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Abstract
Most students know what they spend on tuition and other costs of attending college, but most do not know how much their colleges spend on their education in return. This paper provides figures on instructional spending per full-time equivalent student, broken down by institutional level and sector. Variations in this measure of educational spending can be substantial, even among apparently similar institutions. A cross-sectional multiple regression model utilizing 2016 IPEDS data on every public and private non-profit college and university in the United States is used to explore the possible causes of these variations. It shows that instructional spending per student is positively correlated with the portion of the budget devoted to instruction. It is negatively correlated with the non-tenure-track portion of the instructional staff, with the prevalence of students from low-income backgrounds, and with tuition as a fraction of total revenue. These results are generally consistent with expectations. The finding that instructional spending per student goes down when the non-tenure-track fraction of the instructional staff goes up, all else equal, lends credence to the perception that the increasing employment of non-tenure-track instructors is meant to drive down instructional costs and free up resources for non-academic purposes.

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Most students seem well-informed about tuition and other costs of attending college. Few seem to know how much their college spends on their education in return. A simple metric of how much an institution spends on an average student's education is instructional spending per student. Although small differences in this metric may not mean much, large differences are bound to create corresponding contrasts in educational quality and in the educational experience. All else equal, most students would rather attend colleges that spend more on their education, as opposed to colleges that spend less.

This paper describes and explains patterns in instructional spending per student at U.S. colleges and universities. The data source is the Integrated Postsecondary Education Data System (IPEDS) within the National Center for Education Statistics.[54] IPEDS provides publicly available data on every college and university in the United States. The data in this paper are taken from IPEDS' 2016 files, the most recent year that the final version of the data is available. The sample is restricted to accredited colleges and universities that offer an academic degree. Specialized institutions, institutions that only enroll graduate students, institutions with fewer than 100 students, and institutions on which no data is available are excluded. These restrictions ensure that we are comparing colleges and universities that are all traditional academic institutions with traditional academic missions.

In this paper, instructional spending per student is defined as total instructional spending divided by total full-time equivalent student enrollment. Total instructional spending is the amount each institution spends on the units that run its educational programs. It is defined in the IPEDS data documentation as "the sum of all operating expenses associated with the colleges, schools, departments, and other instructional divisions of the institution, and for departmental research and public service that are not separately budgeted. This would include compensation for academic instruction, occupational and vocational instruction, community education, preparatory and adult basic education, and remedial and tutorial instruction conducted by the teaching faculty for the institution's students." Instructional expenditures thus can include non-instructional functions, such as research and public service, that are not externally funded and budgeted. This may be unavoidable from an accounting standpoint, but it means that the instructional expenditure data can vary for reasons that are unrelated to the money actually spent on each student's education. I return to this potential data problem below.

Total full-time equivalent (FTE) student enrollment is the sum of FTE undergraduate enrollment and FTE graduate enrollment. Calculating student enrollment in terms of FTE weights full-time students more than part-time students. This adjusts for the fact that full-time students require more classes and more instructional spending than part-time students.

[54] https://nces.ed.gov/ipeds

Table 1 provides figures on median instructional spending per FTE student by institutional level (associate degree, bachelor's degree, master's degree, or doctoral degree institutions, as categorized by the Carnegie Commission on Higher Education) and institutional sector (public, private non-profit, and private for-profit) among the 2861 colleges and universities in the sample. It shows wide variation in instructional spending per student. Among public colleges and universities, instructional spending per student goes up with level, with doctoral degree-granting universities spending almost twice as much as associate degree-granting colleges. Private non-profit colleges and universities spend more on each student's education than their public counterparts with the surprising exception of associate degree colleges; however, the difference is especially large at doctoral degree-granting universities. Private for-profit colleges and universities, not surprisingly, spend less on each student's education than their public and private non-profit counterparts but surprisingly spend more at associate and bachelor's degree-granting colleges than at master's and doctoral degree-granting universities.

Table 1
Median Instructional Spending Per FTE Student
by Institutional Level and Sector, 2016

	Public	Private Non-Profit	Private For-Profit	TOTAL
Associate Degree	$5,554	$4,931	$3,889	$5,404
Bachelor's Degree	$7,359	$9,131	$4,314	$7,612
Master's Degree	$7,908	$8,528	$2,920	$7,974
Doctoral Degree	$10,844	$15,484	$2,981	$10,001
TOTAL	$6,474	$8,959	$3,835	$6,743

The breakdowns by institutional level and sector still leave broad categories within which instructional spending per student varies widely. One possible reason for this variation is the presence of an M.D., D.M.D, D.V.M. or other medical degree program. These programs could drive up instructional costs at doctoral degree-granting universities. Table 2 shows median instructional spending per student at public and private non-profit doctoral degree-granting universities (there are no private for-profit universities that offer these degrees). Doctoral degree-granting universities with medical degree programs show much higher levels of instructional spending for each student than universities offering doctoral degrees without such programs, especially in the private non-profit sector. The presence of these programs must be taken into account when making comparisons about instructional spending at doctoral degree-granting universities.

Table 2
Median Instructional Spending Per FTE Student at Doctoral Degree Universities with and without Medical Degree Programs by Sector, 2016

	Public	Private Non-Profit	Total
With Medical Degree Programs	$14,870	$33,137	$17,663
Without Medical Degree Programs	$9,471	$12,654	$10,564
TOTAL	$10,844	$15,484	$12,305

Even when comparing ostensibly similar institutions, the variation in per pupil instructional spending can be surprisingly wide. For example, Table 3 shows instructional spending per student at the top ten universities as ranked by *U.S. News and World Report*. These are all private, wealthy, extremely selective, and research-intensive institutions. Despite these similarities, the variations in instructional spending per student are significant and seem to show no relationship to the presence of a medical degree program. The top two – Stanford and Yale – spend twice as much or more on each student's education as Northwestern, Penn, Harvard, or Princeton. Gaps of this magnitude among seemingly similar institutions are difficult to explain.

Table 3
Instructional Spending Per FTE Student at Top Ten Universities, 2016

Institution	Has Medical Degree Program	Instructional Spending Per FTE Student
Stanford University	Yes	$117,659
Yale University	Yes	$114,352
Columbia University	Yes	$97,694
University of Chicago	Yes	$94,192
Duke University	Yes	$76,965
Massachusetts Institute of Technology	No	$71,755
Princeton University	No	$57,856
Harvard University	Yes	$54,983
University of Pennsylvania	Yes	$53,442
Northwestern University	Yes	$45,461
MEDIAN		$74,360

Another seemingly similar group of institutions are large (20,000 or more students), land-grant, public, doctoral degree-granting universities. These universities with similar missions, programs, and sizes would be expected to spend similar amounts on each student's education. But, as Table 4 shows, the spread in per pupil instructional spending is substantial, varying by almost four times between the highest spending and lowest spending of these institutions. Nor does there appear to be much correlation with the presence of a medical degree program.

Table 4
Instructional Spending Per FTE Student
at Large, Land-Grant, Public, Doctoral Degree-Granting Universities, 2016

Institution	Has Medical Degree Program	Instructional Spending Per FTE Student
University of Connecticut	Yes	$26,643
University of California-Davis	Yes	$25,848
University of California-Berkeley	No	$20,512
Ohio State University-Main Campus	Yes	$19,918
Purdue University-Main Campus	Yes	$18,669
University of Wisconsin-Madison	Yes	$18,403
Rutgers University-New Brunswick	Yes	$17,826
University of Minnesota-Twin Cities	Yes	$17,294
University of Florida	Yes	$17,284
Michigan State University	Yes	$16,469
North Carolina State University at Raleigh	Yes	$15,927
Texas A & M University-College Station	Yes	$15,878
University of Massachusetts-Amherst	No	$15,612
University of Illinois at Urbana-Champaign	Yes	$14,946
University of Maryland-College Park	Yes	$14,759
University of Nevada-Reno	Yes	$14,406
University of California-Riverside	No	$13,934
The University of Tennessee-Knoxville	Yes	$13,865
University of Kentucky	Yes	$12,957

University of Arizona	Yes	$12,906
Clemson University	No	$12,504
Washington State University	Yes	$12,487
Oregon State University	Yes	$12,414
Virginia Polytechnic Institute	Yes	$12,271
University of Missouri-Columbia	Yes	$11,924
Kansas State University	Yes	$11,808
West Virginia University	Yes	$11,661
Louisiana State University	Yes	$11,443
University of Nebraska-Lincoln	No	$10,558
Colorado State University-Fort Collins	Yes	$10,300
Auburn University	Yes	$10,206
University of Arkansas	No	$10,188
Oklahoma State University-Main Campus	Yes	$9,834
University of Georgia	Yes	$9,775
Iowa State University	Yes	$9,641
Utah State University	Yes	$8,991
Mississippi State University	Yes	$8,146
MEDIAN		$12,957

Adjustments for local differences in the cost of living might somewhat reduce the differences in per pupil instructional spending. But that adjustment would not be large enough to offset the basic point of these comparisons: instructional spending per student shows wide variations across seemingly similar institutions. Below I describe a model meant to explore several other possible reasons for these variations.

The empirical strategy is to run separate linear regressions on each type of degree-granting institution: doctoral degree universities, master's degree universities, bachelor's degree colleges, and associate degree colleges. The dependent variable is instructional spending per FTE student. The model explores four possible explanations for the variation in the dependent variable.

The first explanatory variable is instructional spending as a fraction of total institutional expenditures (ISTE). Colleges and universities that devote a larger share of their budgets to instruction should spend more on each student's education, all else equal. Thus, the coefficient on ISTE is expected to be positive.

The second explanatory variable is the fraction of the total instructional staff that is off the tenure-track. Non-tenure-track (NTT) instructors are much cheaper to hire than tenure-line instructors. Institutions that are more dependent upon non-tenure-track instructors

should spend less on each student's education, all else equal. Colleges and universities may hire instructors off the tenure-track in order to reduce educational spending and free up resources for administration, sports, or other non-academic purposes. Thus, the coefficient on NTT is expected to be negative.

The third explanatory variable is the percentage of undergraduates receiving Pell grants (PELL). This variable reflects the prevalence of students from low-income backgrounds. Low-income is typically correlated with lower test scores and other measures of cognitive skill. These students often require more support and remedial education, suggesting that they would tend to raise instructional spending per student. On the other hand, these students are less likely to attend selective colleges and universities with greater resources and greater capacity for instructional spending. Thus, the coefficient on PELL could be either positive or negative.

The fourth explanatory variable is tuition revenue as a fraction of total revenue (TUIREV). This variable represents the contribution of students to institutional resources. As such, it should also represent the obligation of the institution to create a return flow of those resources to students in the form of instructional spending. Thus, the coefficient on TUIREV is expected to be positive.

Several control variables are also included so that the results on the explanatory variables are net of other possible influences on instructional spending per student.

Dummy variables on the presence of a medical degree program (MED=1) and on land-grant status (LAGR=1) are included in the equation on doctoral degree-granting universities. As noted above, universities with medical degree programs spend much more on each student's education, so the coefficient on MEDDEG is expected to be positive. The predicted sign on LAGR is uncertain. Land-grant universities may have a greater commitment to educational spending insofar as it supports their larger institutional mission of service to their states. But land-grant universities may also be more dependent upon state funding and more prone to reduce instructional spending if they face state budget cuts. Thus, the coefficient on LAGR could be either positive or negative.

Dummy variables on the public sector (PUB=1), location in the south (SOUTH=1), and location in a city (CITY=1) are also included in all equations. The coefficient on PUB is expected to be negative since, as Table 1 shows, public institutions generally spend less on each student's education than their private counterparts. The coefficient on SOUTH is also expected to be negative because the southern states traditionally spend less on education than other states. The coefficient on CITY is expected to be positive because the cost of instructional salaries and services are likely to be higher in urban locations.

The sample is restricted to public and private non-profit institutions. For-profit institutions are excluded because their instructors

are almost entirely off the tenure-track, which can distort the results on the NTT variable. These institutions are also more likely to be online only and run on a different (and perhaps more dubious) financial model than traditional colleges and universities. Consequently, the results will be cleaner and easier to interpret if the sample is restricted to traditional colleges and universities.

Results are presented in Table 5 below. T-statistics are in parenthesis below coefficient values. Given the sample sizes, a T-statistic of at least 1.96 indicates significance within 5%, and a T-statistic of at least 2.58 indicates significance within 1%.

Results generally conform to expectations. The R-squares indicate that the equations are explaining approximately one-quarter to two-thirds of the variation instructional spending per student. That is strong, or at least strong enough, for cross-sectional regressions, which often have very low R-squares. Of course, most of the variation remains unexplained in most of the equations. This could reflect noise in the data, or there could be unmeasured or excluded explanatory or control variables such as unfunded research (since IPEDS includes it in instructional spending, as noted above).

Table 5
Regression Results on Instructional Spending Per FTE Student

	Doctoral Degree Universities	**Master's Degree Universities**	**Bachelor's Degree Colleges**	**Associate Degree Colleges**
ISTE	43,981 (5.43)	14,557 (9.89)	16,224 (5.61)	9,840 (14.64)
NTT	-477 (-0.09)	-4,661 (-6.88)	-6,351 (-6.78)	466 (1.55)
PELL	-201 (-4.39)	-36 (-5.38)	-142 (-12.11)	-20 (-4.82)
TUIREV	-63,731 (-13.46)	-2,230 (-2.87)	-1,794 (-1.89)	-2,267 (-5.53)
PUB	-25,036 (-3.52)	-2,229 (-6.07)	-2,915 (-4.16)	-1,757 (-9.93)
SOUTH	-2,861 (-2.06)	-561 (-2.20)	-1,351 (-2.53)	-231 (-1.88)
CITY	-610 (-0.44)	444 (1.91)	677 (1.29)	-365 (-2.84)
MED	4,936 (3.06)			
LAGR	-4,048 (-2.12)			
Sample size/ R-squared	*N=303* R^2*=0.62*	*N = 665* R^2 *= 0.27*	*N = 553* R^2 *= 0.43*	*N = 983* R^2 *= 0.27*

Instructional spending as a fraction of total expenditures (ISTE) is significant and positive, as expected, in all the equations. Colleges and universities that devote larger portions of their budgets to instruction tend to spend more on each student's education. This is an obvious relationship and it would have been surprising if the regression results failed to reflect it.

The non-tenure-track fraction of the instructional staff (NTT) is negative, as expected, except at associate degree-granting colleges where its significance level is below 5%. It is significant for master's degree-granting universities and baccalaureate-granting colleges. The correlation is still negative but smaller and less significant at doctoral degree-granting universities. This may reflect the fact that instructional costs at these universities are driven up by graduate programs, offsetting the cost-savings from employing non-tenure-track instructors in undergraduate programs.

The prevalence of students from low-income backgrounds, captured by the percentage of undergraduates receiving Pell grants (PELL), is negative and significant in all the equations. Students from low-income backgrounds are likely to attend less selective institutions with fewer resources and lower levels of instructional spending on each student. This result may not be surprising, but it is concerning. Students from low-income backgrounds often need advising, tutoring, remedial classes, and other support services. Instructional spending on them should be greater than spending on students from more affluent backgrounds. Yet the opposite was observed.

Tuition revenue as a share of total revenue (TUIREV) is negative and significant in all equations except the equation on bachelor's degree-granting colleges, where it is also negative but below 5% significance. This finding is unexpected. As noted above, TUIREV was predicted to be positive because institutions that depend more upon tuition revenue would be obligated or pressured to spend more on each student's education. Perhaps institutions facing financial difficulties feel pressure to both raise tuition and cut instructional spending, a pattern, if it were widespread, that could cause TUIREV to be negative.

The control variables generally perform as expected. Public sector colleges and universities (PUB) spend less on each student's education compared to their private non-profit counterparts. Location in the south (SOUTH) is also negatively associated with educational spending as expected. Urban location (CITY) is below 5% significance except for associate degree-granting colleges, where it is surprisingly negative.

Finally, at doctoral degree-granting universities, the presence of a medical degree program (MED) is positively correlated with instructional spending per student as expected. Land-grant status (LAGR) is negative and significant. This may indicate that these institutions respond to state budget cuts by taking measures to reduce educational expenditures. In any case, the control variables are generally significant and help ensure that

the impacts of the explanatory variables are net of these institutional characteristics.

In sum, instructional spending per student varies in predictable ways. It rises with the portion of the budget devoted to instruction. It falls with the portion of the instructional staff that are off the tenure-track (a finding of particular concern since it suggests that institutions have hired non-tenure-track instructors in order to drive down instructional costs and free up resources for non-academic purposes), with the prevalence of students from low-income backgrounds, and with the tuition as a fraction of total revenue. It also is lower at public institutions relative to their private counterparts and at southern institutions relative to those in other regions. At doctoral degree-granting universities, instructional spending per student is relatively higher at universities with medical degree programs and relatively lower at universities with land grant status. These patterns generally make sense, even if much else about the instructional spending decision by college and university administrators remains opaque.

The amount of resources that colleges and universities devote to instruction is a metric that should be of great interest to students, educators, administrators, and analysts of higher education. It can provide a measure of an institution's commitment to its educational mission. It can be used to compare one college or university to another in terms of educational resources and, presumably, educational quality. It can help us understand trends, such as the growth in non-tenure-track instructional staff. Instructional spending per student is a simple statistic with any implications that deserves wider circulation and analysis. This paper is a first step in that direction.