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How the Changing Market Structure of U.S. Higher Education Explains College Tuition

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ABSTRACT

This paper presents theoretical and empirical evidence demonstrating the ways in which the changing market structure of American higher education from 1940 to the present affected college prices and college quality. Over this period, the market for baccalaureate education became significantly more competitive, as it was transformed from a collection of local autarkies to a nationally integrated market. I demonstrate that the results of increased competition were what industrial organization models (with product differentiation and students being both consumers of and inputs into higher education) would predict: higher average college quality and tuitions, greater between-college variation in tuition, greater between-college variation in student quality, less within-college variation in student quality, higher average subsidies to students, and greater between-college variation in subsidies. Changing market structure can explain real tuition increases of approximately 50 percent for selective private colleges. Panel data from 1940 to 1991 on 1121 baccalaureate-granting colleges are employed, including data on students' home residences.

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I. Introduction

Since 1940, American higher education has experienced a very significant change in market structure. Essentially, higher education has been transformed from a series of local autarkies to a nationally and regionally integrated market in which each college faces many potential competitors for inputs and consumers. The scale of this change equals or exceeds that of other domestic industries, like banking and retail sales, whose changing market structures are frequently discussed. In Hoxby (1997), I describe the changes in the structure of the market for college education, and I empirically show their causes. In this paper, I investigate the implications of the changing market structure for tuition and student subsidies (pricing), college quality (vertical differentiation), and students' college choices (consumer choice and input purchases in a vertically differentiated market).

Rising college tuition is one of the most salient implications of the changing market structure, and I present both theory and empirical evidence that show how opening trade in the college market generates a substantial rise in average college tuition. Briefly, the argument is as follows. If we open trade between many autarkies, each of which has colleges offering education of varying quality (producing vertically differentiated products), then theory predicts several reactions. Colleges' loss of market power over their local consumers causes a decrease in their rent and a corresponding increase in the average value (quality for cost) they offer students. Colleges' loss of local monopsony power generates an increase in the wages of college inputs. Since these inputs include students (students are simultaneously consumers of and inputs into education), high ability students are predicted to receive increased subsidies after geographic

market integration.[1] Moreover, average college quality should rise in the more integrated market. This is because any given investment in quality has higher returns in the market with open trade. Higher average quality is accompanied by a rise in tuition (though no decrease in value).

In the geographically integrated market, students (both as consumers and as inputs) are sorted more thoroughly among colleges based on their demand for education and ability to contribute to education production. As a result, each college has a student body that is increasingly homogeneous; within-college heterogeneity falls. Between-college heterogeneity, however, rises as colleges produce increasingly differentiated products. The increasing differentiation between colleges shows up not only in students' college choices but also in tuitions and subsidies, which are predicted to grow more variable (not just rise on average).

The final twist to the predictions comes from three related facts: students are both consumers and inputs, they must consume at the same college where they are inputs, and high demand students are typically high quality inputs. The first effect of these facts is that all of the predictions listed above are magnified. This is because high demand students are the same people whose "wages" benefit most from colleges' loss of monopsony power--their demand is simultaneously stimulated by the loss of monopoly and monopsony power. Moreover, when a college invests in quality, it receives the benefits of a multiplier effect. The multiplier exists because a college that offers high quality attracts high demand students, whose high quality inputs further enhance college quality. Theory predicts that opening trade raises average quality; the multiplier magnifies this increase in quality. Also, since a quality competitor can take advantage

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[1] Subsidies, or the per-student difference between college expenditures and tuition revenue, contain students' implicit wages. See section IV for more on subsidies.

of the multiplier but a price competitor cannot, the existence of the multiplier makes it difficult for price competition to displace quality competition.

In this paper, I first discuss how the above predictions are derived from the theory of industrial organization, modified for the peculiar characteristics of higher education. I then test whether, when a college experiences an increase in the geographic integration of the market it faces, it responds as predicted. The empirical work relies on a consistent panel of baccalaureate-granting colleges that begins with 1940 data and ends with 1991 data. The data include information on colleges' tuitions, expenditures, tuition revenues, students' test scores, and students' home residences. The data also include a variety of information on the causes of market integration, which were discussed in Hoxby (1997) and serve as instrumental variables here.

II. Context

Essentially, this paper advances a theory of the industrial organization of college education. It is important to place this hypothesis in context and to acknowledge some intellectual debts. In particular, it is useful to understand how the hypothesis intersects with other explanations of rising college tuition, which is the most salient feature of the college environment.

Since the end of World War II, college tuition in the United States has risen significantly faster than inflation. Although discussion has been particularly heated recently (see Larson, *Time Magazine*, 1997), rising college tuition has been a perennial concern for scholars of education, legislators, and popular commentators. The decade from 1955 to 1965, in particular, witnessed discussions similar to those of today. Economists have proposed several explanations for the tendency of tuition to rise faster than inflation. Baumol (1967) notes that higher education is a

classic example of a (largely) non-traded service that experiences relatively few productivity benefits from improved technology. We should therefore expect its price to rise faster than that of the average good. Instead, its price should rise with the wages of its key inputs: faculty and other professional college staff. Ehrenberg and Murphy (1993) argue that the increase in tuition "list" prices exaggerates the true rise in the price of college. This is because need-based financial aid mechanically makes tuition rise faster than tuition revenue. A one dollar increase in tuition revenue requires a more than one dollar increase in (list) tuition because increasing tuition raises students' financial needs, causing part of any tuition increase to flow immediately into increased financial aid. They predict that tuition revenue (or the average tuition paid) does not rise nearly as fast as tuition. Clotfelter (1990, discussed in Cook and Frank, 1993) argues that recent tuition increases reflect increased demand for college education in the 1980s--due to an increase in the measured rate of return to education during that decade. This argument hinges on the idea that the supply of college education is inelastic. This seems unlikely, particularly in the 1980s, since many colleges entered the decade with substantial excess capacity and a queue for college positions. Among legislators, a popular explanation for rising college tuition is the "Bennett Hypothesis," which suggests that federal grants and guaranteed student loans have fueled the tuition increases. The heart of the hypothesis is that the federal government is a third-party payer, much as in health care, so that neither providers nor consumers of higher education have much incentive to hold down costs. The primary problem with this theory is that federal monies account for a much smaller share of payments in college tuition than in medical bills. Indeed, empirical evidence shows that the effect of increases in the federal Pell Grants on tuition is probably small (Li 1997).

The Clotfelter and Bennett hypotheses implicitly depend on the existence of major market imperfections in the supply of college education (barriers to entry, very poor consumer information about the relative benefits of different colleges).[2] Market imperfections are given an even stronger role in the final class of explanations for rising tuition--which can be roughly described as "collusive behavior among colleges." Collusive explanations enjoy the support of most popular commentators such as Larsen (1997), who suggest that colleges engage in substantial rent-taking. Collusion also has some more analytic supporters. The United States Department of Justice's antitrust case against eight elite colleges suggested that collusive behavior accounted for a substantial portion of the rise in tuition.

The changing market structure of college education does not conflict with theories about the changing demand or supply conditions for education. For instance, understanding the industrial organization of college education is complementary to the Baumol and Ehrenberg/Murphy theories. Figures 1 through 3 demonstrate that, after accounting for these two theories, a large share of the increase in college tuition remains to be explained. Figure 1 shows the dramatic rise in private college tuition relative to the consumer price index (CPI) between 1940 and 1993. The rise is particularly dramatic from 1955 to 1965 and from 1985 to the present. If we examine tuition revenue per student rather than (list) tuition, we see that tuition revenue did increase more slowly than (list) tuition from 1985 to the present. This confirms the Ehrenberg/Murphy hypothesis. Nevertheless, a very substantial rise in tuition revenue per student

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[2] The Bennett hypothesis not only relies on the importance of the third-party-payer, but also (like health care) needs to argue that supply creates its own demand. In health care, this argument is known as induced demand and its basis is physicians' prescriptive prerogative. It is difficult to make a parallel argument in college education. Any argument would need to rely heavily on poor consumer information about the relative benefits of colleges.

remains to be explained. If we deflate by faculty salaries rather than by the (CPI), we get a path of tuition that shows a slightly lower rate of increase overall. This supports the Baumol hypothesis. However, deflating by faculty salaries does not lower the rate of increase after 1965, so that the Baumol hypothesis does not help explain any of the recent increase in tuition. Figures 2 and 3 repeat the exercise for public colleges' "in-state" and "out-of-state" tuitions. Although public college tuition starts out lower and grows at a slightly slower rate, the main implication of Figures 2 and 3 is the same as that of Figure 1: most of the rise in tuition still remains to be explained when we have accounted for the Baumol and Ehrenberg/Murphy explanations.[3]

In contrast, there is a conflict--though only a partial one--between the hypothesis advanced in this paper and the Clotfelter and Bennett hypotheses. The reasons for increased demand that they suggest (an increased rate of return to education, expenditures subsidized by a third-party-payer) are fully compatible with an increasingly competitive market for college education. However, the mechanisms by which increased demand causes tuition to rise--captive consumers (Bennett) and barriers to entry/expansion that prevent a supply response (both Clotfelter and Bennett)--conflict with the increasingly competitive market. The Clotfelter and Bennett explanations particularly attempt to explain the *recent acceleration* in tuition growth, yet the mechanisms (captive consumers, barriers to entry) have been steadily eroding over time as students increasingly act as purposeful and informed consumers and choose from a menu of colleges.[4] In general, explanations that rely on market power conflict with an explanation that

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[3] Detailed statistics on tuition are discussed later. See Tables 8 through 8b.

[4] See Hoxby (1997) for evidence on the increasing use and availability of information in the market for college education.

emphasizes increasingly competitive market structure. In both cases, tuition rises with demand, but market power explanations suggest that colleges take advantage of increased demand to increase their rents. If, instead, colleges are losing market power over time, then tuition is rising because the open market has ignited quality competition. Increased demand (*a là* Clotfelter and Bennett) simply intensifies the impact of market forces.

There is *direct* conflict between the hypothesis advanced in this paper and collusive theories of college behavior. The changing market structure of American higher education suggests that collusion should have become significantly harder--not easier and more prevalent--over the post-war period. Ironically, the antitrust suit may have been caused by the increasingly competitive market structure--coordination that initially required little effort increasingly required an elaborate apparatus to have any chance of success in a more competitive market.

This paper is indebted to a number of important contributions to the economics of higher education literature. Rothschild and White (1993, 1995) worked out much of the price theory for colleges in which students are both consumers and inputs. I rely on this work, taking their price theory into the theory of industrial organization for markets of vertically differentiated products that undergo trade liberalization. McPherson and Whinston (1991) identified the multiplier effect of a college's investment in quality. This is an essential building block for an industrial organization model.[5] In *Buying the Best* (1996), Clotfelter demonstrates how elite colleges spend money in order to create the high quality education they produce. This book is a concrete lesson in how quality competition works. Cook and Frank (1993) examine the increasing concentration

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[5] McPherson and Whinston (1991) also provide foundations for arguments developed in Rothschild and White (1993, 1995) and Cook and Frank (1993).

from 1980 to 1990 of very high ability students at the 10 to 20 most elite colleges. This is a slice of the larger phenomena that I describe in this paper. Although very high ability students and the very top colleges do not represent a significant portion of the college market I describe (and the results do not depend on their inclusion), their behavior reveals, in a magnified way, the same forces that affect other colleges.[6] Cook and Frank are interested in the implications rather than the causes of growing concentration of high ability students. Oddly, their brief listing of possible causes of concentration does not even include market structure or an increasingly geographically-integrated college market.

III. The Changing Market Structure of American Higher Education

In this section, I summarize some of the evidence on how and why the structure of the American market for higher education changed. This is only a brief précis needed for the work of the current paper. Hoxby (1997) describes both the causes and measures of the transformation more thoroughly.

A. Evidence on the Geographic Integration of the College Market

From 1940 to the present, college students have given colleges' geographic proximity to their homes decreasing weight in their college choices. As a result, each college has faced an increasingly spacious market of potential students. Table 1a and 1b show several pieces of evidence on these points. The top panel of Table 1a shows that the percentage of students who attended college "in-state" fell from 93.2 percent in 1949 to 74.5 percent in 1994. The decrease

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[6] Very high ability students are also interesting because they later have important careers. Indeed, Cook and Frank are interested in the concentration of high ability students because they are interested in the *implications* for students' careers and incomes. The work is related to their book, *The Winner-Take-All Society*, 1995.

was especially dramatic among private colleges, whose "in-state" percentage fell from 80.0 percent in 1949 to 54.6 percent in 1994.

The middle panel of Table 1a shows that colleges increasingly drew from the entire nation or a large region. In 1949, only 16.2 percent of colleges drew students from 20 or more states and only 2.4 percent of colleges drew students from 40 or more states. In 1994, these percentages had more than doubled: 35.5 percent drew from 20 or more states and 7.3 percent drew from 40 or more states.

A better measure of the spaciousness of a college's market is a Herfindahl index of the concentration of its students' residences. The Herfindahl index is a familiar measure of concentration from industrial research, and it incorporates several pieces of information because it decreases with the *number* of other states that are in a college's market, with the *shares* of enrollment that come from these other states and the *evenness* of the shares across the other states. The index is equal to:

(1) $$H_i = \sum_{j=1}^{50} s_{ij}^2$$

where i indexes colleges, j indexes states, and s_{ij} is the share of college i's enrollment from state j. The Herfindahl index is equal to one if all of a college's enrollment is from in-state. It approaches 0 as a college's enrollment is spread more equally among the 50 possible states-of-residence. In its bottom panel, Table 1a shows that the Herfindahl index of state concentration of students fell significantly for both private and public colleges. From 1949 to 1994, the average private college's Herfindahl index fell from 0.62 to 0.41. Over the same period, the average

public college's Herfindahl index fell from 0.96 to 0.77.[7]

Table 1b looks at measures of market structure based on students' decision-making behavior. The statistics in the table are based on three separate surveys of high school seniors--the class of 1972, the class of 1980, and the class of 1992.[8] The top panel shows that an increasing percentage of students bound for four-year colleges applied to at least one college that was not only outside their home state but also outside the states that adjoin it. In the class of 1972, 23.4 percent of students applied to a college outside their home state and its adjoining states. In the class of 1992, the percentage had almost doubled: 43.2 percent. The next row examines students who would be considered "good college material" because they scored at or above the 75th percentile on a nationally standardized test (given to all high school seniors, not only college-bound seniors). The increased spaciousness of their market was also dramatic: 39.8 percent of the class of 1972 applied to colleges outside their home state and its adjoining states, but 69.2 percent of the class of 1992 did so. The next row shows that high ability students (those who received a 70 or more on the verbal PSAT test) also had a sizable increase in market spaciousness. High ability students, however, already considered a wide market of colleges in 1972.

The bottom panel of Table 1b shows that the importance of geographic proximity in regression equations for college choice fell significantly from 1972 to 1992. I estimated

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[7] A disadvantage of all of the measures discussed thus far is that they tend to underestimate the amount of market integration for colleges in large states relative to colleges in small states. This is not a significant problem for comparing the same set of colleges across time, and regression analysis manages the problem with college fixed effects.

[8] The three surveys are the National Longitudinal Survey of the Class of 1972 (NLS72), the High School and Beyond senior cohort survey (HSB80), and the National Education Longitudinal Survey (NELS92). Unfortunately, data prior to 1972 cannot be added to the analysis since there is no similarly representative survey prior to 1972 that contains sufficient detail on students' college choices.

conditional logit regressions over possible college-student matches (where a successful match was identified by a student's attendance and *vice versa*). I considered the following determinants of college choice: the college's approximate miles from the student's home, an indicator for the college being in the student's state-of-residence, the college's tuition, and the absolute difference between the college's average combined SAT score and the student's combined SAT score. All four variables are statistically significant determinants of college choice in all three years,[9] but the two geographic variables become less important over time. A college's charging high (list) tuition, all else equal, becomes a more important deterrent to students over time. The match between a college's average student and the applicant becomes a more important draw for students over time.

B. Evidence on the Causes of Increased Geographic Market Integration

Hoxby (1997) examines several potential causes of geographic integration in the market for higher education. The most important are: the advent of modern standardized admissions testing in 1943-48; the information exchange system among students, colleges, and scholarship donors that was initially generated by the National Merit Scholarship program in 1956-58; the advent of standardized financial needs analysis (1956); tuition reciprocity agreements among states' public college systems (various years from 1970 onwards); deregulation in the airline and telecommunication industries that resulted in substantially lower prices for long-distance travel and communication; and the low mobility costs for students who attended college on the GI Bill (1945-58). There is an interesting story and evidence for each of these causes, but the focus here is on

[9] Statistically significant at the 5 percent level, asymptotically. Hereafter, "statistically significant" refers to the 5 percent level unless specified otherwise.

measures of the causes that can supply us with instrumental variables that will credibly identify exogenous variation in the market structure faced by a college.

Table 2 shows the results of regressing two measures of market structure--colleges' in-state percentages and colleges' Herfindahl indices of state-of-residence concentration--on five measures of the causes of integration. The equations include college fixed effects and year fixed effects, so that the causes of integration are distinguished from changes in the circumstances of individual colleges over time. The equations are separately estimated for private and public colleges, because the two college sectors are differentially constrained in many ways--including the admission of out-of-state students.[10] The cost of long-distance travel and communication is more important to the market structure of a college in the center of Colorado than to a college in the New York metropolitan area (where several states are within a few hours automobile ride). Therefore, the measures of long-distance costs are interacted with a college's distance to the nearest metropolitan area *in another state*. The long-distance costs that apply to a college are, thus, college-specific though the basic cost measures are national time series. [11] The final instrument that relies on variation in the cost of attending college is an indicator for the adoption of a non-restrictive tuition reciprocity agreement (an agreement that allows one state's students to attend another state's public colleges at that other state's "in-state" tuition). Such agreements are likely have more influence on market structure for public colleges than for private colleges.

The remaining causes of integration depend on variation in students' and colleges' degree

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[10] See Section IV for further discussion of the different constraints facing public and private colleges.

[11] Note that for most of the 1940-95 period, long-distance telecommunications costs per minute varied dramatically by the distance over which the call traveled.

of information about one another. These causes are measured by variables that purposely proxy for more accurate measures. The reason for proxying is that the regressions shown are effectively the first-stage regressions for later regressions in this paper. Econometrically, it is sensible to run the first-stage regressions in reduced-form rather than have the first-stage regressions themselves be instrumental variables regressions. Therefore, a college own's adoption of a standardized admissions examination is proxied by the adoption of a standardized admissions tests in the state's "flagship" public university. (In an instrumental variables equation, the flagship university's adoption would be an instrument for a college's own adoption.) Similarly, the share of students in the college's region who participate in the National Merit program is proxied by the number of scholarships donated by corporations headquartered in the region. This is because scholarships are provided through corporate sponsors whose locations generate regional variation in students' incentives to participate in the National Merit program.[12]

Table 2 shows that all of the measured causes listed above are statistically significant determinants of the measures of market structure. This is true despite the fact that college fixed effects naturally absorb much of the variation in the market a college faces. Colleges face more competitive markets when their long distance costs fall, when their state has a tuition reciprocity agreement, when admissions testing is adopted in their states, and when there is more corporate support for the National Merit program in their region. (Only public college are affected by tuition reciprocity agreements.) The joint statistical significance of these five variables, which will be the excluded instruments in later regressions, is shown by the $F_{5,N}$-statistics which are all in the

[12] Corporations can effectively "layer" their own programs (which may include with local and other preferences) on top of the National Merit process of determining semi-finalists. See Hoxby (1997) for details.

range of 15.0 to 16.0 (the corresponding p-values are all below 0.001). For a set of instrumental variables, these F-statistics indicate sufficient correlation to protect against finite sample bias.

IV. Theory

In this section, I sketch a theory of the industrial organization of the market for college education and the effects of opening trade in such a market. A thorough exposition is not possible here, given the space requirements of the empirical evidence that follows. It is possible, however, to identify each of the mechanisms at work, its parallel in traditional industrial organization theory, and its implications for college education.

A. Geographic Integration of Imperfectly Competitive Markets

The first two implications of the geographic integration of the market for college education are straightforward. To keep the intuition clear, I explain them in the simplest situation: the geographic integration of autarkies, each of which has a monopoly producer of college education.

In this situation, geographic integration has pro-competitive effects because the former monopolists compete with one another for consumers. This reduces price-cost margins and benefits consumers. The former monopolists also compete with one another for inputs. This raises the wages of college workers. (See Venables 1985 for a thorough treatment of the welfare improving effects of trade in homogeneous, imperfectly competitive markets).

Hereafter, I refer to these phenomena as the "loss of monopoly power" and "loss of monopsony power." These phenomena carry over to the case of vertically differentiated college education (college education of varying quality). Vertical differentiation is important, first because it is realistic and second, because internally it generates the market power that I simply

assumed above for the autarkic colleges. That is, it justifies the assumption that the colleges in the autarkies had market power.

B. Geographic Integration of Markets with a Vertically Differentiated Product

Consider a local autarky in which there are a small number of colleges producing education of varying quality. Production of college education has a number of important characteristics. Colleges have high fixed costs of providing education (maintaining buildings, a faculty, and so on) relative to their variable costs (providing teaching services for an additional student). Variable costs are approximately flat for a considerable region, up to the point where the college needs to make a major expansion in their physical plant or faculty. The ratio of the fixed costs of a high quality college to the fixed costs of a low quality college generally exceeds the ratio of their variable costs. Similarly, the ratio of students' willingness to pay for a high quality college to students' willingness of pay for a low quality college exceeds the ratio of high and low quality colleges' *variable* costs.

If students have heterogeneous demands for college quality, the result is a market in which colleges produce educational services at a number of different quality levels. A finite number of quality levels are offered, where the finite number depends on the distribution of students' demands but does not depend on the size of the market. At each quality level offered, there will be one or more colleges; the number depends on how consumers' demands are distributed and when colleges' increasing variable costs set in. Many colleges may have no direct competitors at their particular point on the quality spectrum. Price competition is relaxed by the colleges' vertical differentiation. This is a "natural oligopoly" market (see Shaked and Sutton 1982, 1983; Beath and Katsoulacos 1991).

Now we are back to the point of having colleges with market power (but natural, not assumed) in the autarkies. So long as the autarkies have initial distributions of student demand that overlap, the outcome of geographic integration will be more direct competition among colleges. Geographic integration will put more colleges in the proximity of each quality level offered. This will decrease the effectiveness of vertical differentiation for relaxing competition, and colleges will experience the loss of monopoly power and loss of monopsony power described above.[13]

Moreover, geographic integration has an additional effect in the case of natural oligopolies with vertical integration. As autarkies integrate, *the average quality of colleges increases* since they enjoy greater marginal returns to expenditure on quality improvements. The intuition is simply that, for a given increase in quality, a college can attract many more students (consumers with higher demands).[14] There is an average price increase that corresponds to the average

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[13] Formally, what is required is that the extent of vertical differentiation does not increase as rapidly as the number of colleges. For simplicity, this requirement is often stated as: the finite number of quality levels offered in the integrated market must be smaller than the sum of the autarkies' numbers of quality levels. This guarantees that there are more direct competitors at each quality level. Gabszewicz, Shaked, Sutton, and Thisse (1981) show that when autarkies with identical distributions of student demand are geographically integrated, the outcome is simply more colleges at each of the finite number of quality levels that is offered. The number of quality levels offered is not expanded, regardless of the autarkies' sizes. When autarkies with different, but overlapping, initial distributions of student demand are geographically integrated, the outcome is both more colleges at each of the levels of quality offered and a greater finite number of offered quality levels.

The finite number of quality levels should not interpreted too literally. No two colleges offer exactly the same quality. All that is necessary is a decrease the level of protection from price competition that is generated by vertical differentiation.

[14] This insight is originally due to Shaked and Sutton (1982). See Beath and Katsoulacos (1991) for a good exposition. Interested readers may obtain an appendix from the author that derives this result for the college example--the Beath and Katsoulacos model requires some (nearly obvious) modifications. If sufficient interest exists, the appendix will be joined to the paper.

Formally, the result follows because, with geographic integration, the number of consumers in the market grows more than the number of quality levels offered. Recall that this is an implication of the structure of fixed and variable costs and consumers' willingness to pay for quality improvements. In the simple case where autarkies with identical distributions of student demand are integrated, the nearest type of quality competitor is as far away in quality space after integration as it was prior to integration. However, the quality space "in-between"

improvement in quality, but the price increase is commensurate, not welfare-reducing.[15]

C. The Industrial Organization of the Market when Students are Inputs as Well as Consumers

The quality of a college is partly determined by the peers with whom a prospective student would be educated. Students, therefore, are inputs into the production of college education as well as consumers of it. Furthermore, students (unlike most consumer-producers) must be inputs at the same college where they consume. Finally, students whose demand for quality education is high also tend to be high quality inputs.[16]

Rothschild and Stiglitz (1995) demonstrate that, because students are consumers and inputs simultaneously, net tuition (tuition minus any institutional grants) combines the price that a student pays and the wage he is paid. In the simplest case, colleges might charge a list tuition for students whose input quality was minimal and offer scholarships (which rose with input quality) to all other students. More generally, colleges offer subsidies to students in many forms. One can consider a student's "wage" to be the entire subsidy he receives: the cost of his education minus tuition minus institutional grants. Note that every student at a college can potentially receive a subsidy, usually through tuition that does not cover educational cost.[17]

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contains a greater number of students. Any college that decides to raise its quality and leave its "pack" of direct competitors (grouped around a quality level) stands to gain many student consumers. All colleges obey this incentive and average quality increases. The case in which the autarkies have non-identical but overlapped distributions of student demand is a direct generalization of the simple case.

[15] Under rather general conditions, the welfare of consumers increases with the average increase in quality--despite the increase in price.

[16] The correlation between demand for quality and input quality is not one, however. Students may have a high demand for college quality because it confers social prestige or because their families traditionally attend certain colleges. Brilliant but anti-social students may have high demand but poor interactions with peers.

[17] In fact, large subsidies for every student are commonplace in private, highly selective colleges. The financial loop is obviously not closed when students are the sole "consumers" of college education. See the sub-section on "other consumers" that follows.

These facts necessitate several modifications to the three predictions given above (loss of monopoly power, loss of monopsony power, increase in average college quality). One immediate effect of these facts is that quality demands of high demand/high quality students will increase after integration. This is because they are the main beneficiaries of the loss of monopsony power. Their "wages" increase and they can afford to buy more college quality. This implies that the quality of a college will rise more if it is initially a high quality college. That is, the distribution of quality not only rises on average but also becomes more right skewed (as does the underlying distribution of student demand for quality).

If colleges offer vertically differentiated services and all colleges offer the same "wage" for a given input quality, then high demand/high input quality students will gather at high quality colleges. Their presence will enhance the colleges' quality. This is the McPherson-Whinston multiplier effect. It implies that a college that makes an investment in quality that contributes to its fixed costs will get expanded returns--the direct improvement in service quality and the indirect in quality through improved peers.[18]

Consider how the multiplier effect makes price competition relatively ineffectual. Suppose a college competes by lowering the tuition it charges for its level of service quality. The college attracts new students, but a disproportionate number of the students have low demand and low quality. The college's quality falls because of peer effects, and equilibrium is reestablished with the college at a lower price and lower quality.

Next, consider a college that competes in quality--not by investing in the sort of service

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[18] Investments in quality that increase a college's variable costs do not have quite the same multiplier effects in equilibrium. See below.

quality that raises fixed costs, but by offering high "wages" (merit scholarships) to attract students it could not otherwise attract. The college does enhance its quality, but it is unlikely to succeed in moving up in quality space by this means. This is because the college must pay more for each high input quality student than a college does that offers high quality educational services (of the type that raise fixed costs). In equilibrium (given the cost structure of college quality described at the beginning of this section), the college that began with high fixed costs and high service quality is likely to retain its position and its high quality students.[19]

In summary, theory predicts at least eight reactions to geographic market integration:

(i) a loss of monopoly power for colleges, generating increased value for students as consumers;

(ii) a loss of monopsony power for colleges, generating higher subsidies for students whose input quality (ability) is high;

(iii) an increase in average college quality because investments in quality earn higher returns;

(iv) an increase in average college tuition commensurate with the average quality increase;

(v) increased sorting of students among colleges based on their demand for quality;

(vi) a larger increase in quality (and tuition) for colleges that were initially of high quality, owing to the fact that high demand students have their demand boosted by the income effect of the loss of monopsony power;

(vii) unusual sustainability of quality competition compared to price competition, owing to the

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[19] Quirks in competitors' cost structures (where rising variable costs set in) may allow a college to raise its quality purely by pursuing high quality students with high subsidy offers. However, most colleges will be unable to raise quality unless they simultaneously invest in (fixed cost) service quality and offer high subsidies to high quality students.

fact that the multiplier effect favors quality competition;

(viii) increasing diversity among colleges along the lines of student ability, quality, tuition, and subsidies--whereby the same colleges that have the greatest increase in student ability have the greatest increase in quality, tuition, and subsidies (this identity is due to the inseparability of students as consumers and inputs).

D. A Note on Colleges' Other "Consumers"

Above, I noted that some colleges offer a subsidy to each of their students. This important phenomenon has been ably documented and discussed by Lewis and Whinston (1997). Such subsidies are possible because colleges have "consumers" other than their current students who close the "financial loop." For private colleges, these "other consumers" include sponsors of research (foundations, governments) and donors (often former students). Public colleges also obtain funds from sponsors of research and donors, but their main "other consumer" is typically state government. Geographic market integration affects the behavior of "other consumers" as well as the behavior of students. Thus, it is not quite correct to associate all changes in a college's expenditures and subsidies with student-related changes in the market for college education. For the purposes of this paper, it is enough to recognize that the behavior of other consumers is similar to the behavior of high demand students (as consumers) and the data may exaggerate the subsidies offered to high ability students. The same colleges that offer high subsidies to high ability students will be paying high wages to other inputs that are being "purchased" by the colleges' "other consumers." Further discussion of this topic is beyond the scope of the current paper.

E. The Differing Effects of Geographic Market Integration on Private and Public Colleges

Public colleges in the United States are significantly more constrained than private colleges

in their admissions policies, tuition policies, college size, use of funds, and ability to price discriminate among students (offer subsidies in the form of merit scholarships). Although public colleges enjoy a source of revenue (taxes) that private colleges do not, the use of these funds invokes the constraints listed above. Because they are constrained, public colleges are generally unable to compete in the upper region of quality space. However, they are also insulated from the revenue losses associated with losing high ability, high demand students that some private colleges can experience.

Public colleges that were selective in autarky face a particularly difficult transition to geographically integrated markets because more of their students are high demand consumers who are likely to be drawn to colleges that are less constrained about raising quality, admissions selectivity, and tuition in response to market integration. Some public colleges evade constraints for a subset of their students by having an honors college, or a more selective college-within-a-college.

F. A Note on Horizontal Differentiation

Colleges may react to increased geographic integration by differentiating horizontally. Horizontal differentiation relaxes direct price and quality competition among colleges whose service quality is similar. There is anecdotal evidence that many colleges have successfully negotiated the transition to a more competitive market by differentiating horizontally or "finding a market niche." For instance, some generic four-year liberal arts colleges have found that they have a comparative advantage in offering programs to working students, older students, or students who wish to work in a local industry. Colleges that once specialized in recruiting students from a particular geographic area or particular secondary schools are now more likely to

specialize in particular curricula or students with particular needs.

V. Data

The market structure and price theory described thus far applies to *baccalaureate* education in the United States. It does not attempt to describe other postsecondary education or training, such as community colleges or specialized technical schools. Each college included in the analysis, therefore, should have been consistently baccalaureate-granting over the period of interest (1940 to the present). Colleges are not only influenced by market conditions, however: each college has idiosyncratic characteristics that also determine its tuition and student body. These considerations suggest that panel data on baccalaureate-granting colleges are appropriate.[20]

I use a panel of 1221 colleges that covers the period from 1940 to 1991 and currently includes data from 1940, 1950, 1960, 1966, 1971, 1976, 1981, 1986, and 1991.[21] Among the colleges in the panel, 731 are private and 390 are public. Every American baccalaureate-granting college was included that had consistent data on tuition, tuition revenue, college expenditures, and students' residences from 1940 onwards. The colleges also had to have consistent data on admissions test scores from 1966 onwards (requiring admissions test score data for prior years would have resulted in too restricted a sample). These colleges represent 56 percent of all colleges

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[20] That is, I want to trace the effects of changing conditions on the well-defined market for baccalaureate education. Another interesting, but different topic, might be the effect of changing conditions on the formation of markets for *new* types of postsecondary education.

The panel would be inappropriate for some uses, such as studying whether students who had poor achievement in high school or who have low income are offered adequate postsecondary educational opportunities.

[21] The eventual goal is to include as many years as possible in the panel data. This is particularly difficult for years prior to 1971, in which the majority of data series must be culled from multiple sources and hand-entered. In addition, colleges' student residence data are available only at irregular intervals prior to 1971.

that ever granted baccalaureate degrees at some point during the 1940-91 period. However, their enrollment represents approximately 83 percent of all enrollment in baccalaureate-granting colleges over the period. This is because enrollment is concentrated in colleges that are stable and likely to report consistently. In any given year, there are a number of very small, private colleges that do not last until the next year in which data are taken (five years distant). Note that the percentage of baccalaureate enrollment represented by the sample is approximately the same at the beginning and end of the period. This is because much of the college *entry* (as opposed to expansion) since 1940 has been concentrated in two-year colleges and other-non-baccalaureate-granting institutions.

Having panel data is important econometrically because it allows college fixed effects to be estimated, eliminating much of the influence of colleges' fixed, idiosyncratic characteristics. These characteristics are too numerous and too particular to be adequately summarized by a few college descriptors. Multiple regression is likely to suffer from omitted variables bias, which panel data methods help to alleviate.

Since the sample was actually picked from series that included the entire population of colleges for any given variable in any given year, it is possible to say something about the likely effects of sample selection. Many of the baccalaureate-granting colleges that were dropped had such small enrollment that they were unlikely to have affected the analysis. Very small colleges often were educational experiments or temporary spin-offs of larger institutions. The only types of colleges that systematically fell out of the sample were private women's colleges (especially Catholic ones) and private black colleges. Both types of college tended to be eliminated or consolidated with other colleges as gender co-education became more popular and racial

segregation became less popular. The remaining colleges that had to be dropped were most similar to the group of remaining colleges classified under "low initial admissions selectivity."

For 1966 onwards, the major sources of enrollment and financial data on the college were the Higher Education General Information Survey (HEGIS), the Integrated Postsecondary Education Data System (IPEDS, the successor to HEGIS from 1986 to the present), and CASPAR (a panel version of selected variables from HEGIS and IPEDS). Even though these data are collected in a standardized way through United States Department of Education Surveys, care must be taken so that the same college is followed consistently--particularly in multi-campus systems.

Data on admissions test scores of colleges' enrolled students were drawn from a variety of sources for 1966 onwards. The most useful sources were *Cass and Birmbaum's Comparative Guide to American Colleges*, *Peterson's Guide to Undergraduate Study/Peterson's Guide to Four-Year Colleges*, and *Barron's Profiles of American Colleges*. However, a variety of minor college guides that were published only once or sporadically or covered one state or one region were also employed to fill in missing data. Finally, some unpublished information was provided by The College Board.

Data on the college students' states-of-residence come from a series of "Residence and Migration" surveys conducted by the Department of Education (originally the Bureau of Education) for the school-years beginning in 1922, 1934, 1940, 1949, 1958, 1963, and 1968. The surveys became a regular part of HEGIS beginning with the 1972 school-year, so that state-of-residence data are also available for 1972, 1976, 1981, 1986, 1988, 1990, 1992, and 1994. Residence data were matched, by year, as best as possible with the other data. For instance, 1949-50 residence data were matched to 1950 financial data.

Like the test score data and the pre-1972 residence data, the pre-1966 financial data were derived from a variety of sources and hand-entered and matched across years. The main source was the American Council on Education's (ACE's) *American Colleges and Universities*, a series that includes every ACE-accredited college. *Lovejoy's College Guide/Complete Guide to American Colleges and Universities* and a number of minor college guides were helpful for filling in missing data.

All National Merit data were taken from the annual reports of the National Merit Scholarship Corporation. Data on the median income and percentage of adults with 16 years of education were taken from the Census of Population and Housing. The process of data acquisition and coding is such that future versions of this paper will include more and better data--for instance, more distributional information on admissions test scores before 1976.

VI. Evidence

Tables 3 through 11b present the main evidence on whether the changing market structure of American higher education affected college choice, college quality, tuition, and subsidies as predicted by theory. It should be noted that, because there is no measure that fully describes market structure in higher education, we expect regressions that use the available measures as independent variables to underestimate the true effects of market structure on tuition and other dependent variables.[22] The statistics and regressions that follow are all weighted by enrollment

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[22] Ideal measures would calculate all the application and/or admissions "links" among colleges. Direct links (overlaps between applicant pools or admittant pools) would presumably be weighed more heavily than indirect links (two colleges, both of which have overlapped pools with a third college). Such measures may become calculable for future years of data, but are not calculable for the period of interest.

The college fixed effects help to reduce omitted variables bias, but they exacerbate the measurement

so that they provide a national representation of the market for baccalaureate education that is as accurate as possible. However, unweighted results are generally similar.[23]

A. The Effect of Geographic Integration on the Distribution of Students Among Colleges

One of the first predictions of theory is that the geographic integration of the American market for college education should *increase* the *between*-college variance and *decrease* the *within*-college variance in students' admissions test scores. In other words, consumers will group more homogeneously based on their demand for quality. Because students are inputs as well as consumers, their contribution to college quality means that the process described would tend to increase vertical differentiation among colleges.

Table 3 shows the distribution of combined SAT scores *between* colleges. All colleges are included in Table 3; Tables 3a and 3b examine the same statistics for private and public colleges, respectively. Note that ACT scores were translated into SAT scores for convenience of estimation and interpretation. The bottom panels of Table 3 show the mean and several quantiles of the SAT score distribution among colleges. The most noteworthy information in these lower panels is the decline in the mean SAT score. It is interesting that this often-discussed phenomenon shows up even in a consistent panel of baccalaureate-granting colleges.

The top panel of Table 3 contains the most important information. It shows three interquantile ranges of colleges' SAT scores: the difference in scores between colleges at the 75th and 25th quantiles, the differences between colleges at the 90th and 10th quantiles, and the difference between colleges at the 95th and 5th quantiles. By any of these three measures, the

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error problem, causing additional attenuation bias.

[23] Unweighted results are available from the author.

variance in average SAT scores *between* colleges has grown rapidly. In 1966, the difference in average test scores between colleges at the 75th and 25th quantiles was a small 69 points (out of a possible 1400). By 1991, the corresponding difference was 180 points. The difference between the 95th and 5th quantiles in 1966 was 347 points; in 1991, the 95-5 difference was 418 points.

Table 3a shows that much of the increase in between-college variance in average test scores took place among private colleges. Though they began in 1966 with higher between-college variance than public colleges had, private colleges nevertheless became more vertically differentiated. In 1966, the difference in average SAT scores between colleges at the 90th and 10th quantiles was 283 points; in 1991, the corresponding difference was 370 points. Figure 4 provides a visual version of Table 3a. The figure shows that private colleges gained between-college variance especially by "spreading out" the *tails* of the distribution.

In contrast, public colleges gained between-college variance especially by spreading out the distribution of test scores in the middle of the distribution. This evidence is shown in Table 3b and Figure 5. In 1966, the 75th and 25th quantiles were separated by only 58 points. By 1991, the average combined SAT score of a college at the 75th quantile exceeded that of a college at the 25th quantile by 145 points. The tails of the distribution of public colleges' scores did not spread much. Why did the private college distribution spread everywhere (including the tails) while the public college distribution spread only in the middle? Public colleges have constraints on their admissions policies imposed by state legislatures. Therefore, they are not found in extreme positions on the distribution of admissions test scores. In fact, because they are constrained, public colleges that are initially selective can have difficulty maintaining their average admissions test scores: unconstrained private colleges may enroll some of their best prospective

students.

Table 4 presents a different measure of the between-college variance in student ability. The table shows Herfindahl indices based on colleges' shares of the National Merit Scholars. If the top American college were to enroll all the National Merit Scholars, the Herfindahl index would be equal to 1.[24] (Note that the Herfindahl indices in the table are multiplied by 100, so a true index of 1 would be written as 100). Table 4 shows that the concentration of National Merit Scholars has never been very high, but that the concentration has grown over time. In 1956, the Herfindahl index was 0.726 (÷100); this is equivalent to dividing the Scholars equally among 137 colleges. In 1991, the Herfindahl index was 2.978 (÷100); this is equivalent to dividing the Scholars equally among 34 colleges. The statistics in Table 4 have two other features that are worthy of note. First, there is a break in the trend towards more concentration between 1966 and 1971. This break was the result of an intentional change in the way that the scholarships were distributed. The goal of the change was to spread the scholarships more evenly across students' states-of-residence (consequently, it is harder to win a scholarship in some states than in others). A consequence of this change was a decrease in the college concentration of Scholars. Second, it is important to adjust the Herfindahl indices for the overall number of scholarships awarded. A larger number of scholarships naturally tends to decrease the concentration of scholars. The adjustment index is based on the Herfindahl index that would result if each years' number of Scholars were distributed *randomly* (not uniformly) among baccalaureate-granting colleges.

In Table 5, we switch from evidence about between-college variance to evidence about

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[24] The proposed experiment is not actually possible because the current number of National Merit scholarships exceeds the size of the freshman class size at any one of the top colleges in the United States.

within-college variance. The entries in the table show the within-college standard deviation in SAT verbal scores for an average college. Colleges are classified by size since very large colleges can educate a more diverse student body, all else equal.[25] The standard deviations shown are necessarily approximate because, though each college's mean score is available, the remainder of the calculation of the standard deviation must be based on grouped scores: x percent of students have scores between 500 and 600, y percent of students have scores between 600 and 700, and so on.

Table 5 demonstrates that within-college variance in students' admissions test scores shrank significantly between 1966 and 1991. Among medium-size private colleges, for instance, the average college had students whose test scores varied with a standard deviation of 114 points in 1966. The corresponding 1991 college had a standard deviation of only 81 points. Similarly, among medium-size public colleges, the average college's students had test scores that varied with a standard deviation of 120 points. By 1991, the parallel college had a standard deviation of only 90 points.

From Tables 3 through 5, we can conclude that between-college variance in student ability increased while within-college variance in student ability decreased. The question that remains is whether these patterns were caused by increased geographic integration of the college market.

Tables 6 through 6b present the results of regressing colleges' average SAT scores on measures of market integration. The equation estimated is:

(2) $$SAT_{ijt}=\alpha_0+\alpha_1 MC_{ijt}+\alpha_2 MC_{ijt}\cdot LO_{ijt_0}+\alpha_3 MC_{ijt}\cdot HI_{ijt_0}+\alpha_4 Inc_{jt}+\alpha_5 \%BA_{jt}+I_t\beta+I_j\gamma+\epsilon_{ijt}$$

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[25] This is simply because large colleges are above minimum efficient scale and can track students of different ability into different classes. The size classification does not turn out to be important, however.

where i indexes colleges, j indexes states, and t indexes time (years). SAT_{ijt} is a college's average combined SAT score, MC_{ijt} is a measure of market concentration, LO_{ijt0} is an indicator variable for a college having had low (at or below the 25th percentile) admissions selectivity at the beginning of the period of analysis (1966), HI_{ijt0} is an indicator variable for a college having had high (at or above the 75th percentile) admissions selectivity at the beginning of the period, Inc_{jt} is the median income of the state in which the college is located, $\%BA_{jt}$ is the percentage of adults who have 16 years of education in the state where the college is located, I_t is a vector of indicator variables for years, and I_j is a vector of indicator variables for colleges. Thus, the equation estimates both year and college fixed effects. The state-level variables describing income and adults' education are designed to pick up state-wide trends in income and education that might influence both local students' scores and the ability of the local colleges to attract out-of-state students.

In addition to alleviating omitted variables bias with fixed effect and state-level demographic variables, I estimate an instrumental variables (IV) version of each ordinary least squares (OLS) regression. Recall that the implied first-stage regressions for the IV equations were shown in Table 2, and that the excluded instruments are based on the long-distance costs that apply to each college, the environment for admissions testing as determined by the state's flagship college, the generosity of National Merit corporate sponsors whose headquarters are in the college's region, and the adoption of tuition reciprocity agreements. Statistics for the Anderson-Rubin-Hausman test of the exogeneity of the instruments are shown at the bottom of the tables.

[26]

When interpreting the results, note that market structure is measured by two alternative measures of *concentration* (not competition): the percentage of students from "in-state" and the Herfindahl index of the concentration of students' states of residence. An *increase* in the geographic integration of the college market (and an *increase* in competition) is evinced through a *decrease* in the measures of concentration.

Table 6 shows that when a college faces a market with more geographic integration and, thus, a greater number of competitors, its average SAT scores tend to rise. Its scores rise by a greater amount if it was initially a high selectivity college. Its scores rise by an amount that is not statistically significantly different from zero if it was initially a low selectivity college. For instance (using the IV results), a twenty percent decrease in the percentage of students who are from in-state generates an increase of 12 points in a typical college's average SAT score. The same twenty percent decrease generates an increase of 24 points in the average SAT score of a college that was initially selective. A 0.2 decrease in the Herfindahl index generates similar results. Note that a twenty percent decrease in the "in-state" student percentage and a 0.2 decrease in the Herfindahl index were approximately what the typical college experienced between 1949 and the present. In summary, Table 6 suggests that greater competition has two effects: it raises average college test scores and it increases the difference between the test scores of students who attend the highest quality schools and the test scores of students who attend the lowest quality

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[26] The Anderson-Rubin-Hausman test is listed at the bottom of the table as the "$F_{5,N-k}$-Statistic for Test of Joint Significance."

schools.[27]

Table 6a repeats the exercise of Table 6 for private colleges only. The most noteworthy difference between Table 6a and Table 6 is that the predicted effects of geographic integration on the average test score and the between-college spread in test scores are greater for private colleges than for public colleges. For instance, a decrease of 25 percentage points in the share of students from in-state (what private colleges actually experienced between 1949 and the present) generates a 15 point increase for a typical private college and generates a 37 point increase for a private college that initially had high selectivity.

In contrast, Table 6b shows that public colleges struggle to maintain their average SAT scores when they face increasingly competitive market structures. For instance, a decrease of 0.18 in the Herfindahl index (what public colleges actually experienced between 1949 and the present) generates an increase of 16 points in typical public college's average SAT scores but generates a decrease of 17 points in the average SAT score of a public college that was initially selective. It appears that relatively elite public colleges initially enroll the students who are most likely to attend private colleges or other public colleges when the market becomes more competitive.

Tables 7a and 7b demonstrate that when a college participates in a market whose geographic integration is growing, its student body becomes less heterogeneous. The tables summarize just the coefficient of interest (δ_1) for the regression equation:

(3) $$SD(SAT_{ijt}) = \delta_0 + \delta_1 MC_{ijt} + \delta_2 Inc_{jt} + \delta_3 \%BA_{jt} + I_i\kappa + I_j\lambda + \iota_{ijt}$$

where all the variables are as above except that $SD(SAT_{ijt})$ is the standard deviation of the verbal

[27] Note that average student quality is not a zero-sum game so far as individual colleges are concerned. A college that raises its service quality to compete better in the more competitive market it faces may attract students who reside in markets that are less competitive.

SAT scores of the college's enrolled students. The specification is similar to equation (2), except that no interaction terms are needed in equation (3) to test the predictions for within-college variance in test scores.

A 20 percentage point decrease in the share of students from in-state (what a typical college actually experienced between 1949 and the present) generates a decrease of 13 points in the within-college standard deviation in SAT scores for a typical college. Among private colleges, the in-state share fell 25 percentage points over the same period. This generates a fall in the within-college standard deviation of 14 points. Among public colleges, the in-state share fell 10 percentage points; this generates a decrease in the within-college standard deviation of 13 points. Reductions in the Herfindahl index generate similar results.

In summary, Tables 3 through 7 confirm that increased geographic integration and competition in the market tends to increase the average college's student ability, increase the variance of student ability between colleges, and decrease the variance of student ability within colleges. Simply because high quality students convey quality, the tables imply that college quality has become more variable since 1940. It is likely that the quality of educational services offered has also become more variable and has risen on average over the period, as colleges compete for high quality students. Unfortunately, it is difficult to measure the quality of educational services directly.[28] In sub-section (C) below, I offer other indirect measures of quality in the form of college expenditures per students.

B. The Effect of Geographic Integration on College Tuition

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[28] The difficulty is illustrated by college rankings in *Barron's* and *U.S. News and World Report*, both of which are based largely on colleges' selectivity.

Tables 8 through 8b present statistics on the distribution of tuition among college from 1940 to 1991. Table 8 includes all colleges, Table 8a only private colleges, and Table 8b only public colleges. Figures 6 and 7 show quantiles of the tuition distribution for private and public colleges, respectively. The statistics in the tables are in nominal dollars. The figures show 1993 dollars, adjusted by the CPI. The tables and figures demonstrate several phenomena. First, tuition has risen rapidly since 1940. Public colleges' in-state tuition has always been significantly lower than (less than a third of) private colleges' average tuition. Yet, average private tuition has risen only slightly faster in percentage terms than has average public tuition. Average private tuition has risen 39-fold since 1949. Average public in-state tuition has risen 37-fold over the same period. The most striking difference in the time paths of private and public tuition is not their growth rates. Rather, it is the fact that the distribution of public colleges' tuition has remained significantly narrower than that of private colleges' tuition. This is especially clear from 1971 to 1991. In 1971, the ratio of the 90-10 interquartile range of tuition to mean tuition was 0.92 for private colleges. In 1991, the same ratio for private colleges was 1.37. The ratio of the interquartile range to the mean tells a similar story: 0.45 in 1971; 0.65 in 1991. Clearly, the distribution of tuition was widening for private colleges. For public colleges, however, the ratio of the 90-10 interquantile range to the mean was 1.14 in 1971 and was 0.99 in 1991. Again, the ratio of the interquartile range to the mean tells a similar story: 0.62 in 1971; 0.54 in 1991. The distribution of tuition was narrowing for public colleges. If we extend the examination back to 1940 in Tables 8a and 8b, we see that the distribution of private college tuition has been steadily widening since 1940, while the distribution of public college tuition has been steadily narrowing.

The changes in tuition shown in Tables 8 through 8b conform to the pattern already

established by the test score results. College quality has risen on average, but the distribution of quality (vertical differentiation) has occurred more significantly in private higher education than in public higher education. It remains to be shown, however, that college market integration has been a significant determinant of two changes in tuition shown: the overall rise in tuition and the widening distribution of private colleges' tuition.

Tables 9a and 9b show regression estimates of the effect of market integration on tuition at, respectively, private and public colleges. The equations estimated are exactly like that specified in (2) except that the dependent variable is the log of (list) tuition and the state's median income is also in logs. The full panel from 1940 onwards is used for estimation since tuition data, unlike test scores data, are available for 1940 through 1960.

Private colleges that face markets that are increasingly integrated and competitive do charge higher tuitions. This is demonstrated by the IV results in Table 9a. A 25 percentage point decrease in the share of students from in-state causes the typical private college's tuition to rise by 13.5 percentage points, but causes the tuition of a college whose initial selectivity was high to rise by 59.3 percentage points. A private college with low initial selectivity is predicted to increase its tuition by an amount that is insignificantly different from zero. Similarly, a decrease of 0.2 in the Herfindahl Index causes the typical private college's tuition to rise by 10.2 percentage points, causes the tuition of a college whose initial selectivity was high to rise by 50.4 percentage points, and causes the tuition of a college whose initial selectivity was low to rise by an amount that is insignificantly different from zero. The changes in market concentration used for the above calculations are those that private colleges actually experienced over the period from 1949 to the present. The results suggest that changing market structure can explain significant portions of the

increases in private colleges' average tuition and in the variance of private college's tuition.

Table 9b shows the corresponding results for public colleges. Even in public colleges that were initially highly selective, the effect of market integration on tuition is more modest. A 20 percentage point decrease in the share of students from in-state causes the tuition of a public college that was initially highly selective to rise by 11.6 percent. However, it also causes tuition to rise by 8.2 percent in public colleges that initially had low selectivity. Similarly, a decrease of 0.2 in the Herfindahl index causes public colleges that initially had high selectivity to increase their tuition by 12.3 percent and causes public colleges that initially had low selectivity to increase their tuition by 12.1 percent. Table 9b thus provides evidence that increasing market integration causes public colleges to raise their tuition on average but also to narrow the distribution of tuition.

We predicted that market integration would cause public colleges, especially those that were initially highly selective, to raise their tuitions. Why, though, does market integration cause a narrowing of the distribution of public colleges' tuitions, by means of low selectivity public colleges raising their tuition nearly as fast as high selectivity public colleges? The reason is almost mechanical. Public colleges that had low initial selectivity are the same colleges that traditionally maintained very low in-state tuitions (a sizable minority retained zero in-state tuition policies into the 1970s). Such policies become unmanageable and unpopular as college markets integrate and students become more mobile. The systems become unmanageable because the residency requirements for in-state tuition are difficult to police and students attempt to arbitrage the subsidy in a highly integrated college market. The systems become unpopular because the children of middle-class taxpayers, traditionally the main beneficiaries of public colleges, are increasingly

unwilling to be constrained to choosing amongst in-state public colleges. These students do not want to geographic location to be the sole determinant of their college choice as it was for their parents. Foreseeing that they are unlikely to reap all the benefits of a highly subsidized public college system, taxpayers refuse to support high subsidies and instead approve of local public colleges raising tuition.

In summary, the increasingly competitive market structure of American higher education appears to explain a large share of the increase in college tuition (especially among private colleges), the widening in the distribution of private college tuition, and the narrowing in the distribution of public college tuition. Particularly large increases in tuition (50 percent or more) are estimated for private colleges that began the 1940-97 period with highly selective admissions.

The statistics shown in Tables 8 through 9b are all for list tuition. Very similar results obtain if tuition revenue per student is used in place of list tuition. See the Appendices to Tables 9a and 9b.

C. The Effect of Geographic Integration on Subsidies to Students

In this final section, I examine the effect of geographic integration of subsidies to students. Per-student subsidy is simply the difference between college expenditure per student and tuition revenue per student. Compared to measures like per-student scholarships, per-student subsidy has the advantage of being insensitive to a college's choice of financial aid policy. For instance, colleges are treated identically whether they subsidize students by giving explicit scholarships to many students or by reducing tuition and giving few explicit scholarships.

Recall that theory predicts that if market integration is the cause of increasing average college quality and corresponding increases in college tuition, then the colleges that offer the

largest subsidies will be the same colleges that raise their average quality and tuition. This is because they attract students whose "wage" is high. Although the McPherson-Whinston multiplier of college quality guarantees that the colleges that high ability students attend do not need to pay them the same subsidy they could receive at a lower quality school, market integration is nevertheless predicted to generate larger growth of subsidies for high ability students than for low ability students.

Tables 10 through 10b show the distribution of per-student subsidies for, respectively, all colleges, private colleges, and public colleges. The overall pattern is somewhat similar to the pattern for tuition (Tables 8 through 8b), though the changes over time are less dramatic. The time trends can be summarized as follows. In both public and private colleges, the median per-student subsidy increased more than six-fold from 1966 to 1991. The median public subsidy is always higher than the median private subsidy, and the median public subsidy rose slightly faster than the median private subsidy. Figures 8 and 9 are the visual counterparts of Tables 10a and 10b, displaying the distribution of subsidies among colleges. Since 1976, the distribution of per-student subsidies has widened dramatically in both private and public colleges. Nearly all of the widening has occurred because the upper tail has become more right-skewed. Among both public and private colleges, the ratio of the 75th percentile to the median has more than doubled. The same is true for the ratio of the 90th percentile to the 75th percentile. While it would be wrong to associate all of the increase in subsidy with students (recall, colleges have other consumers), it is clear that some students attend colleges in which their tuition payments cover only a portion of the cost of their education.

Tables 11a and 11b show, for private and public colleges respectively, the effect of market

integration on per-student subsidies. The results indicate that market integration causes subsidies to rise by a small amount in the typical private college (7.8 percent for a 25 percentage point decrease in the share of students from in-state), by a significant amount in a private college that initially had highly selective admissions (12.4 percent for a 25 percentage point decrease in the share of students from in-state), and not at all in a private college that initially had low selectivity. Using the Herfindahl index as the measure of concentration generates similar results (for highly selective private colleges, a 12.3 percent increase in subsidies is generated by a decrease of 0.2 in the Herfindahl index).

The striking thing about the results is that the same colleges that raise their student ability and tuition the most in response to facing a more competitive market also raise their subsidies the most. Market integration causes the average college, and even more the initially selective college, to supply a more expensive education[29] to students of higher ability who receive higher "wages" for their inputs and pay a higher price for their education. Although we still have no direct measures of college quality, it would be difficult to explain this combination of results without a corresponding increase in quality of educational services offered. It would also be difficult to explain this combination of results without an increase in the competitiveness of the market for college education. In particular, the fact that subsidies are highest in the same colleges that have the highest tuitions (and tuition paid) conflicts with many collusive theories of tuition increases. Most collusive theories imply that colleges that can charge higher tuitions should collect higher rents, not provide higher subsidies.

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[29] See below.

Table 11b shows a similar but muted pattern for public colleges. A decrease in market concentration generates statistically insignificant changes in the per-student subsidy for the typical public college and low selectivity public colleges. In the public colleges that initially had high selectivity, however, a 10 percentage point decrease in the share of students from in-state (what public colleges actually experienced from 1949 to the present) generates a 7.2 percent increase in the per-student subsidy. Using the Herfindahl index as the measure of market concentration generates slightly larger results. Table 11b thus shows that highly selective public colleges are under more pressure than other public colleges to raise per-student subsidies. This suggests that market integration has a particularly intense competitive effect on initially selective public colleges, forcing them to compete against private colleges and other public colleges for their increasing mobile, high ability, prospective students.

The Appendix Table of indicators of college quality confirms that high subsidies are actually associated with high cost college educations. It shows results like those in Tables 10 through 11b for per-student expenditure rather than per-student subsidies.

VII. Conclusions

I argue that an increasingly competitive market structure, due to geographic integration of formerly isolated markets, has caused American colleges to raise their quality, their tuitions, and their expense. It has also caused colleges to become more diverse, so that the distribution of quality, tuition, expense, and student ability *among* colleges was widened substantially. The distribution of student ability *within* any individual college has narrowed. Changing market structure can explain tuition increases of 50 percent or more in real terms since 1950 for

traditionally selective private colleges. It can explain smaller tuition increases (about 15 percent in real terms) for public colleges and less selective private colleges.

Both theory and empirical evidence suggest that the changes in tuition correspond to commensurate changes in college quality. The empirical results confirm a model of the industrial organization of the college market that implies that the average student has higher utility in the geographically integrated market, despite paying higher tuition on average.[30]

An increasingly competitive market structure probably also accounts for colleges' increasing horizontal differentiation. That is, colleges have been moving away from generic liberal arts curricula towards "market niches," where they serve particular student populations or particular vocational needs. Evidence for horizontal differentiation is, however, purely anecdotal.

The changes in market structure that have occurred are due, at least in part, to fundamental changes in students' costs of geographic mobility and the amount of information that students and colleges have about each other. These changes are beyond the control of any individual college and they are unlikely to be reversed. An increasing share of colleges' choices are constrained by increasingly intense market forces in college education. Understanding the changing industrial organization of college education is useful because it gives us a different perspective on college behavior. Much previous work on college behavior treats colleges as independent decision-makers, not as organizations whose choices are increasingly dictated by forces beyond their control. Policy-makers--for instance, Congressional overseers of college tuition setting--should recognize that arbitrary constraints on some colleges' prices or expenditures are likely to provoke

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[30] This statement is for the *average* student. Low ability students are possibly net losers of utility when college markets become more competitive.

responses from students as consumers and inputs. For instance, additional constraints on public colleges' tuition-setting relative to private colleges' is likely to aggravate the differences in selectivity, expenditure, and "other consumer" support that already exist between the two sectors.

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Table 1a
The Increasing Geographic Integration of the Market for College Education

Percentage of Students who Attended College "In-State"					
	1949	1963	1968	1981	1994
All Colleges	93.2	85.1	82.9	77.3	74.5
Private Colleges	80.0	68.2	65.6	62.0	54.6
Public Colleges	95.6	90.8	90.1	89.7	84.0
Percentage of Baccalaureate-Granting Colleges that drew Students from...					
	1949	1963	1968	1981	1994
40 or more states	2.4	6.2	6.5	6.8	7.3
20 or more states	16.2	25.2	26.1	26.7	35.5
Herfindahl Indices for Colleges, showing Concentration of their Students' States-of-Residence					
	1949	1963	1968	1981	1994
All Colleges	0.79	0.71	0.67	0.64	0.59
Private Colleges	0.62	0.53	0.49	0.47	0.41
Public Colleges	0.96	0.91	0.87	0.84	0.77

Statistics calculated from a panel of 1551 baccalaureate granting colleges, taken from the Residence and Migration surveys.

Table 1b
The Increasing Geographic Integration of the Market for College Education

Percentage of Students who Applied to at least 1 College that was Outside their Home State and its Adjoining States			
	NLS -1972	HSB -1980	NELS -1992
All Students who Applied to BA-Granting Colleges	23.4	29.9	43.2
Applicants who Scored at or above the 75th Percentile on the Standardized Tests Administered as Part of the Survey (see column heading for survey name)	39.8	43.0	69.2
Applicants with High PSAT Verbal Scores (70 or more out of a possible 80)	57.6	64.1	77.3
Coefficients from Conditional Logit Regressions for College Choice (Coefficients expressed as Odds Ratios)			
	Regression based on College-Going Students from:		
Covariates:	NLS -1972	HSB -1980	NELS -1992
Distance in Hundreds of Miles between College and Student's Home	-0.053 (0.016)	-0.049 (0.010)	-0.034 (0.011)
Indicator for College being in Student's State of Residence	0.234 (0.085)	0.197 (0.055)	0.156 (0.048)
Log of College's Tuition	-0.142 (0.029)	-0.174 (0.015)	-0.241 (0.020)
Absolute Difference between College's Average Combined SAT Score and Student's Combined SAT Score (in hundreds of points)	-0.041 (0.017)	-0.053 (0.012)	-0.066 (0.010)

National Longitudinal Survey of the Class of 1972, High School and Beyond Senior Cohort (class of 1980), National Education Longitudinal Survey (class of 1992).
In the top panel, observations are students who applied to a BA-granting college. Numbers of observations are: 1387 (NLS-1972), 4029 (HSB-1980), 9235 (NELS-1992).
In the bottom panel, observations are students who enrolled in a BA granting college. Computational constraints required random sampling of this population for the two later surveys. The numbers of observations are, therefore: 1292 (NLS-1972), 1300 (HSB-1980), 1300 (NELS-1992) See Hoxby (1997) for additional details.

Table 2
Causes of Geographic Integration of the Market for College Education

	Dependent Variable			
	Percentage of Students from "In-State"		Herfindahl Index of Concentration of Students' States-of-Residence (coeffs mult. by 100 for conveneince)	
	Private Colleges	Public Colleges	Private Colleges	Public Colleges
Log Price of an Air Mile * College's Distance to Nearest Metro Area in Another State (in hundreds of miles)	0.125 (0.054)	0.099 (0.038)	0.140 (0.051)	0.094 (0.037)
Log Price of Long Distance Telephone Minute based on College's Distance to Nearest Metro Area in Another State	4.893 (1.872)	2.881 (0.944)	4.658 (1.843)	2.756 (0.934)
Indicator for: Flagship Public University in College's State has Adopted a Standardized Admissions Test	-7.020 (2.957)	-4.862 (1.854)	-8.029 (2.862)	-4.714 (1.809)
Number of National Merit Scholarships Sponsored by Corporations Headquartered in College's Region (in hundreds)	-0.426 (0.187)	-0.017 (0.114)	-0.411 (0.176)	-0.029 (0.127)
Indicator for State has Signed a Non-Restrictive Tuition Reciprocity Agreement	0.894 (0.408)	-6.121 (1.547)	0.829 (0.397)	-6.413 (1.498)
Year Indicator Variables	yes	yes	yes	yes
College Indicator Variables	yes	yes	yes	yes
Number of Observations (# of colleges * 9 years)	6579	3510	6579	3510
R^2	0.915	0.882	0.923	0.895
$F_{5,N-k}$-Statistic for Test of Joint Significance of first 5 Covariates Listed Above	15.123	16.061	15.781	16.487

See Hoxby (1997) for additional details about covariates.

Table 3 - All Colleges
The Distribution of SAT Scores Among Colleges
Combined SAT Score (math+verbal) - Enrollment Weighted Statistics

example: 50th percentile is avg combined SAT of college that is median among colleges

	1966	1971	1981	1991
75-25 diff	69	111	143	180
90-10 diff	241	279	300	328
95-5 diff	347	377	395	418
5th percentile	922	898	842	809
10th percentile	961	939	899	853
25th percentile	1029	1006	967	906
50th percentile	1063	1057	1026	991
75th percentile	1098	1117	1110	1086
90th percentile	1202	1218	1199	1181
95th percentile	1269	1275	1237	1227
mean	1065	1062	1035	1001

Analysis sample for 1966-91 ('66, '71, '81, '91), containing 1121 colleges.

Table 3a — Private Colleges
The Distribution of SAT Scores Among Private Colleges
Combined SAT Score (math+verbal) - Enrollment Weighted Statistics

example: 50th percentile is avg combined SAT of college that is median among colleges

	1966	1971	1981	1991
75-25 diff	157	193	203	218
90-10 diff	283	316	334	370
95-5 diff	361	391	411	452
5th percentile	972	942	903	861
10th percentile	991	975	940	896
25th percentile	1045	1026	998	959
50th percentile	1124	1100	1079	1051
75th percentile	1202	1219	1201	1177
90th percentile	1272	1291	1274	1266
95th percentile	1315	1333	1314	1313
mean	1130	1121	1101	1069

Analysis sample for 1966-91 ('66, '71, '81, '91), containing 731 private colleges.

Table 3b - Public Colleges
The Distribution of SAT Scores Among Public Colleges
Combined SAT Score (math+verbal) - Enrollment Weighted Statistics

example: 50th percentile is avg combined SAT of college that is median among colleges

	1966	1971	1981	1991
75-25 diff	58	90	118	145
90-10 diff	219	237	252	276
95-5 diff	289	310	333	358
5th percentile	896	870	833	800
10th percentile	934	917	874	837
25th percentile	995	992	940	896
50th percentile	1025	1026	998	965
75th percentile	1053	1082	1058	1041
90th percentile	1153	1154	1126	1113
95th percentile	1185	1180	1166	1158
mean	1027	1032	1008	970

Analysis sample for 1966-91 ('66, 71 '81, '91), containing 390 public colleges.

Table 4
The Distribution of National Merit Scholars Among Colleges
Herfindahl Index based on National Merit Scholar Distribution*

Herfindahl Indices are multiplied by 100 for convenience

1956	1961	1966	1971	1976	1981	1986	1991
0.726	2.001	2.413	1.510	1.287	1.399	2.063	2.978

*Herfindahl Indices are adjusted for overall number of National Merit Scholarships awarded in each year. *All* National Merit Scholarships ever awarded are used for calculation. Adjustment index is based on what Herfindahl index would result in each year if that year's Scholars were distributed randomly among baccalaureate-granting colleges. The number of Scholarships awarded was, respectively for the years listed above: 520, 1148, 2349, 3312, 3753, 4930, 5387, 5513.

Table 5
The Distribution of SAT Scores Within Colleges
Standard Deviation of Verbal SAT Score Within College - Enrollment Weighted Statistics

example: first entry shows std. dev. of SAT within an average small college

	College Size	1966	1971	1981	1991
All	Small*	116	107	94	82
	Medium*	115	105	92	78
	Large*	118	108	94	84
Private	Small*	114	106	90	81
	Medium*	114	103	89	81
	Large*	111	98	88	80
Public	Small*	122	116	98	89
	Medium*	120	112	97	90
	Large*	122	114	98	85

*Small College: undergraduate enrollment less than or equal to 500
Medium College: undergraduate enrollment greater than 1500 and less than or equal to 6000
Large College: undergraduate enrollment greater than 6000

Analysis sample for 1966-91 ('66, 71, 81, '91), containing 731 private and 390 public colleges.

Table 6
Regression Results: Effect of Market Integration on Distribution of Students Among Colleges

Dependent Variable: Avg Combined SAT Score in College

	OLS	IV	OLS	IV
% of Students from "In-State"	-0.914 (0.105)	-0.559 (0.276)		-
% from "In-State" x Indicator for College's Initial Selectivity was Low	0.284 (0.177)	0.223 (0.367)		
% from "In-State" x Indicator for College's Initial Selectivity was High	-0.749 (0.153)	-0.642 (0.321)		
Herfindahl Index of Conc. of Students' State-of-Residence (coeff. is divided by 100 for convenience)			-0.842 (0.086)	-0.545 (0.234)
Herfindahl Index x Indicator for College's Initial Selectivity was Low (coeff. is divided by 100 for convenience)			0.347 (0.149)	0.319 (0.308)
Herfindahl Index x Indicator for College's Initial Selectivity was High (coeff. is divided by 100 for convenience)			-0.821 (0.142)	-0.761 (0.339)
State's Median Income (in thousands)	10.323 (3.095)	10.265 (3.201)	9.978 (3.167)	9.892 (3.365)
State's Pct. of Adults with BAs	5.398 (1.876)	5.145 (1.913)	4.980 (1.854)	4.955 (1.901)
Year Fixed Effects	yes	yes	yes	yes
College Fixed Effects	yes	yes	yes	yes
# Observations (1121 colleges x 6 yrs)	6726	6726	6726	6726
R^2	0.816		0.826	
Tst Overid Restrctns (Chi-Sq-4df)		1.16		1.10

Analysis sample for 1966-91 ('66, '71, '76, '81, '86, '91). Regressions are weighted by college enrollment. Similar results obtain using unweighted regression. See Table 2 for implied first-stage regressions corresponding to the IV equations. Test of overidentifying restrictions is NR^2 where N is number of observations and R^2 is the uncentered R^2 from a regression of IV residuals on the full set of instruments.

Table 6a - Private Colleges
Regression Results: Effect of Mkt Integration on Distrib. of Students Among Private Colleges

Dependent Variable: Avg Combined SAT Score in College

	OLS	IV	OLS	IV
% of Students from "In-State"	-0.818 (0.103)	-0.606 (0.297)		-
% from "In-State" x Indicator for College's Initial Selectivity was Low	0.052 (0.281)	0.114 (0.400)		
% from "In-State" x Indicator for College's Initial Selectivity was High	-1.049 (0.141)	-0.865 (0.355)		
Herfindahl Index of Conc. of Students' State-of-Residence (coeff. is divided by 100 for convenience)			-0.735 (0.091)	-0.555 (0.269)
Herfindahl Index x Indicator for College's Initial Selectivity was Low (coeff. is divided by 100 for convenience)			0.155 (0.248)	0.119 (0.519)
Herfindahl Index x Indicator for College's Initial Selectivity was High (coeff. is divided by 100 for convenience)			-1.607 (0.142)	-1.235 (0.350)
State's Median Income (in thousands)	12.244 (3.429)	12.321 (3.796)	11.757 (3.868)	11.897 (3.985)
State's Pct. of Adults with BAs	6.002 (2.338)	6.143 (2.421)	5.907 (2.729)	6.032 (2.852)
Year Fixed Effects	yes	yes	yes	yes
College Fixed Effects	yes	yes	yes	yes
# Observations (731 colleges x 6 yrs)	4386	4386	4386	4386
R^2	0.868		0.881	
Tst Overid Restrctns (Chi-Sq-4df)		1.00		0.96

Analysis sample for 1966-91 ('66, '71, '76, '81, '86, '91). Regressions are weighted by college enrollment. Similar results obtain using unweighted regression. See Table 2 for implied first-stage regressions corresponding to the IV equations. Test of overidentifying restrictions is NR^2 where N is number of observations and R^2 is the uncentered R^2 from a regression of IV residuals on the full set of instruments.

Table 6b - Public Colleges
Regression Results: Effect of Mkt Integration on Distrib. of Students Among Public Colleges

Dependent Variable: Avg Combined SAT Score in College

	OLS	IV	OLS	IV
% of Students from "In-State"	-3.010 (0.309)	-1.198 (0.815)		
% from "In-State" x Indicator for College's Initial Selectivity was Low	2.752 (0.712)	2.598 (1.658)		
% from "In-State" x Indicator for College's Initial Selectivity was High	3.234 (0.607)	2.879 (1.425)		
Herfindahl Index of Conc. of Students' State-of-Residence (coeff. divided by 100 for convenience)			-2.108 (0.203)	-0.903 (0.442)
Herfindahl Index x Indicator for College's Initial Selectivity was Low (coeff. divided by 100 for convenience)			1.828 (0.481)	1.655 (0.899)
Herfindahl Index x Indicator for College's Initial Selectivity was High (coeff. divided by 100 for convenience)			2.155 (0.407)	1.882 (0.962)
State's Median Income (in thousands)	9.841 (3.379)	9.867 (3.569)	9.316 (3.387)	9.254 (3.524)
State's Pct. of Adults with BAs	4.871 (2.163)	4.856 (2.241)	4.546 (2.111)	4.657 (2.099)
Year Fixed Effects	yes	yes	yes	yes
College Fixed Effects	yes	yes	yes	yes
# Observations (390 colleges x 6 yrs)	2340	2340	2340	2340
R^2	0.667		0.680	
Tst Overid Restrctns (Chi-Sq-4df)		2.08		2.03

Analysis sample for 1966-91 ('66, '71, '76, '81, '86, '91). Regressions are weighted by college enrollment. Similar results obtain using unweighted regression. See Table 2 for implied first-stage regressions corresponding to the IV equations. Test of overidentifying restrictions is NR^2 where N is number of observations and R^2 is the uncentered R^2 from a regression of IV residuals on the full set of instruments.

Tables 7a and 7b
Regression Results: Effect of Market Integration on Distribution of Students Within Colleges
Dependent Variable: Standard Deviation of Verbal SAT Score Within College

table A shows estimated coefficient on Pct of Students from "In-State"

All		Private		Public	
OLS	IV	OLS	IV	OLS	IV
0.765	0.656	0.625	0.564	1.525	1.339
(0.066)	(0.166)	(0.053)	(0.159)	(0.303)	(0.749)

R^2s are: 0.819 (all), 0.764 (private), 0.864 (public).

table B shows estimated coefficient on Herfindahl Index based on Students' States-of-Residence (coefficients divided by 100 for convenience)

All		Private		Public	
OLS	IV	OLS	IV	OLS	IV
0.689	0.645	0.578	0.561	0.977	0.846
(0.064)	(0.170)	(0.055)	(0.168)	(0.220)	(0.604)

R^2s are: 0.817 (all), 0.763 (private), 0.860 (public).

Notes for both table A and B. Regressions are weighted by college enrollment. Similar results obtain using unweighted regression. See Table 2 for implied first-stage regressions corresponding to the IV equations. Number of observations are: 6726 (1121 colleges x 6 yrs), 4386 (731 private colleges x 6 yrs), 2340 (390 public colleges x 6 yrs).

Table 8
Average (List) Tuition - All Colleges*

	1940	1952	1960	1966	1971	1976	1981	1986	1991
mean	176	297	492	668	941	1196	1902	2668	4418
interquartile range	193	350	520	807	903	1050	2106	2906	4480
90^{th} - 10^{th} %ile range	350	600	958	1950	2157	2664	4434	7313	10023

*Averages are enrollment weighted. Note that public colleges have been assigned their "in-state" tuition for the purpose of these calculations. These averages therefore underestimate true list tuition, since out-of-state students at public colleges are counted as in-state students. The extent of underestimation increases over time. Analysis sample for 1940-91 ('40, '52, '60, '66, '71, '76, '81, '86, '91).

Table 8a
Average (List) Tuition - Private Colleges*

	1940	1952	1960	1966	1971	1976	1981	1986	1991
mean	245	426	682	1534	1999	2592	4118	5565	9492
interquartile range	150	200	375	650	903	1230	2110	4657	6137
90^{th} - 10^{th} %ile range	300	402	760	1316	1845	2495	4550	8589	13036

*Averages are enrollment weighted. Analysis sample for 1940-91 ('40, '52, '60, '66, '71, '76, '81, '86, '91).

Table 8b
Average "In-State" Tuition - Public Colleges*

	1940	1952	1960	1966	1971	1976	1981	1986	1991
mean	48	69	140	219	493	615	899	1325	2134
interquartile range	70	100	200	420	305	330	475	784	1147
90^{th} - 10^{th} %ile range	120	150	280	492	560	645	985	1444	2114

*Averages are enrollment weighted. Analysis sample for 1940-91 ('40, '52, '60, '66, '71, '76, '81, '86, '91).

Table 9a - Private Colleges
Regression Results: Effect of Market Integration on Tuition at Private Colleges

Dependent Variable: Log of (List) Tuition

	OLS	IV	OLS	IV
% of Students from "In-State" (coefficients mult. by 10 for convenience)	-0.066 (0.014)	-0.054 (0.032)		
% from "In-State" x Indicator for College's Initial Selectivity was Low (coefficients mult. by 10 for convenience)	0.030 (0.040)	0.046 (0.097)		
% from "In-State" x Indicator for College's Initial Selectivity was High (coefficients mult. by 10 for convenience)	-0.205 (0.036)	-0.183 (0.075)		
Herfindahl Index of Conc. of Students' State-of-Residence (coefficients divid by 10 for convenience)			-0.063 (0.014)	-0.051 (0.030)
Herfindahl Index x Indicator for College's Initial Selectivity was Low (coefficients divid by 10 for convenience)			0.081 (0.039)	0.072 (0.084)
Herfindahl Index x Indicator for College's Initial Selectivity was High (coefficients divid by 10 for convenience)			-0.270 (0.041)	-0.201 (0.087)
Log of State's Median Income	0.214 (0.011)	0.220 (0.013)	0.235 (0.013)	0.241 (0.014)
State's Pct. of Adults with BAs	0.104 (0.031)	0.108 (0.035)	0.116 (0.032)	0.116 (0.033)
Year Fixed Effects	yes	yes	yes	yes
College Fixed Effects	yes	yes	yes	yes
# Observations (731 colleges x 9 yrs)	6579	6579	6579	6579
R^2	0.984		0.982	
Tst Overid Restrctns (Chi-Sq-4df)		1.57		1.49

Analysis sample for 1940-91 ('40, '52, '60, '66, '71, '76, '81, '86, '91). Regressions are weighted by college enrollment. Similar results obtain using unweighted regression. See Table 2 for implied first-stage regressions corresponding to the IV equations. Test of overidentifying restrictions is NR^2 where N is number of observations and R^2 is the uncentered R^2 from a regression of IV residuals on the full set of instruments.

Table 9b - Public Colleges
Regression Results: Effect of Mkt Integration on Tuition at Public Colleges

Dependent Variable: Log of In-State Tuition

	OLS	IV	OLS	IV
% of Students from "In-State" (coefficients mult. by 10 for convenience)	-0.004 (0.001)	-0.004 (0.001)		
% from "In-State" x Indicator for College's Initial Selectivity was Low (coefficients mult. by 10 for convenience)	-0.040 (0.012)	-0.038 (0.022)		
% from "In-State" x Indicator for College's Initial Selectivity was High (coefficients mult. by 10 for convenience)	-0.057 (0.013)	-0.054 (0.029)		
Herfindahl Index of Conc. of Students' State-of-Residence (coefficients divid by 10 for convenience)			-0.004 (0.001)	-0.004 (0.001)
Herfindahl Index x Indicator for College's Initial Selectivity was Low (coefficients divid by 10 for convenience)			-0.020 (0.011)	-0.018 (0.028)
Herfindahl Index x Indicator for College's Initial Selectivity was High (coefficients divid by 10 for convenience)			-0.035 (0.012)	-0.043 (0.026)
Log of State's Median Income	0.125 (0.053)	0.128 (0.057)	0.120 (0.051)	0.124 (0.053)
State's Pct. of Adults with BAs	0.051 (0.022)	0.053 (0.024)	0.045 (0.017)	0.041 (0.018)
Year Fixed Effects	yes	yes	yes	yes
College Fixed Effects	yes	yes	yes	yes
# Observations (390 colleges x 9 yrs)	3510	3510	3510	3510
R^2	0.946		0.939	
Tst Overid Restrctns (Chi-Sq-4df)		2.41		2.34

Analysis sample for 1940-91 ('40, '52, '60, '66, '71, '76, '81, '86, '91). Regressions are weighted by college enrollment. Similar results obtain using unweighted regression. See Table 2 for implied first-stage regressions corresponding to the IV equations. Test of overidentifying restrictions is NR^2 where N is number of observations and R^2 is the uncentered R^2 from a regression of IV residuals on the full set of instruments.

Table 10
Average Subsidy per Student - All Colleges*

	1966	1971	1976	1981	1986	1991
median	867	1515	2464	3558	5120	6145
interquartile range	1357	1308	2689	4120	5909	8341
90^{th} - 10^{th} %ile range	3041	3543	5469	8348	13183	19531

*Subsidy per student is defined as equal to total college expenditure per student minus total tuition revenue per student. Averages are enrollment weighted. Analysis sample for 1966-91 ('66, '71, '76, '81, '86, '91).

Table 10a
Average Subsidy per Student - Private Colleges*

	1966	1971	1976	1981	1986	1991
median	688	1284	1675	2416	3505	4356
interquartile range	1204	1685	2099	3180	4831	6881
90^{th} - 10^{th} %ile range	3955	6448	7107	10466	16742	29648

*Subsidy per student is defined as equal to total college expenditure per student minus total tuition revenue per student. Averages are enrollment weighted. Analysis sample for 1966-91 ('66, '71, '76, '81, '86, '91).

Table 10b
Average Subsidy per Student - Public Colleges*

	1966	1971	1976	1981	1986	1991
median	957	1558	2750	3990	5801	6752
interquartile range	1405	1226	2600	3765	5717	8473
90^{th} - 10^{th} %ile range	2839	2710	4573	7247	10665	16473

*Subsidy per student is defined as equal to total college expenditure per student minus total tuition revenue per student. Averages are enrollment weighted. Analysis sample for 1966-91 ('66, '71, '76, '81 '86, '91).

Table 11a - Private Colleges
Regression Results: Effect of Market Integration on Subsidy per Student at Private Colleges

Dependent Variable: Log of Subsidy per Student

	OLS	IV	OLS	IV
% of Students from "In-State" (coefficients mult. by 100 for convenience)	-0.299 (0.045)	-0.297 (0.093)		
% from "In-State" x Indicator for College's Initial Selectivity was Low (coefficients mult. by 100 for convenience)	0.296 (0.061)	0.280 (0.128)		
% from "In-State" x Indicator for College's Initial Selectivity was High (coefficients mult. by 100 for convenience)	-0.214 (0.066)	-0.200 (0.158)		
Herfindahl Index of Conc. of Students' State-of-Residence			-0.110 (0.033)	-0.101 (0.072)
Herfindahl Index x Indicator for College's Initial Selectivity was Low			0.064 (0.078)	0.058 (0.145)
Herfindahl Index x Indicator for College's Initial Selectivity was High			-0.418 (0.103)	-0.513 (0.241)
Log of State's Median Income	0.104 (0.037)	0.108 (0.040)	0.108 (0.036)	0.100 (0.039)
State's Pct. of Adults with BAs	0.064 (0.037)	0.066 (0.040)	0.065 (0.038)	0.068 (0.041)
Year Fixed Effects	yes	yes	yes	yes
College Fixed Effects	yes	yes	yes	yes
# Observations	4386	4386	4386	4386
R^2	0.947		0.949	
Tst Overid Restrctns (Chi-Sq-4df)		1.21		1.16

Analysis sample for 1966-91 ('66, '71, '76, '81, '86, '91). Regressions are weighted by college enrollment. Similar results obtain using unweighted regression. See Table 2 for implied first-stage regressions corresponding to the IV equations. Test of overidentifying restrictions is NR^2 where N is number of observations and R^2 is the uncentered R^2 from a regression of IV residuals on the full set of instruments.

Table 11b - Public Colleges
Regression Results: Effect of Mkt Integration on Subsidy per Student at Public Colleges

Dependent Variable: Log of Subsidy per Student

	OLS	IV	OLS	IV
% of Students from "In-State" (coefficients mult. by 100 for convenience)	0.105 (0.064)	0.126 (0.151)		
% from "In-State" x Indicator for College's Initial Selectivity was Low (coefficients mult. by 100 for convenience)	0.077 (0.129)	0.069 (0.280)		
% from "In-State" x Indicator for College's Initial Selectivity was High (coefficients mult. by 100 for convenience)	-0.911 (0.151)	-0.848 (0.349)		
Herfindahl Index of Conc. of Students' State-of-Residence			0.138 (0.046)	0.129 (0.137)
Herfindahl Index x Indicator for College's Initial Selectivity was Low			0.075 (0.096)	0.087 (0.294)
Herfindahl Index x Indicator for College's Initial Selectivity was High			-0.925 (0.112)	-0.827 (0.328)
Log of State's Median Income	0.161 (0.060)	0.165 (0.067)	0.170 (0.061)	0.168 (0.067)
State's Pct. of Adults with BAs	0.070 (0.044	0.081 (0.048)	0.075 (0.041)	0.084 (0.047)
Year Fixed Effects	yes	yes	yes	yes
College Fixed Effects	yes	yes	yes	yes
# Observations	2340	2340	2340	2340
R^2	0.959		0.959	
Tst Overid Restrctns (Chi-Sq-4df)		1.99		1.92

Analysis sample for 1966-91 ('66, '71, '76, '81, '86, '91) Regressions are enrollment weighted. Similar results obtain using unweighted regression. See Table 2 for implied first-stage regressions corresponding to the IV equations. Test of overidentifying restrictions is NR^2 where N is number of observations and R^2 is the uncentered R^2 from a regression of IV residuals on the full set of instruments.

Appendix to Table 9a - Private Colleges
Regression Results: Effect of Market Integration on Tuition Revenue at Private Colleges

Dependent Variable: Log of Tuition Revenue

	IV	IV
% of Students from "In-State" (coefficients mult. by 10 for convenience)	-0.024	
% from "In-State" x Indicator for College's Initial Selectivity was Low (coefficients mult. by 10 for convenience)	0.021	
% from "In-State" x Indicator for College's Initial Selectivity was High (coefficients mult. by 10 for convenience)	-0.150	
Herfindahl Index of Conc. of Students' State-of-Residence (coefficients divid by 10 for convenience)		-0.020
Herfindahl Index x Indicator for College's Initial Selectivity was Low (coefficients divid by 10 for convenience)		0.017
Herfindahl Index x Indicator for College's Initial Selectivity was High (coefficients divid by 10 for convenience)		-0.181

Appendix to Table 9b - Public Colleges
Regression Results: Effect of Mkt Integration on Tuition Revenue at Public Colleges

Dependent Variable: Log of Tuition Revenue

	IV	IV
% of Students from "In-State" (coefficients mult. by 10 for convenience)	-0.061	
% from "In-State" x Indicator for College's Initial Selectivity was Low (coefficients mult. by 10 for convenience)	0.050	
% from "In-State" x Indicator for College's Initial Selectivity was High (coefficients mult. by 10 for convenience)	-0.043	
Herfindahl Index of Conc. of Students' State-of-Residence (coefficients divid by 10 for convenience)		-0.052
Herfindahl Index x Indicator for College's Initial Selectivity was Low (coefficients divid by 10 for convenience)		0.044
Herfindahl Index x Indicator for College's Initial Selectivity was High (coefficients divid by 10 for convenience)		-0.051

Appendix Table - Indicators of College Quality
only coefficients of interest are shown

Private Colleges	Dependent Variable				
	Student-Tenured Faculty Ratio	Log of Avg Faculty Salary	Log of Building Value per Student	Log of Library Expenditures per Student	Log of "Student Support" Expenditures per Student
%In-State	0.514	-0.002	-0.005	-0.007	-0.005
%In-State x Low	-0.115	0.001	0.001	0.001	0.004
%In-State x High	0.516	-0.006	-0.002	-0.001	-0.006
Herf Index	0.432	-0.001	-0.005	-0.006	-0.006
Herf x Low	-0.139	0.001	0.004	0.001	0.006
Herf x High	0.424	-0.002	-0.002	-0.002	-0.004

Public Colleges	Dependent Variable				
	Student-Tenured Faculty Ratio	Log of Avg Faculty Salary	Log of Building Value per Student	Log of Library Expenditures per Student	Log of "Student Support" Expenditures per Student
%In-State	0.204	-0.001	-0.009	-0.005	-0.006
%In-State x Low	-0.006	0.001	0.004	0.005	0.006
%In-State x High	0.142	-0.001	-0.004	-0.002	-0.022
Herf Index	0.147	-0.001	-0.006	-0.003	-0.004
Herf x Low	-0.020	0.001	0.003	0.002	0.004
Herf x High	0.092	-0.001	-0.003	-0.003	-0.022

Figure 1

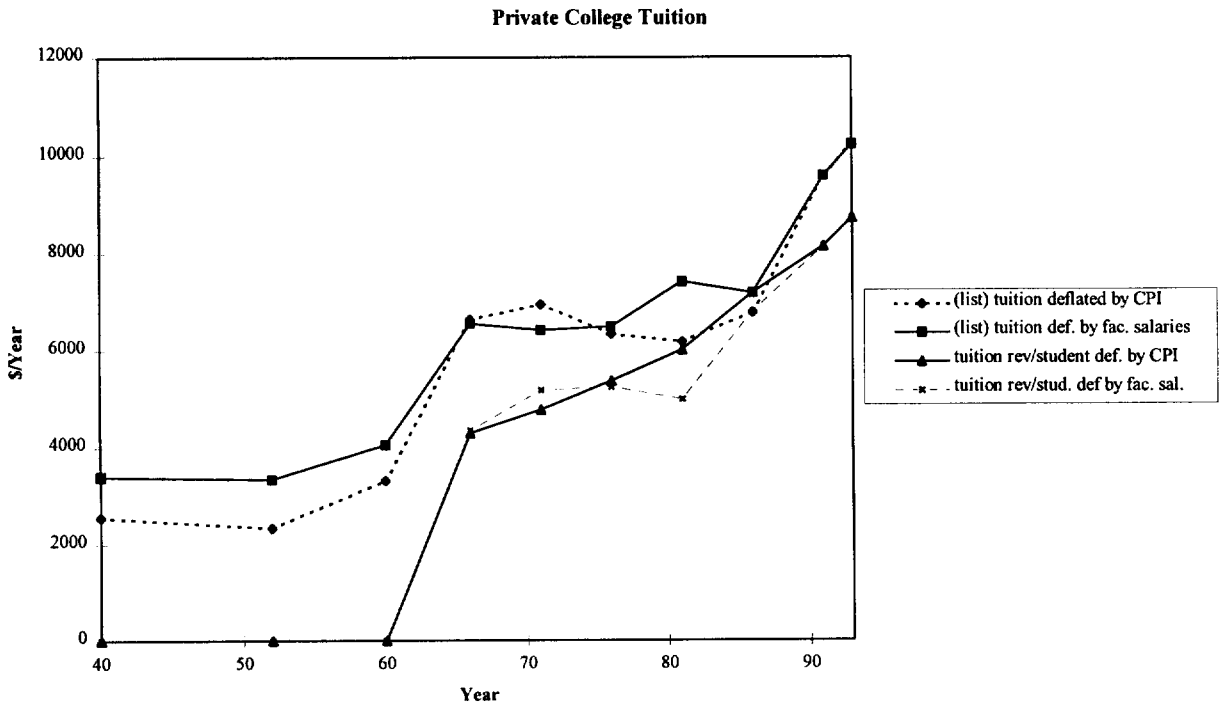

Private College Tuition
12000
10000
8000
6000
4000
2000
0
$/Year
40
50
60
70
80
90
Year
(list) tuition deflated by CPI
(list) tuition def. by fac. salaries
tuition rev/student def. by CPI
tuition rev/stud. def by fac. sal.

Figure 2

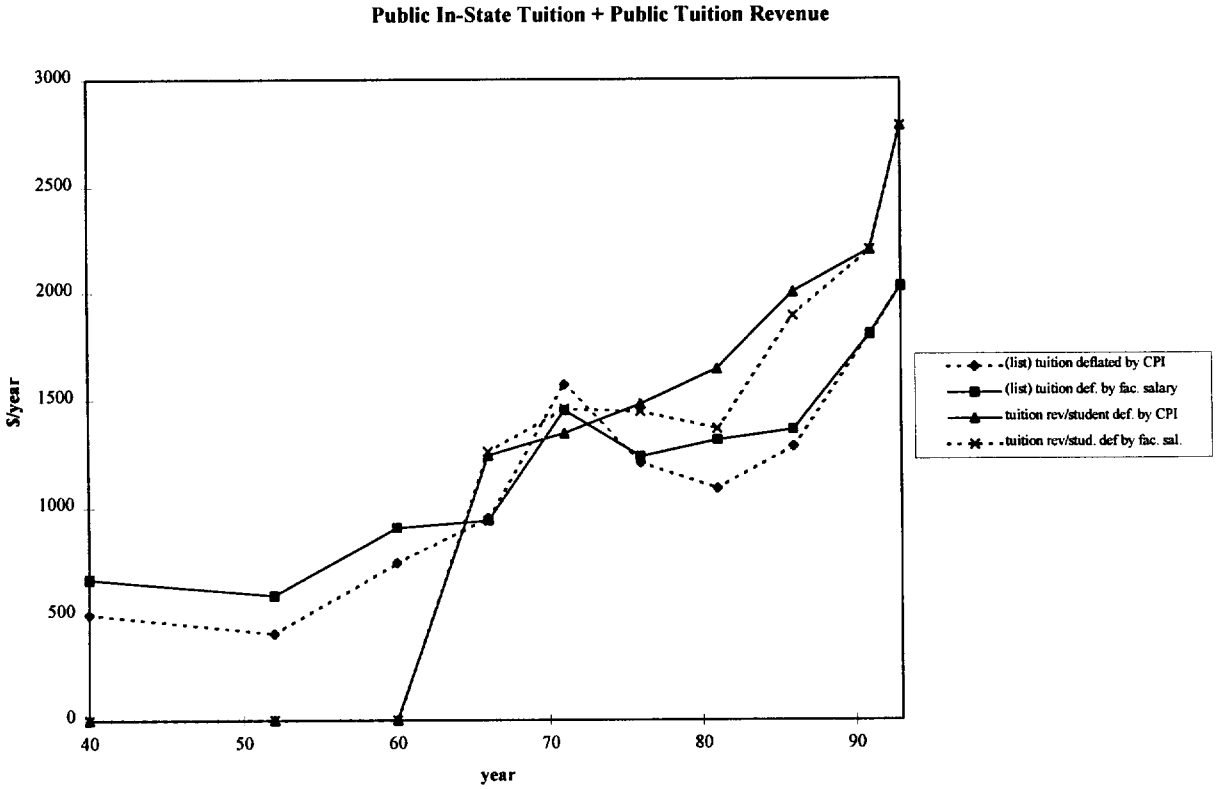

Public In-State Tuition + Public Tuition Revenue
3000
2500
2000
1500
1000
500
0
$/year
40
50
60
70
80
90
year
(list) tuition deflated by CPI
(list) tuition def. by fac. salary
tuition rev/student def. by CPI
tuition rev/stud. def by fac. sal.

Figure 3

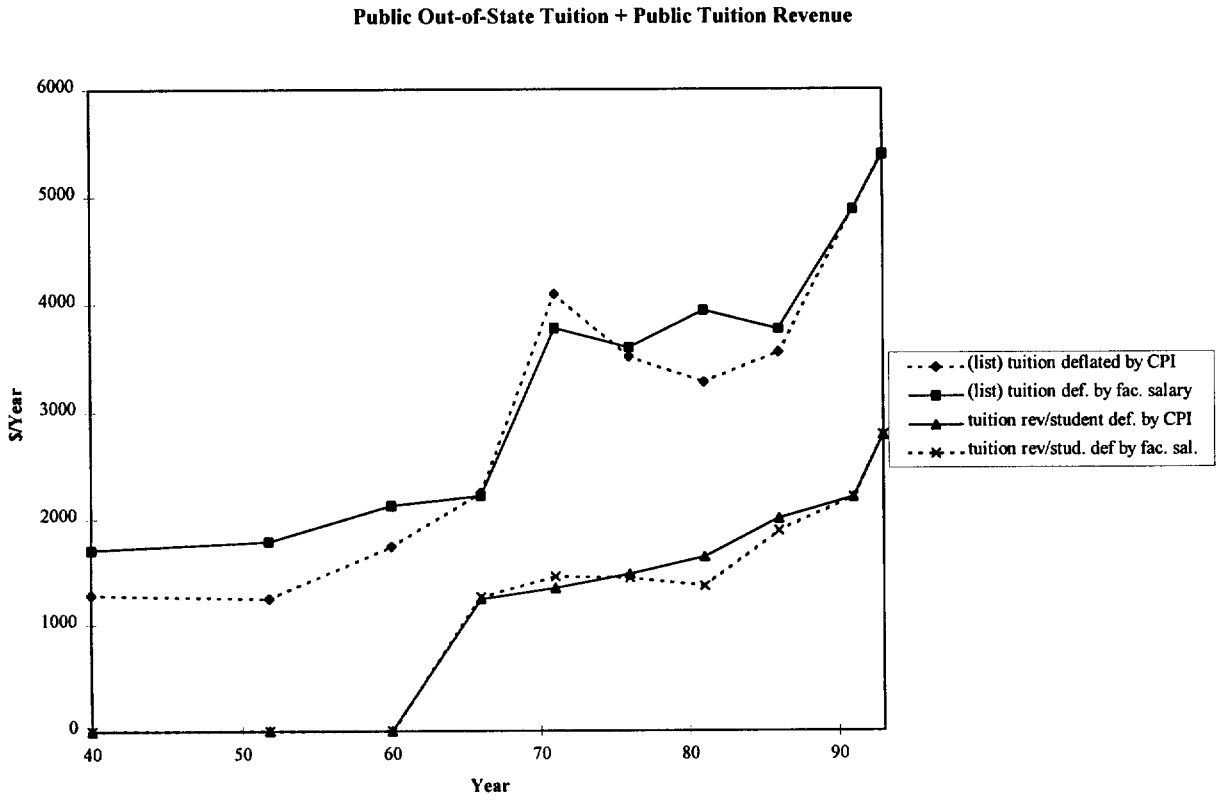

Public Out-of-State Tuition + Public Tuition Revenue
6000
5000
4000
3000
2000
1000
0
$/Year
40
50
60
70
80
90
Year
(list) tuition deflated by CPI
(list) tuition def. by fac. salary
tuition rev/student def. by CPI
tuition rev/stud. def by fac. sal.

Figure 4

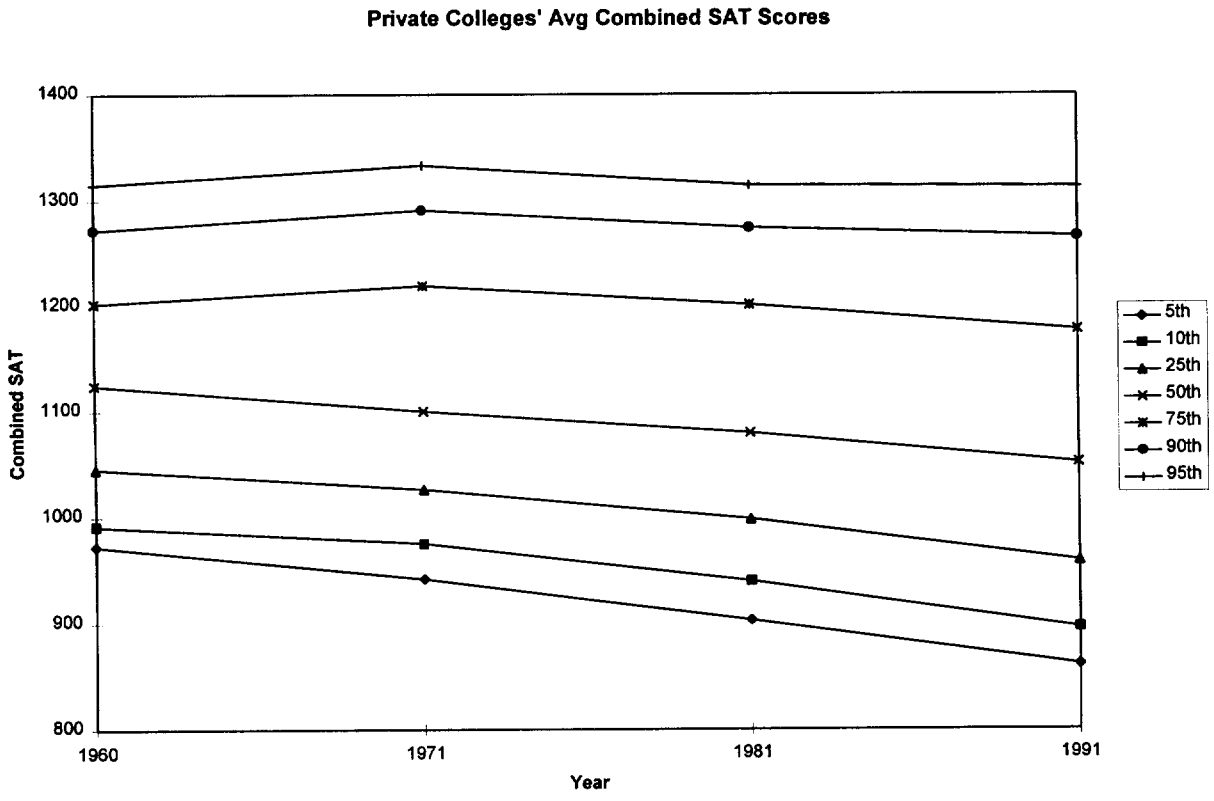
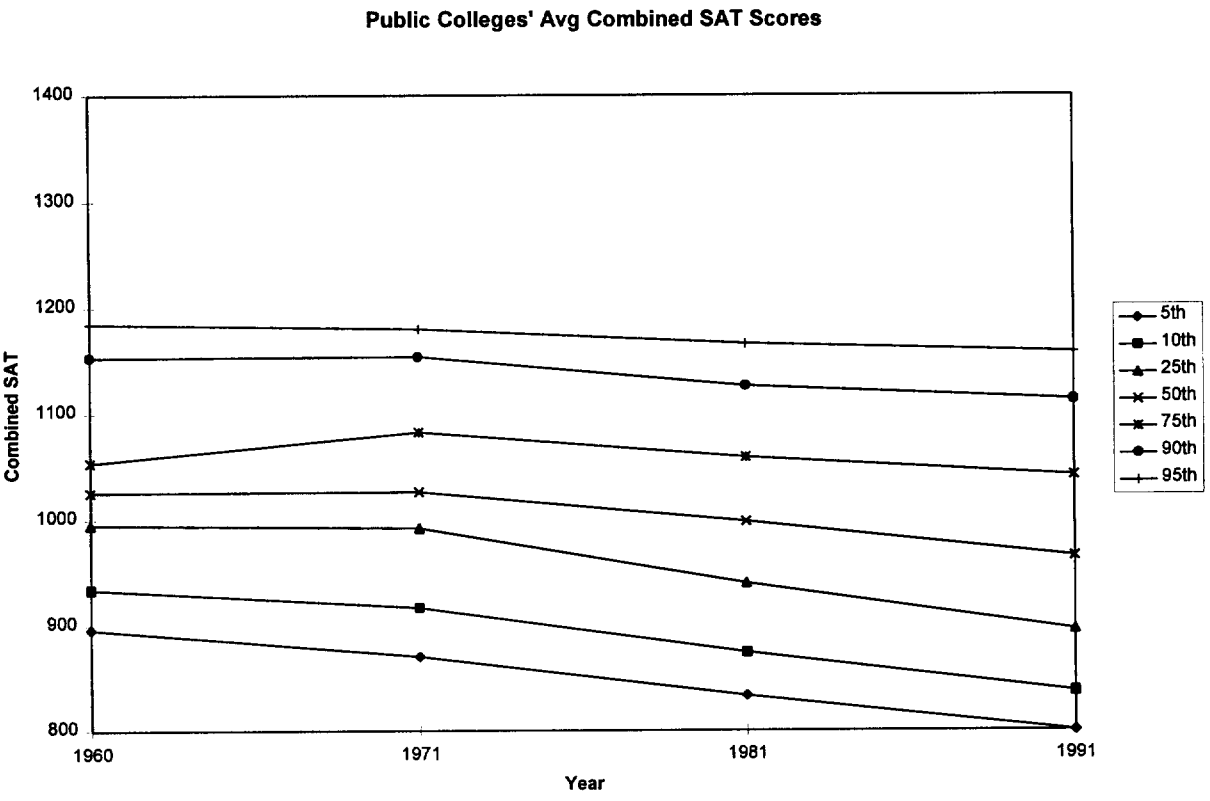

Private Colleges' Avg Combined SAT Scores
1400
1300
1200
1100
1000
900
800
Combined SAT
1960
1971
1981
1991
Year
5th
10th
25th
50th
75th
90th
95th

Figure 5


Public Colleges' Avg Combined SAT Scores
1400
1300
1200
1100
1000
900
800
Combined SAT
1960
1971
1981
1991
Year
5th
10th
25th
50th
75th
90th
95th

Auxiliary Figure 5

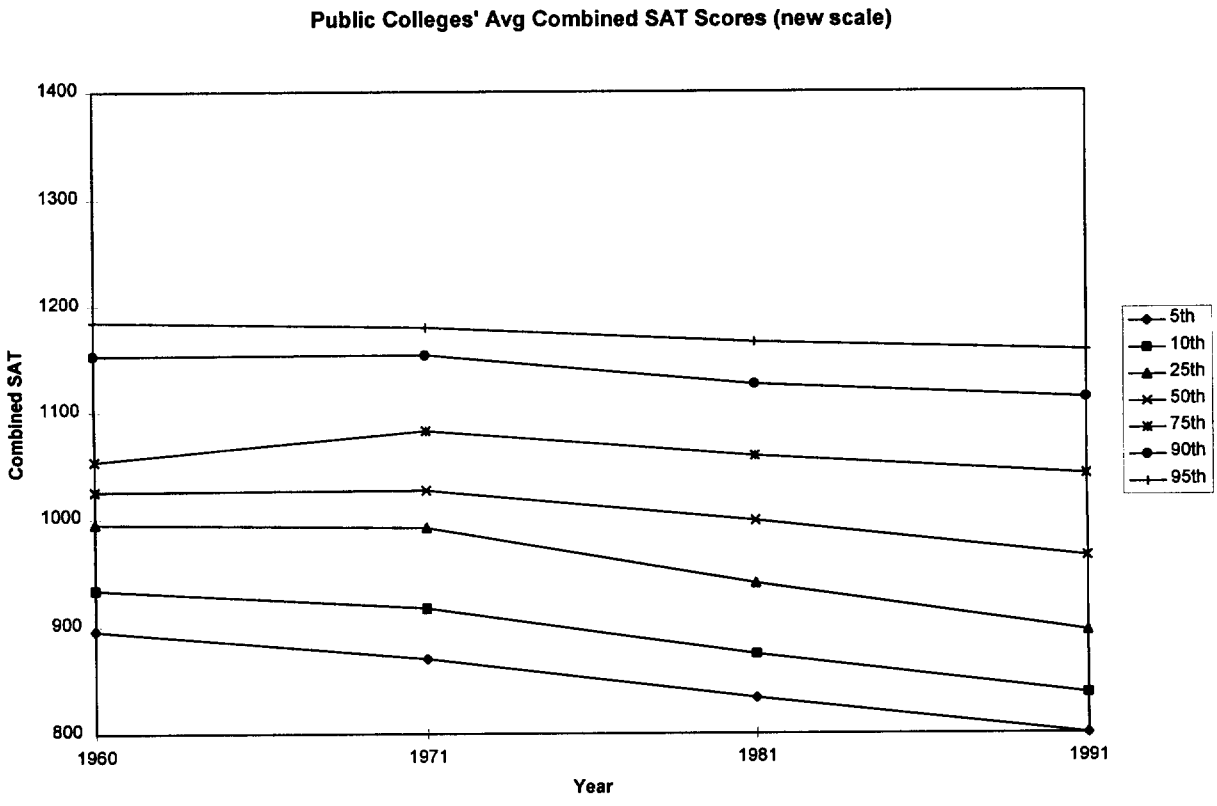


Figure 6

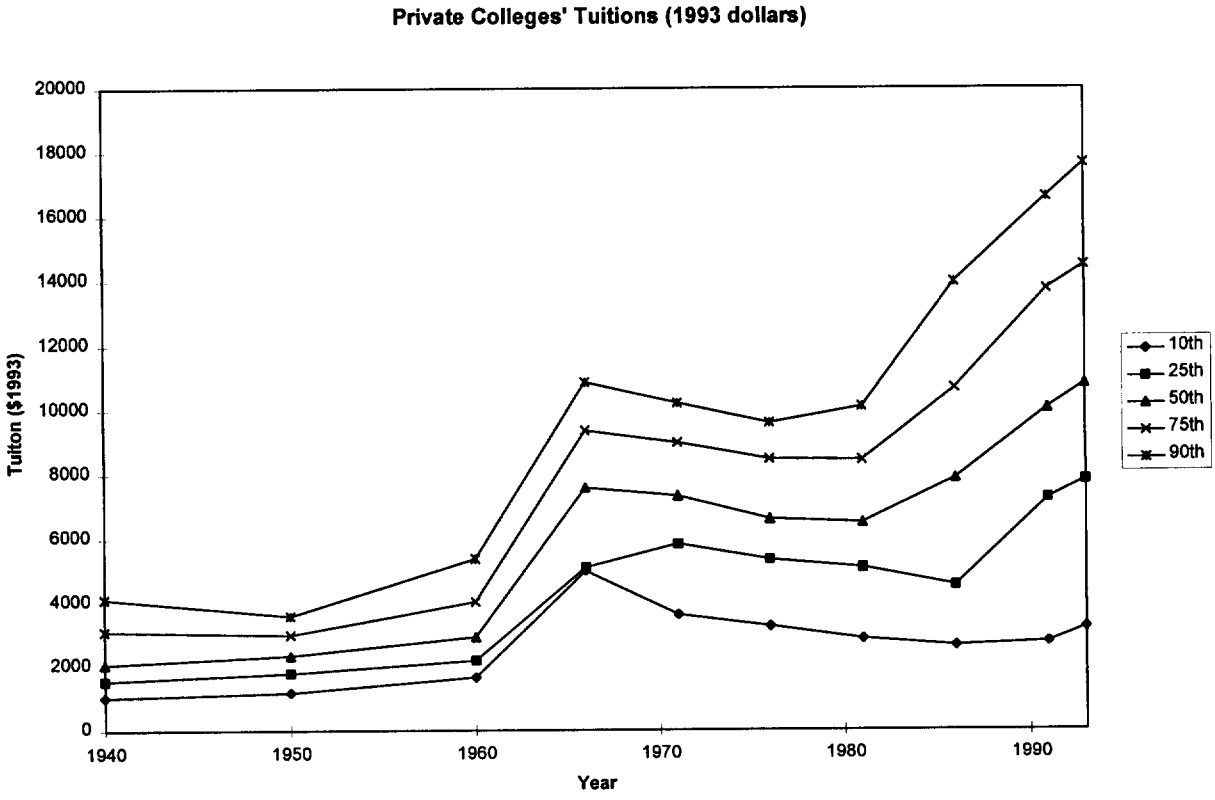
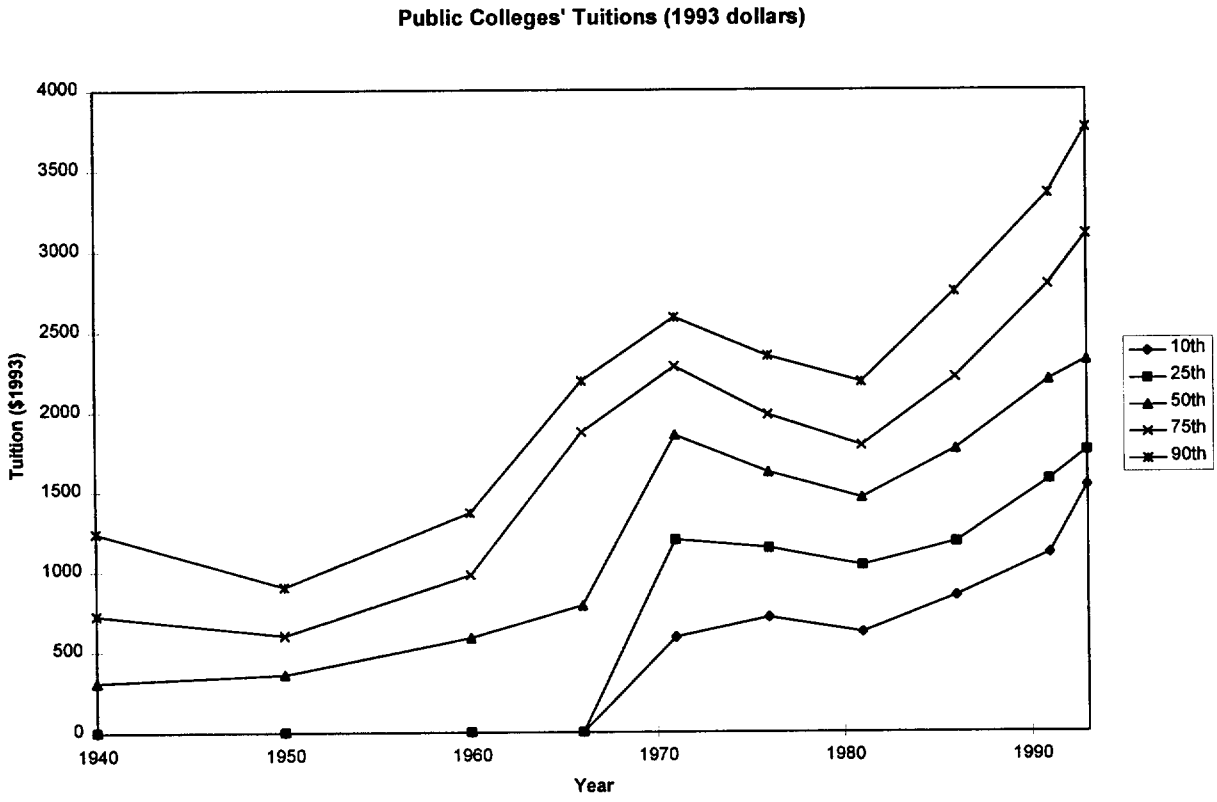

Private Colleges' Tuitions (1993 dollars)
Tuiton ($1993)
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
1940
1950
1960
1970
1980
1990
Year
10th
25th
50th
75th
90th

Figure 7


Public Colleges' Tuitions (1993 dollars)
Tuition ($1993)
4000
3500
3000
2500
2000
1500
1000
500
0
1940
1950
1960
1970
1980
1990
Year
10th
25th
50th
75th
90th

Auxiliary Figure 7

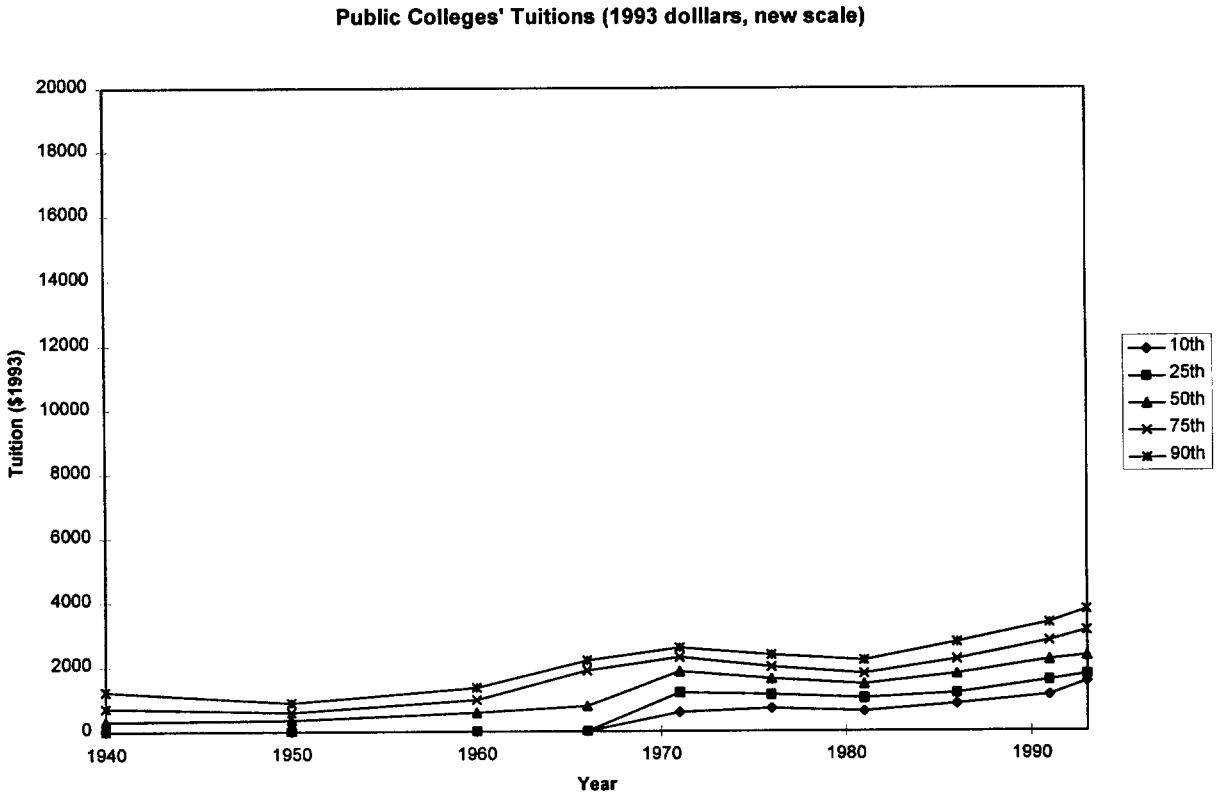


Figure 8

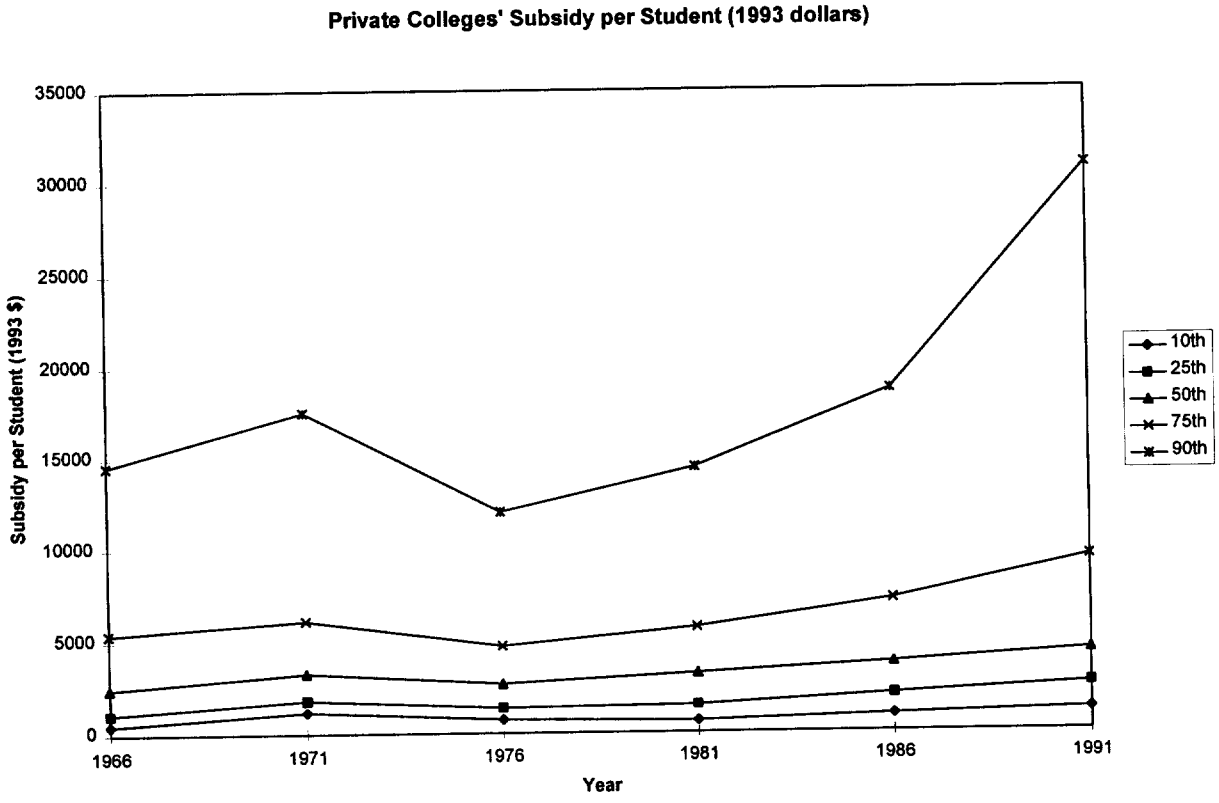
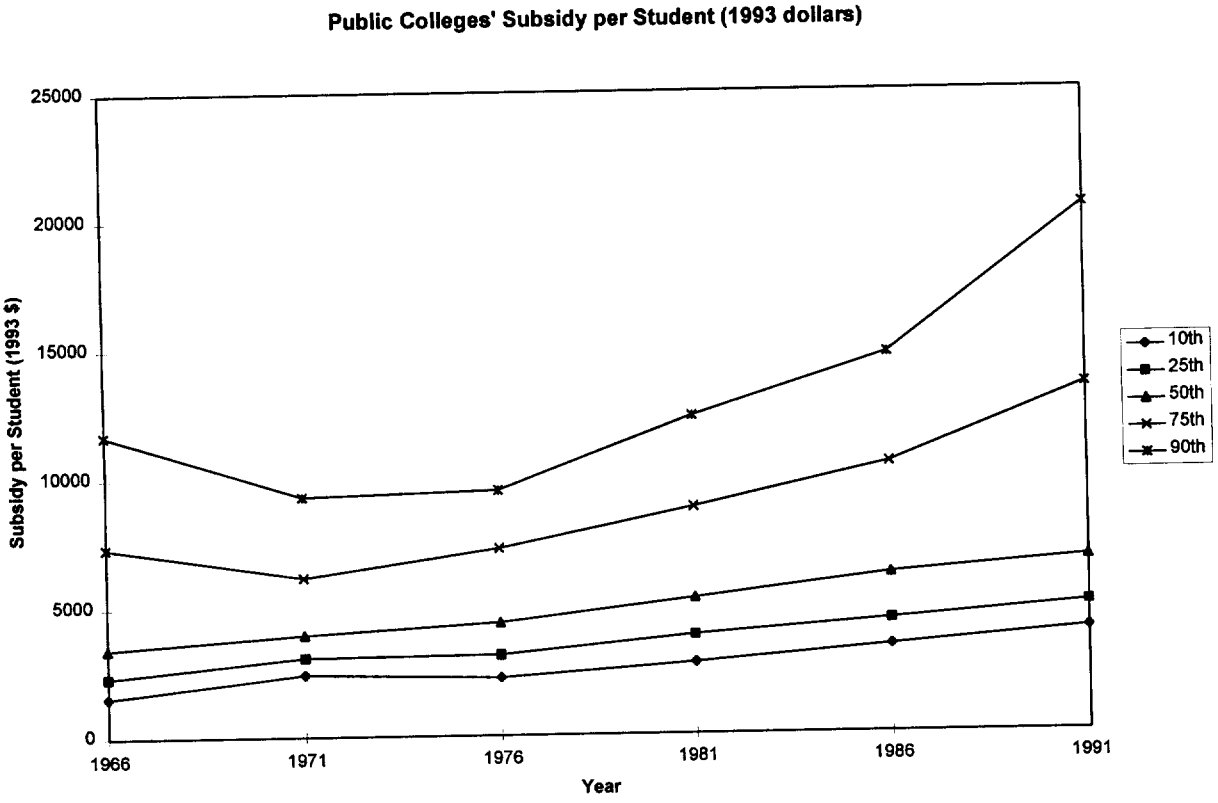

Private Colleges' Subsidy per Student (1993 dollars)
35000
30000
25000
20000
15000
10000
5000
0
Subsidy per Student (1993 $)
1966
1971
1976
1981
1986
1991
Year
10th
25th
50th
75th
90th

Figure 9


Public Colleges' Subsidy per Student (1993 dollars)
Subsidy per Student (1993 $)
25000
20000
15000
10000
5000
0
1966
1971
1976
1981
1986
1991
Year
10th
25th
50th
75th
90th

Auxiliary Figure 9