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The Relationship Between Institutional Spending & College Student Persistence: Where Should Universities Spend Their Money?

A Plan B Paper
SUBMITTED TO THE FACULTY OF THE UNIVERSITY OF MINNESOTA BY

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I. INTRODUCTION

As any U.S. university student can attest, college in America is expensive. Because of this, there has been much public scrutiny over how universities spend their money. Between 2010 and 2022, average institutional expenses at not-for-profit colleges increased from $21,462/student to $35,324/student, accounting for inflation (NCES). It doesn't help that at the same time, states have been struggling to increase their funding for higher education at the same rate that enrollment has been increasing, there being a 10% drop in real state funding per student between 1987 and 2018 (Ma et al., 2019). The increase in university spending has been pegged by the media on a host of things- higher teacher salaries, "administrative bloat", and scope creep in the services colleges are expected to provide to students all being examples (Goodkind, 2024; McGurran, 2023; Weinstein Jr, 2023; Woodhouse, 2015). Of particular ire has been increased spending on lavish amenities, such as infinity pools and lazy rivers, to draw in prospective (and ideally wealthy) students (Korn et al., 2023; Valhouli, 2015; Woodhouse, 2015).

All of this discourse raises an interesting question- where should colleges spend their money to most effectively serve their students? Is the panic around administration costs, amenities, and other non-instructional spending justified or are these non-instructional services helpful at promoting student success? There are a number of ways one might tackle this question, but in this paper I look at how university spending in different areas affects student persistence rates- specifically, undergraduate graduation rates and retention rates.

My primary analysis uses a fixed-effects approach and institution-level data on U.S. universities from the Delta Cost Project, which itself takes data from the Integrated Post-Secondary Education Data System and adjusts it for differences in accounting across years and institutions. I first look at public and private universities separately, then look at baccalaureate,

masters, and doctoral institutions separately, in order to see if university control or research level change what areas of spending have the strongest correlation with improved persistence rates. I further investigate universities that have high or low graduation rates for their given institutional characteristics to see how they are spending differently than the general population. Additionally, while my primary analysis uses per student spending as my expenditure measure, I also test a model using category spending as a percentage of total spending as a measure, to see if the calculation of expenditure changes the results.

I find that the spending categories most directly related to educational services are the only ones consistently associated with improved persistence rates. I further find that the results for research spending and auxiliary enterprise spending (which includes items such as housing and dining) vary depending on institution type and measurement of expenditure. Other areas of spending, such as non-academic administration, are largely found to be insignificant.

Though my results cannot determine causation, they suggest that schools that spend more on matters closely related to academics have higher student success rates. My results also suggest that there are differences in which areas of spending are most effective at supporting students at public vs. private universities, as well as differences between baccalaureate, masters, and doctoral colleges. Investigating these differences in more depth could prove fruitful in understanding the mechanisms behind college student success.

Previous papers have looked at the effect of category spending on graduation, but results have been mixed. Higher spending on instruction has largely been found to be positively correlated with student persistence rates (with the exception of Calcagno, et. al. (2008) which found no clear effect), but other categories have had varied results. One paper looking at four-year institutions found student service spending to positively impact graduation rates (Pike &

Robbins, 2020), another found a negative effect (Gansemer-Topf & Schuh, 2006), and still another found no significant effect (Ryan, 2004). Similar disparities exist in results for the effect of administration spending. Other categories may have consistent results in the literature, but are represented in relatively few papers, such as research spending which has previously been found to negatively impact graduation (Pike & Robbins, 2020; Webber & Ehrenberg, 2009), but has been largely left out of papers in this area.

This paper seeks to contribute to the literature by looking closer at how a variety of institutional factors change the relationship between category spending and persistence rates, as well as how the measures of spending and persistence can shift the results. It simultaneously adds to the small number of papers that analyze and compare the relationship between institution spending and student success at both at public and private U.S. institutions (Scott et al., 2006), the small number that analyze results using both retention and graduation rates as outcome variables (Gansemer-Topf & Schuh, 2006; Sanford & Hunter, 2011), and the small number that analyze how the calculation of expenditure changes the results (Gansemer-Topf & Schuh, 2006). It is also the first paper, to my knowledge, to separate and compare results at the baccalaureate, masters, and doctoral levels. By making these distinctions, I hope to better understand what factors play into how colleges can best support students. This paper also uses a wider array of spending categories than past papers- of particular note, this is the first paper, that I am aware of, to analyze the effect of university operation costs and auxiliary enterprise expenses on student persistence rates.

The remainder of this paper proceeds like such. In Section II, I describe my methodology and data. Then in Section III, I describe my results and discuss their implications, and then provide some final thoughts in Section IV.

II. METHODOLOGY & DATA

Model

To test the effects of spending in different areas on student outcomes I use a fixed effect model. The model takes the following form:

$$Y_{it} = \beta_0 + \beta_{1-7} SpendingCategories_{it} + \beta_{8-14} SpendingCategoriesSquared_{it} + \beta_{15-19} OtherInstitutionalCharacteristics_{it} + \beta_{20-27} YearDummies_t + \alpha_i + \varepsilon_{it}$$

The two outcome variables (Y_{it}) analyzed are the institutional graduation rate and retention rate. Graduation rate is the school's six-year undergraduate graduation rate[1]. In order to analyze institution expenditure's effect on students at different levels of progress towards their degree, I also look at the effect of institutional spending on university retention rates- retention rate in this case being defined as the percentage of full-time, first-year students who return full-time to the college for a second year. This follows in the footsteps of Gansemer-Topf & Schuh (2006), who found that while both retention and graduation rates were positively associated with instruction spending, they differed in how they related to other areas of spending. Student service spending had a negative correlation with retention rates, while there was no clear correlation with graduation rates; meanwhile, graduation rates were found to have positive and negative correlations with different areas of administration spending.

Past research has also found subtle differences in how expenditure affects student outcomes at public and private universities; Scott, et. al. (2006) found that increased expenditure had a greater impact on graduation rates at public universities. It is also probable that whether a a

[1] This only includes students seeking a bachelor's for those schools which offer both bachelor's and associate's degrees. Former students are removed from the calculation of graduation rate if they died or were permanently disabled, or if they left school to serve in the military, a foreign aid service (such as the PeaceCorp), or a church mission. Students who transfer to another institution are considered dropouts. Students who transfer in to an institution are not added to any year's graduating cohort and are effectively treated as though they don't exist for the purpose of calculating graduation rates (*IPEDS Glossary*).

college is a baccalaureate, masters, or research institution may change how its spending decisions relate to student outcomes- higher research spending, for example, may be of more value to students at a research-focused institution. To get a closer look at the effect of categorical expenditure at colleges of different structures, as well as to increase comparability between colleges in each sample, I look at several subsections of the data separately. I first look at public and private colleges separately, then look at baccalaureate, masters, and doctoral colleges separately[2]. Thus there are ten models analyzed, outlined below.

	Graduation Rate	Retention Rate
Public	Model 1	Model 3
Private	Model 2	Model 4
Baccalaureate	Model 5	Model 8
Masters	Model 6	Model 9
Doctoral	Model 7	Model 10

The particular spending categories will be described in greater detail in the "Data & Variables" subsection, but in broad terms I predict that spending directly relating to instruction will have a positive coefficient, in alignment with previous research. Other spending categories have not had consistent results in the literature, so I make no predictions regarding their results. I do expect there will be differences in spending category significances and magnitudes between models.

[2] Carnegie classifications are used to define the research level of an institution. Under the Carnegie classifications, doctoral universities are defined as institutions that award 20 or more different doctoral degrees, while Masters institutions are defined as those which offer 50 or more different Master's degrees, but less than 20 doctoral degrees (*Basic Carnegie Classification*, n.d.).

Data & Variables

Data was pulled from the Delta Cost Project (DCP), which itself is based off the Integrated Post-Secondary Education Data System (IPEDS) surveys. IPEDS surveys over 7,000 U.S. colleges and universities annually on, among other things, their finances, enrollment, and persistence rates. Completing IPEDS surveys is mandatory for any institute that receives federal funding for student financial aid via programs created by Title IV of the Higher Education Act of 1965[3] (*IPEDS Survey Methodology*). The DCP pulls together data from a number of different IPEDS surveys into one database and also updates some data to standardize for changes in accounting and/or reporting standards over the years. For example, from 1997 to 2008 the Governmental Accounting Standards Board (GASB) reporting standards followed by most public universities had them report depreciation and maintenance costs as their own spending category, while private colleges, following the Financial Accounting Standards Board (FASB) regulations, included such costs as part of other spending categories- now public universities do the same. The DCP does its best to account for such discrepancies and report older data by modern accounting standards (*DCP Documentation*, 2011). This paper is the second paper that I am aware of to take advantage of the DCP database, the other being a working paper by Webber and Ehrenberg (2009).

Data is available from 2000-2012 with a total of 87,560 observations (IPEDS continues to survey colleges annually, but unfortunately the DCP has not been extended past 2012). Data on admission rates (one of my control variables) isn't available until 2003, removing 31,843 observations (resulting in a sample size N = 55,717). Another 31,168 observations from for-profit and special focus institutions (e.g. engineering schools, medical schools, etc.) are dropped

[3] Universities that don't qualify for Title IV may also request to be a part of IPEDS, upon review from IPEDS.

to increase comparability between institutions and due to a large number of missing observations at said institutions (N = 24,549). Also to increase comparability and simplify the measure of graduation rates, community colleges are excluded from the sample, removing another 9,927 observations (N = 14,894). Again for comparability, a further 272 observations from institutions located in U.S. territories are dropped (N = 14,622). Another 6,556 observations are dropped due to one or more missing variables (N = 8,066). Ten observations are dropped due to having non-integer graduating class sizes and 40 observations are dropped due to being distinct outliers (N = 8,016). Finally, in order to ensure enough within-institution variance over time, 747 observations are dropped from universities that appear in less than six years of the data set, leaving a final sample size of 7,269 observations. This sample size is only 6,353 observations for the retention rate models, as retention rate data isn't available until 2004.

The DCP includes the following expenditure categories:

- *Instruction*[4]*:* Spending on instruction, not including academic administration costs. Also includes departmentally funded research. Time faculty spends on public service or non-departmental research is budgeted separately.
- *Research*: Spending on research that is either outwardly commissioned or budgeted separate from academic department budgeting (such as research done by specific university research centers).
- *Academic Support:* Non-instruction costs that support the university's mission of education including expenses on libraries, museums, and academic administration (such as academic deans).

[4] Full IPEDS definitions of each category included in Appendix A

- *Institutional Support:* Administration costs not directly related to academics such as larger goal-setting positions (like presidents), as well as departments like legal, publicity, finances, human resources, etc..
- *Student Services:* Costs for services whose primary purpose is to ensure student well-being and/or guide students through university systems, such as student organizations, admission & registration services, and financial aid services. Can include athletics and health services if not operated as auxiliary enterprises (see below).
- *Operations:* Costs related to upkeep of university facilities, such as groundskeeping, utilities, and property insurance.
- *Auxiliary Services:* Costs for essentially self-supporting university enterprises which students/faculty pay a direct fee to access; typically, this will include services such as dining and housing. Can include athletics and health services.
- *Public Service:* Expenses on services beneficial to groups outside the institution, such as conference organization and advisory services.
- *Independent:* This category exists to cover a handful of federally funded research labs that are so large in scope they warrant their own category, such as the Jet Propulsion Laboratory at Cal Tech.
- *Grants:* Financial aid granted to students that does not take the form of a tuition or fees discount or allowance, such as financial aid for off-campus housing. Essentially, financial aid that does not end up back in the coffers of the university.
- *Hospital:* Expenditure on hospital operation for college's which run their own hospital.

- *Other:* The difference between a university's reported total expenditure and the sum of the above categories. Should be zero assuming a university has properly allocated all expenditures to the proper categories.

The Public Service, Independent, Grants, Hospital, and Other categories were not included in this analysis due to either a high number of missing observations, being irrelevant to a large number of institutions (most colleges don't operate a hospital), and/or difficulty of interpretation (what would a significant result in Other spending mean?).

Thus the expenditure categories included in the analysis are *Instruction*, *Research*, *Academic Support*, *Institutional Support*, *Student Services*, *Operations*, and *Auxiliary*. *Operations* and *Auxiliary* are notable because, as mentioned earlier, they have not been an area of study prior to this paper, as far as I am aware. The effect of auxiliary spending on student success seems of particular pertinence considering the ongoing debates around how much colleges should be spending on student "amenities"- though auxiliary spending in no way perfectly captures student amenities, it does represent certain aspects of campus life that people might be concerned about, such as overly lavish dorms or dining halls.

For the *Research* category, 1,662 missing observations were imputed as $0 for baccalaureate institutions. There were no values of $0 for any spending categories before this imputation and the only missing values for *Research* came from baccalaureate institutions, thus it seems reasonable to assume that for a large number of these baccalaureate colleges the missing observation represents zero or close to zero spending on research, as opposed to a failure to report or an error in reporting.

In order to account for institution size, expenditure data was divided by the college's full-time equivalent (FTE) enrollment[5] as done in various prior papers (Crisp et al., 2018; Gansemer-Topf & Schuh, 2006; Monaghan & Sommers, 2022; Pike & Graunke, 2015; Pike & Robbins, 2020; Scott et al., 2006). Expenditure was also divided by an additional 1,000 for ease of interpretation, thus expenditure category variables are in $1,000/student terms.

Multiple chronological aspects of college spending are accounted for as well. A cohort of students graduating in 2012 will have experienced four to six years of different university budgets. Thus for each spending category, I use the four-year averages of expenditure (e.g. for the graduating class of 2012, the value of *Instruction* is equal to the mean of instruction spending from 2009-2012), assuming that the one to two additional years of university spending experienced by students who graduate in five to six years does not significantly affect cohort graduation rates[6]. Spending by category does not vary wildly between years for the majority of institutions, so an average seems appropriate. In the retention models, meanwhile, I use the one-year lag of all expenditure variables, representing the spending of that sophomore cohort's freshman year. Spending data is also adjusted for inflation using the Higher Education Price Index developed by the Commonfund Institute, an inflation index that specifically accounts for the basket of goods typically used by institutes of higher education (Suttles, 2019). All spending is adjusted to 2012 dollars.

[5] Full-time equivalent enrollment is calculated based on formulas developed by the Department of Education that adds a portion of part-time enrollment (between 33% and 41%) to full-time enrollment based on various institutional factors (*IPEDS Glossary*).

[6] Four-year graduation rates would've eliminated the need for this assumption, but unfortunately weren't available in the data set. Also worth noting that in 2012, of students who graduated within six-years, 70% of them did so in four or fewer years (*NCES*, 2020)

Past research at the primary and secondary level has found possible diminishing returns to education spending (Abott et al., 2020). To investigate the possibility of non-linear spending effects at the collegiate level, the square of each expenditure category is included.

The models are estimated using fixed effects estimation to control for time-invariant characteristics of colleges and universities that are both observed and unobserved. In addition, various non-financial institutional characteristics that change over time are included as control variables.

Previous research has found that more selective schools tend to have higher graduation rates, even controlling for other institutional characteristics (Gansemer-Topf & Schuh, 2006; Pike & Robbins, 2020). More selective schools might also be expected to be more "elite" and thereby have access to larger endowments. Here I use university admission rates as a measure of selectivity[7].

The percentage of a school's budget that comes from tuition has been found to be related to improved retention, so I include tuition reliance in the model as well (Titus, 2006). Titus speculates this is because institutions that are more tuition reliant have a greater incentive to retain students in order to maintain funding. This relationship would likely change how a school divvies up its funds- a school with higher tuition reliance might be more inclined to put that money into student services to appeal to students, while one that receives a greater share of its funds from the government might be receiving that money in the form of research grants, and ergo be spending a larger share of its budget on research

[7] A limitation of using admission rate as a selectivity measure, is that the causality between admission rates and persistence rates likely goes in both directions. Not only are universities with lower admission rates more likely to have better persistence rates, but having those better persistence rates likely encourages more prospective students to apply, which in turn affects the institution's admission rate. This is an important area for future research.

The overall demographics and socioeconomic upbringing of a university's student body may also affect a college's persistence rates- a college with a greater percentage of students from marginalized communities may end up with lower graduation and/or retention rates as it attempts to meet the needs of a student body with fewer resources. A variety of similar papers have found a negative relationship between the percentage of students that are non-white and persistence rates; the relationship has been found to be particularly strong for the percentage of black students (Calcagno et al., 2008; Crisp et al., 2018; Monaghan & Sommers, 2022; Pike & Robbins, 2020; Scott et al., 2006; Webber & Ehrenberg, 2009). A 2018 paper looking at broad-access institutions (colleges that do not require students to submit standardized test scores) found that increased expenditure was one of the few institutional variables that improved graduation rates for black and Latinx students (Crisp et al., 2018). To capture the effect of race on graduation, the percentage of the student body that is white[8] is included in the model. Data was not available for the racial make-up of exclusively undergraduates, so the *% White* variable is a measure of white students across the whole university, including graduate level.

Colleges may also differ in the make-up of their students that fit the typical picture of an undergraduate student (i.e. a full-time student having come straight from high school). A paper by Fike & Fike found that students that started college at an older age were more likely to dropout, while another paper found that higher average student age was correlated with lower graduation rates (Fike & Fike, 2008; Scott et al., 2006). To capture the effect of average age, I use the percentage of students between ages 18-24, the age range students who started college right out of high school and graduating in six years or less would fall into. Similarly, past research has found a negative correlation between the percentage of students studying part time

[8] Race is self-reported by students to the institution. In the event a student does not select a race, the institution may choose to categorize them or report them as race unknown (*IPEDS Glossary*)

and institution persistence rates (Crisp et al., 2018; Monaghan & Sommers, 2022; Sanford & Hunter, 2011; Scott et al., 2006), thus the percentage of part time students at an institution is included in the model. As opposed to the *% White* variable, *% Ages 18-24* and *% Part Time* were both calculated using only undergraduate enrollment numbers.

Dummy variables for each year from 2007-2012 are also included, with 2006 excluded as the comparison year. For the retention rate models, dummies are included for the years 2005-2012, with 2004 as the comparison year, due to the fact that the retention rate models use one-year lags as opposed to four-year averages (as such, the retention rate models also end up using more observations than the graduation rate models).

Table 1 below shows descriptive statistics for all variables, except the year dummies. The summary statistics given for the expenditure categories are before applying any lags or multi-year averages. Descriptive statistics split up by public and private institutions, as well as by baccalaureate/masters/doctoral universities can be found in the Appendix.

It should be noted that Breusch-Pagan and White tests revealed heteroskedasticity within the models. A possible source of this, as can be seen in Table 1, is large outliers in the expenditure data- a handful of colleges spend a huge amount of money per student each year compared to the rest; however, logging expenditure did not remove the heteroskedasticity. To account for this, standard errors in all models are clustered by institution.

Table 1. Descriptive Statistics

Variables	Mean	Std Dev	Median	Min	Max
6-Year Graduation Rate	0.5604	0.1779	0.5516	0.0523	0.9806
Retention Rate	0.7664	0.1103	0.7700	0.1600	0.9900
FTE Students	8,051	9,618	4,191	31	70,460
Instruction ($1000/Student)	7.93	5.91	6.30	1.71	95.62
Research ($1000/Student)	2.05	5.85	0.17	0	119.87
Academic Support ($1000/Student)	2.07	2.76	1.52	0.01	67.17
Institutional Support ($1000/Student)	3.21	2.40	2.58	0.23	22.39
Student Services ($1000/Student)	2.20	1.55	1.74	0.20	15.49
Operations ($1000/Student)	1.78	1.45	1.42	0.01	25.75
Auxiliary ($1000/Student)	3.36	2.43	2.89	0	41.68
Admission Rate	0.6669	0.1817	0.6949	0.0348	1
% Tuition Reliance	0.4344	0.1754	0.4223	0.0179	0.9156
% Ages 18-24	0.8846	0.1001	0.9122	0.1614	0.9991
% Part Time	0.1406	0.1188	0.1080	0.0006	0.7224
% White	0.6787	0.2164	0.7400	0	0.9918

N is 7,269

III. RESULTS

Public vs. Private Colleges

Table 2. Fixed Effect Results for Public vs. Private Institutions

Variables	**Model 1: Graduation Rate, Public Colleges** *Coefficient (Std. Error)*	**Model 2: Graduation Rate, Private Colleges** *Coefficient (Std. Error)*	**Model 3: Retention Rate, Public Colleges:** *Coefficient (Std. Error)*	**Model 4: Retention Rate, Private Colleges:** *Coefficient (Std. Error)*
Instruction	0.0256*** (0.0053)	0.0214*** (0.0032)	0.0102*** (0.0023)	0.0141*** (0.0014)
Research	0.0107*** (0.0023)	-0.0007 (0.0020)	0.0065*** (0.0013)	-0.0004 (0.0009)
Academic Supp.	0.0181* (0.0094)	0.0105** (0.0043)	0.0141*** (0.0051)	0.0085*** (0.0022)
Institutional Supp.	-0.0012 (0.0125)	0.0033 (0.0065)	-0.0010 (0.0047)	0.0046 (0.0030)
Student Services	0.0087 (0.0192)	0.0003 (0.0109)	-0.0181** (0.0082)	-0.0035 (0.0045)
Operations	-0.0349*** (0.0119)	0.0101 (0.0061)	-0.0039 (0.0090)	-0.0017 (0.0032)
Auxiliary	0.0130*** (0.0046)	0.0067 (0.0045)	-0.0013 (0.0025)	0.0014 (0.0024)
Instruction Sq	-0.0006*** (0.0002)	-0.0002*** (<0.0001)	-0.0002*** (0.0001)	-0.0002*** (<0.0001)
Research Sq	-0.0002*** (<0.0001)	0 (0)	-0.0001*** (<0.0001)	0 (0)
Academic Supp. Sq	-0.0013*** (0.0004)	-0.0002*** (0.0001)	-0.0005*** (0.0002)	-0.0002*** (<0.0001)
Institutional Supp. Sq	-0.0018 (0.0017)	-0.0003 (0.0004)	0.0001 (0.0003)	-0.0003** (0.0001)
Student Services Sq	-0.0030 (0.0050)	-0.0012 (0.0012)	0.0011 (0.0013)	-0.0004 (0.0004)
Operations Sq	0.0034** (0.0016)	0.0004 (0.0003)	-0.0015 (0.0017)	0 (0)
Auxiliary Sq	-0.0003 (0.0002)	0.0002 (0.0002)	0.0001 (0.0001)	-0.0001 (0.0001)
Admissions Rate	-0.1264*** (0.0280)	-0.1692*** (0.0345)	-0.1395*** (0.0184)	-0.0994*** (0.0179)

% Tuition Reliance	0.1042** (0.0457)	0.1779*** (0.0442)	0.0495 (0.0318)	0.1135*** (0.0244)
% Ages 18-24	0.4782*** (0.1020)	0.4499 (0.0709)	0.3774*** (0.0452)	0.2849*** (0.0397)
% Part Time	-0.3627*** (0.0593)	-0.1613*** (0.0444)	-0.1157*** (0.0338)	-0.1169*** (0.0309)
% White	0.1368*** (0.0226)	0.2047*** (0.0253)	0.0370** (0.0165)	0.0771*** (0.0169)
Intercept	-0.0593 (0.0853)	-0.1239* (0.0409)	0.4302*** (0.0440)	0.3669*** (0.0392)
N	2,419	2,371	3,078	3,162
Clusters	391	440	391	440
R^2	0.6714	0.6250	0.5494	0.5453

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Results for year dummy variables are not shown, available upon request.

Table 2 above shows the results for the public vs. private models, providing a snapshot of similarities and differences across them. The spending categories most directly related to educational services, *Instruction* and *Academic Support*, are significant and positive across all models- though only at 90% certainty for *Academic Support* in Model 1. Their squared terms, *Instruction Sq.* and *Academic Support Sq.*, are also significant, but in the opposite direction, suggesting there are diminishing returns present. This is the overall pattern for the squared terms- if the corresponding linear category is significant, so is it's squared term, but in the opposing direction.

Using Model 1 as an example, *Instruction* has an estimated coefficient of 0.0256, while *Instruction Sq.* has an estimated coefficient of -0.0006. Briefly assuming a causal relationship, the marginal effect of a one-unit change in *Instruction* on graduation rate would then be 0.0256 – 0.0012**Instruction*. For a public institution with a median level of instruction spending of 5.68, this increase in graduation rate would be 0.0256 – 0.0012*5.68 = 0.0188. Increases to instruction

spending would enter the region of absolutely diminishing marginal returns after *Instruction* exceeded 21.33 ($21.33 million for a university of 1,000 students)[9].

Instruction has the greatest positive marginal effect on persistence of all the spending categories in every model except for the public retention model, where *Academic Support* has the greatest magnitude. *Instruction* spending is also more strongly associated with graduation rates than retention rates for both public and private institutions (β's of 0.0256 compared to 0.0102 for public colleges and 0.0214 versus 0.0141 for private). A possible explanation for this is that while quality of education is an important factor for freshman when deciding whether to stay at a university, other factors such as finding a community or the fit of the city play large roles as well- once a student has chosen to stay for another year though, these other effects dampen as the student's comfort in their college environment solidifies and so quality of education starts to play a larger role. It's also possible that many underclassmen are willing to stick it out until they complete their general education courses, only to later find themselves either unsatisfied with or unprepared for classes in their major of choice.

It's also interesting, though perhaps not surprising, that the administrative capacities directly related to academia (*Academic Support)* have a clearer association with graduation and retention than administration focused on other operations of the university (*Institutional Support)*.

Research spending is positively correlated with student persistence as well, but only for public universities, with a marginal effect of 0.0107 – 0.0004**Research* in the public graduation model (Model 1) and of 0.0065 – 0.0002**Research* in the public retention model (Model 3). This

[9] Some observations in the data set do exceed this threshold. In reality for these institutions, their instructional spending above 21.33 probably doesn't actually harm their graduation rates, as the relationship between spending and persistence is more likely logistic than quadratic. A logit/probit model could capture this, but I chose not to use either in this analysis in order to keep marginal effects easier to interpret, at the expense of some accuracy at the edges.

could suggest that, even for undergraduates, research opportunities spur students towards completion, perhaps because they capture student engagement or perhaps because they create more job opportunities on campus. Past research has found that certain undergraduate research programs can improve students' sense of belonging in a university's community, which would also incentivize completion (Lindsay, 2022). Yet another possibility is that colleges with strong research programs may tend to draw students with very clear career goals, who are more likely to make it to graduation.

As for why research spending is only significant at public institutions, this is possibly because a greater number of heavy research universities are public institutions. The median value of research spending for public universities within the 2012 sample is $330/student, as opposed to only $50/student at private colleges; similarly, 43.21% of observations for private colleges had an imputed value of zero for *Research* as opposed to only 2.01% for public institutions. It's possible that research spending is correlated with student success at private universities, for those private colleges that actually conduct significant non-departmental research. On the other hand, running Models 2 & 4 only using observations where *Research* > 0 does not result in significant results for *Research*.

Beyond that, a handful of other significant results appear among the spending categories- a negative correlation for *Student Services* in the public retention model, a negative correlation for *Operations* in the public graduation model, and a positive correlation for *Auxiliary*, also in the public graduation model. There are some fun speculations to be made here about why these categories are only significant in singular models, but ultimately no clear associations can be determined.

The control variables all had the expected signs. A greater reliance on tuition, a higher percentage of traditional age students, and a larger share of white students are all found to have a positive correlation with persistence rates, with exceptions in certain models; meanwhile, lower selectivity (via high admission rates) and a greater number of part time students are found to have a negative correlation.

Magnitude of Results

To better understand the magnitude of the expenditure category coefficients, let's again look at Model 1 and assume causality in the results for a moment. Consider a public university of median size (8,747 FTE students), spending a median amount on instructional costs (*Instruction* = 5.68). If such a university wanted to increase its instruction spending by one to *Instruction* = 6.68, that would require just under an additional $35 million in instruction spending (8,747 * 1,000 = 8,747,000 since spending is in $1,000/student terms, then 8,747,000 * 4 = 34,988,000 since spending is in 4-year averages; thus, a university might choose to spend an additional $8.7 million each year for the next four years). In Model 1, for that investment the university would gain a 1.81 percentage point increase in the 6-year graduation rate, or 158 additional graduates over the following six years[10].

This, at first glance, might seem like a poor exchange- $35 million spent in exchange for only 158 extra bachelor's granted. But consider this in the context of the economic value that a bachelor's degree creates. The Bureau of Labor Statistics reports that in 2023 the median weekly income of a person with a bachelor's degree was $501 greater than that of someone with some college, but no degree (*Education Pays*, 2023)- this amounts to an ~$26,000 difference in

[10] $(0.0265*6.68 - 0.0006*6.68^2) - (0.0265*5.68 - 0.0006*5.68^2) = 0.0181$
$8,747*0.0181 = 158.32$

income over a year. For 158 people, that difference would create $35 million in economic value in about 8.5 years. If those 158 people were to all lead 40-year careers, the value generated over people with only some college adds up to over $164 million. So it seems that the benefits far exceed the cost in the long run, as far as the overall economy is concerned.

Whether the costs are feasible for universities in the short run is another question, largely beyond the scope of this paper. But to provide some context, the median unrestricted revenue (revenue with no stipulation on how it must be spent) of colleges within the sample in 2012 is $85.6 million.

Results by Research Level

The results by level of research can be found in Tables 3 & 4 below. Table 3 shows the results for the graduation rate models (Models 5-7) and Table 4 shows results for the retention rate models (Models 8-10).

When dividing by research level, *Instruction* once again proves to be a consistently relevant category, being significant in all of the models except for the masters graduation model (Model 6), in which none of the spending categories are found to be significant. *Instruction* has the largest correlations in the baccalaureate models, with coefficients of 0.0379 in Model 5 and 0.0163 in Model 8, while in Models 6, 9, & 10 it has a coefficient < 0.01. *Academic Support* is also found to be significant in both baccalaureate models, as well as the masters retention model (Model 9). But it was not significant in either doctoral model.

The results for *Research* spending are more of a mixed bag for these results than they were in the public vs. private models. Significant negative results are found in the baccalaureate graduation model (Model 5) and the masters retention model (Model 9)- though for Model 9, it is

only at 90% certainty. But in the doctoral models *Research* is found to be positively correlated with persistence.

All of this taken together could suggest that colleges which align their budgets with their primary mission produce better student outcomes- e.g. colleges with a focus on teaching which spend a greater chunk of their budget on teaching or research universities that spend a greater portion of their budget on research tend to get more students to degree completion. Alternatively, these correlations could be representative of more efficient spending. Liberal arts colleges may, on average, have more expertise on how to effectively spend their instruction dollars than masters or doctoral colleges, and thus have a stronger correlation between *Instruction* and persistence (and the same case for doctoral universities and research spending).

Also of interest, *Auxiliary* is found to be positively significant, but only in the doctoral models. A possible explanation of this is that prospective students who highly value a vibrant campus life might seek out larger colleges, which happen to often be doctoral universities. For example, doctoral colleges have many of the largest athletic programs and communities surrounding them, and some research has found positive links between college athletics and persistence (Hickman & Meyer, 2017; Mixon & Treviño, 2005), though results have been mixed (Mangold et al., 2003; Rishe, 2003). Services such as dining and housing may also play a greater role at larger universities in connecting students from across campus and fostering a sense of belonging. Alternatively, as many auxiliary enterprises involve outside contracting (very few colleges operate their own dining halls, for example), larger universities may also have the most bargaining power when securing such contracting, resulting in better and cheaper auxiliary services.

Table 3. Graduation Rate Models by Level of Research

Variables	Model 5: Graduation Rate, Baccalaureate Coll. *Coefficient (Std. Error)*	Model 6 Graduation Rate, Masters Colleges *Coefficient (Std. Error)*	Model 7 Graduation Rate, Doctoral Colleges *Coefficient (Std. Error)*
Instruction	0.0379*** (0.0042)	0.0080 (0.0072)	0.0086*** (0.0022)
Research	-0.0135*** (0.0040)	-0.0040 (0.0047)	0.0063*** (0.0015)
Academic Support	0.0224*** (0.0081)	0.0232 (0.0164)	0.0021 (0.0029)
Institutional Support	0.0074 (0.0097)	0.0050 (0.0140)	-0.0050 (0.0084)
Student Services	0.0049 (0.0121)	0.0187 (0.0203)	0.0055 (0.0166)
Operations	-0.0117 (0.0111)	0.0171 (0.0298)	-0.0078 (0.0079)
Auxiliary	0.0132 (0.0090)	0.0138 (0.0092)	0.0145*** (0.0043)
Instruction Sq	-0.0007*** (0.0001)	-0.0001 (0.0002)	-0.0001*** (<0.0001)
Research Sq	0.0001 (0.0001)	0.0001 (0.0001)	-0.0001*** (<0.0001)
Academic Support Sq	-0.0010*** (0.0003)	-0.0028 (0.0025)	-0.0001 (0.0001)
Institutional Support Sq	-0.0007 (0.0008)	-0.0018 (0.0016)	0.0002 (0.0005)
Student Services Sq	-0.0015 (0.0014)	-0.0023 (0.0040)	-0.000` (0.0013)
Operations Sq	0.0020 (0.0013)	-0.0048 (0.0074)	0 (0)
Auxiliary Sq	-0.0004* (0.0008)	0.0003 (0.0011)	-0.0005*** (0.0001)
Admissions Rate	-0.1025*** (0.0277)	-0.1173*** (0.0340)	-0.2497*** (0.0334)
% Tuition Reliance	0.1802*** (0.0333)	0.2884*** (0.0385)	0.1156*** (0.0342)
% Ages 18-24	0.3277*** (0.0643)	0.3867*** (0.0952)	0.5215*** (0.1279)

% Part Time	-0.2084*** (0.0529)	-0.3299*** (0.0648)	-0.4638*** (0.0001)
% White	0.1989*** (0.0294)	0.1419*** (0.0265)	0.1349*** (0.0345)
Intercept	-0.1801*** (0.0612)	-0.0656 (0.0847)	0.1193 (0.1241)
N	1,832	1,621	1,337
Clusters	346	268	217
R^2	0.6901	0.6339	0.7865

***** $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Results for year dummy variables are not shown, available upon request.

Table 4. Retention Rate Models by Level of Research

Variables	**Model 8: Retention Rate, Baccalaureate Coll.** *Coefficient (Std. Error)*	**Model 9: Retention Rate, Masters Colleges** *Coefficient (Std. Error)*	**Model 10: Retention Rate, Doctoral Colleges** *Coefficient (Std. Error)*
Instruction	0.0163*** (0.0018)	0.0059*** (0.0021)	0.0035*** (0.0013)
Research	-0.0033 (0.0038)	-0.0037* (0.0021)	0.0035*** (0.0009)
Academic Support	0.0232*** (0.0060)	0.0297*** (0.0072)	0.0023 (0.0015)
Institutional Support	0.0042 (0.0037)	0.0015 (0.0051)	-0.0006 (0.0037)
Student Services	-0.0063 (0.0047)	-0.0096 (0.0078)	0.0035 (0.0071)
Operations	-0.0029 (0.0063)	-0.0070 (0.0077)	-0.0070 (0.0038)
Auxiliary	0.0037 (0.0044)	0.0049 (0.0043)	0.0046** (0.0020)
Instruction Sq	-0.0002*** (<0.0001)	-0.0001** (<0.0001)	-0.0001** (<0.0001)
Research Sq	0 (0)	0.0001 (<0.0001)	-0.00001*** (<0.0001)
Academic Support Sq	-0.0015** (0.0007)	-0.0028*** (0.0008)	-0.0001** (<0.0001)
Institutional Support Sq	-0.0003* (0.0002)	-0.0003 (0.0002)	0 (0)

Student Services Sq	-0.0003 (0.0004)	0.0010 (0.0010)	-0.0006 (0.0009)
Operations Sq	0 (0)	0.0010 (0.0010)	0.0002 (0.0002)
Auxiliary Sq	-0.0001 (0.0003)	-0.0005 (0.0004)	-0.0002** (0.0001)
Admissions Rate	-0.0782*** (0.0191)	-0.1123*** (0.0219)	-0.1575*** (0.0188)
% Tuition Reliance	0.0799*** (0.0215)	0.1032*** (0.0256)	0.0024 (0.0206)
% Ages 18-24	0.2324*** (0.0405)	0.2521*** (0.0464)	0.337*** (0.0693)
% Part Time	-0.1376*** (0.0362)	-0.1519*** (0.0314)	-0.1898*** (0.0482)
% White	0.0815*** (0.0191)	0.0537*** (0.0180)	0.0475* (0.0248)
Intercept	0.3646*** (0.0387)	0.4753*** (0.0447)	0.5617*** (0.0677)
N	2,249	2,079	1,712
Clusters	346	268	217
R^2	0.5522	0.4698	0.6592

***** $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Results for year dummy variables are not shown, available upon request.

Exceptions To The Rule

Above I've looked at the effect of spending on a general population of institutions. From a policy perspective though, it would also be prudent to look at subsects of schools with certain institutional characteristics. For example, while this analysis has found that higher acceptance rates are correlated with lower graduation and retention rates, that obviously does not mean universities should start dropping their acceptance rates to improve persistence rates- the mission of many colleges is to serve a wide-range of students, not only the highest achieving. A valuable question then might be, what are the colleges that have high acceptance rates, but still have high persistence rates, doing differently with their spending?

I look at these "exceptions to the rule" with four different variables that had a clear effect on one or more of the above models- *Admissions Rate, % Part Time, % Ages 18-24,* and *% White*. For each I look at the uncharacteristically high graduation rate and uncharacteristically low graduation rate schools. So in the case of *Admissions Rate*, I look at the average spending for institutions that are both in the top quartile of admissions rates (*Admission* > 0.80) and the top quartile of graduation rate (*Graduation* > 0.69); I compare this to schools in the bottom quartile of admissions rate (*Admission* < 0.56) and bottom quartile of graduation rates (*Graduation* < 0.42). Both are also compared to the sample averages. For *% Part Time* I compare colleges with high graduation rates within the top quartile of part-time student make-up (*% Part Time* > 0.20) to universities with low graduation rates within the bottom quartile of part-time students (*% Part Time* < 0.05). For *% Ages 18-24* I compare colleges with high graduation rates within the bottom quartile of typical age range make-up (*% Ages 18-24* < 0.84) to colleges with low graduation rates within the top quartile of typical age range make-up (*% Ages 18-24* > 0.96). Finally, for *% White*, I compare schools with high graduation rates also in the bottom quartile of white demographic make-up (*% White* < 0.60) and schools with low graduation rates in the top quartile of white demographic make-up (*% White* > 0.83). Results can be seen in Tables 5-8 below.

The results of this are perhaps not surprising. By and large, the trend is that universities in the high-graduation subsamples are spending more per student than the overall sample is across all categories, while universities in the low-graduation subsamples are spending less per student on everything than the overall sample. This is especially accentuated for *% White* where schools in the high-graduation subsample have strikingly higher averages than the general sample in every spending category.

Table 5. "Exception to the Rule" for *Admission Rate*

Spending Category	Total Sample *(N=7,269)*		High Grad Rate, High Adm Rate *(N=185)*		Low Grad Rate, Low Adm Rate *(N=404)*	
	Mean	Median	Mean	Median	Mean	Median
Instruction ($1000/FTE)	7.93	6.30	8.42	7.97	5.43	5.32
Research ($1000/FTE)	2.05	0.17	1.24	0.14	0.62	0.12
Academic Supp. ($1000/FTE)	2.07	1.52	2.24	2.06	1.40	1.24
Institutional Supp. ($1000/FTE)	3.21	2.58	3.85	3.26	2.82	2.53
Student Services ($1000/FTE)	2.20	1.75	2.78	2.76	1.86	1.48
Operations ($1000/FTE)	1.78	1.42	1.60	1.39	1.55	1.33
Auxiliary ($1000/FTE)	3.36	2.89	4.37	4.15	2.38	2.13

Table 6. "Exception to the Rule" for *% Part Time*

Spending Category	Total Sample *(N=7,269)*		High Grad Rate, High Part Time *(N=42)*		Low Grad Rate, Low Part Time *(N=131)*	
	Mean	Median	Mean	Median	Mean	Median
Instruction ($1000/FTE)	7.93	6.30	9.14	8.14	5.07	4.79
Research ($1000/FTE)	2.05	0.17	2.63	0.11	0.28	0
Academic Supp. ($1000/FTE)	2.07	1.52	1.83	1.79	1.47	1.20
Institutional Supp. ($1000/FTE)	3.21	2.58	3.86	3.53	4.14	3.73
Student Services ($1000/FTE)	2.20	1.75	1.97	1.87	3.02	2.95
Operations ($1000/FTE)	1.78	1.42	1.67	1.44	1.78	1.45
Auxiliary ($1000/FTE)	3.36	2.89	3.09	2.75	3.68	3.42

Table 7. "Exception to the Rule" for *% Ages 18-24*

Spending Category	Total Sample *(N=7,269)*		High Grad Rate, Low % Ages 18-24 *(N=38)*		Low Grad Rate, High % Ages 18-24 *(N=41)*	
	Mean	Median	Mean	Median	Mean	Median
Instruction ($1000/FTE)	7.93	6.30	9.73	6.81	5.07	4.95
Research ($1000/FTE)	2.05	0.17	3.38	0.03	0.26	0
Academic Supp. ($1000/FTE)	2.07	1.52	2.61	2.08	1.43	1.32
Institutional Supp. ($1000/FTE)	3.21	2.58	4.36	3.69	3.76	3.74
Student Services ($1000/FTE)	2.20	1.75	2.33	2.03	3.28	3.24
Operations ($1000/FTE)	1.78	1.42	2.08	1.61	1.54	1.45
Auxiliary ($1000/FTE)	3.36	2.89	3.68	3.26	3.77	3.77

Table 8. "Exception to the Rule" for *% White*

Spending Category	Total Sample *(N=7,269)*		High Grad Rate, Low % White *(N=500)*		Low Grad Rate, High % White *(N=254)*	
	Mean	Median	Mean	Median	Mean	Median
Instruction ($1000/FTE)	7.93	6.30	19.93	16.41	4.65	4.40
Research ($1000/FTE)	2.05	0.17	12.02	7.92	0.20	0.03
Academic Supp. ($1000/FTE)	2.07	1.52	5.41	3.96	0.96	0.82
Institutional Supp. ($1000/FTE)	3.21	2.58	6.41	5.47	2.03	1.57
Student Services ($1000/FTE)	2.20	1.75	3.25	3.00	1.47	1.10
Operations ($1000/FTE)	1.78	1.42	3.85	2.79	1.11	1.00
Auxiliary ($1000/FTE)	3.36	2.89	6.07	5.07	1.89	1.54

Still, some noteworthy results emerge. For *Admission Rate, % Part Time,* and *% Ages 18-24,* the colleges in the high-graduation subsamples have lower median spending on research than the general sample (though not necessarily lower mean spending). And interestingly, for both *% Part Time* and *% Ages 18-24,* colleges in the low graduation subset are spending more on institutional support, student services, and auxiliary enterprises than the overall sample.

An Alternative Approach

With the way expenditure has been constructed thus far, an increase in spending in any one category, all else equal, is an increase in the total budget for that institution. This would explain why there are very few negative estimated coefficients among the spending variables- while spending more on institutional support might not help students towards graduation, without cutting funding to anything else there's little reason it should harm their chances. This was also highlighted in the "exceptions to the rule" analysis, which indicated clearly that what schools with exceptionally high graduation rates are doing differently than their peers is spending more per student on everything. Because of this and because in reality universities often face budgets far below what they wish, many colleges might be more interested in knowing where to direct their spending assuming limited capacity to change their overall budget. One way to more directly capture the trade-offs inherent in allocating a budget, as seen in various other papers, would be to look at different spending categories as a percentage of total spending (Gansemer-Topf & Schuh, 2006; Sanford & Hunter, 2011; Titus, 2006). Calculating expenditures as a percentage makes it so all changes in one category are measured relative to

another- a 1% increase in any one category necessitates a 1% decrease in spending elsewhere[11]. Notably, Sanford & Hunter (2011) made comparison between results using per student spending and percentage spending, and found differing results for academic support and student service spending depending on which measure of spending was used.

Table 9, below, briefly explores this alternative. Models 11-14 once again represent fixed effects for public vs. private institutions, but all spending category data is recorded as a percentage of total budget. In order to avoid perfect collinearity issues, *Instruction* is dropped from the models and used as a reference category (along with any spending in the categories I did not use, for those institutions they are relevant to). To account for institution size, now that it's no longer wrapped up in the spending variables, a new control, *Z-FTE*, is added[12]. *Z-FTE* is equal to the number of standard deviations away from the population mean student enrollment a college's FTE enrollment is (i.e. it's z-score). This is used instead of simple full-time enrollment in order to scale down the magnitude of enrollment and improve result interpretability, as every other variable in these models is bounded between zero and one. Descriptive statistics for percentage spending data can be found in the Appendix.

[11] It does not, however, perfectly simulate a fixed budget. A category's percentage may still be shifted by an increase or decrease in the overall budget, depending on how it's allocated. Creating a better model of fixed budgets in higher education could be a topic of future research.

[12] Institution size does indeed shift at institutions over time within the data set, as overall college enrollment has been increasing, and so does not belong in the fixed effects. Though it may be that relative institution size (as compared to other universities) is fairly constant over time.

Table 9. Public vs. Private Fixed Effects, % Spending

Variables	Model 11: Graduation Rate, Public Colleges *Coefficient (Std. Error)*	Model 12: Graduation Rate, Private Colleges *Coefficient (Std. Error)*	Model 13: Retention Rate, Public Colleges: *Coefficient (Std. Error)*	Model 14: Retention Rate, Private Colleges: *Coefficient (Std. Error)*
Research	0.1951 (0.1539)	0.1534 (0.2062)	0.1001 (0.0949)	0.3436*** (0.1196)
% Academic Support	0.7226 (0.8787)	1.0293*** (0.2916)	0.8844*** (0.3090)	0.6295*** (0.1549)
% Institutional Support	-0.4617 (0.4601)	1.2519** (0.4968)	0.1546 (0.1921)	0.1277 (0.1894)
% Student Services	-1.1406* (0.6155)	-0.0319 (0.5190)	-0.7331*** (0.2224)	0.0906 (0.2167)
% Operations	-1.3809** (0.7000)	-0.3925 (0.4552)	-0.2894 (0.2215)	-0.1419 (0.1658)
% Auxiliary	-0.4518* (0.2531)	0.4789 (0.4329)	-0.4360*** (0.1219)	0.1484 (0.2167)
% Research Sq	-0.0317 (0.4356)	0.0788 (0.4872)	0.0399 (0.2833)	-0.5305* (0.2900)
% Academic Support Sq	-2.2206 (5.2492)	-2.7393*** (1.0152)	-2.6193* (1.5512)	-1.6329*** (0.5375)
% Institutional Support Sq	1.8375 (1.8384)	-4.0810*** (1.4192)	-0.2480 (0.6877)	-0.6447 (0.4867)
% Student Services Sq	6.3145* (3.4144)	-1.8098 (1.7476)	2.6623*** (0.9013)	-1.7054** (0.7232)
% Operations Sq	6.7360* (3.7327)	1.3645 (2.1151)	1.0300 (1.0293)	-0.3509 (0.6701)
% Auxiliary Sq	2.0000** (0.8874)	-2.684* (1.4187)	1.2906*** (0.3772)	-1.2165* (0.6812)
Admissions Rate	-0.1415*** (0.0308)	-0.2799*** (0.0297)	-0.1195*** (0.0181)	-0.1597*** (0.0172)
% Tuition Reliance	0.0312 (0.0447)	0.0422 (0.0397)	0.0081 (0.0287)	0.0536** (0.0227)
% Ages 18-24	0.4058*** (0.1100)	0.5505*** (0.0612)	0.3044*** (0.0403)	0.3265*** (0.0365)
% Part Time	-0.4458*** (0.0652)	-0.2924*** (0.0486)	-0.2031*** (0.0314)	-0.1814*** (0.0325)
% White	0.1448*** (0.0227)	0.2286*** (0.0314)	0.0483*** (0.0151)	0.1062*** (0.0185)

Z-FTE	0.0392*** (0.0050)	0.0788*** (0.0118)	0.0284*** (0.0036)	0.0427*** (0.0070)
Intercept	0.2856** (0.1127)	0.0672 (0.0799)	0.5574*** (0.0411)	0.5270*** (0.0437)
N	2,412	2,317	3,072	3,162
Clusters	391	440	391	440
R^2	0.6780	0.6346	0.6100	0.5297

***** $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Results for year dummy variables are not shown, available upon request.

Some interesting similarities and differences to Models 1-4 arise when looking at spending in this manner. Academic support remains a relevant category in all but the public graduation model (Model 11). To get a feel for the magnitude of these results, let's look at *% Academic Support* in Model 12. The marginal effect would be 1.0293 – 5.4786**% Academic Support*. For a private university with a median level of *% Academic Support* of 0.0725 (7.25%), the marginal effect would be 0.63 percentage points. In Model 12, a university would enter the region of absolutely diminishing marginal returns once *% Academic Support* exceeded 0.1879.

Both *% Student Services* and *% Auxiliary* are found to have negative associations with persistence in the public institution models. A negative correlation is further found for *% Operations* in the public graduation model (Model 11). Additionally, *% Research*, rather than being positively associated in the public models like before, is only found to be significant in the private retention model (Model 14). All of this combined could suggest that for public universities changing spending in a way that detracts from instructional resources is not the best path for student success. This may be reflective of students at public universities having a greater preference for instructional services than those a private; or, it could be reflective of public universities spending less efficiently on non-instructional services.

There is also a positive significant value found for *% Institutional Services* in the private graduation model (Model 12), perhaps further suggesting that private universities are more

effective at utilizing their non-academic services to support student success- but, no significant value for *% Institutional Services* is found in relation to retention rates.

Limitations

This analysis has a number of limitations. Perhaps chief among them is the broadness of the spending categories. Many of the categories cover a large swath of different programs/services/operations. Using student service spending as an example, it could be that a well-supported financial aid department is in fact helpful in guiding students towards completion, while admission and registration services are not- mixing the two would then deflate the impact of financial aid services in the results.

Additionally, the degree to which different universities' categorization of various items truly aligns is uncertain. As can be seen in the category definitions, certain university functions are expressly placed under different categories depending on how they're funded. Sports programs that don't self-fund qualify as student services, while sport programs that do self-fund are auxiliary services. Research conducted within a department's budget falls under instruction spending, but research conducted by a research center falls under the research category. Beyond that, while GASB & FASB standards provide certain guide rails, it's very likely that colleges- intentionally and unintentionally- place similar items into different categories than one another or place certain items in different categories than an outside observer would assume they belong. Some colleges, for example, may feel pressured to fit as much as possible under the instruction category, for fear of public criticism of their high administration costs. Future research might investigate how similar the categorization of various services truly is across different universities.

Further complicating the interpretation of results, is the uncertain relationship between higher spending and quality. I have tried as best I can in my analysis to consider both, but it is difficult to disentangle whether larger expenditure in a category is representative of higher quality services or of inefficient spending. A large expense in the *Operations* category, for example, may just as likely be the result of outdated infrastructure across campus which requires a large amount of maintenance as it could be representative of high-quality facilities.

Additionally, the data used in this analysis is not the most recent data available. As mentioned previously, while the Delta Project has not cleaned up any data past 2012, the IPEDS surveys it's based on are conducted annually. Future research may bring in IPEDS data from more recent years. One specific benefit of more recent data is that as of 2017 IPEDS calculates graduation rates that include students who transfer-in and those who enter college as a part-time student, providing a more holistic view of graduation (Itzkowitz, 2018). Additionally, how the COVID-19 pandemic has affected college expenditures and student preferences for college services could prove an interesting vein of research.

It should also be stressed that due to the nature of this paper's methodology, causation cannot be claimed. The results presented merely reflected correlations between spending behaviors and student persistence outcomes. Other factors that influence both student success and institution spending may be the drivers of persistence rates. It is also possible that persistence rates affect spending decisions, so reverse causality may be present- for example, 23 states currently link institution persistence rates to funding (Rosinger et al., 2020). Future research might try and determine causality by exploiting an exogenous shock to institution spending- a sudden, large donation to a university might serve this purpose[13].

[13] Worth noting that a large donation that was used exclusively for improving financial aid would not work, at least if IPEDS/Delta Project data was used for calculating expenditure. This is because IPEDS considers financial aid to

Finally, there is a possibility for unobserved institutional characteristics that were not captured by the fixed effects to create omitted variable bias. Though I accounted for many aspects, factors such as the college-preparedness of the student body might feasibly be related to both expenditure decisions and persistence rates, as well as vary over time.

IV. CONCLUSION

This paper has looked at how university spending in a variety of different areas affects student graduation and retention rates using panel data from the Delta Cost Project. It adds to previous papers that found a positive correlation between instruction spending and student persistence and finds that that positive correlation is consistent across a number of different university types, as well as methods of measuring expenditure and persistence. Academic support spending largely also seems to have a positive association with student success, but not as consistently.

The results for other areas of spending, however, can vary depending on institutional factors and methods of measurement. Research spending, for example, was found to positively relate to persistence at public universities, but not at private institutions nor when considered as a percentage of total spending; it also was found to have a positive association with persistence at doctoral universities, but may actually be negatively correlated with student success at baccalaureate institutions. Auxiliary services was also found to have positive, negative, or no association depending on the model in question. It seems that institutional context plays a large role in determining the relationship between category spending and student success.

be a cost reduction, rather than an expense, and so is not added to expenditure costs, but rather subtracted from tuition revenue.

While this paper cannot establish causation, it does appear that public concern over non-instruction focused higher education spending has some merit- while I don't find strong evidence that spending on areas such as student services or non-academic administration are correlated with worse student outcomes, they don't seem to help. Universities may want to look at their finances and consider whether they have funds which can be redirected back towards educational goals- though it should be noted from a university management perspective, what draws students to apply to a school may be different than what entices them to stay, a potential topic for future research.

Future research in this realm would also greatly benefit from more detailed data on where colleges spend their money, as the IPEDS categories are imperfect. More specific categories would allow researchers to provide colleges much better insight on where to target their spending.

Along with all the possible extensions previously discussed, I believe that further research into the relationship between student success/satisfaction and auxiliary enterprises could prove a deep vein. Auxiliary enterprises are a unique category in that they represent a cost to the university, but also a revenue source, as well as a non-tuition cost to students, all in one. Research into the proper pricing of auxiliary enterprises in serving both university financial interests and student interests would provide valuable understanding into the mechanisms of college operations. Not to mention that university housing and dining services, and the costs associated with them, seem too large of aspects of the college experience to not be investigated further.

V. BIBLIOGRAPHY

Abott, C., Kogan, V., Lavertu, S., & Peskowitz, Z. (2020). School district operational spending and student outcomes: Evidence from tax elections in seven states. *Journal of Public Economics, 183*, 104142. https://doi.org/10.1016/j.jpubeco.2020.104142.

Basic Classification. (n.d.). Carnegie Classification of Institutions of Higher Education. Retrieved May 16, 2024, from https://carnegieclassifications.acenet.edu/carnegie-classification/classification-methodology/basic-classification/

Calcagno, J. C., Bailey, T., Jenkins, D., Kienzl, G., & Leinbach, T. (2008). Community college student success: What institutional characteristics make a difference? *Economics of Education Review*, *27*(6), 632–645. https://doi.org/10.1016/j.econedurev.2007.07.003.

Crisp, G., Doran, E., & Salis Reyes, N. A. (2018). Predicting Graduation Rates at 4-year Broad Access Institutions Using a Bayesian Modeling Approach. *Research in Higher Education*, *59*(2), 133–155. https://doi.org/10.1007/s11162-017-9459-x.

Delta Cost Project Documentation of IPEDS Database and Related Products. (2011). Delta Cost Project. https://nces.ed.gov/ipeds/use-the-data/delta-cost-project-finance-data.

Education Pays. (2023, September 6). Bureau of Labor Statistics. https://www.bls.gov/emp/chart-unemployment-earnings-education.htm

Fike, D. S., & Fike, R. (2008). Predictors of First-Year Student Retention in the Community College. *Community College Review*, *36*(2), 68–88. https://doi.org/10.1177/0091552108320222.

Gansemer-Topf, A. M., & Schuh, J. H. (2006). Insitutional Selectivity and Institutional Expenditures: Examining Organizational Factors that Contribute to Retention and Graduation. *Research in Higher Education*, *47*(6), 613–642. https://doi.org/10.1007/s11162-006-9009-4.

Goodkind, N. (2024, February 21). *How demand and administrative costs are driving up the cost of college*. CNN Business. https://www.cbsnews.com/news/college-tuition-cost-rise-loans-administrative-bloat/.

Hickman, D. C., & Meyer, A. G. (2017). DOES ATHLETIC SUCCESS INFLUENCE PERSISTENCE AT HIGHER EDUCATION INSTITUTIONS? NEW EVIDENCE USING PANEL DATA. *Contemporary Economic Policy*, *35*(4), 658–676. https://doi.org/10.1111/coep.12208

IPEDS Data Collection System Glossary. (n.d.). National Center for Education Statistics. Retrieved March 19, 2024, from https://surveys.nces.ed.gov/ipeds/public/glossary.

IPEDS Survey Methodology. (n.d.). Integrated Postsecondary Education Data System. Retrieved March 19, 2024, from https://nces.ed.gov/ipeds/survey-components/ipeds-survey-methodology.

Itzkowitz, M. (2018, February 1). *New Data Further Cements Completion Crisis in Higher Education – Third Way*. Third Way. https://www.thirdway.org/memo/new-data-further-cements-completion-crisis-in-higher-education

Korn, M., Fuller, A., & Forsyth, J. S. (2023, August 10). Colleges Spend Like There's No Tomorrow. 'These Places Are Just Devouring Money.' *Wall Street Journal*. https://www.wsj.com/articles/state-university-tuition-increase-spending-41a58100.

Lindsay, A. C. (2022). *Avancemos!* Building Partnerships Between Academia and Underserved Latinx Communities to Address Health Disparities Through a Faculty-Mentored Undergraduate Research Program. *Health Promotion Practice, 23*(4), 569–576. https://doi.org/10.1177/1524839920953782

Ma, J., Baum, S., Pender, M., & Libassi, C. (2019). *Trends in College Pricing 2019* (Trends in College Pricing). College Board. https://research.collegeboard.org/media/pdf/trends-college-pricing-2019-full-report.pdf.

Mangold, W. D., Bean, L., & Adams, D. (2003). The Impact of Intercollegiate Athletics on Graduation Rates among Major NCAA Division I Universities: Implications for College Persistence Theory and Practice. *The Journal of Higher Education, 74*(5), 540–562. https://doi.org/10.1080/00221546.2003.11778889

McGurran, B. (2023, May 9). *College Tuition Inflation: Compare The Cost Of College Over Time*. Forbes Advisor. https://www.forbes.com/advisor/student-loans/college-tuition-inflation/.

Monaghan, D. B., & Sommers, O. K. (2022). And Now for Some Good News: Trends in Student Retention at Community Colleges, 2004–2017. *Research in Higher Education, 63*(3), 425–452. https://doi.org/10.1007/s11162-021-09656-6.

NCES. (n.d.). *Institutional Expenses—What are the total core expenses per full-time equivalent enrollment of public and private not-for-profit postsecondary institutions?* National Center for Education Statistics. Retrieved April 3, 2024, from https://nces.ed.gov/ipeds/TrendGenerator/app/answer/9/110.

Mixon, F. G., & Treviño, L. J. (2005). From kickoff to commencement: The positive role of intercollegiate athletics in higher education. *Economics of Education Review*, *24*(1), 97–102. https://doi.org/10.1016/j.econedurev.2003.09.005

NCES. (2020, August). *Graduation rate from first institution attended for first-time, full-time bachelor's degree-seeking students at 4-year postsecondary institutions, by race/ethnicity, time to completion, sex, control of institution, and percentage of applications accepted: Selected cohort entry years, 1996 through 2013*. National Center for Education Statistics; National Center for Education Statistics. https://nces.ed.gov/programs/digest/d20/tables/dt20_326.10.asp?referer=raceindica.asp

Pike, G. R., & Graunke, S. S. (2015). Examining the Effects of Institutional and Cohort Characteristics on Retention Rates. *Research in Higher Education*, *56*(2), 146–165. https://doi.org/10.1007/s11162-014-9360-9.

Pike, G. R., & Robbins, K. R. (2020). Using Panel Data to Identify the Effects of Institutional Characteristics, Cohort Characteristics, and Institutional Actions on Graduation Rates. *Research in Higher Education*, *61*(4), 485–509. https://doi.org/10.1007/s11162-019-09567-7.

Rishe, P. J. (2003). A Reexamination of How Athletic Success Impacts Graduation Rates: Comparing Student-Athletes to All Other Undergraduates. *The American Journal of Economics and Sociology*, *62*(2), 407–427. https://doi.org/10.1111/1536-7150.00219

Rosinger, K., Ortagus, J., Kelchen, R., Cassell, A., & Voorhees, N. (2020). *THE LANDSCAPE OF PERFORMANCE- BASED FUNDING IN 2020* (pp. 1–8). InformEd States. https://informedstates.org/policy-briefs-feed/the-landscape-of-performance-based-funding-in-2020

Ryan, J. F. (2004). The Relationship Between Institutional Expenditures and Degree Attainment at Baccalaureate Colleges. *Research in Higher Education*, *45*(2), 97–114. https://doi.org/10.1023/B:RIHE.0000015691.02545.61.

Sanford, T., & Hunter, J. M. (2011). Impact of Performance Funding on Retention and Graduation Rates. *Education Policy Analysis Archives*, *19*, 33. https://doi.org/10.14507/epaa.v19n33.2011.

Scott, M., Bailey, T., & Kienzl, G. (2006). Relative Success? Determinants of College Graduation Rates in Public and Private Colleges in the U.S. *Research in Higher Education*, *47*(3), 249–279. https://doi.org/10.1007/s11162-005-9388-y.

Suttles, G. (2019, June 24). *The Case for Using the Higher Education Price Index® (HEPI) to Define Inflation for Colleges*. Commonfund. https://www.commonfund.org/blog/hepi-defines-college-inflation.

Titus, M. A. (2006). Understanding the Influence of the Financial Context of Institutions on Student Persistence at Four-Year Colleges and Universities. *The Journal of Higher Education*, *77*(2), 353–375. https://doi.org/10.1353/jhe.2006.0009.

Valhouli, C. (2015, September 7). *These College Dorms Have Infinity Pools and Tanning Rooms*. Fortune. https://fortune.com/2015/09/07/college-dorm-rooms-luxury/.

Webber, D. A., & Ehrenberg, R. G. (2009). Do Expenditures Other Than Instructional Expenditures Affect Graduation and Persistence Rates in American Higher Education? *NBER Working Paper Series*, *NBER Working Paper No. 15216*, 1–32.

Weinstein Jr, P. (2023). *How to Cut Administrative Bloat at U.S. Colleges*. Progressive Policy Institute. https://www.progressivepolicy.org/wp-content/uploads/2023/08/PPI_College_Admin_Bloat.pdf.

What is an HBCU? | White House Initiative on Advancing Educational Equity, Excellence, and Economic Opportunity through Historically Black Colleges and Universities. (n.d.). White House Initiative on Advancing Educational Equity, Excellence, and Economic Opportunity through Historically Black Colleges and Universities. Retrieved February 13, 2024, from https://sites.ed.gov/whhbcu/one-hundred-and-five-historically-black-colleges-and-universities/.

Woodhouse, K. (2015, June 14). *Lazy Rivers and Student Debt*. Inside Higher Ed. https://www.insidehighered.com/news/2015/06/15/are-lazy-rivers-and-climbing-walls-driving-cost-college.

VI. APPENDIX

Table A1. IPEDS Spending Category Definitions

Category	IPEDS Full Definition
Instruction	A functional expense category that includes expenses of the colleges, schools, departments, and other instructional divisions of the institution and expenses for departmental research and public service that are not separately budgeted. Includes general academic instruction, occupational and vocational instruction, community education, preparatory and adult basic education, and regular, special, and extension sessions. Also includes expenses for both credit and noncredit activities. Excludes expenses for academic administration where the primary function is administration (e.g., academic deans). Information technology expenses related to instructional activities if the institution separately budgets and expenses information technology resources are included (otherwise these expenses are included in academic support). Institutions include actual or allocated costs for operation and maintenance of plant, interest, and depreciation.
Research	A functional expense category that includes expenses for activities specifically organized to produce research outcomes and commissioned by an agency either external to the institution or separately budgeted by an organizational unit within the institution. The category includes institutes and research centers, and individual and project research. This function does not include nonresearch sponsored programs (e.g., training programs). Also included are information technology expenses related to research activities if the institution separately budgets and expenses information technology resources (otherwise these expenses are included in academic support.) Institutions include actual or allocated costs for operation and maintenance of plant, interest, and depreciation.

Academic Support	A functional expense category that includes expenses of activities and services that support the institution's primary missions of instruction, research, and public service. It includes the retention, preservation, and display of educational materials (for example, libraries, museums, and galleries); organized activities that provide support services to the academic functions of the institution (such as a demonstration school associated with a college of education or veterinary and dental clinics if their primary purpose is to support the instructional program); media such as audiovisual services; academic administration (including academic deans but not department chairpersons); and formally organized and/or separately budgeted academic personnel development and course and curriculum development expenses. Also included are information technology expenses related to academic support activities; if an institution does not separately budget and expense information technology resources, the costs associated with the three primary programs will be applied to this function and the remainder to institutional support. Institutions include actual or allocated costs for operation and maintenance of plant, interest, and depreciation.
Institutional Support	A functional expense category that includes expenses for the day-to-day operational support of the institution. Includes expenses for general administrative services, central executive-level activities concerned with management and long range planning, legal and fiscal operations, space management, employee personnel and records, logistical services such as purchasing and printing, and public relations and development. Also includes information technology expenses related to institutional support activities. If an institution does not separately budget and expense information technology resources, the IT costs associated with student services and operation and maintenance of plant will also be applied to this function.
Student Services	A functional expense category that includes expenses for admissions, registrar activities, and activities whose primary purpose is to contribute to students emotional and physical well-being and to their intellectual, cultural, and social development outside the context of the formal instructional program. Examples include student activities, cultural events, student newspapers, intramural athletics, student organizations, supplemental instruction outside the normal administration, and student records. Intercollegiate athletics and student health services may also be included except when operated as self-supporting auxiliary enterprises. Also may include information technology expenses related to student service activities if the institution separately budgets and expenses information technology resources (otherwise these expenses are included in institutional support.) Institutions include actual or allocated costs for operation and maintenance of plant, interest, and depreciation.

Operations	A functional expense category that includes expenses for operations established to provide service and maintenance related to campus grounds and facilities used for educational and general purposes. Specific expenses include utilities, fire protection, property insurance, and similar items. This function **does not** include amounts charged to auxiliary enterprises, hospitals, and independent operations. Also includes information technology expenses related to operation and maintenance of plant activities if the institution separately budgets and expenses information technology resources (otherwise these expenses are included in institutional support).
Auxiliary Services	Expenses for essentially self-supporting operations of the institution that exist to furnish a service to students, faculty, or staff, and that charge a fee that is directly related to, although not necessarily equal to, the cost of the service. Examples are residence halls, food services, student health services, intercollegiate athletics (only if essentially self-supporting), college unions, college stores, faculty and staff parking, and faculty housing. Institutions include actual or allocated costs for operation and maintenance of plant, interest and depreciation.
Public Service	A functional expense category that includes expenses for activities established primarily to provide noninstructional services beneficial to individuals and groups external to the institution. Examples are conferences, institutes, general advisory service, reference bureaus, and similar services provided to particular sectors of the community. This function includes expenses for community services, cooperative extension services, and public broadcasting services. Also includes information technology expenses related to the public service activities if the institution separately budgets and expenses information technology resources (otherwise these expenses are included in academic support). Institutions include actual or allocated costs for operation and maintenance of plant, interest, and depreciation.
Independent	Expenses associated with operations that are independent of or unrelated to the primary missions of the institution (i.e., instruction, research, public service) although they may contribute indirectly to the enhancement of these programs. This category is generally limited to expenses of a major federally funded research and development center. Also includes information technology expenses, actual or allocated costs for operation and maintenance of plant, interest and depreciation related to the independent operations. Expenses of operations owned and managed as investments of the institution's endowment funds are excluded.

Grants	The sum of all operating expenses associated with scholarships and fellowships treated as expenses because the institution incurs an incremental expense in the provision of a good or service. Thus, payments, made to students or third parties in support of the total cost of education are expenses if those payments are made for goods and services not provided by the institution. Examples include payments for services to third parties (including students) for off-campus housing or for the cost of board provided by institutional contract meal plans. The amount of expense in this function at the majority of reporting institutions is the total of all institutional scholarships reduced by the amount that is classified as discounts and allowances.
Hospital Services	Expenses associated with a hospital operated by the postsecondary institution (but not as a component unit) and reported as a part of the institution. This classification includes nursing expenses, other professional services, general services, administrative services, and fiscal services. Also included are information technology expenses, actual or allocated costs for operation and maintenance of plant, interest and depreciation related to hospital capital assets.
Other	The residual amount of expenditures between the total expenditure amount reported by an institution and the sum of the functional expenditure categories.

Table A3. Descriptive Statistics by Public vs. Private

Variables	Mean *Public (Private)*	Std Dev *Public (Private)*	Median *Public (Private)*	Min *Public (Private)*	Max *Public (Private)*
6-Year Graduation Rate	0.4916 (0.6274)	0.1539 (0.1740)	0.4794 (0.6338)	0.0628 (0.0523)	0.9390 (0.9806)
Retention Rate	0.7467 (0.7856)	0.0997 (0.1166)	0.7500 (0.8000)	0.1600 (0.1900)	0.9700 (0.9900)
FTE Students	12,739 (3,479)	11,056 (4,604)	8,747 (1,893)	646 (31)	70,460 (37,922)
Instruction ($1000/Student)	6.49 (9.34)	3.09 (7.45)	5.68 (7.37)	1.98 (1.71)	36.96 (95.62)
Research ($1000/Student)	2.21 (1.90)	4.16 (7.12)	0.33 (0.05)	0 (0)	59.48 (119.87)
Academic Support ($1000/Student)	1.63 (2.50)	1.26 (3.62)	1.38 (1.76)	0.01 (0.06)	31.43 (67.17)
Institutional Support ($1000/Student)	1.84 (4.55)	1.00 (2.59)	1.64 (3.85)	0.23 (0.65)	10.38 (22.39)
Student Services ($1000/Student)	1.20 (3.19)	0.62 (1.56)	1.07 (2.94)	0.23 (0.20)	7.12 (15.49)
Operations ($1000/Student)	1.51 (2.04)	0.80 (1.85)	1.30 (1.56)	0.19 (0.01)	8.27 (25.75)
Auxiliary ($1000/Student)	2.63 (4.08)	1.95 (2.62)	2.21 (3.56)	0 (0.05)	28.66 (41.68)
Admission Rate	0.6991 (0.6355)	0.1660 (0.1906)	0.7124 (0.6721)	0.0700 (0.0348)	1 (1)
% Tuition Reliance	0.3197 (0.5461)	0.1105 (0.1531)	0.3093 (0.5623)	0.0214 (0.0179)	0.8101 (0.9156)
% Ages 18-24	0.8633 (0.9054)	0.0895 (0.1053)	0.8820 (0.9428)	0.1629 (0.1614)	0.9881 (0.9991)
% Part Time	0.1809 (0.1041)	0.1149 (0.1090)	0.1531 (0.0598)	0.0095 (0.0006)	0.7224 (0.6549)
% White	0.6698 (0.6873)	0.2229 (0.2096)	0.7359 (0.7441)	0.0117 (0)	0.9584 (0.9918)

N is 3,589 for public institutions and 3,680 for private.

Table A4. Descriptive Statistics by Baccalaureate/Masters/Doctoral

Variables	Mean *Baccalaureate* *(Masters)* *[Doctoral]*	Std Dev *Baccalaureate* *(Masters)* *[Doctoral]*	Median *Baccalaureate* *(Masters)* *[Doctoral]*	Min *Baccalaureate* *(Masters)* *[Doctoral]*	Max *Baccalaureate* *(Masters)* *[Doctoral]*
6-Year Graduation Rate	0.5663 (0.4958) [0.6307]	0.1862 (0.1468) [0.1700]	0.5660 (0.4892) [0.6269]	0.0523 (0.0628) [0.1998]	0.9806 (0.8759) [0.9612]
Retention Rate	0.7458 (0.7405) [0.8279]	0.1217 (0.0865) [0.0942]	0.7500 (0.7400) [0.8300]	0.1900 (0.2500) [0.1600]	0.9900 (0.9600) [0.9900]
FTE Students	1,742 (7,011) [18,414]	1,324 (5,290) [11,664]	1,490 (5,746) [16,192]	31 (490) [1,291]	18,496 (51,620) [70,460]
Instruction ($1000/Student)	7.30 (5.96) [11.23]	4.03 (2.40) [9.01]	6.17 (5.48) [8.58]	1.71 (2.23) [2.41]	34.59 (31.16) [95.62]
Research ($1000/Student)	0.27 (0.51) [6.51]	0.75 (2.61) [9.43]	0 (0.13) [3.98]	0 (0.01) [0.01]	9.45 (59.48) [119.87]
Academic Support ($1000/Student)	1.81 (1.42) [3.24]	1.36 (0.86) [4.72]	1.45 (1.27) [2.20]	0.06 (0.01) [0.25]	9.88 (10.65) [67.17]
Institutional Support ($1000/Student)	4.01 (2.21) [3.29]	2.25 (1.48) [2.99]	3.54 (1.81) [2.34]	0.23 (0.27) [0.31]	15.49 (21.40) [22.39]
Student Services ($1000/Student)	3.14 (1.55) [1.65]	1.67 (0.99) [1.23]	2.98 (1.29) [1.27]	0.26 (0.23) [0.20]	15.49 (9.19) [10.14]
Operations ($1000/Student)	1.84 (1.34) [2.24]	1.26 (0.67) [2.12]	1.52 (1.20) [1.68]	0.01 (0.01) [0.09]	12.10 (6.53) [25.75]
Auxiliary ($1000/Student)	3.91 (2.39) [3.77]	2.27 (1.65) [3.01]	3.53 (2.03) [3.14]	0.01 (0) [0.24]	22.75 (17.40) [41.68]
Admission Rate	0.6629 (0.7017) [0.6300]	0.1833 (0.1545) [0.2011]	0.6945 (0.7142) [0.6726]	0.0348 (0.0700) [0.0710]	1 (1) [0.9938]
% Tuition Reliance	0.4953 (0.4328) [0.3485]	0.1510 (0.1730) [0.1750]	0.5186 (0.3961) [0.3037]	0.0179 (0.0214) [0.0710]	0.8789 (0.9004) [0.9156]

% Ages 18-24	0.8919 (0.8621) [0.9014]	0.1123 (0.0979) [0.0764]	0.9285 (0.8844) [0.9251]	0.1614 (0.1629) [0.3616]	0.9991 (0.9969) [0.9969]
% Part Time	0.1104 (0.1793) [0.1307]	0.1143 (0.1233) [0.1054]	0.0647 (0.1499) [0.1081]	0.0006 (0.0101) [0.0006]	0.6289 (0.7224) [0.5896]
% White	0.7203 (0.6763) [0.6217]	0.2166 (0.2224) [0.1945]	0.7806 (0.7465) [0.6646]	0 (0.0117) [0.0011]	0.9918 (0.9551) [0.9271]

N is 2,861 for baccalaureate institutions, 2,423 for masters institutions, & 1,985 for doctoral.

Table A4. Percentage Spending Descriptive Statistics

Variables	**Mean** *Public* *(Private)*	**Std Dev** *Public* *(Private)*	**Median** *Public* *(Private)*	**Min** *Public* *(Private)*	**Max** *Public* *(Private)*
Instruction (% of Total)	0.3256 (0.3107)	0.0676 (0.0693)	0.3313 (0.3126)	0.1045 (0.0860)	0.5705 (0.5538)
Research (% of Total)	0.0644 (0.0221)	0.0860 (0.522)	0.0215 (0.0010)	0 (0)	0.4773 (0.4705)
Academic Support (% of Total)	0.0815 (0.0758)	0.0298 (0.0401)	0.0785 (0.0716)	0.0004 (0.0060)	0.2675 (0.4458)
Institutional Support (% of Total)	0.0960 (0.1725)	0.0395 (0.0529)	0.0908 (.1697)	0.0096 (0.0101)	0.2519 (0.3969)
Student Services (% of Total)	0.0700 (0.1366)	0.0345 (0.0578)	0.0654 (0.1397)	0.0085 (0.0062)	0.1817 (0.4002)
Operations (% of Total)	0.0675 (0.0691)	0.0285 (0.0336)	0.0652 (0.0647)	0.0085 (0.0015)	0.1767 (0.4002)
Auxiliary (% of Total)	0.1386 (0.1456)	0.0718 (0.0547)	0.1305 (0.1455)	0.0002 (0.0060)	0.3679 (0.4226)
Z-FTE	0.4900 (-0.3452)	1.0199 (0.3964)	0.1169 (-0.4787)	-0.5555 (-0.6202)	5.6365 (2.540)

N is 3,589 for public institutions and 3,680 for private.

Like Table 1, these descriptive statistics represent spending before applying any averages or lags.