

Ideally, one would want to control for differences in ability in an enrollment analysis.

[23]For another discussion of time-series changes in enrollment see Hauptman and McLaughlin (1988).

Obviously, an important aim of federal aid policy is to move toward the equalization of enrollment rates among individuals with similar abilities but different income backgrounds. As indicated in Table 2 (these data are reproduced from Hauptman and McLaughlin (1988)), enrollment rates for students with the highest skills but from the poorest families have not risen from 1961 to 1980 and are still about one-third less than the rates for students with equal ability but from the richest families. Regrettably, our capacity to pursue this important issue in more depth is impaired by the absence of an annual time-series on enrollments by ability and social background.

A further point can be derived from the evidence in Table 2. For students in each socio-economic status group, those with higher levels of academic skills are substantially more likely to attend college. This suggests that policies addressed to raising the academic skill levels of pre-college students have the potential to improve access to higher education.

We turn now to evidence on enrollment patterns by income class. The pre-1974 evidence is scattered. Data on the distribution of student aid by income class are very hard to obtain. Evidence on enrollment distributions are also shaky, partly owing to data availability problems, but also owing to the fact that large swings in military personnel levels and recruitment policies complicate the interpretation of available data.

Nonetheless fragmentary evidence suggests that the late 1960's and early 1970's were a period of rapid change in the socio-economic composition of the U. S. college population. Davis and Johns (1982) examined data on the distribution of college freshmen by income class, as reported in the American Freshman survey. They found a marked increase in the fraction of students from families below the median and below the bottom quartile of U. S. incomes in those years. Similar findings, relying partly on other data, are reported in Carnegie Council (1980).[24]

It seems implausible to attribute very much of this important change to the direct effects of federal student aid policy. The federal commitment of dollars to the main Office of Education programs (Educational Opportunity Grants, College Work Study, National Defense Student Loans, and Guaranteed Student Loans) remained modest through this period, with award levels in 1970

[24]Leslie and Brinkman (1988) discuss additional studies of enrollment changes over time for various economic and demographic groups.

amounting to just 9 percent of total tuition revenues in higher education. And of that total, a large fraction (78%) was in the form of guaranteed loans, which were not at that time strongly targeted on the neediest students. More likely, the proximate causes of the change in enrollment patterns are to be found in changed policies at the state and institutional levels, and in changed social attitudes. The most prominent state level effort was the dramatic expansion in community colleges and urban state-run four year colleges in the 1960's. These institutions were geographically closer to disadvantaged populations than traditional state universities, and often adopted open admissions policies which encouraged the enrollment of educationally disadvantaged students, who are disproportionately from poor economic backgrounds. Meanwhile, Gillespie and Carlson (1983) point out that private colleges and universities expanded their own student aid efforts by 149 percent from 1963 to 1970. Further, it may be that they targeted their funds more heavily on lower-income students. Finally, the strong society wide concern in the late 1960's for combating poverty and promoting racial equality should not be neglected. These forces led to stronger recruiting efforts directed toward disadvantaged youth, and probably had effects as well on the college-going aspirations of minority and low-income students.

While these effects probably outweighed any direct effects of federal student aid spending in increasing lower-income enrollments in the 1965- 1974 period, the indirect effects of federal aid policy on this climate of opinion should not be overlooked. States and private institutions may well have been encouraged in their willingness to expand commitments to education for disadvantaged students by the knowledge that the federal government was putting some support behind those efforts, and seemed likely to increase that support. Student expectations may have been similarly affected. The anticipation of an expanded federal role in student finance in the 1970's may have produced some effect on enrollments even before it came into being; it is not possible, however, to measure the magnitude of such a conjectured effect.

The period 1974- 1985 saw an expanded federal aid commitment followed by a decline, as well as a shift in emphasis from grants to loans. As noted earlier, the period of expanding student aid was also a period of declining tuition (in real terms), while in the 1980's tuitions have risen rapidly as the growth in federal aid has slowed. As a result, all groups of students faced lower costs

in the 1970's and higher ones in the 1980's.

Can we detect the effect of these swings in net costs on enrollment patterns and levels? Figure 3 shows enrollment rates, expressed as percent of the eligible population, for black and white students of different income levels over the 1974-1985 period.[25] The enrollment rates are for full-time dependent students, who are the group on whom federal student aid programs have been most consistently targeted. In these aggregate enrollment graphs, there is no evident effect of net costs of attendance on enrollment for families with incomes above $30,000 (1978 dollars). For families with incomes between $10,000 and $30,000 there appears to be an effect for black but not for white students - with the enrollment rate of blacks higher in the 1970's when net costs were lower and lower in the 1980's when net costs rose. From 1977 through 1981 the black enrollment rate among this middle income group averaged 38 percent; from 1981 through 1985 it averaged 33 percent.

An even more distinct swing, involving both white and black students, is evident for the lowest income group, those with incomes below $10,000 in 1978 terms. The white enrollment rate fell distinctly but modestly from the latter half of the 1970's to the 1980's; the 1975-79 average rate was 33 percent, while from 1981-85 the average rate was 29 percent. For blacks, the dropoff is dramatic: average enrollment rates fell from 35 percent to 25 percent between 1975-79 and 1981-85.

Is this general pattern consistent with student aid changes having played a significant role? As noted above, net cost changes in percentage terms were somewhat larger for lower-income students, and econometric evidence leads us to expect that that group will respond more sensitively to relative price changes of given magnitude. It thus seems very plausible that the change in federal student aid policy, which contributed significantly to the changes in net cost facing lower-income students, played a substantial role in reducing lower-income enrollment rates in the 1980's.

It would, however, be reckless to attribute the whole shift in enrollments to that cause. The

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[25] These data are derived from the U. S. Bureau of the Census Current Population Survey data tapes. Enrollments are full time only. The eligible population is defined as persons aged 18-24, financially dependent on their parents, who have completed high school but have not completed four years or more of college. The enrollment figures are for students from this population who are enrolled in college. Figures are reported only for white and black students because the "other" race category provides too small a sample for statistical reliability.

1980's have seen a greater emphasis on imposing demanding admissions criteria on postsecondary institutions, and these standards tend to weigh heaviest on low-income and especially minority students. Many observers also argue that the strong "affirmative action" commitment to enrolling and retaining black and other minority students has lost some of its force in the 1980's.

A slightly different way of looking at these data may also prove illuminating. W. Lee Hansen (1983) has suggested that it is useful to look at relative enrollment rates of more and less affluent students in gauging the impact of federal student aid, on the grounds that federal student aid is the most obvious factor that should affect the enrollment behavior of these two groups differentially. He used Current Population Survey data in examining enrollment rates for students from families with dependents eighteen through twenty-four for two time periods - 1971/1972 and 1978/1979. He then calculated the ratio of the enrollment rates of below- to above-median-income families in the two periods and found that the ratios declined for whites, blacks, men and women. When a weighted average was taken for whites and blacks and for men and women, the ratios again fell between the two periods.

The conclusion from this study is well known among researchers and policy makers:

> These data force one to conclude that the greater availability of student financial aid, targeted largely toward students from below-median-income families, did little, if anything, to increase access. The results certainly do not accord with expectations that access would increase for lower-income dependents relative to higher-income dependents. p. 93

There are some obvious limitations in interpreting this kind of snap-shot comparison at two points in time. First, year-to-year fluctuations may obscure underlying trends, so that increasing the number of years in the comparison is helpful. Second, controlling for variation in other factors that affect the demand for enrollment is not possible with this methodology. Such factors as overall economic conditions, changes in rates of return to higher education, and changes in opportunity costs of college enrollment (as produced, for example, by changes in the draft law) may influence the comparison if they affect different income groups differently. Finally, this kind of comparison is

not responsive to changes over time in the targeting of student aid. As we have noted above, during the 1970's the total amount of federal student aid not only increased substantially, but also changed significantly in its distribution. A larger fraction of available aid was targeted at middle and upper income students in the late 1970's, tending to obscure any effect on differential enrollment rates that might have occurred.

Some of these limitations can be dealt with by extending the analysis to more years, and by relating the enrollment fluctuations to what we know about year to year fluctuations in amounts and targeting of aid. An extension to more years is offered in Figure 4, which displays a three year moving average of the ratio of the enrollment rates for the lowest (below $10,000) and highest (above $30,000) income groups (in 1978 dollars) over time, looking separately at white and black students. Although the trends are similar for both racial groups, the changes are much sharper for blacks than whites. The late 1970's saw a relative increase in the ratio of low income to high income enrollment, and the 1980's have seen a decrease, with some recovery quite recently. For blacks the swing is marked - low income blacks enrolled at more than 70 percent of the high income black rate in 1979; by 1982 the ratio was just over 40 percent. For whites the change in the ratio was from about 60 percent to under 50 percent.

This narrowing of differences between upper income and lower income participation rates in the late 1970's was importantly influenced by a decline in upper income enrollment rates in the late 1970's, a decline for which there is no obvious explanation. (it certainly wasn't caused by federal student aid policy, which was becoming more generous to affluent students in those years.) It is, however, possible that the reason that lower income students did not share in that decline was that substantial federal student aid was available to them. The underlying reasoning here is that the forces (whatever they were) pressing down on higher income enrollments should have applied across the board; therefore the failure of lower income enrollments to decline in the late 1970's is backhanded evidence of the effectiveness of aid in bolstering enrollments in that group. This is a plausible, but not very strong argument. The fact that in the 1980's the real decline in federal aid was accompanied by a distinct drop in the lower income enrollment rate, while the upper income rate stayed more or less constant, seems considerably more convincing.

These data suggest that extending the Hansen time series analysis to more years, and taking closer account of changes in federal aid targeting, raises questions about the strong conclusion that federal aid was without effect. These extensions do not, however, adequately deal with one the most important concerns about such examination of trend data: the need for an estimation method in which the strength of the relationship between cost variation and enrollment variation is systematically measured. We attempt to respond to that concern with the regression analysis in the following section.

V. Further analysis: is there really an inconsistency between econometric results and history?

Summarizing the above discussion, researchers have found significant econometric evidence of a rather large enrollment response to changes in student aid. However, despite substantial variation in aid over time, enrollment responses are not readily detected in national time-series data. This earlier work has failed to subject these data to econometric analysis.

Table 3 summarizes data on net cost of attendance for different income groups during the period 1974- 1984. Table 4 summarizes enrollment data by income group over the same period. These data were the basis for much of the discussion in the previous section and a disaggregated version are now the data source for an econometric examination. Specifically, individual data points are averages of enrollment rates and net cost for particular demographic and income groups.

Since this is a relatively unusual data set, it may be worth a paragraph to spell out more clearly how these regressions should be interpreted. The individual data points in our regressions are an enrollment rate and an average net cost for a particular population subgroup (e.g., white women, incomes below $10,000) in a particular year. We employ three such data sets: one for public institutions, one for private institutions, and *one* that averages over public and private institutions. Investigations with the data suggest that small samples in the CPS data for blacks and other races make these data points inappropriate for time series analysis at the level of disaggregation we employ. Therefore, the results we report here are limited to whites only. In the regressions that report on enrollments at public and private institutions separately, we are forced to exclude data for 1980 because mistakes made by the Bureau of the Census in coding the 1980 CPS make it impossible

to distinguish public from private enrollment. Thus, regressions using the combined data set are based on 66 observations (three income groups, two genders, and 11 years). Regressions for public and for private institutions have 60 observations (three income groups, two genders, and 10 years). Dummy variables and interaction terms are used to control for differences among income groups in the strength of the relationship between net cost and enrollment and in the average propensity to enroll. Differences between men and women in the average propensity to enroll are controlled for through the use of a gender dummy. Finally, the regressions contain a time trend testing for secular changes in enrollment propensities that are not captured by our other independent variables.

As noted earlier, the data on student aid and family income in the American Freshman Survey are self-reported by students. No doubt this self-reporting introduces measurement error in these variables. Nevertheless, we use these data for several reasons. First, they are the only consistently reported annual data on net costs and income. After the National Postsecondary Student Assistance Survey (NPSAS) has been replicated several times, this data file will provide a useful, and probably statistically superior, source for time series analysis. Since at this point that survey has only been conducted once, it cannot be used in time series analysis. Second, there is no reason to expect the biases in student reporting of income and costs to vary systematically over time. While it is quite likely that student reported data on family income and ways of paying for college are inaccurate in any particular year, their variation over time should be more reliable. Finally, we know of no reason why any systematic biases in these variables should be correlated with time series variations in the dependent variable (the enrollment rate). Note that the dependent variable is obtained from a data set that is collected separately from these independent variables.

Nonetheless, we do have significant reservations about the adequacy of the CIRP data, even for time series comparisons. It would be very useful to undertake some studies aimed at testing the accuracy of these data. One way of doing this would be to compare CIRP data with alternative data sources for particular years when good survey data are available -- for example, the year when the High School and Beyond survey was conducted and the year when NPSAS was conducted. This could provide evidence of biases in the CIRP data and of any trends in those biases over time.

Table 5 presents regression results in which enrollment rates averaged across public and

private institutions are explained by time-series changes in net cost and other variables. Given the nature of the data set, heteroskedasticity is a natural worry. Therefore, for all of the regression results that follow, estimated asymptotic covariance matrices were computed under the assumption of heteroskedasticity in order to calculate the standard errors." These adjusted standard errors were used in all tests of significance. The regression equation includes a time trend along with a dummy variable for gender (1 for females and 0 for males) and dummy variables for the medium-income group (income between $10,000 and $30,000 in 1978 $) and for the high-income group (income over $30,000).[27] The aforementioned dummies allow the constant term in the regression to vary for different income groups and genders. In addition, the equation includes terms which interact income with the net cost variable, the gender dummy and the time trend. These interaction terms permit the enrollment impact of net cost to vary across income groups, and also allow us to test for differences across income groups in the time trend and in the impact of gender differences on enrollment. NETCSTHI interacts NETCOST with the dummy variable representing high income. NETCTMED interacts NETCOST with the medium-income dummy variable. TIMEHI and TIMEMED interact TIME with the income dummies, while FEMHI and FEMMED interact FEMALE with the income dummies.

An example may clarify the interpretation of these interaction effects. The coefficient on NETCOST (call it c) measures the effect of changes in net cost on enrollment among low-income students. The coefficient on NETCSTHI (call it h) measures the difference between the effect of net cost on high-income and on low-income students, while the standard error on NETCSTHI indicates the precision with which this difference is measured. The net effect of changes in net cost on enrollment for high-income students is the algebraic sum of c and h. The statistical significance of this net effect cannot be read directly from the t-tests on the individual variables; instead, it is determined by testing the hypothesis that the sum of c and h is equal to zero. As seen in Table 5, the chi-square value equals 32.57, which is large enough to reject the hypothesis that the sum of c

[26]For the derivation of this technique, see White (1980).

[27]The omitted categories for the dummies are incomes below $10,000 and males. The coefficients on the dummy variables in the regression predict differences relative to the omitted categories.

and h equals 0. Hence, there is a statistically significant effect of net cost on enrollment for high-income students.

We have the following expectations about the signs of the coefficients. The NETCOST coefficient, which measures the responsiveness of enrollment to net cost for the low-income group, should be negative (higher net cost discourages enrollment). The coefficient on NETCTMED measures the difference between the responsiveness of low- and middle-income students' enrollment to changes in net cost. Cross-section studies generally indicate that higher income students are less responsive to price than lower income students. We therefore expect the coefficient on NETCTMED to be positive, muting the negative effect of net cost on enrollment relative to that of lower income students. For the same reason we expect the coefficient on NETCSTHI to be positive (and larger than that on NETCTMED).

As Table 5 shows, all the estimated coefficients on these net cost variables are significant with the expected sign. Increases in net cost lead to lower enrollment for the low-income group, and the interaction effects are positive and significant, showing that this effect is smaller for middle- and upper-income students. In fact, the coefficients on the net cost-income interaction terms are larger in absolute value than the coefficient on net cost, implying that the predicted effect of net cost *on* enrollment in this equation is positive for middle- and upper-income students.[28] For both groups, the net cost coefficient is statistically significant as well as positive. It is possible that this unexpected result for more affluent students is explained by a supply rather than a demand effect: a positive relationship between enrollment and net cost may come about because (particularly in the 1980's) a strong demand among middle- and upper-income students for higher education has caused colleges and universities to raise their prices.[29]

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[28] The values of the intercept, MED and HIGH dummies imply that for all three income groups the intercept terms are positive but are a declining function of income. This may seem surprising, since we expect enrollment rates to vary positively with income. However, the presence of a negative net cost effect for the low income group coupled with positive effects for the other income groups means that predicted levels of enrollment evaluated at means in fact increase with income.

[29] Because enrollment rates are substantially higher for middle- and high- income students than for low-income students, and because these students generally pay higher net costs than low-income students, it is more plausible to expect a supply response to the behavior of middle- and high-income students than to that of the low-income group. Ideally, we could test this conjecture about supply side effects by including demand-shift variables in a multi-equation analysis; this is, however,

The negative coefficient on net cost implies that for lower-income students a $100 net cost increase results in an enrollment decline of about .68 percentage points, which is about a 2.2 percent decline in enrollment for that income group. We noted above that Leslie and Brinkman find a consensus in the literature that a $100 increase in net cost reduces enrollment rates by 1.8 percent. Converting our estimates in 1978-79 dollars to the 1982-83 equivalent relied on by Leslie and Brinkman, we find that a $100 cost increase results in a 1.6 percent enrollment decline for low-income students. The Leslie-Brinkman figure is in effect averaged over all income groups. As noted earlier, most studies find higher price responsiveness among lower income students. Manski and Wise's results, for example, suggest that a $100 net cost increase for low income students (1979 $) leads to a 4.9% decline in enrollment.[30] The result here, while lower than the Manski-Wise estimate, seems broadly consistent with typical cross-section findings. The important point is that our econometrically controlled time series analysis supports the view that changes in costs lead to changes in enrollment for low-income students.

We turn next to the coefficients relating to gender and to the time trend. The coefficient on the FEMALE variable indicates that over the 1974- 1984 period the enrollment rate for women tended to be about 5 percentage points higher than that for men. The fact that the variables interacting FEMALE with income are close to zero and statistically insignificant indicates that this gender effect is constant across income groups. (Chi-square values show that the net effect of the female variable on enrollment is positive and significant for all three income groups.) The time trend is negative and significant for the low income group, suggesting a tendency for the enrollment propensity for that group to fall over time, but it is important to note that the coefficient is quite small, with the estimated rate of decline being just .36 percentage points per year. The interaction effects imply that there is no significant time trend for middle income students, but that there is a significant negative time trend of .66 percentage points per year for high income students.

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beyond the scope of the present study.

[30] This coefficient is computed from information in Manski and Wise's Tables 7.2 and 7.4.

Tables 6 and 7 examine private enrollment and public enrollment separately. This breakdown is potentially important because the earlier analysis, in averaging over enrollments and over costs in the two sectors, may distort the picture of behavior in each of the sectors considered separately. The structure of the equations is similar to that in Table 5, which combines public and private enrollment, except that the net cost variable (NETCSTPU and NETCSTPR, respectively) and the net cost-income interaction terms (NTCSTMPU and NTCSTHPU for public middle- and high-incomes and NTCSTMPR and NTCSTHPR for private middle- and high-incomes) are specific to the sector whose enrollment is being explained. It would be natural to test for the significance of variables measuring cross-price effects (for example, the effect of public sector prices on private enrollment). Unfortunately, a high correlation between the time series for public and private net costs (on the order of 90 percent) makes it impossible to include both variables in the same equation.

As in the combined equation, all the coefficients in the private and public equations which are significant have the expected sign. For private enrollment, we estimate that a $100 increase in net cost lowers enrollment by about 3.6 percent for low-income students. In the private equation the net cost-middle income interaction is significant, implying that the price responsiveness of students from middle-income families differs significantly from that of students from low-income families. The overall net effect of cost on private enrollment for middle income families is negative and significant, indicating that, as for low-income students, rises in net cost reduce enrollment for middle-income students as well. The net cost-income interaction variable for students from high-income families is also positive and significant, indicating that they are less responsive to price. However, the overall net effect of cost increases on high-income private enrollment is not significantly different from zero.

Continuing with the results for private enrollment in Table 6, we find that low-income women have a significantly higher enrollment propensity than low-income men -- that is, the coefficient on FEMALE is significantly different from zero. Moreover, chi-square values indicate that enrollment propensities in private colleges are also significantly higher for middle-income and high-income women than for men of the same income class. We find a .34 percentage point negative and significant time trend for high-income students. The time trends for the low-income and

middle-income groups are not significant.

Turning to the results for public enrollment in Table 7, we find that the coefficient on net cost for low-income students has the expected negative sign but is not significant. As expected, the coefficients on the net cost-income interactions are both positive and significant. For both middle- and high-income groups, chi-square values indicate that the net effect of cost on enrollment is positive and statistically significant. The FEMALE variable was significant for all income groups. The only significant time trend is a small negative one (-.36 percentage points per year) for low-income students at public institutions.

In a further refinement of the analysis, we break down net cost into its two components - the published tuition (the sticker price, called STIK in the table) and the subsidy value of aid (AID). This step serves the purposes, first, of shedding light on the relative magnitudes of the aid and sticker price effects and, second, of pushing the data to see if anomalies or inconsistencies surface. Table 8 reports these results for equations that average over public and private institutions. The coefficients on STIK and AID, which indicate effects for low income students, have the expected sign --a higher "sticker price" lowers enrollment and more aid raises enrollment. The sticker price coefficient is significant, but the AID coefficient fails to be significant at the 10% level. It is interesting to note that the parameter estimates are virtually identical (and the same as the net cost coefficient reported above), suggesting that aid and sticker price variations have similar effects.[31] The interaction coefficients all have the expected signs, indicating that both the negative effect of price and the positive effect of aid are muted as income rises. The interactions of STIK with income are statistically significant, while the interactions of AID with income are not. Considering the overall effects of the AID and STIK variables on the enrollment of middle- and high-income students, we find no significant effect of AID for either group, while STIK has a perverse positive effect for middle-and high-income students.

Tables 9 and I0 report the effect of distinguishing sticker price and aid in the equations that examine public and private enrollment separately. These variables are called STIKPU and STIKPR

[31] The last test statement on Table 8 verifies that the difference in absolute value between the STIK and the AID coefficients is not statistically significant.

and AIDPU and AIDPR. Table 9 reports results for private institutions. We find that for low income students, AID has the expected positive sign and is significant; sticker price has the expected negative sign and is also significant. Again, the aid effect and the price effect are almost identical. The aid-income interaction terms are not significant; the overall effect of aid on enrollment is not significant for middle-income or high-income students. As expected, the interaction term for sticker price and high-income is positive and significant, while the overall effect of price for middle- and high-income students is insignificant.

Table 10 reports results for public institutions. For low income students, the signs on STIKPU and AIDPU are as expected but are not statistically significant. The interaction term with AID for the high-income group is negative and significant, as we expect. The overall effect of aid for the middle-income group is positive and significant, while for the high-income group, the overall effect is (perversely) negative and significant. The interaction effects for sticker price and income are both significant with the expected positive signs; the overall effects of sticker price are significant and (perversely) positive for both income groups.

These various regression results present a somewhat complicated picture. It may be useful to pull together the most illuminating results in a brief summary. Our most important and reliable finding is that increases in the net cost of attendance have a negative and statistically significant effect on enrollment for white students from low-income families. Moreover, the magnitude of this net cost effect is similar to that found in cross-section studies of enrollment demand. It is not possible to use our data set to test for net cost effects for blacks or other racial-ethic groups because of excessive sampling variation in the estimated enrollment rates for these students.

Our finding that the time-series and cross-section results for low-income white students are consistent is an important first step in resolving a longstanding controversy in the literature. These results derive from the fact that we have systematically related changes in net cost to changes in enrollment, rather than simply looking at enrollment levels at two points in time. It is important to appreciate that these findings for low-income students would be obscured in an analysis that aggregated over income groups, since our evidence suggests (in line with the findings of cross-section studies) that the behavior of these income groups is quite different.

The next step in our analysis was to break down our enrollment and cost measures into separate variables for public institutions and for private institutions. Once again we found evidence of a negative net cost effect for low-income students attending private institutions; for public institutions the net cost variable had a negative coefficient but was statistically insignificant.

We went on to break down net cost into its two components of sticker price and the subsidy value of student aid. For the combined public-private sample, we found an expected negative and significant coefficient on sticker price among low-income white students; the aid effect was positive, as expected, but insignificant. The point estimates of these two effects were virtually identical, suggesting that students responded equally to price cuts or aid increases. When public and private enrollment were considered separately, all the variables had the expected signs, with the aid and price variables in the private enrollment equation being significant. Point estimates of the aid and price effects in the private equation once again indicate highly similar magnitudes.

Stepping back, we see that the results tell a consistent story about the behavior of low-income white students. In our simpler specifications, the coefficients on variables measuring costs of attendance were significant with expected signs and reasonable coefficients. As we refined the analysis further, for the most part, we continued to find significant coefficients of reasonable magnitude without finding a single significant coefficient with an unexpected sign.

We found a very different picture when we looked at the behavior of more affluent students. We found no evidence in these data that increases in net cost inhibited enrollment in these income groups. In fact, for the upper-income group, there was a fairly consistent positive effect of net cost on enrollment, which may be interpreted as indicating a tendency for high enrollment demand among affluent students to lead to higher net costs for those students. For middle-income students, we found that net cost did not have a consistent effect on enrollment in our equations.

A by-product of our efforts to estimate the effects of net cost on enrollment was a set of estimates of the impact of a time trend and of gender differences on enrollment behavior. To the extent that there has been a trend in enrollment over the 1974-1984 period (after controlling for gender and net cost), it appears to be negative. It is worth pointing out, however, that the magnitude of the estimated trend is small. Finally, we found that, all things equal, women had a greater

propensity than men to enroll in institutions of higher education. This is particularly true for the non-poor.

The above analysis indicates that changes in the net price facing lower-income students have significant effects on their enrollment behavior. An important policy issue, however, is whether changes in federal aid in fact wind up changing net cost. If, for example, increases in federal aid led to decreases in the amount of aid awarded by institutions or to increases in tuition, the effect of aid on net cost would be muted. This issue deserves more systematic treatment than we can give it here. However, preliminary findings from a study of the effects of student aid on institutions that the present authors have underway (McPherson, Schapiro and Winston (1988)) suggest that these potential offsetting effects may not be empirically important. The time series evidence on net cost further suggests that periods when federal aid is generous coincide with periods when the net cost facing low-income students is lower. This supports the view that these potential offsets are not an important factor.

VI. Pushing the analysis forward: where do we go from here?

While the preceding discussion helps reconcile important points of disagreement in the literature, it also points to further areas of investigation. For one, time-series data on enrollment and net cost by ability would help us get a better handle on the nation's success in achieving a critical goal of aid policy - to enable high ability students to pursue advanced education regardless of their income background. Although it would be very expensive to maintain such data on an annual basis, useful work could be done by pooling data across those years in which large surveys such as High School and Beyond and NELS88 are undertaken.

A second point is that future attempts to monitor the effectiveness of aid in changing enrollment rates by inspecting enrollment trends over time should attempt to control for actual variations in net cost and other relevant variables. It would be desirable, for example, to include proxies for opportunity costs and rates of return to higher education investments in regressions such as those we have run. Reasonable proxies might be age-, sex-and income-specific unemployment rates and education-related earnings differentials. Whenever the data allow, disaggregating aid by

type (grant, loan and work study) and source (federal, state, local, institutional) may reveal interesting differences among aid packages. Of course, developing data sets which would permit analysis of enrollment effects by race over time would be highly desirable. In addition, while our other work thus far has failed to find important effects of federal aid on institutional aid and tuition, further study of the supply side effects of aid is needed in order to evaluate properly the various links among federal aid, institutional behavior, and enrollment patterns.

Finally, it would be useful to extend the time-series to deal with the question of choice as well as access. Although we were able to estimate separate equations for enrollment at public and at private institutions, collinearity between the public and private price variables impeded our efforts to include "cross-price" effects in these equations. Such cross-effects, for example of public tuitions on private enrollment, have considerable importance for institutional and governmental policies. Conceivably, extending the data set over more years, or experimenting further with functional forms that might reduce the collinearity, would permit meaningful estimates to be developed.

In sum, a more careful analysis of the time-series data has raised serious doubts about the hypothesis that federal student aid has failed to significantly affect enrollment patterns in U.S. higher education over the past two decades. Our assessment indicates that time-series evidence on the enrollment behavior of low-income white students is quite consistent with the many econometric estimates of aid effects in the literature. While further analysis seems warranted, it is nonetheless clear that policy makers must carefully consider potential enrollment effects when determining student aid policy.

Table 1: Aid Awarded to Students by Source, Selected Academic Years

(constant 1982 dollars in millions)

Federally Supported Programs Generally Available Aid	1963-64	1970-71	1975-76	1979-80	1981-82	1983-84	1985-86
Pell Grants	-	-	1,629	3,113	2,358	2,648	3,163
SEOG	-	325	350	414	371	342	364
SSIG	-	-	34	95	79	57	67
CWS	-	552	513	740	640	648	582
NDSL	356	584	800	803	595	647	623
GSL, PLUS, and SLS	-	2,466	2,204	4,880	7,407	7,183	7,838
Subtotal	356	3,927	5,530	10,045	11,450	11,525	12,637
Subsidy Value of Generally Available Aid *	178	1,850	3,515	6,464	6,809	6,962	7,825
Specially Directed Aid							
Social Security	-	1,212	1,901	1,972	2,047	209	0
Veterans	211	2,724	7,271	2,218	1,385	1,088	753
Other Grants	27	39	110	142	112	62	60
Other Loans	-	102	78	52	111	250	330
Subtotal	238	4,077	9,360	4,384	3,655	1,609	1,143
Total Federal Aid	594	8,004	14,890	14,429	15,105	13,134	13,780

Source: Gillespie and Carlson (1983), Lewis (1988)

* Subsidy value calculation values loans at one-half their face value and values work-study aid at $0

Table 2

Percent of High School Graduates Entering Postsecondary Education in the Year Following Graduation, By Academic Skills and Socioeconomic Status, Selected Years

Skill Quartile	Year of Graduation	Socioeconomic Status Low	Middle	High
1 (low)	1961-63	13.5	23.8	41.5
	1972	17.8	20.8	34.6
	1980	20.8	25.8	39.7
2	1961-63	23.5	35.8	55.0
	1972	25.3	34.7	52.6
	1980	31.1	39.3	68.1
3	1961-63	37.5	51.0	76.5
	1972	37.7	50.5	71.5
	1980	46.7	59.4	77.4
4 (high)	1961-63	59.5	77.3	91.0
	1972	58.2	67.6	84.4
	1980	58.0	76.3	86.4

Source: Project Talent, National Longitudinal Study, and High School and Beyond, as compiled in The Eureka Project, "The Critical Difference."

Reproduced from Hauptman and McLaughlin (1988), Table 6

Table 3. Cost of attendance not of student aid, by income group (1978 dollars).

YEAK	0-10K	10-30K	>30K
1974	3861	3772	4055
1975	3726	3677	3955
1976	3826	3024	4039
1977	3728	3710	394s
1978	3606	3604	3860
1979	3437	3467	3742
1980	3356	3499	3992
1981	3382	3524	4108
1982	355 1	3694	4396
1903	3740	3980	4734
1984	388 1	4114	488 1

Source: American Freshman Survey

Table 4. Enrollment Rates by Income Group, 1974-1484

YEAR	Income Group 0-10K	10K-30K	>30K
1974	0.31	0.40	0.58
1975	0.35	0.43	0.62
1976	0.33	0.43	0.59
1977	0.34	0.40	0.57
1978	0.33	0.39	0.52
1979	0.33	0.40	0.52
1980	0.29	0.40	0.53
1981	0.31	0.41	0.55
1982	0.28	0.39	0.59
1983	0.27	0.38	0.60
1984	0.26	0.41	0.58

source: Current Population Survey

TABLE 5

COMBINED SAMPLE

DEP VARIABLE: ENROLLMENT RATE

ROOT MSE	0.02282611	R-SQUARE	0.9682
DEP MEAN	0.4271738	ADJ R-SQ	0.9617
C.V.	5.343517	N	66

PARAMETER ESTIMATES

VARIABLE	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0
INTERCEP	0.461157	0.049629	9.292[a]
NETCOST	-0.000068	0.000023	-2.952[a]
TIME	-0.003645	0.001755	-2.077[b]
FEMALE	0.048680	0.008753	5.561[a]
MED	-0.142580	0.063266	-2.254[b]
HIGH	-0.209977	0.073307	-2.864[a]
NETCSTHI	0.000155	0.000028	5.526[a]
NETCTMED	0.000091	0.000027	3.357[a]
TIMEHI	-0.003005	0.002773	-1.084
TIMEMED	0.002917	0.002096	1.392
FEMHI	-0.001193	0.013238	-0.090
FEMMED	-0.000261	0.010992	-0.024

TEST:	NETCOST+NETCSTHI=0	CHISQ VALUE:	32.57[a]
TEST:	NETCOST+NETCSTMED=0	CHISQ VALUE:	2.85[c]
TEST:	TIME+TIMEHI=0	CHISQ VALUE:	9.59[a]
TEST:	TIME+TIMEMED=0	CHISQ VALUE:	0.40
TEST:	FEMALE+FEMHI=0	CHISQ VALUE:	22.86[a]
TEST:	FEMALE+FEMMED=0	CHISQ VALUE:	53.02[a]

[a] significant at 0.01 level
[b] significant at 0.05 level
[c] significant at 0.10 level

TABLE 6

PRIVATE INSTITUTIONS

DEP VARIABLE: ENROLLMENT RATE

ROOT MSE	0.01379395	R-SQUARE	0.9404
DEP MEAN	0.1108635	ADJ R-SQ	0.9267
C.V.	12.44228	N	60

PARAMETER ESTIMATES

VARIABLE	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0
INTERCEPT	0.164585	0.019427	8.472[a]
NETCSTPR	-0.000036	0.000006	-6.272[a]
TIME	0.000487	0.000551	0.884
FEMALE	0.015657	0.004125	3.796[a]
MED	-0.027524	0.027085	-1.016
HIGH	-0.069076	0.053513	-1.291
NTCSTHPR	0.000052	0.000012	4.234[a]
NTCSTMPR	0.000023	0.000008	2.947[a]
TIMEHI	-0.003880	0.002022	-1.918[c]
TIMEMED	0.000156	0.000802	0.195
FEMHI	0.011529	0.009027	1.277
FEMMED	0.005081	0.005152	0.986

TEST:	NETCSTPR+NTCSTHPR=0	CHISQ VALUE:	2.22
TEST:	NETCSTPR+NTCSTMPR=0	CHISQ VALUE:	6.65[a]
TEST:	TIME+TIMEHI=0	CHISQ VALUE:	3.04[c]
TEST:	TIME+TIMEMED=0	CHISQ VALUE:	1.22
TEST:	FEMALE+FEMHI=0	CHISQ VALUE:	11.46[a]
TEST:	FEMALE+FEMMED=0	CHISQ VALUE:	45.11[a]

[a] significant at 0.01 level
[b] significant at 0.05 level
[c] significant at 0.10 level

TABLE 7

PUBLIC INSTITUTIONS

DEP VARIABLE: ENROLLMENT RATE

ROOT MSE	0.02084145	R-SQUARE	0.9281
DEP MEAN	0.3177716	ADJ R-SQ	0.9117
C.V.	6.558626	N	60

PARAMETER ESTIMATES

VARIABLE	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0
INTERCEPT	0.327110	0.059491	5.498[a]
NETCSTPU	-0.000038	0.000034	-1.121
TIME	-0.003646	0.001960	-1.860[c]
FEMALE	0.028666	0.008981	3.192[a]
MED	-0.178774	0.072434	-2.468[b]
HIGH	-0.256200	0.076028	-3.370[a]
NTCSTHPU	0.000149	0.000038	3.905[a]
NTCSTMPU	0.000098	0.000038	2.588[b]
TIMEHI	0.003209	0.002350	1.365
TIMEMED	0.002631	0.002246	1.171
FEMHI	-0.007328	0.012655	-0.579
FEMMED	0.001272	0.011050	0.115

TEST:	NETCSTPU+NTCSTHPU=0	CHISQ VALUE:	43.17[a]
TEST:	NETCSTPU+NTCSTMPU=0	CHISQ VALUE:	13.84[a]
TEST:	TIME+TIMEHI=0	CHISQ VALUE:	0.11
TEST:	TIME+TIMEMED=0	CHISQ VALUE:	0.86
TEST:	FEMALE+FEMHI=0	CHISQ VALUE:	5.73[b]
TEST:	FEMALE+FEMMED=0	CHISQ VALUE:	21.63[a]

[a] significant at 0.01 level
[b] significant at 0.05 level
[c] significant at 0.10 level

TABLE 8

COMBINED SAMPLE

DEP VARIABLE: ENROLLMENT RATE

ROOT MSE	0.02329594	R-SQUARE	0.9687
DEP MEAN	0.4271738	ADJ R-SQ	0.9602
C.V.	5.453503	N	66

PARAMETER ESTIMATES

VARIABLE	PARAMETER ESTIMATE	STANDARD ERROR	T FOR HO: PARAMETER=0
INTERCEP	0.459218	0.114308	4.017[a]
STIK	-0.000068	0.000024	-2.818[a]
AID	0.000069	0.000051	1.344
TIME	-0.003635	0.001989	-1.828[c]
FEMALE	0.048684	0.008704	5.593[a]
MED	-0.278997	0.142833	-1.953[c]
HIGH	-0.189528	0.176219	-1.076
AIDHI	-0.000172	0.000106	-1.624
AIDMD	-0.000014	0.000064	-0.225
STIKHI	0.000150	0.000039	3.855[a]
STIKMED	0.000114	0.000031	3.683[a]
TIMEHI	-0.002410	0.004400	-0.548
TIMEMED	0.001500	0.002349	0.639
FEMHI	-0.001494	0.013533	-0.110
FEMMED	0.000664	0.010839	0.061

TEST:	STIK+STIKHI=0	CHISQ VALUE:	6.93[a]
TEST:	STIK+STIKMED=0	CHISQ VALUE:	5.75[b]
TEST:	AID+AIDHI=0	CHISQ VALUE:	1.23
TEST:	AID+AIDMD=0	CHISQ VALUE:	2.02
TEST:	TIME+TIMEHI=0	CHISQ VALUE:	2.37
TEST:	TIME+TIMEMED=0	CHISQ VALUE:	2.92[c]
TEST:	FEMALE+FEMHI=0	CHISQ VALUE:	20.74[a]
TEST:	FEMALE+FEMMED=0	CHISQ VALUE:	58.36[a]
TEST:	STIK+AID=0	CHISQ VALUE:	0.0003

[a] significant at 0.01 level
[b] significant at 0.05 level
[c] significant at 0.10 level

TABLE 9

PRIVATE INSTITUTIONS

DEP VARIABLE: ENROLLMENT RATE

ROOT MSE	0.01405429	R-SQUARE	0.9420
DEP MEAN	0.1108635	ADJ R-SQ	0.9239
C.V.	12.6771	N	60

PARAMETER ESTIMATES

VARIABLE	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0
INTERCEPT	0.151874	0.049227	3.085[a]
STIKPR	-0.000034	0.000008	-4.449[a]
AIDPR	0.000038	0.000011	3.337[a]
TIME	0.000468	0.000536	0.872
FEMALE	0.015830	0.004210	3.760[a]
MED	-0.039105	0.082808	-0.472
HIGH	-0.134988	0.121489	-1.111
AIDHI	0.000015	0.000108	0.140
AIDMD	-0.000017	0.000024	-0.727
STIKHI	0.000063	0.000020	3.209[a]
STIKMD	0.000024	0.000012	1.957[c]
TIMEHI	-0.007402	0.004866	-1.521
TIMEMED	-0.000183	0.001097	-0.167
FEMHI	0.013390	0.010638	1.259
FEMMED	0.005357	0.005301	1.011

TEST:	STIKPR+STIKHI=0	CHISQ VALUE:	2.55
TEST:	STIKPR+STIKMD=0	CHISQ VALUE:	1.10
TEST:	AIDPR+AIDHI=0	CHISQ VALUE:	0.25
TEST:	AIDPR+AIDMD=0	CHISQ VALUE:	1.02
TEST:	TIME+TIMEHI=0	CHISQ VALUE:	2.06
TEST:	TIME+TIMEMED=0	CHISQ VALUE:	0.09
TEST:	FEMALE+FEMHI=0	CHISQ VALUE:	8.95[a]
TEST:	FEMALE+FEMMED=0	CHISQ VALUE:	43.29[a]
TEST:	STIKPR+AIDPR=0	CHISQ VALUE:	0.06

[a] significant at 0.01 level
[b] significant at 0.05 level
[c] significant at 0.10 level

TABLE 10

PUBLIC INSTITUTIONS

DEP VARIABLE: ENROLLMENT RATE

ROOT MSE	0.02053711	R-SQUARE	0.9346
DEP MEAN	0.3177716	ADJ R-SQ	0.9142
C.V.	6.462853	N	60

PARAMETER ESTIMATES

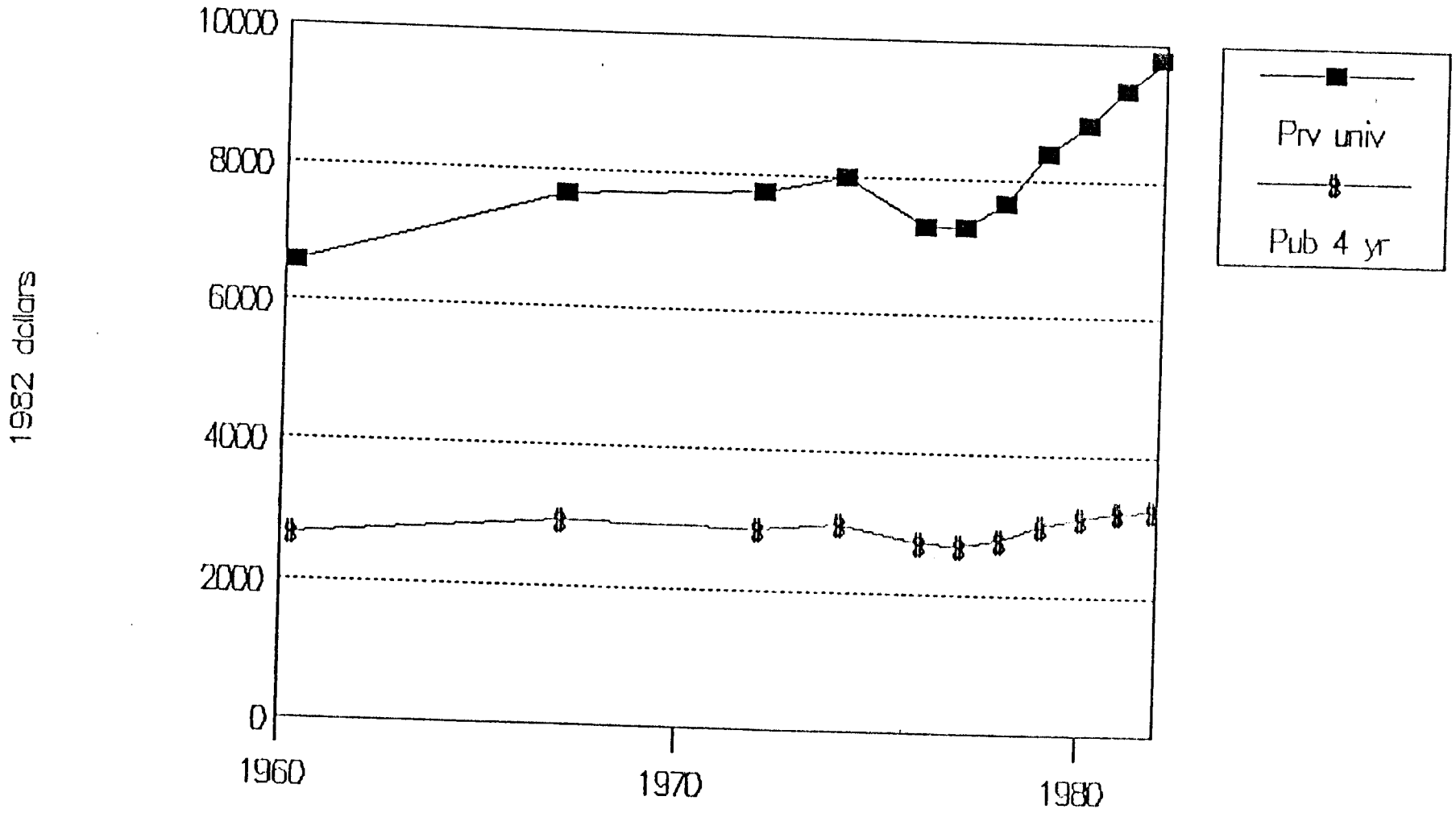
VARIABLE	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0
INTERCEPT	0.380366	0.125456	3.032[a]
STIKPU	-0.000049	0.000037	-1.352
AIDPU	0.000020	0.000066	0.310
TIME	-0.003868	0.002240	-1.727[c]
FEMALE	0.028309	0.008917	3.175[a]
MED	-0.438030	0.157962	-2.773[a]
HIGH	-0.092041	0.149601	-0.615
AIDHI	-0.000343	0.000106	-3.230[a]
AIDMD	0.000080	0.000086	0.926
STIKHI	0.000098	0.000043	2.275[b]
STIKMD	0.000152	0.000044	3.442[a]
TIMEHI	0.006152	0.002430	2.532[b]
TIMEMED	0.001606	0.002439	0.658
FEMHI	-0.012045	0.011502	-1.047
FEMMED	0.003761	0.010841	0.347

TEST:	STIKPU+STIKHI=0	CHISQ VALUE:	4.49[b]
TEST:	STIKPU+STIKMD=0	CHISQ VALUE:	17.03[a]
TEST:	AIDPU+AIDHI=0	CHISQ VALUE:	14.95[a]
TEST:	AIDPU+AIDMD=0	CHISQ VALUE:	3.24[c]
TEST:	TIME+TIMEHI=0	CHISQ VALUE:	5.90[b]
TEST:	TIME+TIMEMED=0	CHISQ VALUE:	5.52[b]
TEST:	FEMALE+FEMHI=0	CHISQ VALUE:	5.01[b]
TEST:	FEMALE+FEMMED=0	CHISQ VALUE:	27.05[a]
TEST:	STIKPU+AIDPU=0	CHISQ VALUE:	0.17

[a] significant at 0.01 level
[b] significant at 0.05 level
[c] significant at 0.10 level

Figure 1. Costs of attendance, 1963–85

Selected years and institution types



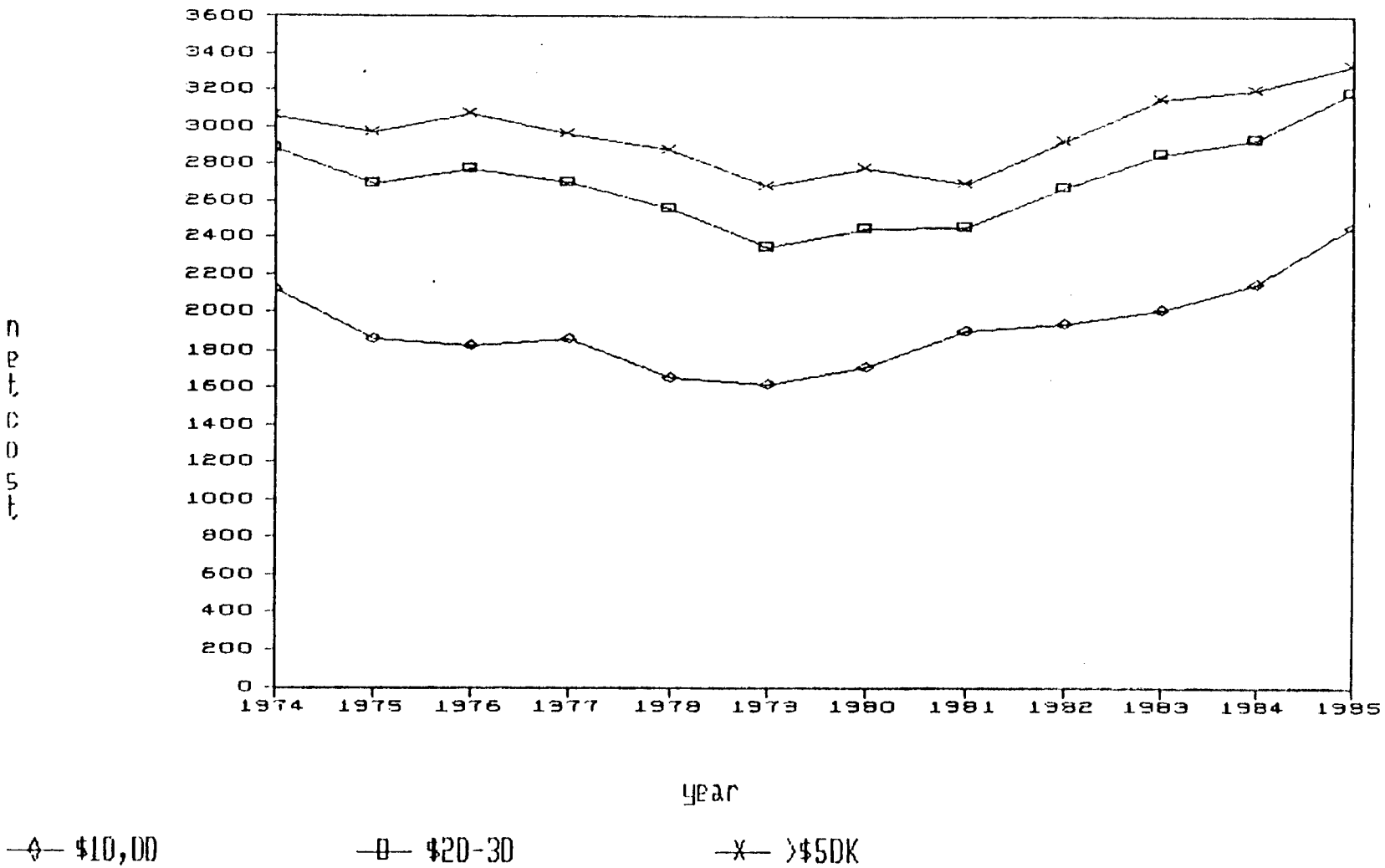


Figure 2. Net cost of attendance for three income groups, in 1978 dollars. Panel A Public institutions.

Source: American Freshman Survey

Enrollment rates, 1974–85

blacks and whites, income below $10,000

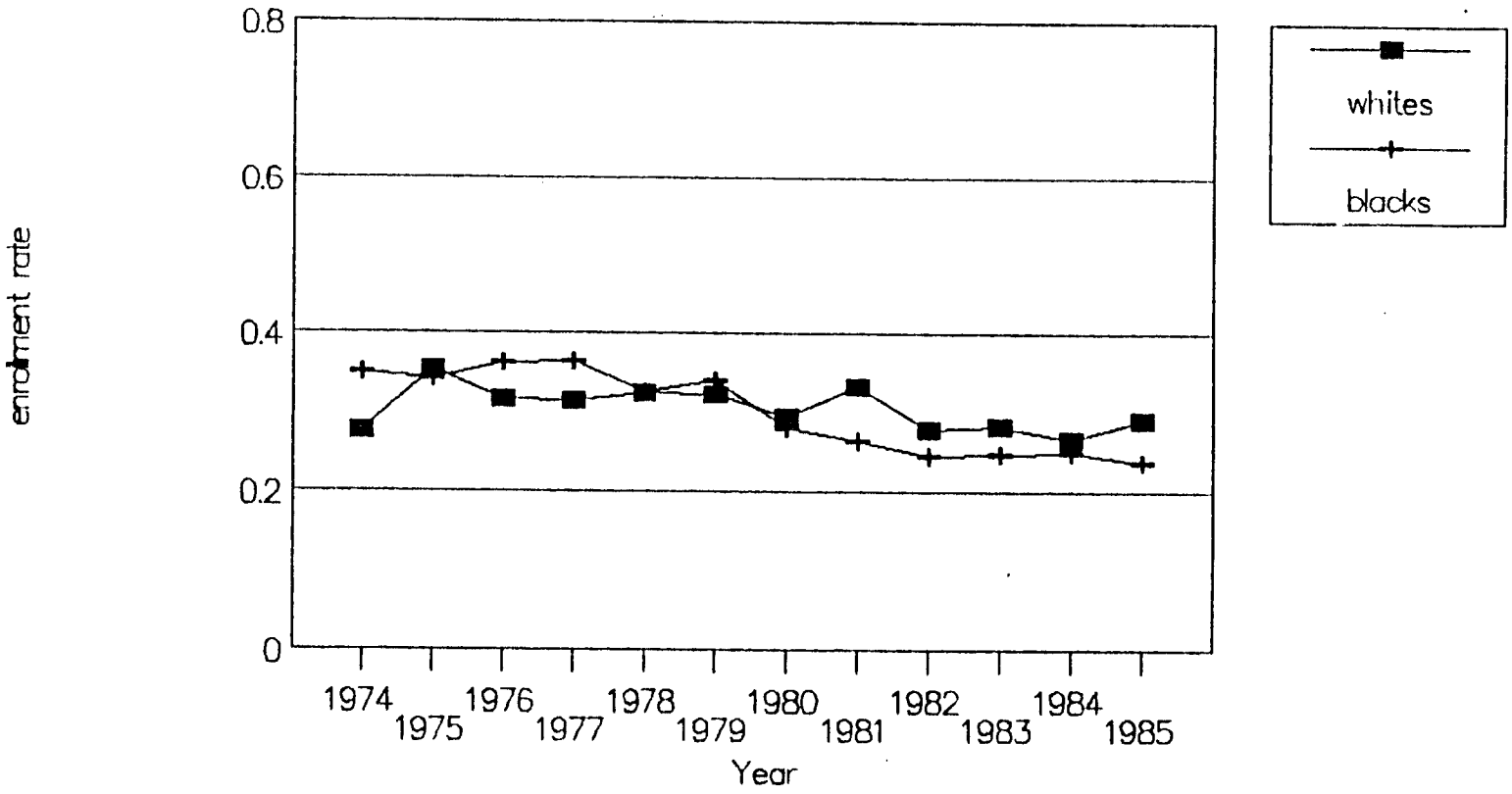


Figure 3. Panel A

Source: Current Population Survey

Note: Income is in 1978 dollars.

Enrollment rates, 1974–85

blacks and whites, income $10–$30,000

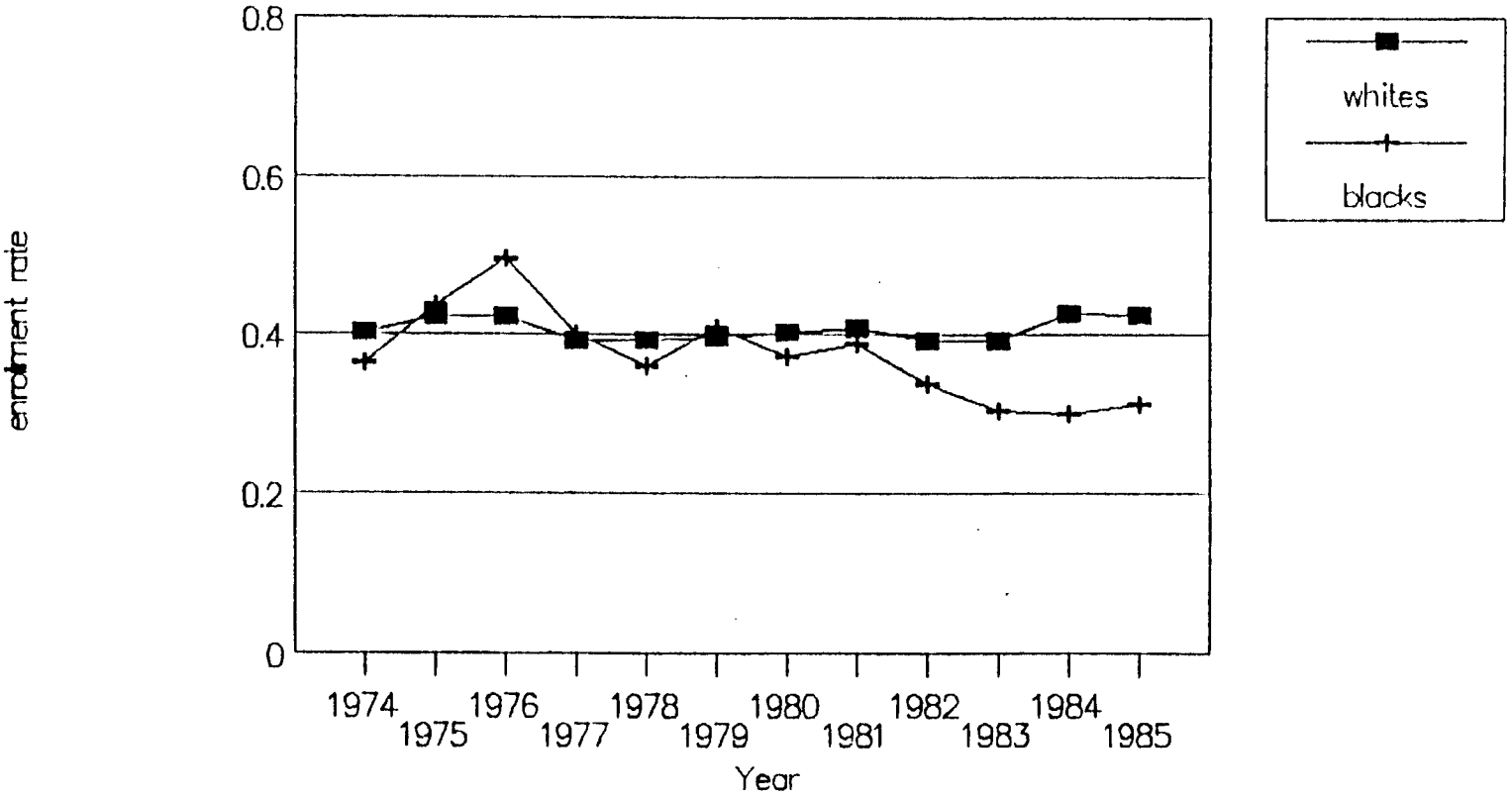


Figure 3. Panel B

Source: Current Population Survey
Note: Income is in 1978 dollars.

Enrollment rates, 1974–85

blacks and whites, income above $30,000

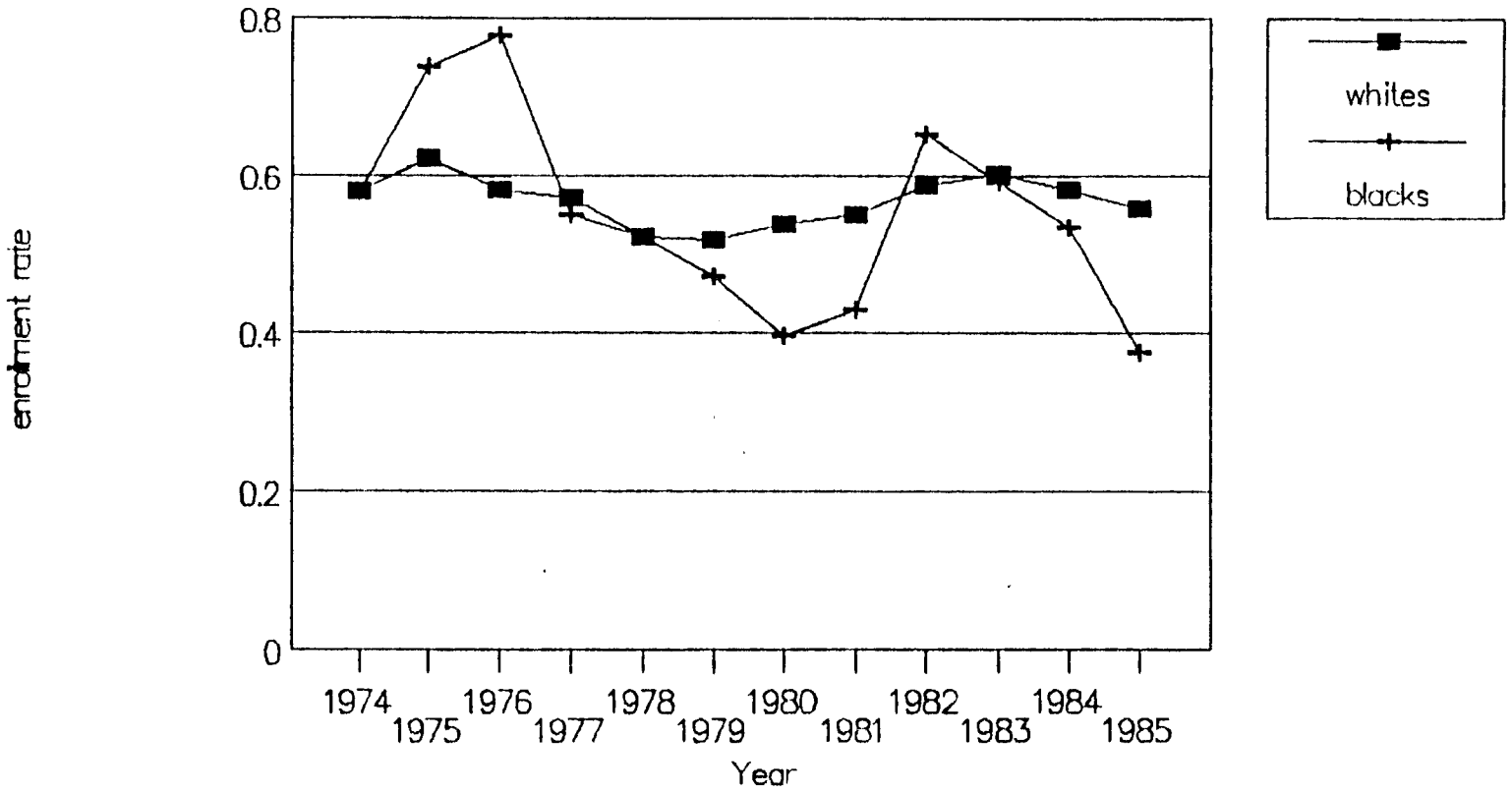


Figure 3. Panel C

Source: Current Population Survey
Note: Income is in 1978 dollars.

Ratio of low- to high-income enrollment rates, 3 year moving averages, 1975-84

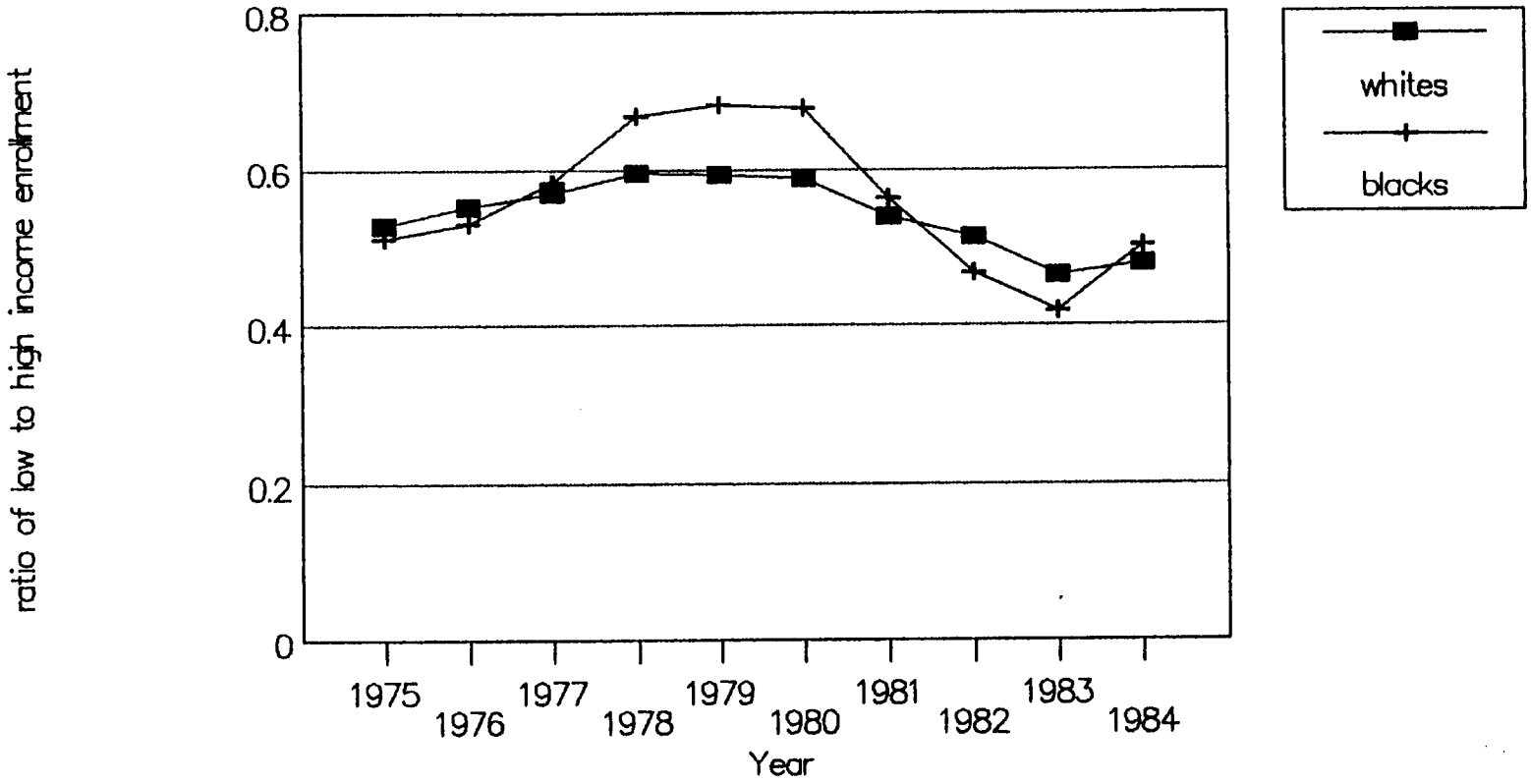


FIGURE 4

Low Income: 0 - $10,000 1978 $
High Income: greater than $30,000 1978 $

REFERENCES

Berne, R. 1980. "Net Price Effects on Two-Year College Attendance Decisions," Journal of Education Finance, 5, 4, 391-414.

Blakemore, A. E. and Low, S. A. 1985. "Public Expenditures on Higher Education and Their Impact on Enrollment Patterns," Applied Economics, 17, 33 l-340.

Carlson, D. E. A Flow of Funds Model for Assessing the Impact of Alternative Student Aid Pronrams (Menlo Park, CA: Stanford Research Institute, 1975).

Carnegie Council. Three Thousand Futures: The Next Twenty Years for Higher Education (San Francisco, CA: Jossey-Bass, 1980).

Carroll, S. J. and Mori, B. M., and Relles, D. A., and Weinschrott, D. J.. The Enrollment Effects of Federal Student Aid Policies (Santa Monica, CA: Rand Corporation, 1977).

Crawford, N. C. Effects of Offers of Financial Assistance on the College-Going Decisions of Talented Students with Limited Financial Means (Evanston, IL: National Merit Scholarship Corporation, 1966).

Davis, J. S. and Johns, K., Jr. 1982. "Low Family Income: A Continuing Barrier to College Enrollment?" Journal of Student Financial A id, 12, 5- 10.

Ehrenberg, R. G. and Sherman, D. R. 1984. "Optimal Financial Aid Policies for a Selective University," Journal of Human Resources, 19, (Spring), 202-230.

Gillespie, D. A. and Carlson, N. Trends in Student Aid: 1963-1983 (Washington, DC: Washington Office of the College Board, 1983).

Hansen, W. L. "Impact of Student Financial Aid on Access," in J. Froomkin (Ed.), The Crisis in Higher Education (New York: Academy of Political Science, 1983).

Hauptman, A. and McLaughlin, M. 1988. "Is the Goal of Access to Postsecondary Education Being Met?" unpublished.

Hearn, J. C. "Effects on Enrollment of Changes in Student Aid Policies and Programs," in J. B. Henry (Ed.), The Impact of Student Financial Aid on Institutions (San Francisco, CA: Jossey-Bass, 1980).

Jackson, G. A. 1978. "Financial Aid and Student Enrollment," Journal of Higher Education, 49, 6, 548-574.

Jensen, E. L. 1983. "Financial Aid and Educational Outcomes: A Review," College and Universitv, (Spring), 287-302.

Leslie, L. L. and Brinkman, P. T. 1987. "Student Price Response in Higher Education: The Student Demand Studies," Journal of Higher Education, 58, 2, 18 l-204.

Leslie, L. L. and Brinkman, P. T. The Economic Value of Higher Education (New York: Macmillan Publishing Co., Inc., 1988).

Lewis, G. L. Trends in Student Aid: 1980- 1988 (Washington, DC: Washington Office of the College Board, 1988).

Manski, C. F. and Wise, D. **A.** College Choice in America (Cambridge, MA: Harvard University Press, 1983).

McPherson, M. S. How Can We Tell If Federal Student Aid is Working? (Washington, DC: Washington Office of the College Board, 1988).

McPherson, M. S. and Schapiro, M. O., and Winston, G. C. 1988. "The Impact of Government Expenditures on the Operation of Colleges and Universities: An Empirical Study," unpublished.

McPherson, M. S. "The Demand for Higher Education," in David Breneman and Chester Finn (Ed.), Public Policy and Private Higher Education (Washington, DC: The Brookings Institution, 1978).

Newman, Frank. Higher Education and the American Resurgence (New York: Carnegie Foundation for the Advancement of Teaching, 1985).

St. John, E. P., Kirshstein, R. J., and Noell, J. 1988. "The Effects of Student Financial Aid on Persistence: A Sequential Analysis," unpublished.

St. John, Edward P. and Noell, Jay. 1988. "The Effects of Student Financial Aid on Access to Higher Education: An Analysis of Progress with Special Consideration to Minority Enrollment," unpublished.

St. John, E. P. and Byce C, "The Changing Federal Role in Student Financial Aid," in M. Kramer (Ed.), Meeting Student Aid Needs in a Period of Retrenchment (San Francisco: Jossey-Bass, 1982).

Schwartz, J. B. 1985. "Student Financial Aid and the College Enrollment Decision: The Effects of Public and Private Grants and Interest Subsidies," Economics of Education Review, 4, 7, 129-144.

Schwartz, J. B. 1986. " Wealth Neutrality in Higher Education: The Effects of Student Grants," Economics of Education Review, 5, 2, 107- 117.

Tierney, M. L. 1980. "Student Matriculation Decisions and Financial Aid," Review of Higher Education, 3, 14-25.

White, Halbert 1980. "A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity," Econometrica, 48, 8 17-838.