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Cost spreading in college athletic spending in the United States: estimates and implications

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ABSTRACT

With rising costs, mounting student debt, and many schools experiencing financial hardship, the higher education industry faces unwanted scrutiny from the popular media and political sector. College athletics too have come under close examination because of rising costs and internal subsidies. In this paper, we provide estimates of the per-student costs of college athletic programs for US colleges and universities by the number of undergraduate students enrolled, National Collegiate Athletic Association division, and whether the institution is public or private. These estimates find significant potential for cost spreading, so that costs per-student fall as the number of students rises.

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Introduction

A barrage of articles in the popular press has pointed out the escalating cost of higher education (Jamrisko and Kolet 2012; Slaper and Foston 2013), and industry analysts blame a host of contributory factors, ranging from a facilities arms race to federal subsidies that reduce sensitivity to price (Ehrenberg 2001; Finley 2013). Not surprisingly, student debt levels have risen accordingly (FRB of NY 2015), with the *Wall Street Journal* reporting that the class of 2015 was the 'most indebted class ever' (Sparshott 2015).

Despite higher charges to students who are taking on ever more debt, many colleges are struggling financially. According to the *New York Times*, Moody's has 'put a negative outlook on the entire higher education sector,' and they, along with Standard & Poor's, have downgraded the bond offerings of numerous institutions. Excess capacity, surging costs, changing technology, and tuition discounts have put many colleges in a state of financial hardship (Selingo 2013).

The escalating cost of higher education has led many critics to question the role of athletic spending. According to the Knight Commission on Intercollegiate Athletics, '(t)he greatest challenge facing universities and their athletic departments today is dealing with the rapid rise of expenses' (Knight Commission 2009, 10). Orszag and Orszag (2005a) report spending on athletics has grown at a faster rate than overall institutional spending, and Desrochers (2013) reports that the cost to educate an athlete exceeds that of educating an average student by three to six times. In addition, spending on athletics is growing at approximately twice the rate of spending on the academic program. Competitive forces reinforce these trends, as schools tend to increase athletic expenditures when a rival does the same (Orszag and Israel 2009).

Supporters counter that college athletic programs generate millions in revenues. Although revenues can be significant, The Center for College Affordability and Productivity (2010) reports that only 19 of 119 Division 1 programs generated revenues in excess of costs. The *USA Today* (Brady, Berkowitz, and Schnaars 2015), in a more recent analysis, points out that only 24 of 230 Division 1 public

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schools generated sufficient revenues to cover the costs of their athletic programs, and that each of these schools was a member of one of the 'Power Five' conferences.[1] Similarly, the *Chronicle of Higher Education* reports that only six of 201 Division 1 schools cover athletic costs (Wolverton, Hallman, Shifflett, and Kambhampati 2015).

This controversy is unique to US colleges and universities[2] that, unlike their counterparts in other countries, provide large-scale spectator sports of a near professional caliber. Dating to the mid-1850s, intercollegiate athletic contests began among the nation's most prestigious schools, primarily in the sports of rowing, baseball, (American) football, and track. These contests enhanced institutional reputation, became a rallying point for comradery, and helped to fulfill the institutional ideal to develop the mind and body.

College athletics in the United States have grown into enterprises that may be quite surprising to visitors from other countries and that have little to do with the primary mission of tertiary education. College athletic events often attract tens of thousands of spectators and broad television coverage. Playoff and tournament games draw especially large crowds and exhaustive media attention. Top athletic department budgets can exceed $100 million, and top head coaches can earn in excess of $5 million. At the other end of the spectrum, many small athletic program budgets average less than $3 million. Sports at these smaller institutions generate little revenue and the broader budget provides most of the funding.

In this paper, we undertake a detailed study of the costs of college athletic programs. In particular, we examine how per-student costs vary with the number of students, National Collegiate Athletic Association (NCAA) division, and whether the institution is public or private. Using data collected under the Equity in Athletics Disclosure Act (EADA) for 482 institutions over the years 2003–2013, we find evidence that athletic costs per-student fall significantly as student numbers increase. Costs also rise markedly with the NCAA division (e.g. from Division 2 to Division 1AA to Division 1A),[3] for private institutions, and with the presence of a football program. Further, athletic costs have risen consistently and significantly over time. These findings hold whether financial aid costs are included or excluded from the analysis. One implication of our work that may be relevant to college and university administrators and athletic directors is that as cost pressures rise, some educational institutions may need to consider carefully the scale and division of their athletic programs.

Our paper is organized as follows. In the following section, we provide a brief discussion of pertinent issues relating to the measurement and funding of athletic costs and the benefits derived from these expenditures. We then examine athletic costs directly. We begin with a brief discussion of the literature on economies of scale in higher education. We then examine the implications of cost fixity for per-student spending on athletics. After a discussion of the data, we present empirical estimates for total and operating costs and elaborate on their significance and implications for college and university administrators and athletic directors. Finally, we offer thoughts on the future of college athletic spending in the conclusion.

Athletic expenditures: questions of measurement, funding, and benefit

Athletic costs are subject to criticisms of measurement and to controversy over the sources of funding. In addition, an examination of costs alone ignores the potential benefits of an athletic program. In this section, we briefly address these criticisms.

Questions of measurement

Critics of athletic cost data charge that the accounting data collected by the Education Department under the EADA are measured poorly and inaccurately.[4] Zimbalist (2010) argues, for example, that capital costs and debt service are often excluded. A particularly thorny issue is accounting for athletic scholarships or grants-in-aid. Given that many schools discount tuition and fees, often heavily, counting an athletic scholarship at the full, stated value is inappropriate in many cases. In addition, if a

school is not at full capacity with respect to classroom or dormitory space, the marginal cost of a student may be low.

In the end, Zimbalist (2010) reasons that in balance, 'the omitted costs appear to significantly exceed the overstated costs' (112). His rationale is that as nonprofit enterprises, athletic departments have little incentive to minimize costs. As Hansmann (1980) points out in his seminal work, nonprofits are characterized by a 'nondistribution constraint' so that earned revenues are reinvested in the enterprise and show up as higher costs. Fort and Winfree (2013) do not concern themselves with cost minimization, pointing out that athletic directors will always spend additional revenue, given the budget model they face. Yet, they argue that with cooperation coordinated through the NCAA, athletic programs keep expenditures under control.

Questions of funding

As we observe in the introduction, few athletic programs generate sufficient revenues to cover their costs. As the Center for College Affordability and Productivity points out, '(w)hen an athletic program cannot cover its expenses through generated revenue, it is forced to rely on allocated funds from the wider institutional budget' (66). The share of institutional resources used to support college athletics varies across type of institution, ranging from under 4% for the top quartile of D1 programs to over 70% for D1AA schools and in excess of 77% for D1 schools without a football program. In the *USA Today* dataset, the average subsidy is almost 54%, and the median subsidy is a still higher 66%.

Although Fort and Winfree (2013) acknowledge that few athletic programs cover costs from their own sources, they counter that university administrators provide institutional support to athletics as an investment that, in the majority of cases, yields a positive, often high, return. Of particular importance, they point out that for the vast majority of schools, spending on athletics is a small percentage of the overall institutional budget.

Questions of benefits

Considerable research addresses the non-monetary benefits of collegiate athletic programs. This research finds that athletic success and membership in a major conference increase applicants, improve student quality, and raise enrollment (Fort and Winfree 2013; McCormick and Tinsley 1987; Mixon 1995; Mixon, Trevino, and Minto 2004; Pope and Pope 2009). Taking a different approach, Stinson, Marquardt, and Chandley (2012) conclude that the return to investment in college athletics is positive with respect to core and gift revenues and is also associated with higher graduation rates. In a contrast of emphasis, Kelly and Dixon (2011) and Denhart, Villwock, and Vedder (2009) argue athletics bring community solidarity and alumni loyalty, along with development of teamwork, discipline, leadership, and character for participants.

In contrast, Litan, Orszag, and Orszag (2003) and Smith (2009) call many of these benefits into question. Even for large schools, Frank (2004) argues that the positive effects of athletic success on student quality and donations is suspect, and that because of the prevailing 'winner take all' nature of the market, few programs are likely to reap long-term financial benefits. Last, as Zimbalist (2010) points out, if athletic success brings benefits, those benefits may evaporate with poor performance.

While the indirect benefits of athletic programs may be substantial for large D1 schools, especially those in the Power Five conferences, small schools are likely to reap fewer and less certain benefits. Looking at D1AA schools, Zoda (2012) finds that spending on athletics does not significantly raise SAT scores, and Orszag and Orszag (2005b) also find no consistently statistically significant relationship between athletic spending or football winning and SAT scores, alumni contributions, or acceptance rates. In a study of reclassification from D2 or D3[5] to D1AA, Tomasini (2005) finds no gains in donations, freshman applications, attendance at home football games, or undergraduate enrollment in the three years following reclassification.

Summary thoughts on these questions

Sorting through questions of cost measurement, funding, and indirect benefits is beyond the scope of this paper. Our point is a simple one. Irrespective of whether costs are over- or under-estimated, whether institutional support is a wasteful subsidy or a beneficial investment, and whether indirect benefits are trivial or significant, understanding how athletic costs vary with the number of students, NCAA division, public or private organization, and the presence of a football program is valuable. The question on institutional support is of particular significance: whether it is regarded as a subsidy or an investment, the smaller it is on a per-student basis, the better it is for a school's finances. We now turn to the cost estimates. Afterward, we consider their implications for college and university administrators and athletic directors.

Athletic costs: review, examination, data, and estimates

To determine the effects of student enrollment, NCAA division, public-private organization, a football program, and grants-in-aid on per-student costs, we utilize regression analysis. Before we present these estimates and their implications, we review the literature on economies of scale in higher education. We then provide a simple examination of the link between average athletic costs and the number of students. After a description of the dataset and how we address the aforementioned difficulties related to athletic costs, we present the empirical results.

Economies of scale in higher education

Economists have undertaken extensive research on costs in higher education. In an early effort, Cohn, Rhine, and Santos (1989) analyze a large sample of institutions and find mixed results of economies of scale. Ray economies are substantial for private schools but only up to mean output values for public institutions. They find limited economies of scale for undergraduate education for private schools and strong evidence of economies of scale in graduate education and research for public schools. Economies of scope are more evident in private institutions.

Koshal and Koshal estimate economies of scale for doctoral-granting institutions, comprehensive institutions, and liberal arts colleges (Koshal and Koshal 1995, 1999, 2000). Their findings are generally consistent with economies of scale and scope in higher education and indicate many institutions may be operating inefficiently.

Building on the work of Cohn, Rhine, and Santos (1989), Laband and Lentz (2003) find strong evidence of economies of scale. Though large institutions may experience diseconomies of scale, economies of scope may overwhelm these higher costs.

Frazier (2012) provides a unique analysis by estimating economies of scale in college athletic departments specifically. Modeling operating costs per athlete, he finds economies of scale through 648 athletes. However, Frazier does not provide separate estimates of economies of scale for different sanctioning bodies.

An examination of the link between athletic costs and the number of students

As noted in the introduction, US colleges and universities provide entertainment in the form of large-scale spectator sports that appeal to many prospective students, current students, and alumni.

But, what is the link between the costs of providing athletic entertainment and the number of students, a link of particular significance when institutional funds support a large share of athletic costs? Our empirical findings show that as the number of students rises, per-student costs fall. This finding is consistent with a theory of a budget-maximizing bureaucrat (Niskanen 1971) and with some degree of fixity in athletic costs. In either case, there is potential for cost spreading, so that per-student costs fall with the number of students.

First, athletic directors may behave as budget-maximizing bureaucrats, striving to maximize revenues from donations, ticket sales, media, and institutional support. Given the nondistribution constraint, athletic directors channel these revenues into costs. Once maximized, the cost per student necessarily falls with additional students.

Second, some degree of fixity in athletic costs also means that costs per student necessarily fall. Colleges and universities use athletics to produce entertainment for students, alumni, and other constituents. If entertainment, E, is a function of total expenditures on athletics, A, and diminishing marginal returns apply, $E'(A) > 0$, $E''(A) < 0$, and the administration or athletic department will maximize entertainment, given the resources available to spend on athletics.

Recognizing that total athletic expenditure, A, depends in part on institutional support, and that greater student enrollment, S, provides additional funds that may be allocated to athletics, we may write expenditure on athletics as $A = a(S)S$, where a is per-student expenditures on athletics that may vary with student numbers.[6] Differentiating expenditures on athletics with respect to the number of students yields $dA/dS = a(S) + S(da/dS)$. Multiplying the second term by a/a yields $dA/dS = a(S)(\eta_{a,S} + 1)$, where $\eta_{a,S}$ is the elasticity of per-student athletic spending with respect to student enrollment. If the elasticity of per-student athletic expenditures with respect to student enrollment is negative (i.e. $\eta_{a,S} < 0$), the marginal cost of athletic spending, dA/dS, is less that the average (per-student) cost of athletic expenditure, $a(S)$, so that average (per-student) cost necessarily falls.

There are sound reasons for believing the value of the elasticity is negative. In particular, athletic expenditures exhibit some degree of fixity. For example, limits on grants-in-aid and the number of coaches do not vary with the number of students. In addition, conference schedules largely set travel expenses. Similarly, uniform, game day, and medical expenses are largely unaffected by enrollment. Additional students may lead to greater athletic expenditure on, for example, the salaries and benefits of athletic personnel, but these additional expenses are unlikely to rise in proportion to changes in student numbers.

Table 1. NCAA-mandated requirements and median spending by division.

Requirement	D2 No Football	D2 Football	D1AA	D1A
Minimum number of sports	10	10	14	16
Football scholarships		36	63	85
Minimum football scholarships				90% of 85 (2 year average)
Maximum football coaches			7 full time + 4 restricted	10 full time + 2 graduate assistants
Financial aid in football				≥ 90% of permissible grants-in-aid
Minimum athletic grants (all sports)	50% of maximum in each sport	50% of maximum in each sport	50% of maximum in each sport	≥200 grants-in-aid or ≥ $4 million, at 50% of maximum in each sport
Median expense (2013)	**D2 No Football**	**D2 Football**	**D1AA**	**D1A**
Grants-in-aid	$1,494,600	$1,699,700	$4,152,000	$8,747,000
Salaries and benefits	$1,257,500	$1,777,900	$4,620,000	$20,706,000
Team travel	$341,600	$418,000	$1,260,000	$3,973,000
Equipment, uniforms, and supplies	$154,600	$214,500	$468,000	$1,345,000
Game expenses	$84,400	$91,300	$342,000	$1,916,000
Recruiting	$32,300	$57,300	$255,000	$920,000
Medical	$52,800	$106,700	$223,000	$628,000
Fundraising	$15,700	$36,500	$189,000	$1,219,000
Total expenses	$4,171,100	$5,643,900	$14,493,000	$62,227,000

Sources: NCAA Division I Manual, 2013–2014, Indianapolis: National Collegiate Athletic Association, 1 August 2013; NCAA Division II Manual, 2013–2014, Indianapolis: National Collegiate Athletic Association, 1 August 2014; Fulks, Daniel L. 2014. *Revenues and Expenses: NCAA Division I Intercollegiate Athletics Programs Report 2004–2013*. Indianapolis: National Collegiate Athletic Association; and Fulks, Daniel L. 2014. *Revenues and Expenses: NCAA Division II Intercollegiate Athletics Programs Report 2004–2013*. Indianapolis: National Collegiate Athletic Association.

Note: Listed expenses do not sum to totals because we omit a number of minor and unallocated expenses.

A closer look at actual athletic expenditures supports this conclusion. Table 1 summarizes NCAA-mandated requirements and median levels of expenditure by division. The top half shows that as the division rises from Division 2 without football to Division 2 with football to Division 1AA to Division 1A, requirements, in terms of the minimum number of sports, grants-in-aid, and coaching staff, rise substantially. When we consider specific expense components, as shown in the bottom panel of the table, we find that these also rise markedly with division.

More students provide additional revenue that administrators may choose to spend on athletics, but some degree of fixity means that costs are unlikely to rise in the same proportion as student numbers. Large student numbers spread these fixed costs and allow schools to approach or reach minimum efficient scale. The estimates that follow measure per-student costs in college athletics and provide insightful implications for college and university administrators and athletic directors, taking into account questions of cost measurement as well as the data allow.

The data

The US Department of Education, Office of Post-Secondary Education requires all schools that receive Title IV funding to report data on the cost of athletics, under the EADA of 1994. These data are available from 2003 to 2013, and the NCAA categorizes schools into eight scholarship-offering groups: D2 Private without Football, D2 Public without Football, D2 Private with Football, D2 Public with Football, D1AA Private, D1AA Public, D1A Private, and D1A Public.

In total, we obtained 4903 observations on data from 482 schools. Of these 482 schools, 68 are D2 Private without Football, 45 are D2 Public without Football, 48 are D2 Private with Football, 93 are D2 Public with Football, 42 are D1AA Private, 70 are D1AA Public, 17 are D1A Private, and 99 are D1A Public. We employed four criteria to delete schools from the sample: ambiguity over whether data were for the main campus only or included branch campuses, a change in NCAA division during the period, obvious coding errors in the data (e.g. a school reporting hundreds of athletes every year except one in which a single or double digit number of athletes was reported), and having fewer than six years of data. The average number of years available is 10.2 per school.

We deal with the problem of athletic grants-in-aid in two ways. First, we distinguish between private schools that typically charge higher tuition and fees and public schools. Second, to avoid this problem entirely, we estimate costs exclusive of athletic grants-in-aid.

We have no illusion that athletic departments attempt to minimize costs in the way that for-profit firms are usually assumed to do. If anything, we share Zimbalist's (2010) assessment that athletic costs are higher than they would be if athletic departments were for-profit firms facing significant competitive pressures. Pressures to choose an appropriate division or to minimize costs at the division chosen are likely muted.

Nonetheless, we point out that nonprofits do face cost pressures. Further, as college and university budgets tighten and public scrutiny increases, these pressures may intensify. With the possible exception of large D1 schools in the Power Five conferences, it strikes us as naïve to think that athletic departments, especially those that generate little revenue and rely heavily on institutional support, can turn a blind eye to costs. To help deal with this problem, we distinguish between NCAA divisions in our estimates.

The total cost estimates

As shown by Shulman and Bowen (2001), the key driver in athletic costs is NCAA division. Because the time-invariant effects of NCAA division (D2 with or without football, D1AA, D1A,) and type of school (whether public or private) are central to our analysis, we initially estimated a random effects model that included these variables.[7] However, a Hausman test rejects the hypothesis that the random effects model is preferred to a fixed effects model ($\chi 2 = 93.80$).

As a result, we estimate the fixed effects model given below using log-log format:[8]

$$\text{Ln(Real Total Expenditures Per Undergraduate}_{i,t}) = \alpha_0 + \alpha_1 \text{Ln(Total Undergraduates}_{i,t}) + \alpha_2 \text{Ln(Total Athletes}_{i,t}) + \alpha_3 \text{Year2004}_{i,t} + \alpha_4 \text{Year2005}_{i,t} + \alpha_5 \text{Year2006}_{i,t} + \alpha_6 \text{Year2007}_{i,t} + \alpha_7 \text{Year2008}_{i,t} + \alpha_8 \text{Year2009}_{i,t} + \alpha_9 \text{Year2010}_{i,t} + \alpha_{10} \text{Year2011}_{i,t} + \alpha_{11} \text{Year2012}_{i,t} + \alpha_{12} \text{Year2013}_{i,t} + \varepsilon_{i,t}.$$

We use the natural log of total expenditures per student in 2013 dollars as the dependent variable. To determine how this average cost measure changes with the size of the student body, we include the number of undergraduates. To account for the size of a school's athletic program, another factor Shulman and Bowen (2001) cite as an important determinant of athletic costs, we include the total number of athletes.[9] Last, we include a series of year dummy variables to capture spending trends across time.

The results of the fixed effects regression are shown in Table 2. As shown in the table, the estimate is highly significant.

Turning to the estimated coefficients, we find that athletic expenditures per student are negatively and significantly correlated with the number of undergraduates. A 10% increase in the number of undergraduates reduces athletic costs per student by almost 9%. Also as expected, total athletic costs per student are positively and significantly correlated with the size of the athletic program, as measured by the number of athletes. A 10% increase in the number of athletes raises athletic costs per student by just under 4%.

Of particular note, the time series dummy variables point to escalating costs of athletic programs. For each year, real expenditures exceed 2003 values, and the margin increases from year to year. We point out that the increase in athletic expenditures continues without pause through the years of the Great Recession and increased approximately 67% in real terms over the decade analyzed.[10]

Unfortunately, the regression of the full model with fixed effects does not allow distinction between schools by NCAA division, public-private categorization, or the fielding of a football team. To allow for this, we estimated eight separate total cost equations for institutions that are D2 private without football, D2 public without football, D2 private with football, D2 public with football, D1AA private, D1AA public, D1A private, and D1A public. In each case, we again use fixed effects and the log–log functional form. In lieu of reporting the full results of all these regressions, we summarize our findings in Tables 3 and 4 and Figure 1(a) and (b).[11]

As shown in Table 3, the fit and explanatory power of these eight regressions are generally good. Further, the coefficients on the natural log of total undergraduates are always negative and highly significant.

Figure 1(a) and (b) show declining per-student costs of athletics as the number of students increases for all categories of institutions.[12] D1A schools spend significantly more per student than D1AA schools, and both spend more than D2 schools. In the D2 sample, we observe that a football program significantly raises average costs. The difference between public and private institutions is

Table 2. Estimates of the average total cost of athletics: fixed effects model.

Variable	Coefficient	*Z*-score
Ln(Total Undergraduates)	−0.866	−38.57*
Ln(Total Athletes)	0.371	18.55*
Year 2004	0.090	8.26*
Year 2005	0.179	16.77*
Year 2006	0.243	22.85*
Year 2007	0.305	29.00*
Year 2008	0.327	31.29*
Year 2009	0.370	35.03*
Year 2010	0.405	37.81*
Year 2011	0.447	41.46*
Year 2012	0.474	44.01*
Year 2013	0.513	47.38*
Constant	12.378	58.93*

Note: *$p < .001$, R^2 within = 0.55, R^2 between = 0.07, R^2 overall = 0.08, $F(12, 4409) = 444.61$, $F(481, 4409) = 49.7$, $N = 4903$, number of groups = 482.

Table 3. Key statistics for separate regressions of the average total cost of athletics.

Sample	*R*-square			*F*-statistic	Coefficient/(*t*-statistic) on Ln(Total Undergraduates)	*N*
	Within	Between	Overall			
Division 2, Private, No Football Program	0.60	0.52	0.51	74.90	−0.967/(−17.84)	678
Division 2, Public, No Football Program	0.51	0.46	0.47	35.05	−0.719/(−7.57)	467
Division 2, Private, Football Program	0.50	0.59	0.56	34.82	−0.731/(−11.45)	475
Division 2, Public, Football Program	0.59	0.63	0.60	104.39	−0.903/(−16.18)	968
Division 1AA Private	0.60	0.66	0.65	45.03	−0.808/(−12.15)	412
Division 1AA Public	0.60	0.43	0.45	78.16	−0.867/(−16.12)	697
Division 1A Private	0.61	0.78	0.73	19.84	−1.196/(−4.62)	180
Division 1A Public	0.59	0.00	0.01	107.50	−0.878/(−19.89)	1,026

also readily apparent. In every case, private schools report higher per-student costs than their public counterparts do, reflecting in part higher grants-in-aid resulting from higher tuition and fees.

Although we wish to avoid artificial and arbitrary definitions of minimum efficient scale, to better assess the implications of these estimates, we calculate the number of students needed to reach an average cost of $1000 and $2000 per student and the number of students needed for ten additional students to lower average cost by $1 and $2. These values, while unavoidably arbitrary, demonstrate the importance of fixed costs and how they vary by NCAA division, whether an institution is public or private, and whether an institution has a football program. They provide a 'common denominator' to determine the number of undergraduates required to reach per-student cost thresholds. What is truly important is the comparison of enrollment required to reach these cost thresholds across institutions. These calculations, along with the average size of school, are shown in Table 4.

What is notable is how rarely any institutions attain the measured efficiency criteria. Although the average D2 public school without football meets these efficiency measures, the average D2 private school without football only achieves the efficiency measure of $2000 of athletic costs per student. The average D2 private school with football is undersized, though the average D2 public school with football fares well by these criteria.

At the D1AA level, larger student numbers are necessary to reach these efficiency measures. The average D1AA public school has enough students to lower average costs below $2000 and an additional 10 students lowers average cost by $2. D1AA private schools, averaging 4728 students, are too undersized to reach any of these efficiency measures.

Table 4. Total undergraduate students needed to achieve specified measures of efficiency for total costs.

Category	Average number of students	Students needed to reach average cost of $1000 per student	Students needed to reach average cost of $2000 per student	Students needed for 10 additional students to lower average cost by $1	Students needed for 10 additional students to lower average cost by $2
Division 2, Private, No Football Program	2010	4000	2000	6500	4500
Division 2, Public, No Football Program	6432	3000	1500	5000	3500
Division 2, Private, Football Program	2031	8500	3500	8000	5000
Division 2, Public, Football Program	4958	4500	2000	6500	4500
Division 1AA Private	4728	28,500	12,000	14,000	9500
Division 1AA Public	8815	14,500	6500	11,000	7500
Division 1A Private	8645	46,500	26,000	25,000	18,500
Division 1A Public	18,740	57,000	26,000	21,000	14,500

Notes: Calculations made at intervals of 500 students. Derivatives calculated as $\alpha(Y/X)*10$, where α is the coefficient on log of the number of undergraduates, Y is the predicted per-student cost, and X is the number of undergraduates.

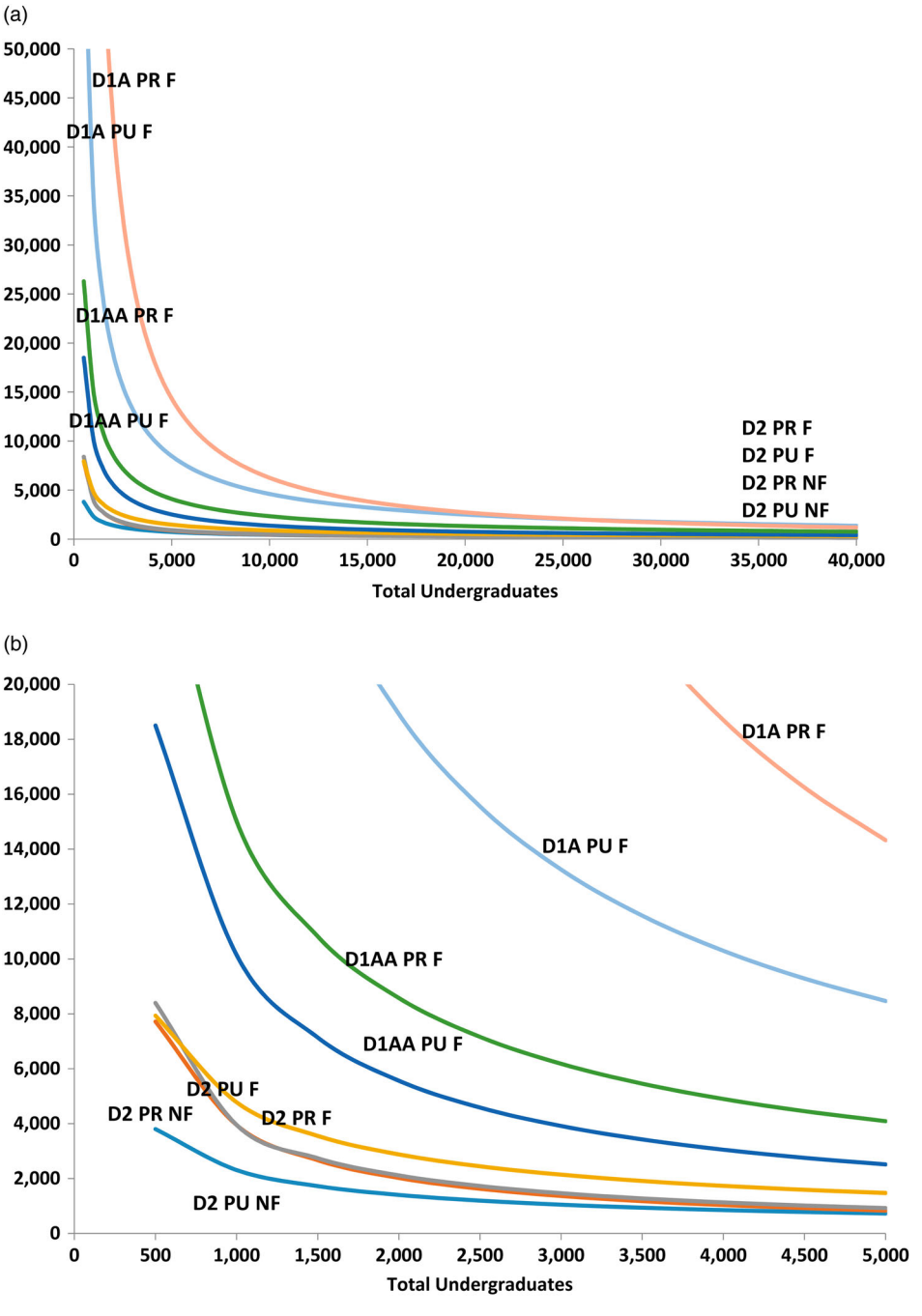

Figure 1. (a) Average cost curves (2013 dollars). (b) Average cost curves (2013 dollars): a closer look.

For the largest schools, those playing at the D1A level, the number of students required to reach these levels of efficiency is substantial. With the exception of the number of students required to reduce average cost by $2 for D1A public schools, the average D1A school is too small to reach these efficiency measures. On the other hand, many large flagship state universities are larger than the average school and meet more of these efficiency standards. These schools also have athletic programs that often bring in substantial revenues to offset these costs.

We reiterate that institutional support can provide a high share of athletic costs, especially for schools playing at the D2 and D1AA divisions. Whether this support is regarded as a subsidy or as an investment, institutions can reduce per-student support significantly by spreading these costs over a large number of students. Schools may also lower costs by playing at a lower NCAA division and by not fielding a football team.

The operating cost estimates

As previously discussed, a central difficulty to cost estimation is the value to assign to grants-in-aid that may vary dramatically from private to public schools and across all schools as rates of tuition discount vary. To account for this problem, we estimate what we term operating costs that include all athletic costs except grants-in-aid.

Again, a Hausman test rejects the random effects model in favor of a fixed effects model ($\chi 2 = 65.15$). The results for the fixed effects estimate are given in Table 5.

Although the overall significance and fit of the model are inferior to those of the total cost model, the results are fundamentally the same.

Declining per-student costs are evident, with a 10% increase in undergraduate students reducing per-student operating costs by over 8%. A large athletic program increases operating costs, as a 10% increase in athletes raises operating costs per student by over 4%. The time trend dummy variables make clear that escalating athletic costs are not confined to financial aid. By 2013, operating costs had increased by 76%.[13]

To capture the effects of NCAA division, public versus private schools, and whether or not a school has a football program, we again estimate fixed effect equations for each category. We present the results of these estimates and their implications in Tables 6 and 7 and Figure 2(a) and (b). As shown in Table 6, the goodness of fit and explanatory power of the eight separate regressions are generally good. The coefficients on the natural log of total undergraduates are again negative and significant.[14]

The average cost curves show that declining per-student costs apply to operating costs just as to total costs. D1A schools outspend D1AA schools, and both outspend D2 schools. We observe that private schools outspend public schools, a finding that indicates that all of the cost difference is not the result of higher grants-in-aid.

Using the same measures of efficiency we applied to total costs, we find a similar pattern. D2 public schools are, on average, large enough to meet the measures of minimum efficient scale. D2 private schools are less likely to do so, especially if they have a football team. At the D1AA level, private schools on average are too small to meet any of the efficiency criteria, but the average public school meets or nearly meets all of the criteria. Meeting these measures of minimum efficient

Table 5. Estimates of the average operating cost of athletics: fixed effects model.

Variable	Coefficient	*Z*-score
Ln(Total Undergraduates)	−0.834	−24.77*
Ln(Total Athletes)	0.425	14.16*
Year 2004	0.106	6.51*
Year 2005	0.232	14.48*
Year 2006	0.306	19.13*
Year 2007	0.374	23.69*
Year 2008	0.395	25.24*
Year 2009	0.425	26.84*
Year 2010	0.460	28.62*
Year 2011	0.505	31.30*
Year 2012	0.528	32.69*
Year 2013	0.568	35.04*
Constant	11.359	36.07*

Note: $*p < .001$, R^2 within = 0.36, R^2 between = 0.01, R^2 overall = 0.02, $F(12, 4409) = 233.47$, $F(481,4409) = 75.3$, $N = 4903$, number of groups = 482.

Table 6. Key statistics for separate regressions of the average operating cost of athletics.

Sample	*R*-square Within	*R*-square Between	*R*-square Overall	*F*-statistic	Coefficient/(*t*-statistic) on Ln(Total Undergraduates)	*N*
Division 2, Private, No Football Program	0.45	0.33	0.33	40.51	−1.000/(−11.34)	678
Division 2, Public, No Football Program	0.41	0.33	0.35	23.58	−0.781/(−5.86)	467
Division 2, Private, Football Program	0.31	0.52	0.44	15.49	−0.530/(−5.66)	475
Division 2, Public, Football Program	0.38	0.52	0.45	44.14	−0.846/(−8.81)	968
Division 1AA Private	0.47	0.36	0.35	26.44	−0.761/(−8.50)	412
Division 1AA Public	0.49	0.34	0.35	48.29	−0.888/(−12.95)	697
Division 1A Private	0.51	0.64	0.56	13.11	−1.408/(−3.75)	180
Division 1A Public	0.51	0.00	0.00	77.90	−0.823/(−15.92)	1026

Table 7. Total undergraduate students needed to achieve specified measures of efficiency for operating costs.

Category	Average number of students	Students needed to reach average cost of $1000 per student	Students needed to reach average cost of $2000 per student	Students needed for 10 additional students to lower average cost by $1	Students needed for 10 additional students to lower average cost by $2
Division 2, Private, No Football Program	2010	2000	1000	4500	3500
Division 2, Public, No Football Program	6432	2000	1000	4500	3000
Division 2, Private, Football Program	2031	4500	1500	5000	3000
Division 2, Public, Football Program	4958	3000	1500	5000	3500
Division 1AA Private	4728	20,500	8000	11,500	8000
Division 1AA Public	8815	9500	4500	9000	6500
Division 1A Private	8645	29,500	18,000	21,500	16,500
Division 1A Public	18,740	49,000	21,000	18,500	12,500

Notes: Calculations made at intervals of 500 students. Derivatives calculated as $\alpha(Y/X)*10$, where α is the coefficient on log of the number of undergraduates, Y is the predicted per-student cost, and X is the number of undergraduates.

scale is a challenge for the average school at the D1A level, though public schools fare better, with an average size large enough so that ten additional students lower per-student costs by $1 and reduce average costs to almost $2000.

Implications of estimates

These estimates, the first of their kind to our knowledge, yield a number of important implications that should be of interest to college and university administrators and athletic directors and personnel. We summarize these implications in this section.

1. The potential for cost spreading in college athletics is substantial, meaning that large numbers of students reduce per-student athletic costs significantly. This conclusion holds for total athletic costs and for costs that exclude grants-in-aid. It holds for all NCAA divisions and for public and private institutions. Similar to what the literature on economies of scale suggests, small schools may reap substantially lower costs per student by increasing enrollment.
2. Irrespective of the number of students, as the NCAA division advances from D2 to D1AA to D1A, per-student costs rise, and a football program raises per-student costs among D2 schools. Private schools spend more per student than their public counterparts do, regardless of division. These

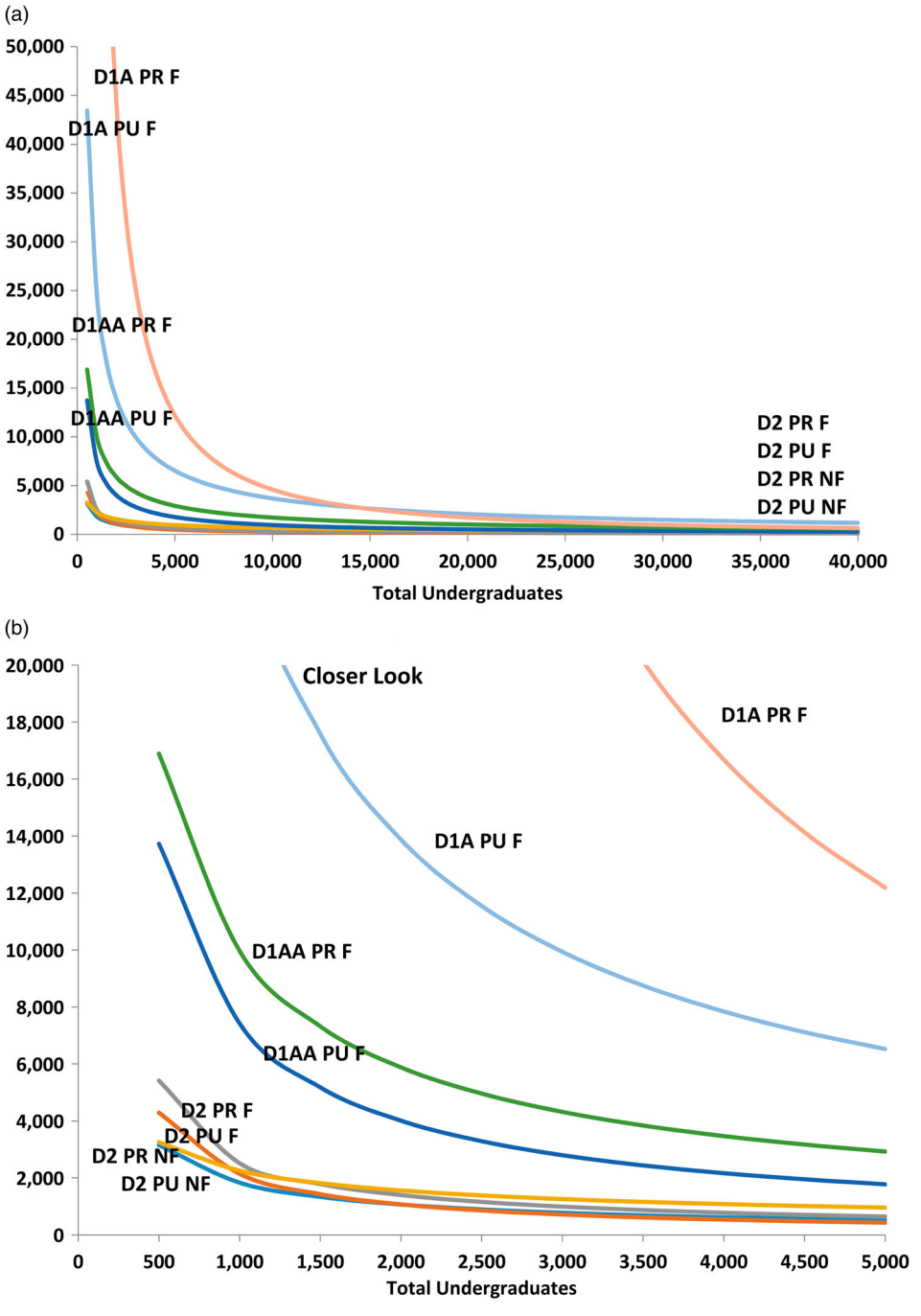

Figure 2. (a) Average cost curves, operating costs (2013 dollars). (b) Average cost curves, operating costs (2013 dollars): a closer look.

estimates indicate that administrators seeking greater applications and donations by moving up NCAA divisions should proceed with caution. Even if these benefits materialize – which, as the literature shows, is by no means certain – the costs associated with changing divisions are substantial and certain.

3. Expenditures on athletics have risen consistently and significantly over time. Administrators contemplating a change in NCAA division should be keenly aware that costs are likely to escalate in the coming years, so that any forthcoming gains in enrollment and donations would have to be sustained to match increased costs.
4. As Stigler ([1958] 1968) pointed out decades ago, 'the competition of different sizes of firms sifts out the more efficient enterprises' (73). Stigler was analyzing for-profit firms. Still, the application to nonprofits has merit. A relatively small number of schools may have to evaluate their athletic programs to ensure that their costs allow them to remain financially viable, particularly small schools that play at the D1AA level and rely heavily on institutional support to fund their athletic programs. For 2013, there were 12 schools in the bottom 30% of undergraduate enrollment that played at the D1AA level. With fewer than 2700 students, we predict these schools are especially vulnerable to rising athletic costs and may have to right size their athletic programs. As Hutchinson (2013) points out, it is possible for a school to deescalate its commitment to athletics, in particular because of increased costs, demands placed upon student-athletes, and philosophical inconsistency, but de-escalation is difficult, and many schools continue their commitment to large-scale athletics.

Concluding thoughts

By the assessment of those inside and outside of higher education, the industry faces challenging times, if not outright turmoil. Increased competition from technological change, a facilities arms race, and increased federal scrutiny plague the industry. Through it all, colleges and universities continue to provide costly entertainment to alumni, students, and fans in the form of athletic contests.

The costs of these athletic programs often run into tens of millions of dollars and are largely fixed, meaning they decline on average with greater enrollment. Large flagship state universities as well as private universities with large endowments and strong student demand can sustain these costs. In addition, many of these schools generate significant athletic revenues, and the indirect benefits of athletics, well documented by supporters, are substantial. For these schools, institutional support is small and likely a good investment.

For small schools, however, the story may be different. With relatively few students, they incur significantly higher per-student costs than large schools. In particular, when small schools choose to play at the Division 1 level in lieu of Division 2, average costs are extremely high and may exacerbate financial pressures on the institution as a whole. Further, these schools generally lack offsetting revenues that generate millions of dollars for large schools. Institutional support may be relatively large and constitute a subsidy to the athletic program at the expense of other institutional priorities.

While it is impossible to foresee the outcome of the tectonic forces shaping the college athletic landscape, administrators at many Division 1A and 1AA schools may reassess their athletic programs. For some institutions, the aforementioned financial challenges may yield unrelenting pressure. A scaled-down athletic program may be necessary to ensure financial viability.

Notes

1. The Power Five conferences are the Atlantic Coast Conference, the Big Ten, the Big Twelve, the Pacific Twelve, and the Southeastern Conference. The schools in these conferences generally have the most prestigious athletic programs in the country.
2. In the US, the terms 'college' and 'university' are used interchangeably because they both refer to institutions of higher education.
3. The NCAA divides Division 1 schools into two subsets, based on the scale of their football programs. Schools with large-scale football programs are known as Football Bowl Series (FBS) schools, and schools with smaller scale football programs are known as Football Championship Series (FCS) schools. Throughout this paper, we will refer to these schools by their former designation as D1A and D1AA, respectively.

4. As Shulman and Bowen (2001) acknowledge, the EADA data may face limitations and shortcomings, but they are the best available, and improvements should make them better each year.
5. Division 3 schools offer no athletic scholarships.
6. It is possible that the number of students is a function of athletic expenditures. We ignore this possibility in our specification because if other schools follow suit with increased athletic expenditures and the demand for higher education is inelastic, the effect of athletic expenditures on enrollment is likely to be small.
7. The Breusch-Pagan Lagrangian Multiplier test for random effects indicates the random effects model is preferred to simple OLS ($\chi^2 = 14{,}720$).
8. The log-log form provides the best overall fit and significance, but results are qualitatively the same in the reciprocal form and when estimates include squared values of total undergraduates and total athletes.
9. We note that the simple correlation coefficients between total athletes and NCAA division are small, ranging from −0.01 to 0.38.
10. $e^{0.513} - 1 = 0.670$.
11. Complete results may be obtained from the authors upon request.
12. In the figures, PR designates private, PU designates public, F indicates a football program, and NF indicates no football program. All D1 and D1AA schools in this sample have football programs.
13. $e^{0.568} - 1 = 0.764$.
14. Complete results may be obtained from the authors upon request.

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