
What's Happened to the Price of College?

Quality-Adjusted Net Price Indexes for Four-Year Colleges

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ABSTRACT

In this paper we estimate hedonic models of the (consumer) price of college to construct quality-adjusted net price indexes for U.S. four-year colleges, where the net price of college is defined as tuition and fees minus financial aid. For academic years 1990–91 to 1994–95, we find adjusting for financial aid leads to a 22 percent decline in the estimated price index for all four-year colleges, while quality adjusting the results leads to a further, albeit smaller, decline. Nevertheless, public comprehensive colleges, perhaps an important gateway to college for students from low-income backgrounds, experienced the largest net price increases.

I. Introduction

Since the early 1980s the “sticker price” or “list price” of a college education in the United States has, according to estimates from the Consumer Price Index (CPI), risen significantly faster than the overall rate of inflation. This has raised considerable concern among policymakers, parents, and students that college attendance was becoming less affordable even as it was becoming more important for economic success in the job market. Federal and state policymakers have responded with a variety of programs and policies aimed at addressing the “affordability” problem. As an example, the federal Taxpayer Relief Act of 1997 created HOPE Scholarships

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[Submitted June 2001; accepted February 2003]

ISSN 022-166X © 2004 by the Board of Regents of the University of Wisconsin System

and Lifetime Learning Credits to partially offset the cost of college and were, together, expected to provide tuition assistance for as many as 13 million students.¹

As policymakers consider interventions in the higher education market, an accurate understanding of what is happening to the consumer price of college overall and in the various college submarkets is critical. Unfortunately, the price information used by the federal government in constructing the Consumer Price Index for Higher Education is limited to the “sticker prices” of four-year colleges (tuition and fees). There is no adjustment for scholarships given or other discounts, even though the importance of financial aid in offsetting the cost of tuition is well recognized.² Further, no adjustments are made for changes in the quality or characteristics of the services provided. Thus, price indexes reflect changes in the quality and characteristics of college as well as constant quality changes in “pure” prices (BLS 1997). This is particularly troubling since there is no consensus on quality trends—while some believe quality is decreasing (implying faster rises in quality-adjusted prices), others argue that quality is increasing (implying slower growth in quality-adjusted prices).

The inadequacy of the price information and its importance for good policymaking has been recognized and efforts made to address the gap. As an example, the U.S. Congress convened a National Commission on the Cost of Higher Education in 1997 to explore trends in the cost of a college education and policies that might be used to ensure the affordability of a quality college education. Equally important, the Bureau of Labor Statistics is considering revising the CPI for higher education, based, in part, upon a commissioned report (Schwartz and Scafidi 2001) that explored using hedonic methods for constructing a CPI for college.

Of course, parents and prospective students need good information about consumer prices, too. In fact, the American Council on Education reports that 65 percent of respondents listed “the cost of a college education” as a worry regarding their children (ACE 1998).³ Unfortunately, while the popular press regularly reports large increases in the sticker price of college (the CPI), most students (especially low-income students) do not pay the sticker price of college. It is, then, unsurprising that both adults and high school students dramatically overstate the price of attending college.⁴ Notice that overestimating the consumer price of college might, for example, lead students to “give up” on college either at graduation or even earlier, affecting curricular and other academic choices. Finally, there is little information about the difference in prices across market segments

1. U.S. Department of Education (2001), p.1 contains a description of these programs.

2. The “tuition and other school fees index,” which includes college tuition and fees, elementary and high school tuition and fees, childcare and nursery school and technical school and business school fees, had a relative importance of 2.544 percent in the CPI-U (the CPI for All Urban Consumers) in 1999, with college tuition and fixed fees accounting for about 47 percent of the weight of this index (BLS 2001).

3. According to ACE (1998), more adults worried about the cost of college than their children becoming a victim of crime (64 percent), health care for their children (55 percent), or the quality of their public schools (55 percent).

4. For adults in the 1998 ACE survey, the estimated consumer price of attending college was triple the true average price (ACE 1998). Further, students from disadvantaged backgrounds may have worse information about the price of college than their suburban counterparts. High school students in Boston and a nearby suburb overestimate the cost of a local community college at almost double the true cost and overstate the cost of a local four-year institution at about three times the true cost (Kane 2002).

although designing policies to promote access for individuals in different segments of the higher education market requires such information.⁵ This seems especially important to efforts to address concerns regarding access to higher education for low income and historically disadvantaged individuals (Kane 1999; Bowen and Bok 1998).

In this paper, we develop and explore the construction of an aid- and quality-adjusted price index for U.S. four-year colleges, based on the estimation of hedonic models of the consumer (net) price of college. We focus on estimating an index that reflects the out-of-pocket costs—net price—paid by a consumer in order to attend a four-year college and not, for example, an index of the cost of producing higher education services. We then estimate aid- and quality-adjusted price indexes for different segments of the higher education market.

While many studies have considered the underlying causes of the growth in tuition (for example, Clotfelter and Rothschild 1993; Clotfelter 1996; Hoxby 1997; Winston 1997, 1999; Winston et al. 1998; Ehrenberg, 2000), these have typically focused on investigating changes in the costs of higher education, examining the sources of revenues (especially government support and private contributions), assessing levels of competition, or more generally on estimating aspects of the supply or demand for college education. We know of no previous work estimating aid- and quality-adjusted price indexes and hedonic equations for college education, although Monks and Ehrenberg (1999) represents a significant step in that direction.⁶

To estimate hedonic price models, we use information on college attributes from the Annual Survey of Colleges (ASC) data from the College Board and data on tuition and fees from the Integrated Postsecondary Education Data System (IPEDS) collected by the National Center for Education Statistics. While these data do not capture all of the college attributes potentially valued by undergraduates, we also include college “brand” effects which capture the time-invariant features of colleges including, for example, location, weather, etc.⁷

The next section presents the theoretical and conceptual background for the empirical analysis and Section III describes a hedonic model for estimation. Section IV describes our data, and Section V provides the estimates of the hedonic models. Conclusions are in Section VI.

5. While the net price of college for students from disadvantaged backgrounds is critical for understanding access to higher education, we are not aware of any comprehensive data that can be used to estimate net prices for only these students across all institutions. Nevertheless, average net prices paint a more accurate picture of changes to consumer prices in segments of the higher education market than sticker prices. Better information on consumer prices of higher education paid by particular student populations is clearly needed.

6. Monks and Ehrenberg (1999) investigate the relationship between a college’s price and its ranking in U.S. News and World Report. Their sample includes 30 highly selective private schools and tracks prices over an 11-year period. Noting that the rankings do not measure “true” quality, since changes in U.S. News’s methodology have, at times, induced large shifts in rankings (for example, Bryn Mawr dropped from five to 23 in a single year), rankings were found to matter to prices. A ten spot decrease in the rankings, they estimate, leads to a three percent decrease in net price. They use a fixed effects estimator, as we do, but a more limited sample and set of hedonic attributes.

7. As noted by a referee, an incomplete specification of attributes implies that quality changes may not be fully captured. This is a challenge faced generically in constructing price indexes and not unique to the college market. Adjustments for quality are typically viewed as imperfect, but preferable to ignoring quality change entirely.

II. The Market for College

To estimate hedonic models of the price of college, we must first gain an understanding of the market for college. A hedonic model of the price of college explains the prices paid for college as a function of the attributes of the bundle that is college. Explanatory variables include only attributes of college valued by consumers—in this case, undergraduates and their parents.

The market for college education is characterized by discrete goods in which each institution contains a bundle of attributes valued by consumers, differentiated products, not-for-profit firms, imperfect competition, significant donated resources, and heterogeneous consumers, among other “familiar but curious” idiosyncrasies that present formidable challenges to modeling supply and demand and understanding price determination.⁸ Before turning to a model of college choice, three particular items are worth discussing: the output of colleges, the products that tuition buys, and the role of donors in financing colleges.

A. *What do Colleges Produce?*

While fully modeling the production process of a college is outside the scope of this work, some discussion of the output of colleges is necessary. Colleges can be best viewed as multi-product firms, producing a range of services including education, food, accommodations, and amusements, minor league “professional” athletics, research, and investment management.⁹ Verry and Davies (1976) focus on the educational mission, providing this list of outputs:

- “(i) *Instructional or teaching outputs* (the transmission of knowledge). This involves the teaching of various kinds (general, vocational etc.), in different subjects and at different levels, all generally leading to certification of some description.
- (ii) *Research outputs* (the extension of knowledge).
- (iii) *General Social Services*. This is something of a catch-all category for the less tangible and often most controversial activities of the university. It is intended to include the general socialization function (the instillation of desirable work habits, co-operative behavior, respect for laws and institutions, and, some would say, docility and obedience), and the related function, primarily benefiting employers, of sorting, selecting and screening individuals . . .” (page 10.)¹⁰

8. Articles by Charles T. Clotfelter and Gordon C. Winston and others in a Symposium on the Economics of Higher Education in the Winter 1999 *Journal of Economic Perspectives* pp. 3–116 provide a nice overview.

9. This list was suggested to us by Jack Triplett. “Investment management” refers to the management of the university’s endowment and other financial resources. Minor league “professional” sports refers to high quality amateur sports where athletes are compensated with scholarships in exchange for participation on an athletic team.

10. “Instructional or teaching outputs” would include nonpecuniary benefits that accrue to individuals themselves, and “General Social Services” would also include all pecuniary and nonpecuniary benefits that accrue to others.

Understanding the objectives of universities is far from straightforward. Most universities are not-for-profit and might be viewed as acting to maximize some objective function such as “prestige,” “human capital,” or “endowment” rather than profits. Universities compete with one another for the “best” students—through the allocation of financial aid, the setting of tuition and the provision of attributes—in the face of resource constraints. Better students may enhance an institution’s prestige/human capital/endowment by increasing the production of some of the outputs of college. Therefore, some of the customers of college—students—are inputs to the production process as well.¹¹ For our purposes, the supply curve for the college attributes should be upward sloping—providing better attributes costs more and universities face capacity constraints that suggest increasing costs at some student body size.

B. What do Students Buy?

In paying for college, the consumer of undergraduate education buys only output (i). The college student (or her parents) is not buying research outputs (ii) or general social services (iii) directly. Paying tuition does not particularly entitle a student to (ii) or (iii), which may also be available to others. For example, research may enhance the prestige and/or learning experience at a particular college but may also be valued by other consumers than undergraduate students—university research is “consumed” by governmental agencies and industrial clients far more frequently than by undergraduate students. Thus, these outputs will be important in the hedonic analysis only to the extent they enhance the *undergraduate college experience*.

At the same time, college admissions officers like to say that students choose which college to attend based on “resources and reputation.” That is, the choice is based upon his or her perception of the each school’s reputation and the resources each school offers—such as language courses, the availability of dormitories or sororities, the ratio of students to faculty, and the quality of student peers. This suggests that in addition to attributes capturing college resources, a hedonic price equation should also capture or control for college reputation. “Reputation effects” can be viewed as essentially the same as the “brand effects” utilized in the hedonic analysis of automobiles or other goods. Thus, we include time-invariant brand effects in our hedonic model.

An additional and perhaps important output of a college is the increase in the student’s future earnings or their “market value,” often referred to as the “value added” of the college. We know of no broadly available data on the salaries of recent (or other) graduates or any other direct measure of the value-added to a student’s education, for individual American colleges for the sample period of our analysis.

C. Donors

The financing of college differs from that of profit maximizing firms in myriad ways—most notably in the importance of donations, both from private and from public (governmental) sources. Subsidies can be provided directly to institutions and

11. See Rothschild and White (1993, 1996) for more on this point. For evidence of peer effects in academic outcomes of college students see Stinebrickner and Stinebrickner (2002), Sacerdote (2000), and Zimmerman, et al (1999).

directly to students (for example, scholarships, stipends). In either case, subsidies can lead to increases in expenditures by the school and/or decreases in the net cost of college. Either can lead to increases in quality—decreases in the cost to students may increase the quality of the student body by allowing better students to attend; increases in expenditures can yield smaller classes, improvements in the faculty, and so on. Importantly, private and public institutions differ in their reliance on public and private donations and so changes in any one of these are likely to have different impacts on their net prices. For a more comprehensive description of college costs, prices, subsidies, and quality see Winston (1997, 1999) and Winston, et al. (1998).

D. A Model of College Choice

Here, we model a consumer's choice of a college to make clear the role that tuition and financial aid play in college choice. The choice of whether to go to college at all or whether to attend a two-year or four-year college is viewed as predetermined and therefore outside the model.¹² For our purposes, college is a discrete commodity with several attributes that contribute directly to consumer utility. Consumers cannot buy attributes directly, nor can they observe the prices of individual attributes. Instead, consumers can only buy attributes in bundles and the price of the bundle of attributes of college, the out-of-pocket tuition price, is observed.

Assume consumers value two attributes of college, X_{1j} and X_{2j} , which are observed by each consumer. C_{ij} is consumption of all other goods if student i attends college j , Y_i is household income, T_j is the "sticker" price of tuition at college j , and A_{ij} is the aid offered to student i at college j .¹³ Thus, for student i , $(T_j - A_{ij})$ is the net price of attending college j . Let $U(X_{1j}, X_{2j}, C_{ij})$ be the utility that student i derives from attendance at college j . Conditional on obtaining acceptance to both k and j , student i chooses college j over college k if:

$$(1) \quad U(X_{1j}, X_{2j}, C_{ij}) > U(X_{1k}, X_{2k}, C_{ik}), \forall k \neq j, \text{ where}$$

$$(2) \quad C_{ij} = Y_i - (T_j - A_{ij}) \text{ and } C_{ik} = Y_i - (T_k - A_{ik}).^{14}$$

12. Whether the student or her parent is the primary decisionmaker will likely affect a household's willingness to pay for various attributes of college. Since the primary decision maker is unobserved, the empirical work assumes that the average decision making power among students and their parents is unchanged over the sample period.

13. Rothschild and White (1996) suggest two ways to think about why colleges offer financial aid. (1) Given high fixed costs and low marginal costs, colleges maximize net revenues through price discrimination, implying financial aid is correctly viewed as a price discount. (2) Students can be viewed as inputs in the production of education in which case financial aid is actually a payment to students for inputs provided. For our purposes, financial aid that is a payment for inputs provided may also be viewed as a price discount—from the consumer's point of view—if student inputs have a market value of zero outside of college. From her own point of view, a student's input is a sunk cost. At the same time, these student-provided inputs are attributes of a college that may be valued by consumers. In our hedonic models described below, we include measures of student excellence and diversity as attributes of college.

14. It is assumed, then, that the student can (or has) been admitted to both j and k . The vast majority of students are admitted to their first choice college. While selective colleges have low admissions rates, the market for nonselective colleges, which educate the vast majority of college students, is quite different. "Although most people are admitted to their first choice four year college or university, this is not to say that most people would be admitted to every school. Most *would* be admitted to a college of average or lower quality; but certainly admission to some schools—relatively few—is very selective." (Manski and Wise 1983, pages 8).

Substituting Equation 2 into Equation 1:

$$(3) \quad U(X_{1j}, X_{2j}, Y_i - (T_j - A_{ij})) > U(X_{1k}, X_{2k}, Y_i - (T_k - A_{ik})), \forall k \neq j,$$

The implication is that the consumer's choice is based upon college attributes and the net price she faces. The finding that it is the *net price* (and not the sticker or list price) that matters for decision-making is consistent with empirical work on college choice found in Manski and Wise (1983, p.19). Thus, the net price should be used in the hedonic analysis and in the formation of price indexes for the CPI.

III. Hedonic Model

The centerpiece of the empirical work is a hedonic analysis of the price of college based, conceptually, on Rosen (1974) and following, essentially, the methodology outlined in Triplett (1971, 1990), and Berndt (1991). Adopting a log-linear specification, the logarithm of the average net price of a year of school at the j th college at time t (P_{jt}) is written as a function of the characteristics of a year of college:

$$(4) \quad P_{jt} = \alpha + \beta_z Z_j + \beta_X X_{jt} + \beta_S S_{jt} + \rho_t I_t + C_j + \epsilon_{jt}; j = 1, \dots, J; t = 1, \dots, T$$

where Z_j is a vector of time invariant characteristics of college j , that is, location, etc; X_{jt} is a vector of time varying characteristics of college j at time t , that is, size of the undergraduate student body, student/faculty ratio, availability of dorms, course offerings, quality of the faculty; S_{jt} is a vector of time varying characteristics of the student body attending college j in time t , I_t is a vector of year dummies that take a value of one in year t for $t = 1, \dots, T$; and C_j is a dummy that takes on a value of one for college j (a college fixed, "brand," effect).

Following from the previous discussion, we define P_{jt} as the natural log of the net or discounted price $P_{jt} = \ln(T_{jt} - A_{jt})$, where T_{jt} is the tuition (plus fees) price for one year for one undergraduate student (full-time) at college j in time t , (the "sticker price") and A_{jt} is average financial aid for one year at college j in time t .¹⁵ Financial aid is restricted to grants only—student loans and work-study income were not included.¹⁶ All public and institutional grants to students are included in the ASC

15. While an individual level model would be ideal, student-level data on prices paid and college attended are not available on a sufficiently broad scale to allow estimation of a student-level model. Publicly available data sets, such as the National Center for Education Statistics data, include only a sample of students nationwide, typically including only a small number of students at each school surveyed. Notice that if the model were a simple linear model then the use of the college-level data would have no impact on parameter estimates, although standard errors would have to be computed using weighted least squares, as we do. Intuitively, this is because the individual level model is easily aggregated to derive the college-level model. In a log-linear specification such as we have, however, the story is more complicated, deriving from the potential heterogeneity in prices paid by students in a college. Clearly there is heterogeneity in prices paid within colleges. We investigate this by estimating linear specifications, which are not be subject to this potential bias, and find qualitatively similar answers as those reported in Section V.

16. The ASC data include average student loans and average income from work-study jobs which we did not include in the financial aid measure. Ideally, we would have measures of the value of student loan terms and work-study jobs that exceed what could be obtained in private capital or labor markets—the aid component of loans and work study income. Such measures are unavailable. Clearly, if either of these has increased (decreased) over time in scope and/or generosity, then our methodology will overstate (understate) increases in the net price of college.

data: Pell grants, other federal grants such as grants from the G. I. Bill, state merit and need-based grants, grants to students from institutions themselves, etc. Any private grants to students not reported to a university, such as an employer provided subsidies given directly to the employee, would not be included in the ASC grants data.

Here, the estimates of the ρ coefficients can be used to form a price index. Normalizing the level of the quality adjusted college price index to 100 in t , estimates of the price index for the following years can be created by exponentiating the ρ 's. For example, the quality adjusted price index for $t + 1$ can be found as $100 \cdot \exp(\rho_{t+1})$; the quality adjusted price index for $t + 2$ can be found as $100 \cdot \exp(\rho_{t+2})$.

We estimate Equation 4 with a fixed effects estimator to purge the equation of the college brand (fixed) effects. This eliminates the time-invariant variables Z_j from the equation and has the added advantage of reducing any bias due to the omission of unobserved time-invariant characteristics. The disadvantage is that coefficients are identified only by the variation within each college across years. Each observation is weighted by full-time equivalent undergraduate enrollment in the first year of our sample (1991) to minimize the potential for substitution bias and so that the estimates better reflect the actual distribution of spending in the market. In doing so, we construct a fixed market basket of college, analogous to methods used in computing the CPI.¹⁷ We estimate Equation 4 both for the market as a whole, and separately for public and private colleges, and for several market segments, defined by Carnegie classification.

Note four important caveats. First, if college was a "typical" good, such as a car or VCR, each β could be interpreted as an estimate of the shadow price to consumers of a particular attribute of college. In this case, however, the β s cannot necessarily be interpreted in this way. Many colleges, especially selective colleges, charge net, and perhaps even sticker, prices below market clearing prices. Thus, the estimates of the shadow prices may lie below the willingness to pay of the marginal consumer at the market clearing net price. As explained in Pakes (2001), although hedonic coefficients cannot be interpreted in the standard way in markets (such as the college market) in which equilibrium may not be characterized by marginal cost pricing, hedonic models can still be used to construct accurate price indexes.¹⁸

Second, the indexes that we estimate reflect only the change in net price of college services to students/consumers—and *not* the full set of services and outputs produced

17. In contrast, unweighted results would capture the prices of the average college, giving equal weight to small colleges and large universities, despite potentially wide differences in enrollment. Failure to use a fixed weight would confound changes in prices and changes in the college choices of students.

18. Pakes (2001) discusses the estimation of hedonic price indexes and the interpretation of the coefficients under alternative assumptions about equilibrium conditions and, particularly, the implications of the failure of the marginal cost pricing assumption. Regarding markets that tend to have departures from marginal cost pricing, Pakes (2001) writes, "Hedonic regressions have been used in research for some time and they are often found to have coefficients which are 'unstable' either over time or across markets, and which clash with the naive intuition that characteristics which are generally thought to be desirable should have positive coefficients. This intuition was formalized in a series of early models whose equilibrium implied that the 'marginal willingness to pay for a characteristic equaled its marginal cost of production'. . . . The derivatives of a hedonic price function should not be interpreted as either willingness to pay derivatives or cost derivatives; rather they are formed from a complex equilibrium process. . . . Of course just because we can not interpret the coefficients from hedonic regressions does not mean that these regressions cannot provide information on how to construct an appropriate price index."

by colleges. Thus, since colleges are multiproduct firms, we cannot use the price indexes estimated in this paper to deflate total university expenditures to get a measure of university “output.” For example, the benefits of research—an important university output valued by nonstudents—may be only partially capitalized in the net price of an undergraduate education. As described above, obtaining measures of the value of all the outputs of a university and the full cost of providing those outputs is outside the scope of this paper. And third, as is always true in a hedonic analysis, price may determine the attributes, implying reverse causality. Since students may be viewed as inputs to the production of some of the outputs produced by colleges, this may be especially problematic here. Fourth, hedonic methods are best suited to products in which the product space is rich enough such that all combinations of attributes correspond to a bundle available in the marketplace. Hedonic methods are less well suited for products such as housing and college, where some attributes are inexorably linked. For example, colleges with high average SAT scores tend to have large percentages of faculty members with a Ph.D. Thus, the β 's may well not represent good estimates of the shadow prices of attributes.

IV. Data

We use five years of data from the College Board's Annual Survey of Colleges (ASC) for academic years 1990–91 to 1994–95 and the National Center for Education Statistics' Integrated Postsecondary Education Data System (IPEDS) to estimate hedonic models following Equation 4. Given the high rate of missing data on tuition and fees in the ASC, we use information on tuition and fees from IPEDS, which increases our sample by approximately 100 colleges per year. Explanatory variables in the hedonic model come from the ASC and should include only and fully the information that purchasers use when making their decisions. Thus, we attempt to capture the information available to consumers about the characteristics of colleges, relying on data that is publicly available and widely used by college bound students.

As described above, a long list of characteristics would be required to fully capture the services provided by a college to a tuition-paying student. We use a relatively parsimonious specification because the fixed effects specification excludes all variables that are time-invariant either in principle or in practice (that is, variables that might vary over time but are unchanging or essentially unchanging in our sample and study period) and constrained by the availability of comparable data across institutions.¹⁹

A. The Sample

Following Winston (1999), our sample includes only four-year colleges that reported nonzero enrollment and expenditures, with at least 20 percent of the student body

19. We have included all attributes of college that are appropriate and available to us—which includes much of the information publicly available to college customers on a large group of colleges. Of course, there are many more attributes of college that are valued by undergraduates and their families, even though they are not broadly available; many of these will be time-invariant and captured by the college fixed effects. The omission of time-varying attributes known to consumers choosing among colleges may lead to biased estimates.

composed of undergraduates, excluding both “Specialized Schools” and “Associate of Arts Colleges.”²⁰ We include only schools with Carnegie classification located in the 50 U.S. states or Washington DC.²¹ Schools may be excluded because they are missing values for critical data elements, or missing an entire year of data, or because it failed to meet the criteria for inclusion in the sample for the full study period 1990–91 to 1994–95—schools offering only a two-year degree in the early part of the study period may have offered a four-year degree at the end, for example.²² The result is a balanced panel of 534 colleges, which we use to estimate the hedonic model.

Alternatives would have been to interpolate missing explanatory variables, which would have increased the size of our balanced panel or estimated the hedonic models with an unbalanced panel. Results from our estimates based upon an unbalanced panel were, on the whole, qualitatively similar to the results from the balanced panel.²³

Tables 1 and 2 provide definitions and descriptive statistics for model variables for the whole sample, and for public and private colleges separately for 1990–91 only, revealing significant differences between public and private colleges. Unsurprisingly, public colleges have much lower mean sticker prices, aid per student, and net prices than private colleges.²⁴ On average, public colleges are larger (with more full and more part-time students), have a greater share of faculty with Ph.D. degrees and a smaller share of part-time faculty, and are more likely to have NCAA membership and

20. The Associates of Arts (two-year) colleges typically graduate few (if any) students with bachelor's degrees, and “Specialized Schools” are very small and different in focus than the institutions included in our analysis. Two-year colleges have unique features that suggest that separate consideration is appropriate. For our purposes, the most important unique feature is that many two-year colleges have students who pay average net prices that are negative due to low sticker prices and relatively generous financial aid. Thus, this paper considers only four-year colleges.

21. The 1994 Carnegie Foundation Report, “the Carnegie Classification of Higher Education groups American colleges and universities according to their missions” (foreword). All degree-granting colleges and universities in the United States that are accredited by an agency recognized by the U.S. Secretary of Education are classified in the following groups: Research Universities I, Research Universities II, Doctoral Universities I, Doctoral Universities II, Master's (Comprehensive) Universities and Colleges I, Master's (Comprehensive) Universities and Colleges II, Baccalaureate (Liberal Arts) Colleges I, Baccalaureate (Liberal Arts) Colleges II, Associate of Arts Colleges, Specialized Institutions. The groups are distinguished by the emphasis placed upon research, the degrees and courses of study offered and their admissions criteria, among others.

22. The schools excluded because of this criteria served relatively few students. In 1990–91, 1,361 institutions fit the inclusion criteria. Of these, 534 had complete data for each of the five years. While colleges have an incentive to provide data, since the ASC provides that data to high school seniors shopping for schools, that incentive may be stronger for some schools than others. Thus, it is possible that the schools in the balanced panel differ from the excluded schools. We discuss this below.

23. The changes in the price index for college tuition and fees estimated from our sample of 534 colleges closely matches the changes in the CPI for “College Tuition and Fees,” which suggests our sample is generally representative of U.S. colleges in an important respect (Table 4, Columns 2 and 3). Further, our sample generally matches the population well, although our sample has an over representation of students in Liberal Arts I schools (3 percent) and an under representation of students in Research I institutions. (6 percent). The sample contains about 5 percent more institutions and students in the Midwest, and 5 percent fewer institutions in the West. Other regions differ by less than 3 percent. Private institutions are underrepresented in the sample by almost 4 percent.

24. Although each attribute could be measuring aspects of more than one category, we can use the Verry and Davies (1976) categories to classify the attributes of college used to estimate the hedonic models. Variables

Table 1
Variable Definitions

Variable*	Definition
Tuition + fees	Undergraduate tuition plus fees
Aid per student	Average grants per student
Tuition + fees—aid per student	Undergraduate tuition plus fees minus average grants per student
Pupil-teacher ratio	(# FTE undergrads + grads) / (# FTE Faculty)
Faculty with Ph.D.	fraction of faculty with PhD degree
Part-time faculty	fraction of faculty who are part-time
LN full-time students	Natural log of the number of full-time undergraduates
LN part-time students	Natural log of the number of part-time undergraduates
PhD granting institution	=1, if institutions grants PhDs; 0 otherwise
NCAA member	=1, if institution is a member of the National Collegiate Athletic Association
Fraternities and/or sororities	=1, if institution has fraternity and/or sororities; 0 otherwise
Verbal SAT score 75th percentile*	Verbal SAT score of the 75th percentile of entering freshman
Reports SAT score	=1, if institution reports SAT scores
Requires SATs for admission	=1, if institution requires SATs for entering freshman
Average age of entering freshman	average age of entering freshman
Minority students	fraction of undergraduates who are racial or ethnic minorities
Living in dorms	fraction of undergraduates who live in campus housing
Weight	Number of FTE undergraduates in 1990–91

* All variables except tuition plus fees comes from the College Board. Tuition and Fees comes from the U.S. Department of Education's Integrated Postsecondary Education Database System (IPEDS)

such as pupil-teacher ratio, characteristics of faculty, and information on SAT scores of entering students can be thought of as measuring teaching or educational aspects of college that are valued by undergraduates. The size and composition of the student body, dorm availability, and the presence of social clubs can be thought of as measuring "general social services" that may be valued by undergraduates. Finally, the indicator for Ph.D. granting institution and characteristics of teachers are measures of research outputs that may (or may not) be valued by undergraduates. Of course, any time-invariant aspects of the teaching, research, and general social service outputs of college are captured by the college fixed effects. As discussed later, these fixed effects are empirically important, which indicates a substantial presence of time-invariant attributes of college.

Table 2
Summary Statistics for 1990–91

	Whole Sample		Public Colleges		Private Colleges	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Tuition + fees	5,480	4,301	2,661	1,106	10,409	3,237
Aid per student	1,600	1,278	848	312	2,914	1,265
Tuition+fees-aid per student	3,880	3,315	1,813	1,107	7,495	2,740
Pupil-teacher ratio	20.643	5.014	22.015	3.823	18.243	5.885
Faculty with Ph.D.	0.806	0.917	0.840	1.143	0.746	0.177
Part-time faculty	0.272	0.165	0.236	0.156	0.335	0.163
LN Full-time students	8.617	1.026	9.152	0.696	7.680	0.817
LN Part-time students	6.592	1.874	7.431	1.232	5.124	1.902
PhD granting institution	0.470	0.500	0.567	0.497	0.302	0.460
NCAA member	0.870	0.337	0.931	0.254	0.762	0.427
Fraternities and/or sororities	0.838	0.369	0.964	0.187	0.617	0.487
Verbal SAT score 75th percentile*	611	51	592	39	616	53
Reports SAT score	0.667	0.472	0.601	0.491	0.783	0.413
Requires SATs for admission	0.942	0.235	0.926	0.263	0.969	0.173
Average age of entering freshman	18.628	1.186	18.830	1.178	18.275	1.122
Minority students	0.145	0.148	0.149	0.136	0.139	0.167
Living in dorms	0.424	0.254	0.306	0.178	0.631	0.234
N	534		148		386	
Total number of students	1,924,330		1,224,315		700,015	

Source: 1990–95 College Board Data; 1990–95 IPEDS data. All variables weighted by FTE in 1990–91. *Colleges that did not report an SAT score received a value of 0, and are not included in the mean and standard deviation reported.

fraternities or sororities than private colleges. Public colleges have students with lower average SAT scores, higher average age in their freshman year; and a greater share of their students are minorities.

Table 3 provides a time series of means for the model variables. Although the sticker price of college, tuition plus fees, increased by 31.6 percent over the five-year period, the net price of college (again, tuition plus fees less aid) increased by only 19 percent over those five years. NCAA membership, and minority enrollments increased monotonically over the sample period, while the percent of faculty members holding Ph.D. degrees and the number of students tended to decrease. The means of other variables were relatively constant over the sample period.

In the hedonic analysis, colleges are separated into three market segments, as follows: “PHD” which includes Carnegie classifications Research I and II and Doctoral I and II; “Comprehensive” which includes Carnegie classifications Comprehensive I and II; and “Liberal Arts” which includes Carnegie classifications Liberal Arts I and II. The balanced panel includes 40 public and 22 private PHD institutions, 101 public and 134 private Comprehensive colleges, and 7 public and 230 private Liberal Arts institutions.

Table 3
Means by Year

Variable	1991	1992	1993	1994	1995
Tuition + fees	5,480	5,971	6,406	6,810	7,220
Aid per student	1,600	1,791	1,998	2,399	2,619
Tuition + fees—aid per student	3,880	4,179	4,407	4,412	4,601
Pupil-teacher ratio	20.64	20.71	20.57	20.27	20.37
Faculty with Ph.D.	0.81	0.75	0.76	0.77	0.79
Part-time faculty	0.27	0.26	0.26	0.27	0.27
Full-time students	8,507	8,498	8,311	8,147	8,154
Part-time students	1,828	1,834	1,805	1,827	1,743
PhD granting institution	0.47	0.46	0.48	0.48	0.48
NCAA member	0.87	0.88	0.90	0.90	0.91
Fraternities and/or sororities	0.84	0.84	0.84	0.84	0.85
Verbal SAT score 75th percentile*	611	609	609	612	611
Reports SAT score	0.67	0.69	0.70	0.70	0.74
Requires SATs for admission	0.94	0.95	0.94	0.95	0.94
Average age of entering freshman	18.63	18.58	18.59	18.53	18.58
Minority students	0.15	0.15	0.16	0.17	0.18
Living in dorms	0.42	0.42	0.42	0.42	0.42
N	534	534	534	534	534

Source: 1990–95 College Board Data; 1990-95 IPEDS data. All variables weighted by FTE in 1990–91.

*Colleges who did not report an SAT score received a value of 0, and are not included in the mean and standard deviation reported.

V. Results

A. Baseline (Sticker) Price Indexes

We begin by estimating baseline price indexes for the sticker price of college for comparison with the CPI-U (the overall consumer price index for urban consumers) and the CPI for “college tuition and fees.” These are weighted by first period enrollments and include only college fixed effects in addition to the year dummies—but no college characteristics. We estimate analogous regressions for the net prices for all schools and net price regressions for public and private colleges separately. All estimated coefficients on the year dummy variables are significant at the one percent level.

The resulting price indexes, the CPI-U, and the CPI for college tuition and fees are shown in Table 4. These indicate the commonly cited “explosion” in college prices implied by the CPI—the CPI-U rose 11.9 percent between 1991 and 1995, *while the CPI for tuition and fees rose 37.3 percent*. Our regression-based estimates, shown in Column 3, indicate that tuition and fees (the sticker price) rose 36.8 percent over the sample period—quite close to the CPI estimate.

B. Baseline (Net Price) Indexes with College Fixed Effects

Notice, however, that the “net price” indexes (based upon prices adjusted for average financial aid), shown in Column 4 of Table 4, indicate increases of a considerably lower 28.6 percent over the sample period for the whole sample. Thus, although the sticker price of college was rising rapidly in the early 1990s, financial aid was rising at a somewhat faster rate.

The separate analyses of private and public institutions, shown in Columns 5 and 6, reveal significant differences across sectors. As the net price of public institutions increased by 37.2 percent, the net price of private institutions increased by only 14.9 percent.

Looking beyond sector, price indexes differ significantly across college “types.” Table 5 reveals the highest net price increases were in public “Comprehensive”

Table 4
Comparison of CPI and Baseline Price Indices

Year	CPI: College		All Colleges		Public Net Price*	Private Net Price*
	CPI-U (1)	Tuition and Fees (2)	Tuition + Fees* (3)	All Colleges Net Price* (4)		
1991	100.0	100.0	100.0	100.0	100.0	100.0
1992	103.0	110.7	110.9	112.3	116.2	105.8
1993	106.1	121.1	119.8	120.4	126.4	110.6
1994	108.8	129.6	127.9	122.2	129.2	110.9
1995	111.9	137.3	136.8	128.6	137.2	114.9

* These price indices were created using estimates from weighted fixed effects regressions of the natural log of the sticker or net price of college on year dummy variables. All regression coefficients are significant at the 1 percent level.

Table 5
*Comparison of CPI and Aid-adjusted Price Indices by College Type**

Year	CPI (1)	CPI: College Tuition and Fees (2)	Public PHD (3)	Private PHD (4)	Public Comprehensive (5)	Private Comprehensive (6)	Public Liberal Arts (7)	Private Liberal Arts (8)
1991	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1992	103.0	110.7	108.8	112.2	123.5	103.9	112.3	104.9
1993	106.1	121.1	118.2	111.9	134.5	110.0	119.5	110.7
1994	108.8	129.6	120.7	109.7	137.7	111.2	117.1	111.2
1995	111.9	137.3	131.1	116.7	143.1	114.9	135.0	114.0

* "Ph.D." colleges include Research and Doctoral I and II institutions. "Comprehensive" colleges include Comprehensive I and II institutions. "Liberal Arts" colleges include Liberal Arts I and II institutions. These price indices were created using estimates from weighted fixed effects regressions of the natural log of the net price of college on year dummy variables. Excluding the "public liberal arts" and "private PHD" regressions, all regression coefficients are significant at the 1 percent level.

colleges, public “Liberal Arts” colleges, and public “Ph.D.” colleges. Private Comprehensive colleges, and private Liberal Arts colleges had the lowest rates of net price increases.

Turning to the price indexes for the full sample again (Column 4 of Table 4), we find monotonically increasing net prices over the sample period, but the estimated increase between 1992–93 and 1993–94 is small—rises in the sticker price were mostly offset by increases in financial aid during this period. We cannot point to one sweeping policy change regarding financial aid that caused the substantial increase, but as noted by McPherson and Shapiro (1998) two small changes were contributors:

- A 12 percent rise in federal tuition aid to veterans
- The beginning of the state of Georgia’s HOPE scholarship program, which offered free tuition and books at any Georgia public college to any Georgia high school graduate with a “B” average or better, and a substantial grant to eligible students attending a private college in the state

Based on the financial aid information reported in McPherson and Shapiro, the balance of the rise in grants between 1992–93 and 1993–94 is likely due to state merit aid and grants from institutions themselves.²⁵ Note, however, that both public and private institutions show the small increase in net prices between 1992–93 and 1993–94.

C. Quality-Adjusted Net Price Indexes with College Fixed Effects

Table 6 contains the results of the hedonic regressions of the log of the net price of college on year dummies and several attributes of college, first for the full sample, and then separately for public and private institutions.²⁶ Again, each regression includes college-specific fixed effects in order to purge the regression of time-invariant “brand” effects and eliminate any omitted variable bias from unobserved time-invariant attributes.²⁷

Although the hedonic coefficients need to be interpreted with caution, due to the idiosyncratic nature of the college market, many of the estimated coefficients have signs that are consistent with intuition and are suggestive of interesting patterns.²⁸

25. Based on tables in McPherson and Shapiro (1998), we are able to rule out several programs as causes of the rise in aid between 92–93 and 93–94, including Pell grants and state need-based aid.

26. The model considers fraction of students from racial and ethnic minorities, the average age of entering freshman, and standardized test scores of freshman as attributes of college valued by consumers of college. In the regressions in Table 6, these three attributes are lagged. For example, the log of the net price charged for the 1993–94 academic year is a function of the percent of minority students enrolled in the 1992–93 academic year. Contemporaneous attributes of the student body (peers) may be correlated with the error term, and by using the lagged measures of these attributes we ameliorate this problem. This is consistent with consumers choosing colleges based on information available at the time of their decision: only prior year measures are known at decision-making.

27. Random effects models were also estimated. The Hausman specification test rejected the random effects model in favor of a fixed effects model. We also estimated models with additional variables from the U.S. News and World Reports Rankings of colleges, which were only available for 42 percent of our sample. Results were virtually unchanged.

28. Note that while the coefficients on attributes in hedonic equations are often interpreted as shadow prices, such an interpretation may not be appropriate here, since some colleges charge net prices below the market clearing price. Thus, estimated coefficients may fall below the marginal consumer’s willingness to pay for each attribute of college.

Table 6
*Hedonic Equations**

	Full Sample		Public		Private	
	Estimate	Std. Error	Estimate	Std. Error	Estimate	Std. Error
p92	0.106	0.014	0.134	0.021	0.062	0.013
p93	0.168	0.013	0.200	0.020	0.112	0.014
p94	0.177	0.014	0.209	0.024	0.116	0.013
p95	0.226	0.018	0.258	0.032	0.155	0.014
Pupil-teacher ratio	0.0002	0.003	0.002	0.007	-0.002	0.001
Faculty with Ph.D.	0.007	0.011	0.012	0.013	-0.045	0.045
Part-time faculty	-0.080	0.092	-0.087	0.141	0.005	0.095
LN Full-time students	0.236	0.075	0.134	0.122	0.373	0.060
LN Part-time students	0.012	0.007	0.015	0.009	0.010	0.005
PhD granting institution	0.017	0.033	-0.001	0.049	0.039	0.027
NCAA member	-0.001	0.052	0.011	0.083	-0.017	0.021
Fraternities and/or sororities	-0.016	0.046	0.139	0.215	-0.048	0.020
Verbal SAT score 75th percentile	0.0004	0.000	0.0019	0.0010	-0.00014	0.0002
Reports SAT score	-0.235	0.227	-1.104	0.580	0.088	0.101
Requires SATs for admission	-0.074	0.027	-0.104	0.037	-0.024	0.037
Average age of entering freshman	-0.026	0.012	-0.033	0.018	0.0000	0.004
Minority students	1.027	0.526	1.731	0.833	-0.382	0.222
Live in dorms	0.105	0.049	0.054	0.066	0.110	0.053
Constant	6.210	0.688	6.312	1.176	6.065	0.455
N	2,670		740		1,930	
R**2	0.976		0.931		0.958	

* Dependent variable equals LN(Net_price). Weighted by the number of FTE undergraduates in 1990-91. Each regression is estimated via fixed effects.

Beginning with the full sample analysis in Table 6, colleges with more part-time faculty and older entering freshman have lower net prices. Colleges that offer Ph.D. degrees, higher SAT scores of entering freshman, a higher percentage of faculty with Ph.D. degrees, and have larger proportions of undergraduates living in campus housing have higher net prices.²⁹ Although many of the time-varying attributes are not individually significant in each of the hedonic regressions, they are jointly significant.

29. Some colleges reported SAT scores only, some reported ACT scores only, and some reported neither. To adjust for missing information on standardized test scores and the high correlation between SAT and ACT

The full sample analysis masks considerable differences between the public and private institutions. As shown in Table 6, public colleges with higher verbal SAT scores and a greater representation of minority students have higher net prices but no such differential is found for private institutions. Both public and private colleges with larger fractions of undergraduate students living in campus housing have higher prices—the coefficient is twice as large for private institutions. Further, while the presence of fraternities and sororities seems to be irrelevant to the net price of a public institution, private colleges with fraternities and sororities have lower prices than those without. Finally, private institutions with larger student bodies have higher prices, but the price of public institutions does not seem to vary with size.

We ran a set of separate regressions for public and private institutions each of which includes additional sets of year dummies, one for each college “type” described above—Ph.D. colleges, Comprehensive colleges, and Liberal Arts institutions. Put differently, these regressions include different year effects for each of the three different types of colleges within the public and private sectors, allowing the estimation of different price indexes for each college type.³⁰ We do not report the result of these hedonic regressions, but Table 7, described below, contains the price indexes derived from these regressions. Interestingly, the introduction of the additional price coefficients had little impact on the estimated coefficients on the college characteristics. In all specifications, the college brand effects were found to be jointly statistically significant at the one percent level.

D. Estimated Price Indexes

Table 7 presents the resulting quality adjusted net price indexes from all of the hedonic regressions.³¹ As discussed previously, the price indexes are constructed by exponentiating the estimates of the year dummy variables from the hedonic results and multiplying by 100. Introducing quality-adjustments yields significant changes in the estimated price indexes. The quality adjusted index for “all colleges” indicates a price increase of 25.4 percent (Column 3) between 1991 and 1995, compared with the 28.6 percent increase in the unadjusted net price index, noted above in Table 4—suggesting increases in the quality of college services provided. This change in the price index, although small, is statistically significant ($p < .05$). We note that the difference between these two price indexes is not driven by the change in any one of the

scores, we included an SAT score variable, a dummy indicating the school reports an SAT score, and a dummy indicating the school requires the SAT or ACT scores for admission.

30. Although it would be better to derive price indexes from separate hedonic regressions for each type of college, there are too few public liberal arts and private PHD institutions to do so.

31. The basic pattern of the estimated price indexes in Table 7 is robust to many alternative specifications. Models estimated using a linear specification, without weighting or excluding selective colleges (defined as Research I and Liberal Arts I institutions) yield results qualitatively very similar to those reported in Table 7. Our results are also robust to another specification change as well. An anonymous referee suggested interacting all attributes with the time dummy variables to allow changes in the impact of attributes over time. In none of the hedonic regressions did this specification change the qualitative results reported in this paper. Further, the impacts on the estimated price indexes for a given year were generally less than 1 percentage point different from the results reported in Table 7, and all were less than 1.7 percentage points.

Table 7
*Quality-Adjusted Net Price Indices**

Year	CPI-U (1)	CPI: College Tuition and Fees			All		All		Public		Private		Comprehensive		Public		Private	
		All Colleges (3)	All Public Colleges (4)	All Private Colleges (5)	Ph.D. (6)	Ph.D. (7)	Comprehensive (8)	Comprehensive (9)	Liberal Arts (10)	Liberal Arts (11)								
1991	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1992	103.0	110.7	111.2	114.3	106.4	107.3	113.3	121.8	104.4	112.8	105.4	104.4	112.8	105.4	104.4	112.8	105.4	105.4
1993	106.1	121.1	118.3	122.2	111.8	114.9	114.3	130.7	111.0	116.1	111.4	111.0	116.1	111.4	111.0	116.1	111.4	111.4
1994	108.8	129.6	119.3	123.3	112.3	116.5	113.3	131.7	112.3	112.8	111.6	112.3	112.8	111.6	112.3	112.8	111.6	111.6
1995	111.9	137.3	125.4	129.5	116.8	125.0	121.1	135.8	116.6	130.9	114.6	116.6	130.9	114.6	116.6	130.9	114.6	114.6

* Price indices in Columns 3–5 are created using regression coefficients reported in table 6. Analogous hedonic regressions, not reported in this paper, were used to create columns 6–11.

attributes included in the hedonic analysis. Rather it is explained by small changes in a number of the attributes.³²

As comparisons between Tables 4 and 7 show, quality adjustment leads to substantial decreases in the estimated net price increase for public colleges over the study period (29.5 percent compared with the 37.2 percent unadjusted net price index) but slight increases for private colleges (16.8 percent compared with 14.9 percent). The implication is that quality seems to have increased in public institutions, but decreased (slightly) in private institutions. Even with the quality adjustments, however, net prices rose far more rapidly in public institutions than private institutions due, perhaps, to declining taxpayer subsidies given directly to public institutions.³³

The college type-specific price indexes shown in Table 7 reveal significant differences in net price increases between Ph.D., comprehensive, and liberal arts institutions, even within the public or private sector. At the high end are public comprehensive colleges that saw quality adjusted price increases of 36 percent between 1991 and 1995 and public liberal arts colleges that saw increases of 31 percent. At the low end are private comprehensive and liberal arts colleges that saw increases of only 16.6 and 14.6 percent, respectively. Again, these differences may be due to differential changes across segments in donor subsidies (Winston 1997, 1999), competition, or other factors over the time period of analysis. As before, quality adjustment generally leads to decreases in the estimated price indexes for public colleges, suggesting quality improvement, and increases in indexes for private colleges (albeit slight), suggesting quality declines.

Finally, note that the larger increases in price indexes for public colleges translate into smaller increases in net price, measured in dollar terms, since public colleges have far lower average net prices. Nevertheless, the larger price increases in the public sector may cause a decrease in access to higher education for disadvantaged students if these trends persist. Access to college for students from disadvantaged backgrounds may be most affected by price increases in public comprehensive institutions. These schools tend to have lower admissions standards and the lowest tuition levels.³⁴

In summary, adjusting the price of college for financial aid leads to a 22 percent decline in the estimated price index for all four-year colleges, while quality adjusting the results leads to a further decline. Given both adjustments, our estimate of the quality-adjusted net consumer price increase of college over this time period is 31 percent below the price increase in the current "college tuition and fees" price index in the CPI. Nevertheless, public comprehensive colleges, perhaps an important gateway to college for students from low-income backgrounds, experienced larger net price increases than colleges overall.

32. We investigated this question by estimating the hedonic models iteratively, removing a different single attribute while retaining the other explanatory variable and examined whether removing any one attribute led to a substantial change in the estimated price indexes. We found that the removal of no single attribute resulted in large changes. Given the relatively small change in the year coefficients as a result of including *all* the attributes, this result was not unexpected. We thank Shane Greenstein for suggesting this procedure.

33. As shown in Table 1 of Winston (1997), public colleges experienced a small real decline in donor subsidies (of which taxpayer subsidies comprise a large majority) between 1987 and 1995.

34. The mean of the verbal SAT scores as defined in Table 1 (seventy-fifth percentile) are 577 for public comprehensive colleges, and the means for other public colleges is 612. Net prices are lower in public comprehensive colleges than in other public colleges as well, \$1,623 versus \$2,708 over the sample period.

VI. Concluding Remarks

While there are important caveats to the use of hedonic analysis in the college market (in Section III), our analyses indicate that estimating price indexes using hedonic methods is both feasible and useful. Four particular conclusions emerge from this research. First, the price of college should be measured as the “net” (tuition plus fees minus aid) rather than the “sticker” price for computing a consumer price index. Price indexes computed based upon tuition plus fees net of financial aid indicate significantly lower price rises than the price indexes computed based only upon tuition plus fees—adjusting for financial aid leads to a 22 percent decline in the estimated price index for all four-year colleges over the 1990–95 time period. Second, the “brand” effect of individual colleges is important, so that price indexes should be computed controlling for the college-fixed effect. Third, it is important to include the attributes of colleges in constructing the price index in order to control for changes in the quality of college. Given both adjustments (financial aid and quality), our estimate of the aid- and quality-adjusted consumer price increase of college over this time period is 31 percent below the price increase in the current “college tuition and fees” price index in the CPI. And fourth, colleges of different types (public versus private; various groups of Carnegie classifications) demonstrate different pricing patterns. Most importantly, public colleges, which offer lower net prices than private colleges, have experienced the largest percentage increases in price. If this trend continues, it may have an adverse effect on access to higher education for disadvantaged groups.

While the conceptual framework for implementing a quality-adjusted price index for higher education is straightforward, practical implementation presents empirical challenges—identifying data sources for characteristic variables with consistent definitions, and with consistently available data. An important concern is to construct a representative sample for which data is consistently available over time. Our analysis is based on secondary data provided by the College Board and the Department of Education and contains a significant number of missing values, which introduces the possibility of sample selection bias. In addition, the data on college attributes and characteristics we have used, while appealing because of their use by college bound high school students, falls short of the ideal in a variety of ways. As an example, although the use of computers and information technology is clearly changing in universities—and changing the services delivered by universities—we were unable to find variables that could be used to capture and control for these changes. The implication is that our quality adjusted price indexes may be biased upward as an improvement in services provided is ignored. Given the growing importance of information technology in university budgets and academic life, this is a data gap that is important to fill.³⁵ Undoubtedly the Bureau of Labor Statistics (with the help of the U.S. Department of Education) could assemble a more complete data set for computing price indexes in the future, which would allow for more precise and useful estimates.

35. See Ehrenberg (2000) Chapter 14 for a fuller discussion of the need to adjust the price of college for changes in quality, in general, and for changes associated with information technology, specifically. The case for quality adjusted price indexes for college made there closely mirrors the argument we have made in this paper.

The large and increasing labor market returns of a college education make it important to design and implement public policies that promote access to higher education. A crucial first step, taken in this paper, is the measurement and investigation of the cost of attendance for college students. While this paper considers average net (consumer) prices of college, access may be better understood by investigating the price of college paid by low income students. Although such data is unavailable for the large sample of colleges we analyze, Hill, Winston, and Boyd (2003) use data on net prices paid by individual students at 28 highly selective private colleges for academic year 2001–2002. They find that, on average, the consumer price is just under half of the mean sticker price of over \$33,000. Importantly, students in the lowest income quintile pay only 22 percent of the sticker price, while students in the highest income quintile pay 70 percent of the sticker price. Persistent overstatements of the average consumer price of college and the price paid by low income students are occurring at the same time as parents and high school students dramatically overestimate the true cost of attending college. Thus, some students may be dissuaded from adequately preparing for (and/or ultimately attending) college by mistaken beliefs that the consumer price of college is beyond their means. Good information about the *consumer* cost of college is, then, critical. This paper takes a step toward providing it.

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