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RISING PUBLIC COLLEGE TUITION AND COLLEGE ENTRY: HOW WELL DO PUBLIC SUBSIDIES PROMOTE ACCESS TO COLLEGE?

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ABSTRACT

Though economists have spent the past decade analyzing the rising payoff to schooling, we know much less about the responses of youth or the effectiveness of policies aimed at influencing those decisions. States and the federal government currently spend more than $53 billion annually, hoping to promote greater access to college. This paper evaluates the price sensitivity of youth, using several sources of non-experimental variation in costs. The bulk of the evidence points to large enrollment impacts, particularly for low-income students and for those attending two-year colleges.

The states have chosen to promote college enrollment by keeping tuition low through across-the-board subsidies rather than using more targeted, means-tested aid. As public enrollments increase, this has become an expensive strategy. Means-tested aid may be better targeted. However, the evidence of enrollment responses to such targeted aid is much weaker. After a federal means-tested grant program was established in 1973, there was no disproportionate increase in enrollment by low-income youth. Given the number of public dollars at stake, the two sets of results should be reconciled.

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I. Introduction

The states and the federal government currently spend $53 billion dollars annually to promote greater "access" to college.[1] Much of this money is a pure transfer, received by students who would have attended college in the absence of public support. The size of the marginal group-- those who would not have entered college without the subsidy-- has always been a subject of debate. As fiscal pressures have mounted and public enrollments have swollen, states have shrank from their traditional commitment to keeping tuitions low: after adjusting for inflation, public tuition levels rose by 76% at public 4-year universities and by 63% at community colleges between 1980 and 1993[2]. This paper employs a range of non-experimental evidence to study the price sensitivity of different groups of students and the effectiveness of different forms of financial aid in increasing college enrollment.

The extensive literature on the effect of tuition on access to college has fallen into two camps: On one hand, most cross-sectional studies have found large effects of tuition on enrollment rates, particularly for low-income youth.[3] On the other hand, the time series evidence has been much less clear. The question may have been left to languish in the good company of other unresolved questions in social science, but two recent developments call for a resolution. First, fiscal pressures have led the states to question the size of their subsidies to post-secondary education. Given the growth in the public

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[1]State spending is approximately $40 billion annually, primarily in the form of direct subsidies to institutions. The federal government spends $6 billion annually in grants to low-income students and $22 billion in loans. Approximately one-third of the value of such loans represents a subsidy.

[2]Estimates are drawn from the National Center for Education Statistics, Digest of Education Statistics: 1994, Table 304.

[3]For a review of this literature, see Leslie and Brinkman (1987).

cost of health care, the "shadow price" on public budgets for higher education has risen. Second, as the earnings prospects of high school graduates deteriorate, the stakes have been raised for those seeking to enter college.

The gap in enrollment rates between African American and white youth and those from high and low-income families grew during the eighties. To investigate the potential role of the public tuition increases, the following four sources of variation in college costs are exploited:

- Between-state differences in public tuition at 2-year and 4-year colleges.
- Within-state differences in public tuition increases since 1980.
- Changes in state and federal minimum wages.
- The establishment of the Pell Grant program in 1973.

Between-state differences in public tuition charges suggest large impacts of college cost on enrollment, particularly at 2-year colleges and for low-income youth. This paper reports results from three different data-sets: the *National Longitudinal Survey of Youth*, the *High School and Beyond* senior survey and the *October Current Population Survey*. Consistent with an earlier literature, a $1000 dollar difference in public 2-year tuition is associated with a 19-29% difference in enrollment rates among 18-19 year-olds.

A weakness of these cross-sectional estimates-- which serve as the basis for the conventional wisdom in the field-- is that they are based upon differences in tuition between states which have been fairly stable for two decades. We may grossly overstate the impact of tuition, if low-tuition states such as California and North Carolina encourage college-going in other ways, such as by building a number of community colleges around the state. As a result, two sources of data are used to weigh the effects of within-state tuition increases: administrative data on opening fall enrollments and the *October Current Population Survey, 1977-93.* Administrative data suggest an impact of

a tuition increase only slightly smaller than the cross-sectional estimates: a $1000 increase in public 2-year tuition is associated with a 11% decline in public college enrollment, particularly at 2-year colleges. Further, the *October Current Population Survey* data suggest that the gaps in enrollment between high and low-income youth grew the most in the states with the largest tuition increases.

Another test of the importance of college costs is provided by increases in the minimum wage in the late eighties. As long as any increase in unemployment is not so large as to completely offset an increase in wage levels, an increase in the minimum wage represents an increase in the earnings foregone by youth considering college. The increase in California's minimum wage in July 1988 was followed by a decline in enrollment, particularly by Blacks and Hispanics and those attending two-year community colleges. Further, after the rise in the national minimum in 1990, enrollment rates in the rest of the nation came back in line with California.

Therefore, the bulk of the non-experimental evidence suggests that college enrollment decisions are quite sensitive to rising costs. The gap in enrollment rates between youth in the highest and lowest family income quartiles grew by 12 percentage points between 1977 and 1993. According to the estimates below, 20% of the widening may be due to rising public 2-year college tuition.

But keeping public tuition low through across-the-board subsidies is an expensive way to promote college enrollment. In theory, means-tested aid may more effectively target the marginal youth. But the evidence for the effectiveness of means-tested grant aid is much less clear: After the establishment of the Pell Grant program 1973, college enrollment did not increase disproportionately for low-income youth. Marginal youth may be more aware of the "sticker price" published in the newspapers than they are

capable of anticipating their financial aid eligibility. If so, any further increase in grant spending may simply go to inframarginal youth, who are already planning to attend college and, therefore, more familiar with program rules. In concluding, I propose an experimental evaluation which would identify the distinct effects of aid itself versus the role of knowledge of financial aid eligibility.

II. Trends in Enrollment and Public Tuition Levels

University administrators may have been misled by the fact that enrollments continued to rise during the eighties, despite repeated tuition increases. Figure 1 portrays the proportion of 18-19-year-olds enrolled in college as well as the average public 2-year and 4-year tuition each year from 1977 through 1993. College enrollment rates increased throughout the eighties as public tuition levels rose. Though state legislators and university administrators might be tempted, one would not want to conclude from these two figures that the demand curve for college education is upward-sloping in tuition. Presumably, enrollment rates were changing over time for a number of reasons unrelated to the tuition increases. Most importantly, the incomes of college graduates rose dramatically relative to those of high school graduates during the eighties.[4] Male college graduates aged 25-34 working full-year, full-time earned 26% more than similar high school graduates in 1980 and 54% more in 1990.[5] Although enrollment expanded after the public tuition hikes, we would have expected an increase in enrollment due to the rising payoff to schooling.

However, the increases in enrollment were not evenly distributed. Figure 2 reports the trend in enrollment rates by family income quartile for dependent 18-19 year-olds from 1977 through 1993. In each year, enrollment rates are higher for youth coming from families in the top income category. More importantly, however, the increases in enrollment rates during the eighties were larger for those from families in the top three

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[4]See, among others, Murphy and Welch (1989).

[5]Estimates drawn from Bureau of the Census, Money Income of Households, Families and Persons in the U.S., Series P-60, Nos. 132 and 174.

quartiles of the income distribution. (Mortenson(1992) and Manski(1992) report similar results.) As reported in the bottom panel of Figure 2, the gap in enrollment rates between the lowest income youth and those from the top three quartiles of the income distribution grew by 12 percentage points between 1980 and 1993. Given that African American youth are more likely to come from low-income families, the same trend was reflected in an increase in the racial gap in enrollment.[6]

One hypothesis to explain this growing gap is that low-income youth were particularly vulnerable to the rising public tuition levels, due to lower family assets and restricted access to capital markets for human capital investments[7]. Rising tuition levels themselves need not have been the cause, however, since inequality grew along a number of dimensions during the eighties. We will explore this hypothesis in greater detail throughout the paper.

III. Between-State Differences in Tuition and Enrollment Rates: Random Effects Estimates

There are two basic strategies for subsidizing the cost of college enrollment. States can either provide aid in the form of across-the-board subsidies (low public-tuition) or more targeted, means-tested aid. Although keeping tuition low is an expensive

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[6]For a more detailed analysis of racial differences in college entry, see Kane (1994).

[7]Most low-income youth do have access to Guaranteed Student Loans. But over most of the relevant period, GSL's were capped at $2500-2600 per academic year in nominal dollars. While this would be sufficient to pay tuition bills at most public universities, it generally could not cover living expenses as well. Kane (1994) reports that rates of delayed entry are higher in high-tuition states, suggesting the potential importance of borrowing constraints even in the presence of Guaranteed Student Loans.

strategy (given the large number of inframarginal students receiving subsidies), it has been the traditional policy: less than 7% of state spending for higher-education comes in the form of means-tested grants. The next two sections evaluate the effectiveness of this low-tuition strategy in promoting access.

I will assume that the supply side is completely responsive to demand changes. Given that 85% of students from the high school class of 1972 reported being accepted to their first choice and that most community colleges traditionally have had open admissions, this seems to be a reasonable simplification. This is only fortuitous, though, since it would be difficult to implement any other structure, given the lack of instrumental variables with which to estimated a system of simultaneous equations.

We will essentially be looking for differences in enrollment between high and low tuition states. From the perspective of the empiricist, it is useful that tuition at public 2-year and 4-year institutions varies dramatically across states.[8] For instance, in 1987, tuition and required fees ranged from roughly $900 in California (1991 dollars) to $2600 in Virginia. In the same year, tuition at public 2-year colleges ranged from $120 in California to $1670 in Wisconsin.

Three different data-sets are employed in the cross-sectional analysis:

- *The October Current Population Survey from 1977-93 (CPS)*
- *The National Longitudinal Survey of Youth (NLSY)*
- *The High School and Beyond Senior Cohort from 1980 (HSB)*

To generate the first set of data, samples of 18-19-year-olds each year were used

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[8] These data were provided by Jacqueline Johnson of the Higher Education Coordinating Board in the state of Washington. Each figure represents an average for each state from a number of public 4-year comprehensive universities. The comprehensive universities represent such institutions as the California State Universities in California and North Carolina A&T and Appalachian State University in North Carolina, as opposed to the flagship universities from each of these states.

from the *October Current Population Survey* each year from 1977 through 1993. The dependent variable is the proportion of youth who report being enrolled in college (either 2-year or 4-year). There were approximately 4800 18-19-year-olds in each year of the survey. In order to make use of background measures, the sample consists only of those 18-19-year-olds who were not heads or spouses in their own households. These "dependent" youth represented approximately 80-85% of the original sample in each year. A number of measures such as public tuition levels at 4-year comprehensive universities, state unemployment rates and state need-based grant spending were added by state and year.

The *National Longitudinal Survey of Youth* contains data on college-going, family background, standardized test scores and place of residence for a sample of roughly 12 thousand 14-21 year-olds in 1979. The data reported here contain members of the cross-section sample as well as the supplementary sample for disadvantaged youth. Because family income is often not observed for those sample members who were over 19 at the beginning of the survey, we limit the sample to those who were 14-19 years old in 1979.

The *High School and Beyond* survey of the senior class of 1980 reports data for roughly 12,000 high school seniors in their senior year and for 6 years afterward. The sample was limited to the 8,030 youth who participated in all three follow-ups, who reported family background information and who took the standardized test administered in the base year.

Two-Stage Random Effects Model:

For simplicity of interpretation, the following linear specification will be estimated:

$$P_{ij}=X_i\beta+Z_j\gamma+\eta_j+\epsilon_{ij} \quad (1)$$

where P_{ij} is the probability that person i, in state j, will enter college. The first set of regressors, X_i, is person-specific (including such characteristics as race, parental education, gender, etc.). If all the regressors were measured at the individual level, we could simply proceed with a simple linear probability model. However, a second set of regressors is state-specific, including the primary coefficient of interest-- state public tuition. As Moulton (1986) and others have emphasized, OLS estimates of the standard errors for these group-level regressors could be substantially understated, if there are group-level random effects, such as η_j. As a result, I employ a two-stage estimator . The goal of the first stage is to generate a set of estimates of group-level effects, D_{jq}, by state j and income quartile q. I am essentially calculating enrollment rates by state and income quartile after adjusting for personal characteristics, X_i, (which includes race, parental education, home ownership and, with two of the data-sets, student test scores.)

$$P_{ij}=X_i\beta+D_{jq}\delta_{jq}+\mu_{ij} \quad (2)$$

The estimated group effects, δ_{jq} , were then used to run a number of second stage GLS specifications of the following form, including the state-level variables, such as public tuition and state unemployment rates, as regressors:

$$\begin{aligned} \delta_{jq} &= Z_{jq}\gamma+e_{jq} \\ \hat{\gamma}_{GLS} &= (Z'\Omega^{-1}Z)^{-1}Z'\Omega^{-1}\delta \\ where\Omega &= I\sigma_e^2+A \\ A &= V(\delta) \end{aligned} \quad (3)$$

The "weighting matrix" in the second stage, Ω, consists of the variance-covariance matrix for the group-level effects estimated in the first stage as well as an estimate of the variance of e, the second stage error. The latter is estimated using the method proposed by Borjas (1987).[9]

Results

The first column in each panel of Table 1 estimates the effect of a $1000 difference in both public 2- and 4-year tuition levels on the probability of college enrollment. As might be expected, differences in public 2-year tuition are more strongly related to differences in enrollment rates across states than differences in public 4-year tuition. The marginal price-- determining whether or not people attend college at all-- is public 2-year college tuition and not 4-year tuition.

The third column tests for evidence of an interaction between the effect of a $1000 increase in 2-year tuition by family income quartile. Although the point estimates suggest that higher income youth are less sensitive to tuition levels, the standard errors are often large. If we were to calculate elasticities of demand, however, low-income youth would still be found to be more price-sensitive, given that their average enrollment rates are much lower.[10]

The fourth column adds state effects. While the main effects of tuition and the other state-level variables are no longer identified (because there is no within-state

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[9]In Table 1, the groups are defined by state and income quartile; in Table 3, groups are defined by state, income quartile and time period. Even though the group effects from separate quartiles within a state are likely to be correlated, the weighting matrix allows for any off-diagonal covariances estimated in the first stage.

[10]Mean college entry rates by income quartile are reported at the bottom of Table 1.

variation in these measures), the interaction terms by income quartiles continue to be estimable. By including state effects, we are basically asking whether the gaps in enrollment rates by income quartile are any larger in the high tuition states. At least in the *October Current Population Survey*, this seems to be true.[11]

Figure 3 provides a convenient graphical presentation of both findings, using the *October Current Population Survey*. The left panel plots enrollment rates against public 2-year tuition levels by state and family income quartile. (To be consistent with the regression results in Table 1, these are residuals from separate regressions enrollment rates and public 2-year tuition on unemployment rate, state grants and census division effects.) As suggested by the negative slope, enrollment rates are lower in the high tuition states. The right panel in Figure 3 reports the *difference* in enrollment rates between youth from the top and bottom income quartiles plotted against public 2-year tuition. Although these results are less precise and rely heavily upon the small gap in enrollment between high and low-income youth in California (a low-tuition state), the positive slope suggests that gaps in enrollment between high and low-income youth are wider in high-tuition states.

Discussion

The estimates in Table 1 imply a very large price elasticity of demand for a college education.[12] If we count tuition alone in calculating the price, the NLSY results suggest

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[11]Even if the absolute effect were the same for all age groups, the *percentage* effect of tuition on enrollment rates would be much larger at the low-income levels, because enrollment rates are lower.

[12]Youth seem to be more sensitive to direct costs than they are to future earnings. Between 1980 and 1990, the earnings differential between full-time, full-year employed male college and high school graduates aged 25-34 grew by 108%. Over the same

an elasticity of demand with respect to tuition alone of .20 (using a mean enrollment rate of .48 and mean 2-year tuition level of $753 in 1980). But tuition is only part of the cost of college attendance. A $1000 tuition increase is not a large increase in the total cost of college entry, once one recognizes the importance of foregone earnings. The mean income of a 18-24 year old high school graduate employed full-time, full-year in the March, 1980 CPS was $18,387 in 1991 dollars. If the opportunity cost for 9 months of schooling were three-quarters of this, $13,790, the estimated elasticity of demand would be much higher, -3.9.[13]

Similar cross-sectional results have served as the basis for the conventional wisdom on the effect of cost on access. However, although it is rarely recognized in the literature, they could be quite misleading. The primary weakness is that they are primarily identified by fixed differences between the states. Figure 4 reports public 4-year tuition levels in 1972, 1982 and 1992. If states had not changed tuition levels at all over the period, all of the points would lie along the 45° lines. If states had raised their tuition levels by the same amount, all of the points would lie along a line parallel to the same 45° lines. Low-tuition states have, for the most part, always been low-tuition states. Therefore, as a matter for statistical inference, it is difficult to distinguish the impact of tuition from any other characteristic of a state which would have remained constant over time. The impact of within-state changes in tuition are studied below.

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period, the college enrollment rate of male 18-19 year-olds grew by 21% (from .34 to .41). Even if we attributed all of the increase over time to a demand response to the increasing payoff to education, this would imply an elasticity with respect to future earnings of only .20. That is, if youth perceived the growing payoff to college among contemporary 25-34 year-olds to signal a similar increase in their own payoff to college.

[13] Of course, the opportunity costs for the marginal student may in fact be much lower than $13,790, particularly if they work part-time, but the elasticities implied by these estimates are still likely to be high.

IV. Tuition and Enrollment Rates: State Fixed-Effect Estimates

States have differed greatly in their willingness to dramatically raise public tuition in the face of fiscal crises. For instance, Massachusetts nearly doubled its public tuition levels between 1989 and 1991 while cutting need-based grant spending. Such differences in state tuition increases provide leverage in identifying the effect of tuition itself, as distinct from fixed state effects. This section uses two different data-sets to ask whether trends in enrollment were any different in the states with the largest tuition increases.

However, the states which raised their tuition levels were not a random draw of states with respect to other factors which might influence enrollment rates. Figure 5 reports trends in average tuition levels and average unemployment rates by region, after removing region and year effects from both series.[14] Tuition increases are counter-cyclical, rising when unemployment is high: the northeast, which experienced the greatest increases in unemployment rates during the latest recession also saw the largest tuition increase; the southeast, which fared well in the last recession, saw smaller increases in tuition levels. This would pose no difficulty if we believed *a priori* that unemployment were unrelated to tuition. But foregone earnings are potentially important in the decision to enter college. Therefore, I will attempt to distinguish between the effects of tuition increases and economic conditions in various ways, by including state unemployment rates, time effects within census divisions and, where possible, dummy variables by state and year.

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[14]Each series is simply the residual from a regression equation including census division and year specific dummies.

Administrative Data

To generate accurate estimates of changes in public enrollments within states, I pooled administrative data on fall undergraduate enrollments for over 3000 post-secondary institutions during the period 1980 through 1992.[15] In collecting these data, the U.S. Department of Education conducts a census of all postsecondary institutions in the U.S.. Therefore, they should provide a fairly accurate measure of changes in enrollment within states. Total fall undergraduate enrollment (combining full-time and part-time) was summed by state and year, at public and private, two-year and four-year colleges. (Data from private, for-profit, less than 2-year degree institutions were not used, due to changes in the Department of Education's sampling frame in the late Eighties.) To calculate enrollment ratios, inter-censal estimates of the population of 15-24 year-olds by state were used as denominators.[16] To be consistent with earlier results, the same measures of tuition at public 2-year and 4-year colleges were used by state and year.

Table 2 reports the results of specifications of the following form:

$$r_{jt} = Z_{jt}\gamma + \delta_j + \theta_{dt} + \epsilon_{jt} \qquad (4)$$

where r_{jt} is the relevant enrollment ratio; Z_{jt} is a vector of time-varying state characteristics including tuition levels, the unemployment rate and spending per capita on

[15]These data were obtained from the Integrated Postsecondary Education Data System data on opening fall enrollments as provided by the Computer Aided Science Policy Analysis and Research (CASPAR) Database System. The CASPAR data was developed for the National Science Foundation and is available from the Quantum Research Corporation, 7315 Wisconsin Avenue, Bethesda, MD 20814.

[16]Because the HEGIS/IPEDS data are not reported by age for most of the years under study here, they may include students outside of the 15-24 age range. As a result, I will refer to them as "enrollment ratios" as opposed to "enrollment rates."

need-based grants within the states; δ_j are state fixed effects; and θ_{dt} are year effects which are allowed to vary by census division. (The data were weighted by the square root of the size of the population of 18-24 year olds in that state in the 1990 census.)

The first three columns report the impact of two-year and four-year public tuition levels on total public enrollment within a state. When taken by itself, a $1000 increase in public 2-year tuition is estimated to result in a 3.5 percentage point drop in public undergraduate enrollment. This represents an 11 percent fall relative to the mean of public enrollment ratio[17], which is only slightly smaller than the 19-29% change observed in Table 1. As found in the cross-sectional results, when two-year and four-year tuition levels are taken together, the effect of a 2-year tuition increase seems to dominate.

Table 2 also reports the effect of changes in unemployment and state need-based grant spending. (The effect of changes in federal financial aid are presumably picked up by the region by year interactions.) As would be expected if rising unemployment implies lower opportunity costs, a rise in unemployment seems to be associated with a rise in enrollment. State need-based grant spending is also positively related to enrollment rates.

The cross-price elasticities for public 2- and 4-year tuitions in columns 4 and 5 have all the expected signs. In results similar to those reported in Rouse (1994), two-year tuition increases have negative effects on public 2-year enrollments and positive effects on public 4-year enrollment. Four-year tuition increases have just the opposite

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[17]The means for the dependent variables in Table 2 are as follows:

Public Enroll/Population 15-24	.320
Public 4-Yr Enroll/Popul 15-24	.162
Public 2-Yr Enroll/Popul 15-24	.158
Private 4-Yr Enroll/Popul 15-24	.067

impacts. Unemployment is positively related to public 2-year enrollment and negatively related to public 4-year enrollment. Consistent with results in Manski and Wise (1983), state need-based grant spending primarily affects public two-year college enrollment.

These state enrollment ratios are based upon the state in which a student is enrolled, not necessarily the state of residence of their families, as in the CPS. Therefore, a decline in enrollment in one state represents a decline in college entry only if the marginal youth is not moving across state lines to attend college, or if they are not simply moving to private institutions in their own state. More than 80% of students attend colleges within their own state. One might suspect that an even higher proportion of marginal college entrants do so, given the large existing differentials between resident and nonresident public tuition levels. However, column (6) provides some evidence that when public tuition levels rise in a state, there is a partially offseting increase in private enrollment. Summing the coefficients in columns (3) and (6) provides one estimate of the effect of public tuition increases on net college enrollment rates of -2.4 percentage points for a $1000 rise in public 2-year tuition and .2 percentage points for a similar rise in public 4-year tuition.

In the graphical version of these results, Figure 6 reports trends in college costs and enrollment rates in Massachusetts and the other New England states between 1980 and 1992. New England provides a powerful test of within-state tuition impacts, given the size of the tuition increases in Massachusetts in the late eighties. To adjust for any pre-existing differences between Massachusetts and the other New England states (ME, NH, VT, CT, RI), the figure reports the difference in each of these measures relative to their *difference* in 1980. The panel on the left reports changes in the difference in public

2-year and 4-year tuition as well as in need-based grant spending,[18] while the panel on the right reports differences in enrollment ratios. (Changes in the difference in unemployment rates were small, given that we are only using data from New England.) The differentials in enrollment followed each of the changes in the differential in costs. The gap in enrollment between Massachusetts and the remainder of New England widened at the beginning of the eighties when tuition differences grew. The Massachusetts advantage then began to rise when need-based grant spending rose in that state relative to other states in the mid-Eighties, particularly at 2-year colleges. In the late eighties and early nineties, when Massachusetts raised tuition more than the other states and cut grant spending, the gap in enrollment between Massachusetts and other states expanded in the opposite direction. As reflected in the regression results in Table 2, within-state increases in tuition do seem to be reflected in enrollment declines.

October Current Population Survey Results

Given the size of the samples within states, the October Current Population Survey is not the ideal dataset for studying responses to within-state changes in enrollment rates, but it is our only source for studying changes in the gap in enrollment between high and low-income youth. The CPS data were broken into two periods, 1977-87 and 1988-93.[19] To again allow for random effects in estimating the effect of state-level

[18]To be more comparable to the tuition data, need-based grant spending per person aged 15-24 is multiplied by 5, because the ratio of enrollment to the population aged 15-24 is roughly .2.

[19]I have experimented somewhat with different time periods with similar results. This particular break was chosen given the rapid tuition increases of recent years.

variables, I employ a two-stage estimator similar to equation (3).[20]

The results are reported in Table 3. To establish a point of comparison with the results in Table 1, the first column contains a specification similar to the specification in first column of Table 1). As one would have expected, the results are quite similar to those reported earlier.

However, the second column includes a full set of state fixed effects. In other words, the impact of tuition on enrollment rates is being identified by differences in the changes in enrollment rates and tuition levels within states. Although the point estimates on the effect of tuition are no longer negative, the standard errors are quite large. The results are similar in the third column after dropping public 4-year tuition. In the fourth column, income interactions with the tuition measures are added. Although the effect of tuition on the bottom quartile is still imprecisely estimated, the income interactions are again positive, suggesting smaller effects of tuition increases at higher income levels. The last column of Table 3 allows for a separate time effect for each state. Although the direct effect of state level variables such as tuition and unemployment are no longer identified, the income interactions are estimable and remain positive. In other words, while the October CPS offers only very imprecise estimates of the effect of changes in tuition on the level of enrollment rates in a state, the evidence suggests that the states with the largest tuition increases also saw the greatest widening of the gaps in enrollment between high and low-income youth.

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[20]However, rather than estimating group-level effects by state and income quartile, I did so by state, income quartile and time period. The state-level regressors were also averaged within each time period.

V. State-Specific Changes in Minimum Wages

Because foregone earnings represent the bulk of the costs of college attendance, a rise in the minimum wage provides another test for the price elasticity of demand for higher education. In a series of influential papers, Card (1992a and 1992b), Card and Krueger (1994), Katz and Krueger (1992) and Card, Katz and Krueger (1994) evaluated the impact of minimum wage changes on teen employment and wages. They consistently reported large changes in the wage distribution of youth, with little evident negative employment impacts of the recent changes in the minimum wage. In fact, in some cases the estimated employment effects of a rise in the minimum wage were found to be positive.

If youth make the decision to enter the labor force or go to school based upon an expected wage, w(1-u) (where w is the wage and u is the unemployment rate), then an increase in the minimum wage will represent an increase in expected foregone earnings, as long as the demand and supply elasticities are not too large, i.e. if any increase in the unemployment rate is not too large to offset the rise in wages.[21] Further, if the earnings of adults are largely unaffected by the minimum wage, then a change will have little effect on the expected payoff to a year of schooling.[22]

Ehrenberg and Marcus (1980) used cross-sectional differences in minimum wage coverage and the ratio of the federal minimum to average wages in each state to study the effect of minimum wages on the schooling decisions of youth. A higher minimum wage

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[21]This is the same theoretical model proposed by Todaro (1969).

[22]To the extent that a rise in the minimum wage also raises the future earnings of non-college entrants more than the earnings of college graduates, it will also represent a decline in the payoff to schooling.

relative to mean earnings in the state was associated with lower school enrollment rates, with some evidence suggesting that the effects were larger for low-income youth.

In April 1990, the federal minimum wage was raised from $3.35 to $3.80 per hour (nominal dollars). Card (1992a) studied changes in wages and employment before and after the change in the federal minimum by state. One might have expected any such change to disproportionately affect states with low wages in 1989. He reported disproportionately large effects on wages in low-wage states and no significant difference in the change in school enrollment or employment among 16-19 year-olds.

The top two panels of Figure 7 report the differences-in-differences in enrollment per capita aged 15-24 in the three groups of states identified by Card (1992a) as low, medium and high-wage states.[23] The top left panel describes the difference-in-difference in enrollment ratios at 2-year and 4-year public colleges in "medium-wage" states relative to "low-wage" states relative to the difference in 1986. (These enrollment figures come from the administrative data on opening fall enrollment reported to the U.S. Department of Education and are divided by the number of 15-24 year-olds in the state.) There is no apparent change in trend in 1990 for moderate wage states relative to low-wage states. However, the right panel reports the difference-in-differences in enrollment per capita in "high-wage" relative to "low-wage" states. In the 1991-92 school year, the first year following the April 1990 increase, enrollment fell in low-wage relative to high-wage states. This is the direction one would have expected if the rise in the minimum implied a rise in the cost of college attendance in low-wage states. Further, the change was observed

[23]Using Card's categories, "high-wage" states included all of New England, New York, New Jersey, Minnesota, Delaware, Maryland, District of Columbia, Nevada, Washington, California, Alaska and Hawaii. "Low-wage" states were West Virginia, South Carolina, Kentucky, Tennessee, Mississippi, Arkansas, Louisiana, Oklahoma, Montana, Wyoming and New Mexico.

primarily in 2-year colleges, where students may have been more sensitive to the change.

In July 1988, the state minimum wage in California rose from $3.35 to $4.25 per hour. Unlike the results reported in Card (1992a), Card (1992b) noted that school enrollment among 16-19 year-olds fell in California relative to a comparison group of states. We perform a similar test using college enrollment ratios. The bottom left panel of Figure 7 reports the differences-in-differences in college enrollment in California relative to a comparison group of states similar to that used by Card.[24] In the 1988-89 school year, immediately following the July 1988 increase, school enrollment in the comparison group rose 3 percentage points relative to the difference with California in 1986. Further, following the April 1990 increase in the federal minimum-- which would have raised the minimum wage in the comparison states-- the difference-in-differences reversed sign. Again, the change was limited to two-year college enrollment. Further, the direction of each change was consistent with the hypothesis that an increase in the minimum wage represents an increase in the opportunity costs of students considering college entry.

Table 4 reports differences in wages, unemployment and school enrollment for 18-24 year-olds using the merged outgoing rotation groups from the CPS. The table focuses upon differences between California and the remainder of the country for academic years 1986-87 through 1991-92. To approximate the academic year, only those data from the months of September through May were used. (In the 1989-90 academic year, April and May were also dropped for both California and the rest of the country given that the increase in the federal minimum occurred in April, 1990.) The fourth and fifth rows of the table report differences-in-differences between California and the rest of the country

[24]The comparison states used in this graph were Florida, Georgia, New Mexico and Arizona. Card also used Dallas, Texas.

relative to the 1988-89 and 1989-90 school years. Although there were no changes in average hourly earnings, the proportion of 18-24 year old workers earning less than $4.25 per hour declined in California relative to other states between the 1986-87 and 1987-88 school year and rose between the 1988-89 and 1989-90 school year. This is exactly the direction one would have expected. Between the 1986-87 and 1987-88 school years, unemployment did not change in California relative to the rest of the country, but school enrollment declined by 2.0 to 2.7 percentage points for white non-hispanic, hispanic and black youth. Then, after the federal minimum rose in April, 1990, that difference reversed, at least among white non-hispanic youth. As reported in Appendix Table I, these differences were most pronounced at 2-year colleges.

For someone who would have worked 20 hours per week during the academic year (9 months times 4.3 weeks/month) at the old minimum wage, the California increase would have represented a $800 increase in the costs of college attendance in 1991 dollars. Using the estimates in Table 1, we would have expected a 3 to 6 percentage point decline in college enrollment, if half of the marginal youth were working at minimum wage jobs. The point estimate from Table 4, therefore, is certainly in the ball park given what we would have expected from the cross-sectional evidence on the effects of tuition on enrollment rates.[25]

[25]The increase in the minimum wage in New Jersey in April 1992 provides a similar test. The same estimates are made comparing the changes in enrollment and employment of 18-24 year olds in Pennsylvania and New Jersey for the fall semester of 1992 to the fall semester of 1993. These estimates are much less striking, although there is some evidence that enrollment rates increased more slowly for Blacks and Hispanics between these two years.

VI. Evaluating the Pell Grant Program

In 1973, the federal Pell Grant program was established to provide grant aid to low-income youth. Because the program affected only low-income youth, one might have expected enrollment rates for low-income youth to have increased disproportionately.[26] In an article that prompted a firestorm of criticism, Hansen (1983) reported little growth in enrollment by low-income youth during the Seventies. McPherson and Schapiro (1993) identified two weaknesses in Hansen's approach which are corrected here: Hansen used only two years of data on either side of the policy change, presumably weakening the power of his test. Second, by pooling males and females, the program effect estimated by Hansen was contaminated by any change in college-going behavior by males at the end of the Vietnam war.

To address both of these concerns, Table 5 reports the program effect only for women, pooling 8 years of data. The data from the October CPS are broken into 2 periods: 1970-1972 (prior to the establishment of the Pell Grant program) and 1973-77 (after the establishment the program). The growth in enrollment rates for those from families in the lowest income quartile (most of whom would have been eligible for Pell Grants) is then compared to the trend in enrollment rates for those from the top three quartiles. Three different dependent variables are used: total college enrollment rates, enrollment rates in private universities and enrollment rates in public 2-year institutions. Total college enrollment rates grew 2.6 percentage points more *slowly* for the lowest income quartile over the period (although this difference was not significantly different

[26]Amendments in 1978 would open the program to middle class students. For a description of these changes, see Manski and Wise (1983).

from zero). Further, private college enrollment grew by 2.8 percentage points *less* for low-income youth over the period when the Pell Grant program was established. Only public 2-year college enrollment seemed to grow more quickly for low-income youth. (However, one must bear in mind that total college enrollment rates did not increase more rapidly, suggesting that there may have been some relative shifts in enrollment among different types of colleges.) As reported in columns (2), (4) and (6), adding family background measures such as parental education and home ownership has little effect on the results.[27]

As confirmed by the heated reaction to Hansen's original paper, such evidence certainly presents a challenge to the belief that tuition costs are an important barrier to access. It is not simply that we would have expected the treatment effect of Pell Grants to have been small: The maximum Pell Grant in 1975 was $3544 ($1991). On the basis of the cross-section estimates, we would have expected low-income youth receiving the maximum grant to have increased enrollment rates by over 20 percentage points.

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[27]Not all time-series evidence yields similarly small estimates of the effect of cost on enrollment. For instance, McPherson and Schapiro (1991) use national aggregate time series data on enrollment rates of low-income white students, finding that enrollment rates declined by roughly 6 points for every $1000 increase in net direct costs. Though the estimate is quite similar to that reported in cross-sectional work, it is based primarily on the common timing of a decline in enrollment rates for low-income youth in the early Eighties and an increase in state tuition levels. However, many other things were changing over the same period. For instance, both trends coincided with a serious recession. With only time variation in costs and enrollment rates, it is impossible to distinguish the effect of tuition increases from other unmeasured changes which may have changed over time, affecting the national market for a college education.

VII. Conclusion

Public dollars have become more scarce. At the same time, the earnings prospects of those without a college education have deteriorated sharply. It is time that we reexamine the effectiveness of current public subsidies in opening the doors to higher education. This paper has sought to provide an exhaustive appraisal of the evidence on the price sensitivity of youth. The results are summarized below:

o States with high public tuition levels have lower college entry rates.
o The gap in enrollment between high and low-income youth is wider in high-tuition states.
o Within-state tuition hikes lead to lower enrollment rates and wider gaps between high and low-income youth.
o Increases in the minimum wage seem to lead to lower college enrollment rates, particularly at 2-year colleges.

The states are the primary source of public subsidies to higher education, spending $40 billion annually. By contrast, federal financial aid amounts to approximately $13 billion. Over 90% of the state funding is made in the form of across-the-board subsidies to public institutions, keeping tuition low for all students at these institutions. But this is an expensive way to promote access, given the large number of inframarginal youth. Even using the large elasticities estimated in this paper, only 11 to 29% of the money invested in keeping public tuition low goes to marginal entrants.

In theory, means-tested programs are better targeted upon the marginal youth. But an important piece of evidence should give one pause. After the establishment of the Pell Grant program in the mid-seventies, there was no disproportionate growth in enrollment by low-income youth. Since Pell Grants represent the primary source of means-tested grant aid in the country, this is troubling.

One might offer several different hypotheses to reconcile the results. For instance, the establishment of Pell Grants coincided with an increase in college enrollment by

minorities (both high and low income) and women. Supply constraints in colleges and universities may have muted the enrollment response of low-income youth. Under this hypothesis, a rise in the Pell Grant maximum today may have larger impacts on enrollment, if those constraints have been loosened.

Second, the marginal student may simply have been unaware of the process of applying for Pell Grants. Although many billions of dollars in Pell Grants have been awarded since 1973, much of this money may simply have gone to those who were planning to go to college anyway and, therefore, were better able to negotiate the process of applying.

Orfield (1992) cites several studies suggesting that low-income families may not have been aware of eligibility rules and procedures. For instance, a study in New Jersey in 1975 suggested that a quarter of college students with family incomes below $15,000 (1991 dollars) had not even applied for aid, although virtually all would have qualified for a Pell Grant. (New Jersey Commission on Financing Postsecondary Education (1975)) Further, a study by the Educational Testing Service in the late seventies suggested that the financial aid application for the Pell Grant required a reading ability at the 9th/10th grade level, due to its use of technical language regarding the nature of one's financial assets (Franz (1980)). Familiarity with program rules and the ability to negotiate these barriers may have grown over time. If so, this would be expected to enhance the effectiveness of the program in stimulating college enrollment.

But more recent evidence from the Job Training Partnership Act evaluation suggests that these barriers may still be large. When given the chance to participate in classroom training, youth assigned to classroom training were 15 to 22 percentage points more likely to participate in training than the control group. Ironically, although the

students in the control group may not have been aware of the fact, the program offered them little that was not already available: net of Pell Grants, community college tuition in the 16 states studied in the JTPA evaluation would have been only -$60 for these youth.[28] If the monetary value of the JTPA subsidy was so small, why did so many more youth in the treatment group participate? The guidance youth received in choosing courses and in completing financial aid forms may account for their increased participation, rather than the value of the financial aid offered.

Therefore, we are caught in a quandary. Rising college costs do seem to be related to the growing gap in enrollment between high and low-income youth and between white and minority youth. But the states can not afford to continue paying three-quarters of the cost of attendance at a public university. Means-tested aid is better targeted but, it seems, less effective in promoting college enrollment. An experimental evaluation of alternative ways of packaging aid would help move the debate forward. For instance, an experimental design could identify the distinct effects of additional dollars in aid versus providing better information and streamlining the process of applying for aid. We might compare the eventual college entry rates of three randomly assigned groups:

	Treatment:
Group 1:	Greater guidance in filling out application forms, but no new aid.
Group 2:	Greater guidance in filling out forms, with an increase in the maximum grant.
Group 3:	Control group.

The difference in enrollment rates between groups 1 and 3 would tell us just how important a barrier the applications forms themselves present. Likewise, the difference between groups 1 and 2 would identify the importance of additional dollars in aid. States

[28]Author's calculation under the assumption that all of the youth would have qualified for the maximum Pell Grant at the time.

and the federal government have been making policy financial aid policy in the dark for decades. Given the number of dollars involved and the declining earnings prospects of high school graduates, it may be time to turn on the light.

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Table 1.
GLS Estimates of Between-State Differences in Public Tuition on College Enrollment in 3 Datasets

	HSB Seniors				NLSY				October CPS			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Public 2-Year Tuition ($1000 1991)	-.205 (.037)	-.163 (.029)	-.191 (.038)	---	-.173 (.049)	-.132 (.042)	-.157 (.053)	---	-.095 (.015)	-.084 (.013)	-.088 (.018)	---
Public 4-Year Tuition ($1000 1991)	.054 (.031)				.065 (.042)				.018 (.012)			
Tuition Interactions:												
Second Quartile:			.024 (.044)	.011 (.032)			.023 (.058)	.019 (.034)			-.011 (.021)	.008 (.012)
Third Quartile:			.036 (.045)	.036 (.032)			.027 (.059)	.036 (.037)			.000 (.022)	.021 (.012)
Top Quartile:			.043 (.049)	.042 (.029)			.058 (.049)	.055 (.036)			.032 (.023)	.047 (.014)
Unemployment Rate (*100)	-.501 (.460)	-.425 (.463)	-.442 (.462)	---	1.063 (.745)	.981 (.751)	.959 (.752)	---	-.388 (.287)	-.423 (.289)	-.438 (.288)	---
State Need-Based Grants/ 15-24 Yr Old Population ($1000 1991/person)	1.089 (.253)	.911 (.233)	.910 (.233)	---	.908 (.294)	.745 (.275)	.743 (.276)	---	.254 (.093)	.280 (.093)	.281 (.093)	---
State Fixed Effects?	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes

Note: The above were estimated in a two-stage procedure. The first stage produced estimates of income quartile by state effects, after conditioning on personal characteristics. These group-level parameters were then used in a second-stage GLS procedure described in the text. *High School and Beyond:* The dependent variable is whether one reported entering a 2- or 4-year college during the first 2 years after high school graduation. Other variables included in the regression were race dummies (black non-hispanic, hispanic and other), number of siblings, a gender dummy, dummies for census regions, the HSB composite test score, high school grades, dummies for family SES quartile, dummies for parental education, census division, urbanicity of high school and the presence of both parents at home. Because the family income data reported by youth is often not reliable, socioeconomic status measures were used which take into account income as well as parental education and parental occupation. *National Longitudinal Survey of Youth:* The dependent variable was whether or not one entered college by age 19. Other regressors included census division at age 14, aged dummies, race dummies, income quartile dummies, number of siblings, AFQT score, gender and parental education. *October Current Population Survey:* The dependent variable was being enrolled in a 2-year or 4-year college at age 18-19. Other variables included in the regression were race dummies (black non-hispanic, hispanic and other), family size, a gender dummy, dummies for census divisions, dummies for parental education, family income, family size, individual year dummies and a dummy for home ownership.

Mean of Dep Var — *Income Quartile:*

Dataset:	1st	2nd	3rd	4th	Total:
October CPS	.247	.402	.539	.710	.446
HSB	.351	.458	.603	.818	.553
NLSY	.302	.417	.495	.705	.481

Table 2.
Evaluating the Effect of Tuition Increases
Within-State using Administrative Enrollment Data, 1980-1992

	Total Public Enrollment			Public 4-year	Public 2-year	Private 4-year
	(1)	(2)	(3)	(4)	(5)	(6)
Public 2-year Tuition ($1000 1991)	-.035 (.011)		-.029 (.013)	.018 (.006)	-.047 (.012)	.004 (.004)
Public 4-Year Tuition ($1000 1991)		-.014 (.006)	-.007 (.007)	-.012 (.003)	.005 (.006)	.005 (.002)
State Unemp Rates (/100)	.279 (.113)	.297 (.114)	.296 (.114)	-.256 (.056)	.552 (.109)	-.095 (.031)
State Need-Based Grants/15-24 Yr Olds ($1000 1991/youth)	.237 (.072)	.253 (.074)	.253 (.073)	.068 (.036)	.088 (.031)	-.047 (.020)
N:	596	596	596	596	596	596

Note: All specifications include state fixed effects and division by year interactions. Enrollment rates were calculated using total public college enrollment in the state divided by estimates of the number of 15-24 year-olds by state.

Table 3.
GLS Estimates of Within-State Differences in Public Tuition on College Enrollment: October CPS, 1977-87 and 1988-93

	(1)	(2)	(3)	(4)	(5)
Public 2-Year Tuition ($1000 1991)	-.088 (.014)	.014 (.051)	.008 (.045)	.001 (.045)	---
Public 4-Year Tuition ($1000 1991)	.013 (.011)	-.006 (.029)			
Tuition Interactions:					
Second Quartile				.010 (.015)	.009 (.014)
Third Quartile				.009 (.013)	.013 (.012)
Top Quartile				.044 (.016)	.045 (.015)
Unemployment Rate (*100)	-.370 (.307)	-1.160 (.777)	-1.212 (.745)	-1.270 (.733)	---
State Need-based Grants/ 15-24 Yr Old Population ($1000 1991/Youth)	.260 (.101)	-.116 (.365)	-.147 (.340)	-.151 (.331)	---
Time Effect? (1977-87 or 1988-93)	Yes	Yes	Yes	Yes	Yes
Division*Time Effect?	Yes	Yes	Yes	Yes	Yes
Inc Quart*Time Effect?	Yes	Yes	Yes	Yes	Yes
State Fixed Effect?	No	Yes	Yes	Yes	Yes
State*Time Effects?	No	No	No	No	Yes

Note: The above were estimated in a two-stage procedure. The first stage produced estimates of income quartile by state by time effects (1977-87 vs. 1988-93, after conditioning on personal characteristics. These group-level parameters were then used in a second-stage GLS procedure described in the text. The dependent variable was being enrolled in a 2-year or 4-year college at age 18-19. Other variables included in the regression were race dummies (black non-hispanic, hispanic and other), family size, a gender dummy, dummies for census divisions, dummies for parental education, family income, family size, individual year dummies and a dummy for home ownership.

Table 4.
Evaluating the Impact of the California Minimum Wage Increase on Wages and College Enrollment (CA vs. Remainder of U.S.)

	White Non-Hispanic				Blacks, Hispanics			
18-24 Yr Olds	Hourly Wage (W)	P(W<4.25)	P(Ulf)	P(Enr)	Hourly Wage (W)	P(W<4.25)	P(Ulf)	P(Enr)
California (Rest of U.S.=0)	1.156 (.110)	-.110 (.009)	-.003 (.007)	.019 (.009)	.467 (.147)	-.111 (.013)	.010 (.013)	-.007 (.011)
Academic Year: (88-89 & 89-90=0)								
86-87&87-88	.043 (.042)	-.002 (.003)	.045 (.003)	-.026 (.003)	-.015 (.088)	-.002 (.008)	.101 (.087)	-.008 (.006)
90-91&91-92	-.115 (.043)	-.028 (.003)	-.002 (.003)	.008 (.003)	-.195 (.088)	-.006 (.008)	-.008 (.007)	.012 (.006)
CA* 86-87&87-88	.074 (.142)	.051 (.011)	.009 (.009)	.020 (.011)	.171 (.194)	.043 (.017)	-.025 (.017)	.027 (.014)
CA* 90-91&91-92	-.124 (.144)	.039 (.012)	-.001 (.010)	.054 (.012)	.063 (.187)	.024 (.017)	-.007 (.017)	-.022 (.013)
Gender and Age Dummies?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N:	79,581	79,581	97,379	124,385	18,313	18,313	25,501	36,003

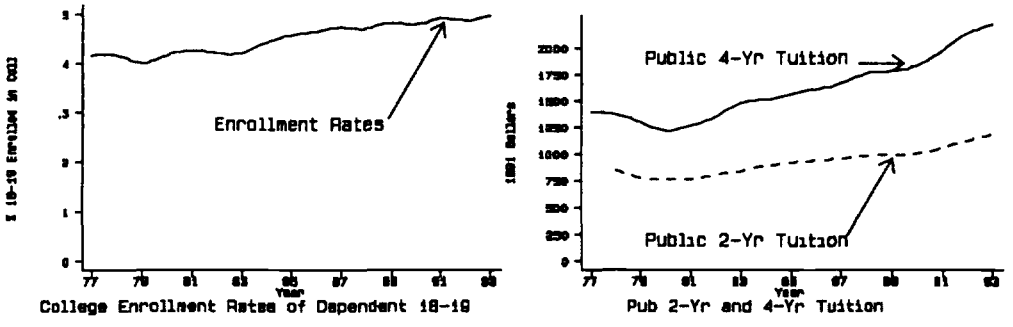
Note: The above were estimated using the CPS outgoing rotation group files for the months September through May in each year but 1989-90. Because the national minimum wage was raised in April, 1990, April and May are dropped for California and the comparison states for April and May, 1990.

Table 5.
Changes in College Enrollment Rates
of Dependent 18-19 Year Old Females
by Family Income Quartile: 1970-72 to 1973-77

	Any College Enrollment		Private College Enrollment		Public 2-Year College Enrollment	
	(1)	(2)	(3)	(4)	(5)	(6)
Black	-.027	.044	.000	.034	-.029	0.000
	(.023)	(.020)	(.013)	(.013)	(.014)	(.013)
Post (1973-77)	.025	-.008	.022	-.003	-.009	-.010
	(.010)	(.010)	(.006)	(.005)	(.007)	(.007)
Black*Post	.027	-.015	-.010	-.027	.005	.012
	(.028)	(.025)	(.016)	(.015)	(.018)	(.017)
Lowest Income Quartile* Post	-.026	.005	-.028	-.002	.034	.024
	(.023)	(.022)	(.013)	(.009)	(.015)	(.015)
Family Background Included?	No	Yes	No	Yes	No	Yes
N:	12,163	12,163	12,163	12,163	12,163	12,163

Note: The above were estimated within a linear probability framework. Included in all equations were dummy variables for income quartiles, region and a constant term. Family background measures included 10 dummy variables for the education of parents and home ownership.

Figure 1



Public Tuition and Enrollment Rates

Figure 2

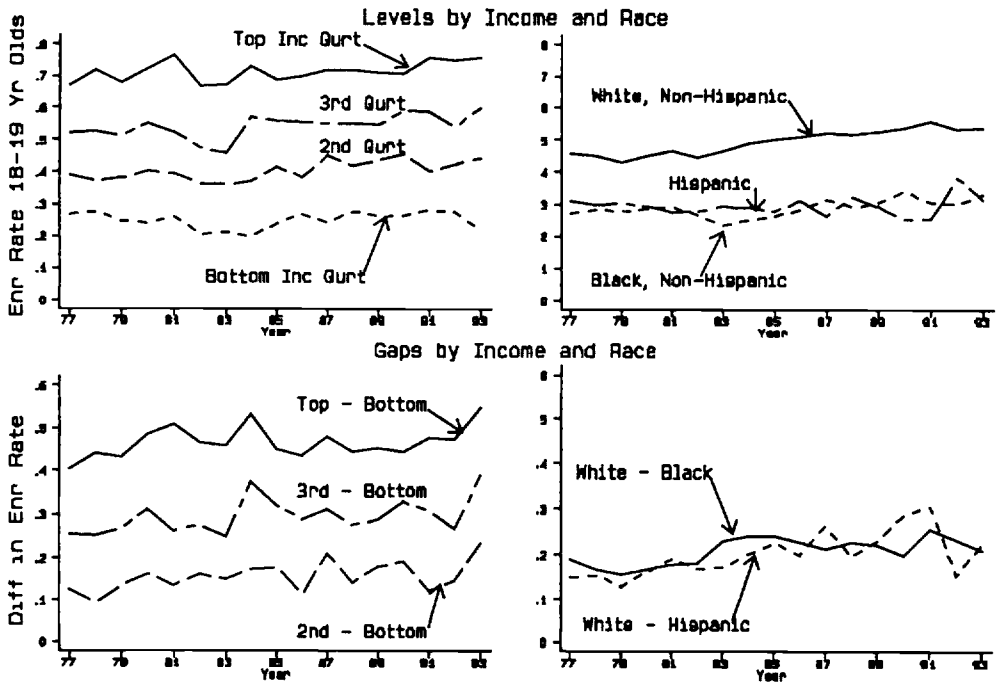
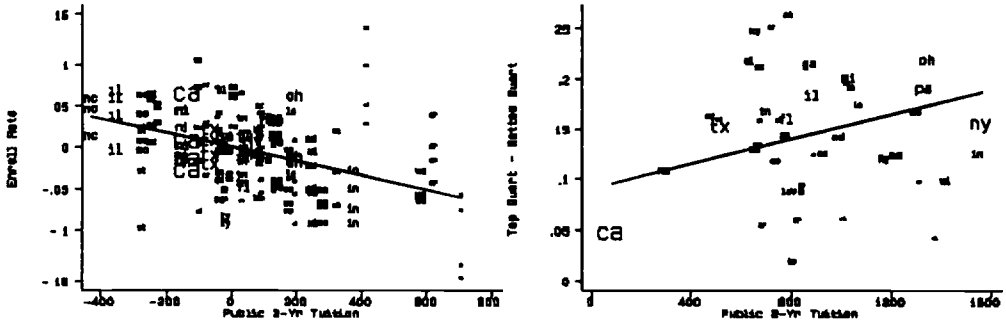

Levels by Income and Race
Enr Rate 18-19 Yr Olds
Top Inc Qurt
3rd Qurt
2nd Qurt
Bottom Inc Qurt
White, Non-Hispanic
Hispanic
Black, Non-Hispanic
Year
Gaps by Income and Race
Diff in Enr Rate
Top - Bottom
3rd - Bottom
2nd - Bottom
White - Black
White - Hispanic
Year

Figure 3



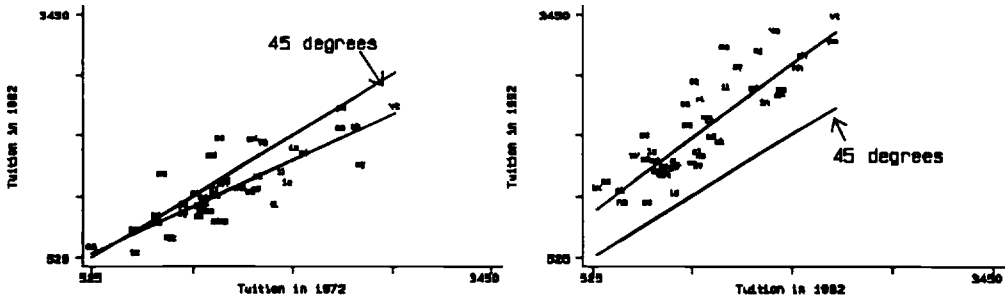
Levels

Gaps (High - Low Income)

Public 2-Year Tuition and Enrollment of 18-19 Yr Olds

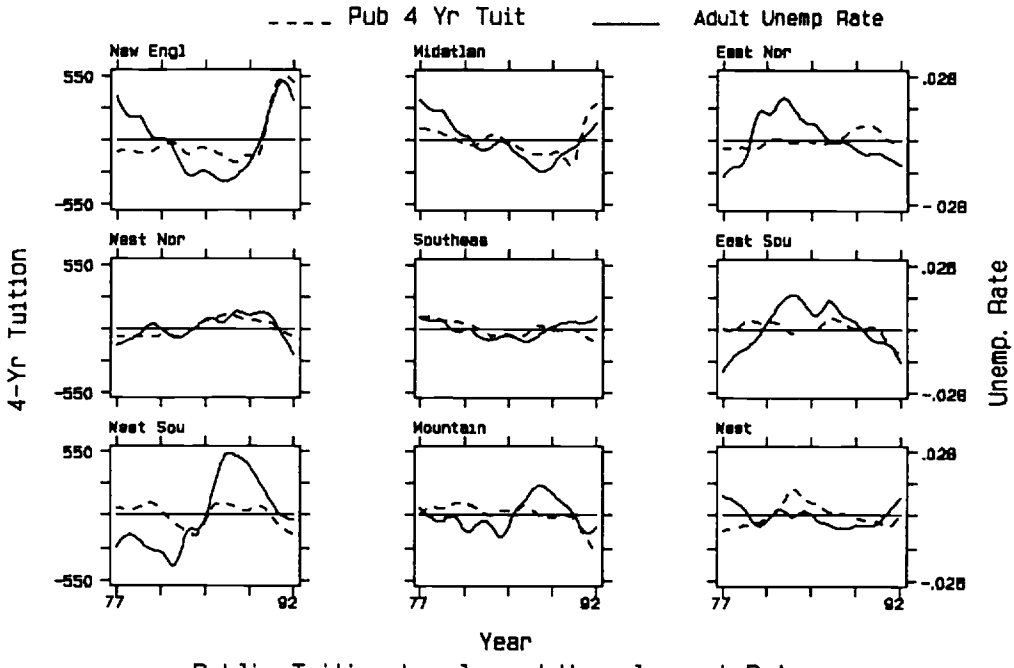
(October CPS, 1977-93)

Figure 4



Public 4-Yr Tuition by State: 1972-92

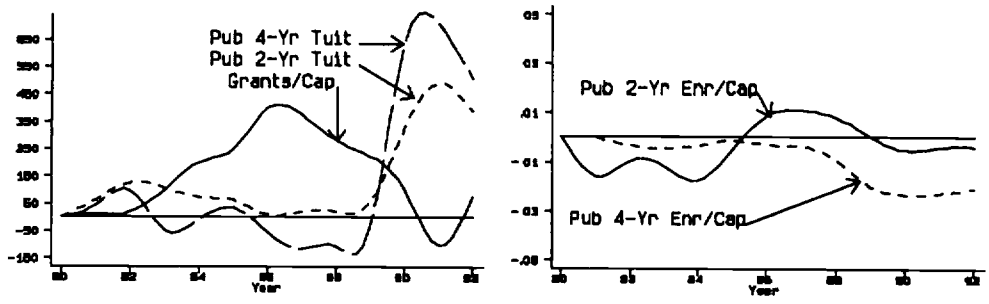
Figure 5



Public Tuition Levels and Unemployment Rates

Note: Residuals from regression on division dummies and year effects

Figure 6

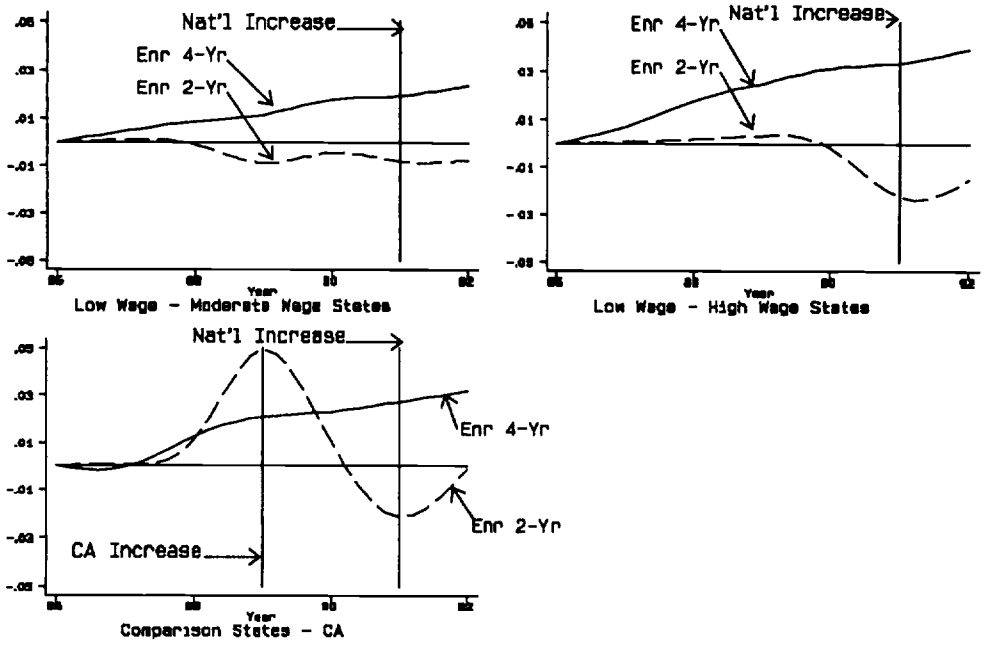


College Costs and Enrollment Ratios

MA vs. Other New England States

(Differences-in-Differences)

Figure 7



College Enrollment Ratios and Minimum Wage Changes
(Differences-in-Differences)