Education, Research, and Spending Decisions: Linking revenues and expenditures in public and non-profit higher education

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1 Introduction

American postsecondary education is a highly unique and interesting industry. It shares characteristics with a wide variety of other markets but has several aspects unique to it. Like most businesses, institutions of higher education provide goods and services to paying customers. However, these goods and services are complex. Consumers pay for many goods and services that are all bundled together as the single "good" of education. Like other personal service industries, educational institutions employ knowledgeable professionals whose knowledge is the good itself. Unlike these other industries, this knowledge is directly passed on to consumers rather than merely used to accomplish a specified task. In addition, education is a good that is consumed over a long period of time and is rarely an end in itself. It is usually an investment for future use in the job market and in life.

The demand side of higher education is also worth noting. Consumers of higher education are not the standard buyer. These consumers are typically younger and, for many, are just leaving the nest for the first time. Their tuition costs are rarely paid for entirely through self-funding. A combination of grants, scholarships, loans, personal finances, and help from home typically go toward funding students' education.

Colleges also fund their operations in a variety of ways. Like most non-profit and public institutions in other markets, colleges and universities have access to diverse revenue streams. In addition to tuition revenues, institutions of higher learning also receive government contracts and appropriations, donations and endowments, and auxiliary revenues from school-ran outside enterprises, such as hospitals. Also like most public and non-profit institutions in other fields, most postsecondary schools cannot distribute profits to owners. This is because the field is largely dominated by public and non-profit institutions. This makes having a variety of revenue sources even more interesting because all of those revenues will go directly back into running the institution.

All of the above factors make higher education a field worth studying. This has become especially true lately due to a number of developing trends. Over the past couple of decades, costs in higher education have been skyrocketing. In particular, the last decade has seen massive increases in tuition at most higher education institutions. (Desrochers et. al, 2009) There has been much literature and research done on this worrisome trend in recent years. The works range from trying to explain the cost increases to policy suggestions and the creation of cost and revenue accountability metrics. The methods vary widely, but the type that caught my eye relied on the diverse revenue streams available to institutions of higher education. While I do not seek to explain cost increases specifically, I will attempt to link costs and revenues. In particular, I want to model spending as a function of different types of revenue sources.

In conjunction with these cost increases, there have been rising tensions between parties advocating for expansion in the field of research and those advocating for the traditional mission of providing high quality

education. (Desrochers et. al, 2010) These tensions are particularly strong at four year research institutions. The Carnegie Foundation classifies an institution as a research school if a substantial portion of activities are research related. (Carnegie Foundation, 2012) These institutions already engage in large amounts of research, and the trend has been an increasing proportion of total spending going toward research. (Desrochers et. al, 2010) This "mission drift," which will be discussed more extensively later, has been a point of contention in recent years.

There are multiple reasons for an institution to engage in research. For example, high powered research draws attention and prestige to an institution. It also acts as an attraction for highly skilled and nationally regarded professors and researchers. Then there are the potential revenue benefits. Private donors and businesses might want to support a school that engages in a particular kind or level of research. The federal, state, and local governments are also interested in advancing research, and provide lucrative contracts to institutions that engage in such research. These pressures increase the difficulty for institutions choosing between spending on education and spending on research.

This paper looks at one aspect of this research-education tension. The focus is on how diverse revenue streams and revenue driven incentives affect four year research institution spending decisions when it comes to research and education related expenses. The goal is not to find the optimal amount of education and research spending. The main task here is to better understand how changes in revenue structures affect spending decisions at four year research institutions. This will be done theoretically and then with regression analysis. The final product is a set of linear regressions that estimates spending on research and education as functions of the different possible revenue sources for these institutions. These regressions can then be used to estimate spending under specific conditions and to analyze what happens to education and research spending when revenue structures change. In this paper, I will focus on the latter use of the regressions. I will also pay special attention to any differences over time and any differences between public and non-profit institutions. The regressions will be constructed in order to highlight possible differences. I conclude that non-profits and public institutions behave differently when it comes to revenues and education and research spending, and this leads non-profits to be more insulated from the mission drift associated with increased research spending relative to education.

It should be noted that this is not a policy paper. There will be no prescriptions for how to ease the education-research tension, nor any opinion as to how institutions should structure expenditures. However, the hope is that the metrics and analysis provided here can aid institutions, future researchers, and policy makers in making these decisions. It is also my desire for this piece to contribute to the literature on differences between the different sectors in mixed markets.

As a guideline for what will come, here is a brief outline of the paper. In the second section, brief back-

grounds on non-profits and the field of higher will be given. Relevant literature will be reviewed throughout the section. The section will finish with a theoretical discussion of the relationship between revenue streams and expenditures and the development of a utility maximization model to explain and predict such relationships. The third section discusses the statistical methods I used in my analysis. The methodology is developed and the data I used is described in detail. In section four, the results of my linear regression analysis are presented. Particular emphasis is put on describing and explaining differences in regression coefficients over time and between non-profit and public institutions. The fifth section is a brief discussion of the implications of the results section. The sixth section is the conclusion.

2 Background and Theory

Before I launch into the econometric portion of my thesis, I will give some theoretical background. There are three parts here. First, I will discuss non-profit theory as it relates to my paper. Next, I will give background on the higher education field, its similarities to non-profits, and its unique aspects. Finally, there will be a discussion of what the theory tells us and what claims arise. In this section, relevant previous works will be discussed as it is necessary.

2.1 Non-profit Theory

Non-profit organizations have a long history in the field of economics. There are many definitions and defining characteristics of non-profits. The definition I will use is that a non-profit is any private organization that is subject to the non-distribution constraint. This means that these institutions voluntarily give up their ability to distribute excess profits to owners. (Frumkin, 2002) The moniker of non-profit is often confusing for this reason. Non-profits can generate profit just like any typical for-profit business; they just cannot distribute that excess profit. Owners get fixed, predetermined compensation.

This leads to the question of why any institution would voluntarily do this. The simple answer is that the definition of non-profit is both a legal and tax-based provision. That is, non-profits are provided special tax benefits if they follow the appropriate laws. These benefits typically come in three varieties. First, all non-profits are not taxed on revenues that are directly related to their missions. This includes sources such as donations or sale of mission-related goods and services. (Frumkin, 2002) For example, a non-profit might have the mission of providing cheap healthcare to underprivileged families. Any revenues that this company generates through the sale of healthcare will not be taxed.

The second potential benefit is that many non-profits receive other tax breaks. For example, many institutions do not pay local property or sales tax. (Salamon, 1999) The third benefit applies to a special class of non-profits. Institutions in this category are referred to by the title of the portion of the tax code

in which they are defined, 501 (c)(3). These 501 (c)(3) organizations can receive tax-deductible donations. Donors to such an organization get the dollar amount of their donation deducted from their taxable income. This increases the incentive to donate to 501 (c)(3)'s because the government essentially pays part of the donation in the form of a tax deduction. (Salamon, 1999)

There are also many non-tax benefits to being non-profit, such as being considered more trustworthy by consumers and having access to diverse revenue streams. (Weisbrod, 1988) There is extensive economic literature that describes in detail these non-tax benefits. For my purposes, I will only discuss revenue streams. Non-profits have access to sources of revenue that are typically closed to their for-profit counterparts. In particular, non-profits receive donations and government funding and contracts. For-profits can legally receive this kind of revenue, but rarely do. (Weisbrod, 1988) These extra revenue sources often make non-profit organizations more flexible than for-profits. For instance, if a non-profit college is down on enrollment, it can appeal to the government and donors for additional funds. It can also rely on endowments and stockpiled funds. A for-profit college in the same situation would have far fewer recourses.

Despite the benefits of having access to diverse revenue streams, there are some consequences. One of the most well documented problems is that of mission drift. This typically occurs when a non-profit "follows the money". That is, a non-profit does something uncharacteristic in relation to its mission in order to obtain funds. (Scheitle, 2009) For example, an environmental group that advocates an immediate switch away from gasoline as fuel may change its opinion to a more gasoline and coal friendly view in order to receive government funding. The ability to control revenue sources partly allows this kind of diversion of mission to occur.

One example of an empirical study of mission drift comes from Scheitle (2009). He considers a form of mission drift for Christian non-profits. He is interested in showing whether receiving government funds affects the stated identity of Christian non-profits. Scheitle uses variables such as statement of religious identity and the religious strength of words used in the mission statement as measures of Christian identity. He compares government funded institutions with institutions that do not receive government funds. This is particularly interesting for me because I am comparing public and non-profit institutions in higher education. Although both types receive government funding, public institutions receive far more government funds.

Scheitle carries out his comparison using logistic regression. He concludes that expressed religiousness has a negative relationship with government funding. In other words, institutions with stronger religious identities tend to not receive government funds. In particular, the coefficient for references to God is -1.7, the coefficient for references to Jesus Christ is -1.12, and the coefficient for use of any religious key word is -0.617. It should be noted that this conclusion does not imply that receipt of government funding changes religious identity or vice versa. Scheitle looks specifically at this by considering 20 transition institutions,

those that did not receive government funding before 2002 but received it after. He finds that 85 percent of these institutions did not change their religious identity over the time period. He also notes that these institutions had more inclusive religious identities to begin with. Scheitle concludes that some underlying factor explains both religious identity and the relative amount of government funds received for Christian non-profits.

This piece is useful to me for two reasons. First, Scheitle compares two institution types that are different based on level of government funding. I am also comparing institution types, non-profit and public in higher education. In addition, public research universities tend to receive more government funding. Just as Scheitle hypothesized, I believe that this difference will change the behavior of public institutions relative to non-profits. The second reason this piece is important is that it helped me with my statistical model. Although I am not doing a logistic regression, I am performing a regression that relates mission to some underlying structure of the institutions. In my case, mission is measured by spending on education and research, and the underlying structure is manifested by the revenue structures of public and non-profit institutions.

2.2 Higher Education

As suggested by its name, the higher education industry is in the business of providing postsecondary education to paying customers. Like businesses in any other industry, colleges and universities buy factors of production in order to sell goods and services. However, there are many unique aspects to the industry. One interesting characteristic of higher education is the presence of an atypical market structure. On the surface, the market shares some similarities with the usual profit maximizing market structure. Higher education is highly competitive on both the demand and supply sides. Institutions seek to differentiate themselves from each other through advertising, increasing quality and quantity, and specialization. The major difference, however, is that this competition is not underscored by the pursuit of profit. (Clotfelter, 1996) Institutions battle for prestige, pride, and revenues. Competition is fueled by these pursuits as well as the simple notion that a lack of funding, whether it comes from students, the government, Aunt Marge's hefty donations, or investment returns, will lead to institution failure and bankruptcy. This worry exists for for-profits as well, but it is typically encompassed by the pursuit of profits. If a company is making a profit, then it will avoid closure.

Another major structural difference is the presence of a concrete mission for public and non-profit institutions. At for-profit companies, the major goal is profit, even though other goals may exist. Since public and non-profit institutions cannot be profit-maximizers, they must have some other reason for existing. This reason is their mission. In higher education an institution's stated mission deals heavily with its key product, education. (Desrochers et. al, 2009) This is true of public and non-profit institutions across the sector.

In recent years, much more emphasis has been placed on research. This is especially true at research institutions. Such institutions put a significant proportion of their spending into research, and this proportion has been recently increasing. (Desrochers, et. al, 2009) With the rapid advancements in technology over the last couple decades, especially in computer technology, many research projects that were computationally or temporally prohibitive are now doable. This has increased the demand for high powered research by both the public sector and the private business sector. (Desrochers et. al, 2010) Just as with non-profits, the higher education industry is subject to mission drift. In this case, the drift is largely considered to be away from education and toward research. I hope to display this mission drift and the components of it by statistically linking revenues to education and research spending and then considering differences in revenue structures over time and between non-profit and public institutions.

Another unique aspect of higher education is the nature of the good being sold. As mentioned in the introduction, higher education is a complex good. The provision of this "good" involves many inputs as well as outputs. Classes, lab classes, Room and board, athletics, clubs, community service opportunities, and assorted educational opportunities are all often considered part of the college experience. Academic buildings, dormitories, professors, laboratories, coaches, athletic and dining facilities, and plenty of faculty and staff extra hours are needed to provide all of these aspects of the educational experience.

As a result educational institutions have a wide variety of spending categories. At the same time, revenue streams are diverse because the higher education industry is dominated by public and non-profit institutions. These institution control types allow for other forms of revenue generation besides the typical sale of goods and services. (Salamon, 1999) This leaves colleges and universities with a slew of choices to make. Institutions need to figure out what to spend money on and how much to spend. They also can decide how to structure revenues effectively and efficiently in order to achieve spending goals. The rest of this paper focuses on this interplay between revenue and cost decisions.

In order to proceed with the theoretical and econometric analysis, a framework must be set. This framework largely comes from Desrochers et. al (2009). The authors of this paper seek to increase cost accountability in higher education. To do this, they consider revenue and cost categories and decision making. Each category is based on the well-known measure of full-time equivalent (FTE) student. FTE measures the effective number of students at an institution. Each spending and revenue category is measured per FTE student. University spending is broken up into five categories: education, research, public service, auxiliary spending, and scholarships and fellowships. The revenue categories are tuition, state and local appropriations, government contracts, auxiliary revenues, and private donations and endowments. These categories will be described in greater detail in the Models section below.

Desrochers et. al (2009) use these spending and revenue categories to discuss trends in higher education

and the consequences that result. They begin by considering revenue sources and trends. They do this because revenues drive costs and "dictate functionality in higher education." (Desrochers et. al, 2009) This is what is called the "revenue theory of costs." This theory, first articulated by Howard Bowen, states that overall spending levels and spending decisions are dictated by revenue structures. (Archibald and Feldman, 2008) In light of this, Desrochers et. al link revenues to costs.

The revenue trends that the authors articulate are summarized below. General revenues differ by institution control type. Public institutions receive most of their general revenues from government appropriations and tuition while non-profits rely on tuition and private donations and endowments. In addition, tuition in public institutions is often used as a recovery mechanism when state funding is cut. Public institutions increase tuition in order to offset budget declines in other areas. Government contracts are typically restricted revenues that are largely for public service or specified research. Auxiliary revenues come from school operated self revenue generating enterprises, such as hospitals and bookstores. These revenues are typically not available for general use by the institution because they are poured back into the auxiliary enterprise.

For cost trends, Desrochers et. al consider a wide variety of cost measures. I am interested in those for education and research related expenses, so I will describe those here. The first major trend is that non-profit research schools spend far more per FTE student than public schools. In 2006, the level was over double with non-profits spending $64,000 per FTE student on average and public institutions only spending $31,000. The second trend is that research spending is on the rise in both public and non-profit institutions. Between 2002 and 2006, not only did research spending increase, it increased more than any other category for both public and non-profit research institutions.

The final set of trends deals with spending as it relates to tuition. The most important occurrence here is that tuition increases outpaced education spending increases for both non-profit and public institutions. Desrochers et. al argue that this implies that all institutions, regardless of control type, "are becoming more dependent on tuition as a source of general revenue." This includes not just revenues used for education spending, but those used for research spending and other spending categories as well. In addition, the tuition increases relative to education spending increases were far larger at public institutions. From 2002 to 2006, tuition increased 29.8 percent at public schools while education spending went up only 2.5 percent. Non-profits, on the other hand, saw similarly sized increases in both tuition and education spending. These increases were 12.6 and 9.1 percent respectively. I will test these cost-revenue relationships statistically.

I used the above framework and assumptions in three ways. The revenue and spending categories are first used to create an economic model, introduced below, that looks at the relationships between revenues and costs. Next, the trends that Desrochers et. al analyzed are the basis for a theoretical discussion of differences over time and between non-profits and public institutions. Finally, I took two of the spending categories,

education and research, and for each, I created multiple linear regressions with the five revenue variables as independent variables. I hope to test some of the relationships discussed in Desrochers et. al (2009), as well as discover some new trends.

2.3 An Economic Model

The econometrics portion of this paper seeks to quantify the previously discussed relationships between spending and revenue structures. In particular, the focus will be on education and research spending. The goal is to gain insight into the education-research tension that has been developing in higher education. Econometrics is helpful in that it can give us tangible numerical approximations for the possible relationships between spending on education and research and the different revenue categories described previously. Still, this is not the only method. To fully understand the questions at hand, let's first see what we can glean from economic theory and mathematical economics. To do this, I will develop a simple economic model based on utility maximization.

Consider the spending decisions of some research university. As mentioned above, this institution can spend money in five different categories: education, research, public service, auxiliary expenses, and scholarships and fellowships. Since my statistical analysis will focus on research and education, I will simplify the economic model and consider just these two expenditure categories. Thus, the college can buy units of research or units of education. Notice that the language here is in terms of consumer, not producer, choice. Technically, the institution is buying the means to provide education and research opportunities to consumers (i.e. students, faculty, visiting faculty), but for simplification, I will view the university as a utility-maximizing consumer itself.

The utility maximization approach makes sense when you think in terms of the institution's mission. Research colleges, whether public or private, seek to provide high quality education and high-powered research opportunities. We can think of spending on education and research as a proxy for this mission. The more an institution spends on one of the categories, the more it can provide of this category, and better quality can also be provided. This leads to a greater ability to fulfill the mission. Since the non-distribution constraint is in effect, the institution can be viewed as a "mission maximizer" and not a profit maximizer. If we think of satisfying the mission as providing utility to the institution, we have a standard utility maximization problem. Furthermore, we have a constrained utility maximization problem because the institution is subject to a budget constraint. Specifically, the constraint is total revenue, which we can break down into the five revenue categories mentioned above. This gives us the following utility maximization problem:

$$\max_{\{(E,R)\}} U(E,R) \quad \text{subject to} \quad M = p_E E + p_R R,$$

where $U(E, R)$ is the instition's utility function, E is units of education, R is units of research, p_E is the price of a unit of education, p_R is the price of a unit of research, and M is total revenue. We can separate M into its components using the equation: $M = X_1 + X_2 + X_3 + X_4 + X_5$ where each X_i for $i \in \{1, 2, 3, 4, 5\}$ is one of the five revenue categories.

We can introduce some assumptions into this model based on standard economic theory and higher education theory. First, we expect all prices to be positive and all revenue variables to be positive. Since all research institutions provide at least some research and education, we will assume positive interior solutions to the problem. In addition, we assume that we have a nice utility function. That is, we have a utility function that exhibits positive but diminishing marginal returns with respect to education and research. The first part of this assumption is justified by the fact that research and education are goods. An increase in either will increase the institution's ability to satisfy its mission, which increases its utility. Diminishing marginal returns makes sense as an assumption due to the nature of a "unit" of education or research. A unit includes purchases such as professor salaries, new lab materials, and building upkeep. In most cases, these goods and services exhibit diminishing marginal utility. For instance, the increase in educational quality and quantity provided by hiring the first professor is likely to be much larger than the increase provided by hiring the one hundredth professor.

Our final assumption is that the mixed partial derivative of utility with respect to education and research is positive. That is, $\frac{\partial^2 U}{\partial R \partial E} = U_{ER} > 0$. In plain terms this means that having more units of research increases the amount of utility that an additional unit of education provides and vice versa. The basis for this assumption goes back to Nerlove (1972). He argues that education and research are complements in production. This is equivalent to my assumption because I define increased utility by an increase in the ability to provide education and research (i.e. the output of the production function for an institution). Nerlove's argument is that the resources for education, such as libraries, collections of scholarly works, and labs, are also necessary for research. In addition, Nerlove states that many introductory courses at big research schools are taught by the very same people doing the research because this teaching informs and improves research. In this sense, education and research are complementary.

With the model framework set, we can start our theoretic analysis. In particular, we want to find out how changes in the different revenue categories affect spending on research and education. With the above assumptions we can actually use comparative statics on the first order conditions for Lagrangian maximization in order to sign:

$$\frac{\partial E}{\partial X_i} \text{ and } \frac{\partial R}{\partial X_i} \text{ for each } i \in \{1, 2, 3, 4, 5\}.$$

The associated Lagrangian for this maximization problem is:

$$L(E, R, \lambda) = U(E, R) + \lambda(X_1 + X_2 + X_3 + X_4 + X_5 - p_E E - p_R R),$$

where λ is the Lagrange multiplier.

This gives us the first order conditions:

$$L_E = 0 = U_E(E^*, R^*) - \lambda^* p_E$$

$$L_R = 0 = U_R(E^*, R^*) - \lambda^* p_R$$

$$L_\lambda = 0 = X_1 + X_2 + X_3 + X_4 + X_5 - p_E E^* - p_R R^*$$

where an asterisk indicates a value that is an optimal solution. We cannot solve these conditions directly, but we know that the optimal values for education and research can be expressed as functions of the revenue variables, the price of education, and the price of research. That is, $E^* = E^*(X_1, X_2, X_3, X_4, X_5, p_E, p_R)$, $R^* = R^*(X_1, X_2, X_3, X_4, X_5, p_E, p_R)$, and $\lambda^* = \lambda^*(X_1, X_2, X_3, X_4, X_5, p_E, p_R)$.

Let's assume that we have such a set of solutions. This means that the first and second order conditions are satisfied. The second order conditions are:

$$|\bar{H}_1| < 0 \text{ and } |\bar{H}_2| = |\bar{H}| > 0,$$

where $|\bar{H}_1|$ and $|\bar{H}_2|$ are the determinants of the first and second order border principle minors for the Hessian matrix associated with the Lagrangian function, respectively. Notice that the second order border principle minor is just the Hessian matrix itself.

Now we plug the functional forms of our optimal values for research and education back into the first order conditions. This gives us a set of three identities:

$$0 \equiv U_E(E^*(X_1, X_2, X_3, X_4, X_5, p_E, p_R), R^*(X_1, X_2, X_3, X_4, X_5, p_E, p_R)) - \lambda^*(X_1, X_2, X_3, X_4, X_5, p_E, p_R) p_E$$

$$0 \equiv U_R(E^*(X_1, X_2, X_3, X_4, X_5, p_E, p_R), R^*(X_1, X_2, X_3, X_4, X_5, p_E, p_R)) - \lambda^*(X_1, X_2, X_3, X_4, X_5, p_E, p_R) p_R$$

$$0 \equiv X_1 + X_2 + X_3 + X_4 + X_5 - p_E E^*(X_1, X_2, X_3, X_4, X_5, p_E, p_R) - p_R R^*(X_1, X_2, X_3, X_4, X_5, p_E, p_R).$$

We can take the partial derivatives of each side of the three identities with respect to one of the revenue variables. Note that we just choose an arbitrary revenue variable, X_i, because the structure of the budget constraint will lead to all of the partial derivatives in which we are interested having the same sign. This

gives us a system of three equations in three unknowns. In matrix form, this system is as follows:

$$\begin{bmatrix} U_{EE} & U_{ER} & -p_E \\ U_{ER} & U_{RR} & -p_R \\ -p_E & -p_R & 0 \end{bmatrix} \begin{bmatrix} \frac{\partial E^*}{\partial X_i} \\ \frac{\partial R^*}{\partial X_i} \\ \frac{\partial \lambda^*}{\partial X_i} \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ -1 \end{bmatrix}$$

Note that the three by three matrix is simply the Hessian matrix, H. Using Cramer's Rule, we can solve for $\frac{\partial E^*}{\partial X_i}$ and $\frac{\partial R^*}{\partial X_i}$. For $\frac{\partial E^*}{\partial X_i}$ we get:

$$\frac{\partial E^*}{\partial X_i} = \frac{\begin{vmatrix} 0 & U_{ER} & -p_E \\ 0 & U_{RR} & -p_R \\ -1 & -p_R & 0 \end{vmatrix}}{|H|} = \frac{p_R U_{ER} - p_E U_{RR}}{|H|}$$

For $\frac{\partial R^*}{\partial X_i}$ we get:

$$\frac{\partial R^*}{\partial X_i} = \frac{\begin{vmatrix} U_{EE} & 0 & -p_E \\ U_{ER} & 0 & -p_R \\ -p_E & -1 & 0 \end{vmatrix}}{|H|} = \frac{p_E U_{ER} - p_R U_{EE}}{|H|}$$

By the previous assumptions, U_{ER}, p_E, p_R, and $|H|$ are positive and U_{EE} and U_{RR} are negative. Thus, both $\frac{\partial E^*}{\partial X_i}$ and $\frac{\partial R^*}{\partial X_i}$ are positive. This means that an increase in any revenue source will lead to an increase in units of education and units of research purchased. Since all prices are positive, this means that an increase in any revenue source will increase spending on research and education.

In addition to allowing us to hypothesize the signs of regression coefficients, the above economic model also informs the building of the regressions that will be introduced in the next section. In particular, it gives us the basic regression model framework. In the utility-maximizing model, the choice variables are education and research. This suggests that these variables should also be the dependent variables in the regressions. This will give us a set of education regressions, where education spending is the dependent variable. The same will be true for research. Also, the economic model led to viewing education and research spending as functions of the different revenue categories. This implies that the regressions should have revenue categories as the independent variables.

It should be noted that this is not the only way to approach the modeling of this scenario. Inherent in both the economic model above and the regressions that follow is the assumption that revenue structures inform spending decisions. Revenue variables are treated as givens. Institution spending decisions then naturally follow based on the given revenue structure. After the modeling is played out, then it is acknowledged that

institutions, in reality, have some measure of control over revenue sources and amounts. I could just have easily considered a model with revenue categories as the choice variables. This would have led to revenues as a function of spending and perhaps other variables. The resulting regressions would have revenue variables as the dependents and spending variables as explanatory variables.

The above economic model gives good initial insight, but cannot tell us everything by itself. In particular, it does not allow us to discuss the magnitude of the relationships between spending on education and research and the five revenue sources. It also does not answer the two major questions in which I am interested: how are these relationships affected by the control type of the institution and how are these relationships affected by the passing of time? I will leave analysis of magnitudes until the regressions are introduced. However, I will try to get some feeling as to what revenue variables should be significant in the education and research regressions by using theory. I will also use theory and higher education trends to get preliminary answers to my two questions.

To obtain the background for this theoretical discussion, I return to Desrochers et. al (2009) and another piece by the same authors, Desrochers et. al (2010). Let's consider differences and similarities based on institution control type first. Starting with education spending, Desrochers et. al (2009) claim that tuition is related to education spending. This can be attributed to the fact that tuition is technically revenue from selling educational instruction to students. (Desrochers et. al, 2009) For this reason, it is expected that tuition will be significant for all education regressions, regardless of year or control type. Since state and local appropriations are a major source of general revenues for public schools, it is reasonable to assume that they will affect public institution education spending. (Desrochers et. al, 2009) By the same argument, I hypothesize that private donations and endowments will be related to non-profit education spending.

For the research regressions, the major player is contracts. As noted previously, government contracts are primarily given for public service or research. This indicates that contracts should be very important in determining research spending for all institution types and for all years. However, the fact that public institutions are more restricted by government implies that the relationship should be weaker for public schools. Public institutions are more likely to receive and accept public service contracts. This means a smaller proportion of contracts revenue is going into research for public institutions. Desrochers et. al (2010) expands on the 2009 paper. In particular, it describes cost and revenue trend changes in the period from 1998 to 2008. Since my regressions will be for 1999 and 2008, the 2010 paper is useful for hypothesizing trend changes. The authors list four major revenue trends over the decade. The first trend is that revenues increased for most institutions, but state and local appropriations and investments were erratic. The volatility of these measures indicates a potential change in their relationship with education and research spending.

The second revenue trend is that public institutions experienced government funding cuts starting in 2001

and continuing until late 2005. With less local and state appropriations, public schools had to pick up the slack somehow. As mentioned in Desrochers et. al (2009), this resulted in tuition increases without much increase in education spending. This implies that tuition became more important for all spending categories, including education, while state and local appropriations became less important for education spending.

The third trend is that tuition continued to rise at non-profit institutions even though access to private donations and endowments increased. This seems to indicate increased spending in general. This spending increase was split between research and education.

The final trend is that non-profits tend to provide high amounts of tuition discounting to students while public institutions actually experienced the situation of higher gross tuition revenues than the "sticker price." That is, public schools increasingly turned to out-of-state students, which must pay far above sticker price, in order to increase tuition revenues. This returns us to the increasing importance of tuition for public institutions. This trend also indicates that tuition revenues are treated differently based on institution control type. This further reinforces the potential difference between non-profit and public institutions when it comes to tuition driven spending.

Finally, I will compare research and education spending. It has already been mentioned that research spending increased more than any other category. This increased interest in research should be reflected in the econometrics in the next few sections. If this is the case, we would expect the significant coefficients in the later research regressions to be larger than the same coefficients in the earlier regressions. We would also expect the research coefficients to be greater than the corresponding education coefficients. We should also be able to figure out what possible mix of revenue sources would account for the changes in the relative importance of education and research.

3 Regressions

3.1 Data

For my empirical analysis, I chose to focus my attention on four-year government (public) and non-profit research universities as defined by the 2005 Carnegie Classifications and the Integrated Postsecondary Education Data System Database (IPEDS). (IES, 2012 and Carnegie Foundation, 2012) According to the IPEDS glossary, public institutions are those that are supported mainly by public funds and are controlled by "publicly elected or appointed school officials." (IES, 2012) According to the IPEDS glossary, private non-profit institutions are those that cannot provide additional compensation (i.e. beyond wages or rents) to controlling officials for taking on risk. (IES, 2012) The Carnegie Foundation uses principle component analysis and discriminant analysis to classify universities as research schools. Classification is based on level of research

activity as measured by research and development expenditures and doctoral degree conferrals. (Carnegie Foundation, 2012)

The data I used comes from the Delta Cost Project 20-year matched set. (Delta Project, 2010) The Delta Cost data span 1987 to 2009. I focused on the period from 1999 to 2008. In this data segment, there are 152 public research institutions and 103 private research institutions. The two major variables of interest are revenues and spending. In accordance with Desrochers et. al (2009), each of these variables is broken up into five categories. Revenues are partitioned into net tuition; state and local appropriations; federal appropriations and federal, state, and local contracts; private donations, investments, and endowments; and auxiliary revenues. Spending is split into the following categories: education, research, public service, auxiliary spending, and scholarships and fellowships. I am focusing on all of the revenue categories but just two of the spending categories, research and education.

The Delta Cost data variables are expressed in 2009 dollars and reflect the dollar amounts spent or received per full time equivalent student. Full time equivalent student (FTE) is a per institution measure that reflects the effective number of full time students attending the university. For example, two half time students would be considered one full time student. The reason for dividing the cost and revenue variables by the FTE measure is to account for differences in institution size. This is especially important because I will be comparing public institutions with non-profit institutions. Public institutions have, on average, more FTE students than non-profits, even though average total operating revenues are similar. (Desrochers et. al, 2009)

Net tuition is revenue from student tuition net of university-provided scholarships and fellowships. State and local appropriations are funds that come directly from a state or local government and have no specific requirements attached. Federal appropriations are like state and local appropriations but come from the federal government. Federal, state, and local contracts are funds from government that have stipulations on their use. For example, many contracts are specifically for research or public service activities. Private donations come from individuals. These donations are often alumni or local business contributions. Investments and endowments both refer to invested money that receives a return. These revenue sources are often flexible and can be used to overcome budget shortfalls.

Private donations, investments, and endowments are grouped together for two reasons. First, reporting mechanisms for the three revenue sources have changed over time relative to each other. Second, public universities historically have had much smaller endowments than non-profits. Separating these three revenue streams would pose problems for comparative research due to the extreme magnitude differences. Finally, auxiliary revenues are a conglomeration of revenue sources with the defining feature that they do not directly relate to the stated mission of the institution. This category includes enterprises such as hospitals, bookstores,

side businesses, and university sponsored clinics and training programs.

Education spending is a large cost for most universities that includes any expenditure that relates to providing academic instruction. This includes faculty and staff salaries, student services, facility upkeep, and institutional and academic support. Research refers to activities that are commissioned by an outside or institutional agency and are intended to create research outcomes. This also includes expenditures related to research facilities and centers and information technology. Public service activities are intended to provide non-educational services that benefit people outside of the campus community. This includes services such as conferences, community service, and broadcasting. Auxiliary spending is simply money that goes towards the maintenance of the auxiliary revenue sources discussed above. Finally, scholarships and fellowships are university sponsored awards that are given to students to offset the costs of tuition and living expenses.

3.2 Methodology

The major goal of this subsection is to present and explain my method for comparing non-profit schools' costs and revenues and public schools' costs and revenues. To begin, the data was segmented based on year and control. The two years I looked at were 1999 and 2008. The idea here is to capture differences over time. 1999 and 2008 were chosen because they represent a decade spread and they occurred at similar points in the business cycle. That is, both years happened near the end of sustained economic growth periods. I wanted to have a decent time spread but still account for possible differences in economic condition based on year. The goal is to detect trend changes over time, not trend changes based on the condition of the economy.

The other data divider, control, refers to whether an institution is non-profit or public. The motivation for dividing the data in this way is to highlight differences based on institution control type. In many mixed markets, (i.e. industries in which more than one of the three economic sectors - non-profit, for-profit, and government - have significant presence) each sector exhibits characteristics that both differentiate the sector from its counterparts and provide justification for its existence in the market. (Salamon, 1999) For example, in the market for health care non-profits often benefit from being considered more trustworthy and less likely to cut corners than for-profits since non-profits cannot be profit maximizers. (Salamon, 1999) This is important for consumers because most demanders of health care are not doctors and have to trust that the treatment they are provided is correct and actually helpful. For-profits, on the other hand, often have easier access to financial and other forms of capital because they are profit maximizers. (Salamon, 1999) This allows them to be on the leading edge in technology, medicine, and treatment processes. This is also important for consumers because serious conditions or non-routine procedures often require high levels of technology or brand new treatment methods. A major goal of this econometric study is to determine whether non-profit and public institutions in higher education exhibit such differences, and if so, to explain using economic

theory why this occurs and what consequences it has.

The main format for the regressions is a multiple linear regression with one spending variable as the dependent variable. In particular, I focused on the expenditure categories for education and research. The independent variables depend on the data segment being considered. The first data division considered was by year only. This led to four regressions, one for each of the following: education spending in 1999, research spending in 1999, education spending in 2008, and research spending in 2008. The five revenue categories are always used as independent variables, but for these regressions there are also a dummy variable corresponding to control and each of the dummy-revenue category interaction variables. The second division was by control only. As expected, all revenue variables are still used as independents, but now there are a dummy corresponding to year and the interaction variables again. There are four regressions here as well: education spending for non-profits, research spending for non-profits, education spending for public institutions, and research spending for public institutions. The two regression types above will collectively be called the large regressions. The final division is by both year and control and these regressions will be referred to as the small regressions. Dummy variables are not needed since the qualitative differences in which I am interested are accounted for. There are eight regressions for this data division, one for each combination of expenditure category (education or research), year (1999 or 2008), and control type (non-profit or public).

There are a few notes to make here. First, dummy variables are structured as follows. For the year variable, a value of zero means 1999 and a value of one means 2008. For the control variable, a value of zero means non-profit and a value of one means public. This means that non-profits in 1999 are considered the base case. Starting in 1999 makes sense because I want to investigate changes over time. The reason why non-profits are used as the basis for comparison is a little more complicated. One might expect public universities to be the starting point. The reason why I did not go this direction is because I wanted to focus on how being constrained by government might alter public universities' decision-making. Higher education as an industry shares many similarities with the non-profit sector in other markets, so I used non-profit as a base line to highlight differences in public institution behavior. (Salamon, 1999)

The second note deals with the decision to divide the data in the above ways. For this kind of analysis, one choice would be to not separate the data and run two regressions, one for research and one for education, with both the control and year dummy variables. The reason I did not do this was because it would have oversaturated the model. After accounting for all of the revenue categories, the dummy variables, and the possible cross effects, very few interesting trends would have remained. If my only goals were to predict university spending and analyze coefficient differences based on year and control, then this method would be ideal. Instead, I am most interested in the actual relationships between revenues, year, and control type and spending, with differences merely being a precursor to the overall goal. By running both combined and

separated regressions, I can still analyze model differences while keeping information about significance levels intact.

Finally, there are a couple of important methodological notes to make. The first deals with the state and local appropriations variable for non-profit institutions. This variable was largely unreported for non-profits in the Delta Cost data set. Rather than just scrapping the variable, which I expected to be highly significant for public institutions, I supplemented this variable using average proportions. First, I calculated the average proportion of non-profit revenues that comes from state and local appropriations for the institutions for which I did have data. I then multiplied this proportion by each unreported institution's total revenue and recorded that number as the level of state and local appropriations for that institution. Although this data should be approached with caution, the average proportion with which I was dealing was very small.

The second methodological note regards treatment of other missing data. As with most data sets of this magnitude, the Delta Cost data set is not complete. Some values were unreported. The way I dealt with missing data was to pre-delete institutions that had missing entries. This was done by looking at each data segment for the small regressions separately. For each of the eight segments, if an institution was missing one or more of the six variables (i.e. either research or education spending and the five revenue variables) then that institution was manually deleted from that segment. This means that each segment was based on slightly different sets of institutions. This does not interfere with interpretation of the aggregate data, but it is worth noting since it leads to each regression being based on a differently sized sample.

4 Results

With the econometric framework set, now I will discuss how the analysis itself was carried out and the results. As a note, all statistical analysis was carried out with the open source statistics program R. Also, all point and interval estimation was done using the small regressions. The large regressions were used to detect statistically significant differences in coefficients between the small regressions. For my purposes, a coefficient estimate or a difference between coefficients is considered statistically significant if it has a p-value less than 0.05. In other words, I used a significance level of 0.05 as my decision rule. While this method is a bit clunky, it gives clear yes and no answers to the questions in which I am interested. That is, whether education and research can be explained by specific revenue categories and whether relationships differ over time and between non-profit and public institutions. However, confidence intervals are considered where more explanation or deeper insight is required.

4.1 Education Regressions

Let's look at the small education regressions first. Using the summary tables, I cataloged the regression coefficients including whether each coefficient was significant or not. These results are contained in Table (1). As expected, education spending depends on many factors. Note that regardless of control type or year, education spending can be thought of as a function of four of the five revenue categories. That is, four of the five revenue variables are significant in each regression. In particular, tuition and auxiliary revenues are significant for all small education regressions. For non-profits in 1999 and 2008, revenues from government contracts and revenues from private donations, endowments, and investments are also significant. For public institutions, the significant variables depend on the year. For 1999, all variables are significant except contracts. For 2008, all variables are significant except private donations, endowments, and investments.

For non-profits, it is logical that the only not significant variable is state and local appropriations. This revenue category is by far the smallest revenue source for non-profits throughout the decade. (Desrochers et. al, 2009) It makes sense that local and state appropriations do not factor prominently into explaining education spending, the major spending focus for institutions. For public institutions in 2008, the same argument could be advanced for private donations and endowments. This was the smallest revenue source for public institutions throughout the decade. (Desrochers et. al, 2009) The insignificance of contracts for public institutions in 1999 can be explained by the fact that contracts are typically for public service or research. The reasons behind why the contracts variable is significant in the other three regressions are more mysterious. This is a question I will not attempt to answer in this paper, and may be a good avenue for future research.

Now consider the coefficients themselves. All significant coefficients in the four regressions are positive. This means that an increase in any revenue source will lead to no change or an expected increase in education spending regardless of year or control type. Furthermore, all of the coefficients but one are significant in each of the four regressions. This is very similar to the results from the economic model that was developed in the background and theory section of this paper. In that model, all coefficients were hypothesized to be positive. The slight difference might be attributable to the simplicity of the model. It should also be noted that the variable that was not statistically significant for the non-profit regressions was based on data that I had to supplement due to missing values. This likely has something to do with the small discrepancy between the economic model and the regressions.

Regression	Variable	Estimate	Std. Error	t value	Pr(>|t|)	α
np.edreg1999	(Intercept)	9.87E+06	1.12E+07	0.881	0.38051	
	np.tuition1999.ed	1.05E+00	8.81E-02	11.894	<2E-16	***
	np.statelocapp1999.ed	-1.04E+00	3.34E+00	-0.31	0.75715	
	np.contracts1999.ed	3.58E-01	1.08E-01	3.329	0.00125	**
	np.priv1999.ed	1.32E-01	3.95E-02	3.356	0.00115	**
	np.auxrev1999.ed	1.33E-01	4.41E-02	3.009	0.00337	**
pub.edreg1999	(Intercept)	-2.48E+05	7.11E+06	-0.035	0.97219	
	pub.tuition1999.ed	7.01E-01	8.90E-02	7.872	7.89E-13	***
	pub.statelocapp1999.ed	7.56E-01	6.01E-02	12.568	<2E-16	***
	pub.contracts1999.ed	1.83E-01	1.05E-01	1.741	0.0838	.
	pub.priv1999.ed	4.46E-01	1.99E-01	2.243	0.02642	*
	pub.auxrev1999.ed	7.33E-02	2.64E-02	2.776	0.00624	**
np.edreg2008	(Intercept)	-1.86E+06	2.12E+07	-0.088	0.930347	
	np.tuition2008.ed	1.02E+00	8.87E-02	11.532	<2E-16	***
	np.statelocapp2008.ed	-3.39E-01	6.55E-01	-0.518	0.605927	
	np.contracts2008.ed	6.30E-01	1.04E-01	6.069	2.76E-08	***
	np.priv2008.ed	3.13E-01	3.68E-02	8.52	2.75E-13	***
	np.auxrev2008.ed	1.24E-01	3.38E-02	3.661	0.000417	***
pub.edreg2008	(Intercept)	-8.79E+06	1.18E+07	-0.744	0.458	
	pub.tuition2008.ed	7.66E-01	7.12E-02	10.758	<2E-16	***
	pub.statelocapp2008.ed	6.57E-01	6.86E-02	9.566	<2E-16	***
	pub.contracts2008.ed	4.08E-01	6.53E-02	6.251	4.42E-09	***
	pub.priv2008.ed	-5.80E-03	1.12E-01	-0.052	0.9586	
	pub.auxrev2008.ed	6.81E-02	2.37E-02	2.872	0.0047	**

Table 1: Small education regressions. The asterisks refer to level of significance: . = .1, * = .05, ** = .01, *** = .001

Now we look at the values of coefficients and simultaneously consider differences in coefficient values by year and control type. In order to do this, the large education regressions must be utilized. These can be seen in Table (2) and Table (3). It needs to be noted that the coefficient estimates that are being considered are point estimates. That is, the coefficients are being approximated by one value. Confidence interval estimates were also constructed. These give a range of values wherein the actual coefficient values would likely lie. What point estimates buy us is a single value that can be cited and used in analysis. What we lose is the fact that two point estimates can look very different on the surface but still be statistically similar. When a situation like this occurs, we will look at the confidence intervals to get further insight. The confidence intervals are in Table (4) and Table (5).

Regression	Variable	Estimate	Std. Error	t value	Pr(>|t|)	α
ed1999	(Intercept)	9.87E+06	9.11E+06	1.084	0.279604	
	tuition1999.ed	1.05E+00	7.17E-02	14.628	<2E-16	***
	statelocapp1999.ed	-1.04E+00	2.72E+00	-0.381	0.703226	
	contracts1999.ed	3.58E-01	8.75E-02	4.094	5.83E-05	***
	priv1999.ed	1.32E-01	3.21E-02	4.127	5.09E-05	***
	auxrev1999.ed	1.33E-01	3.59E-02	3.701	0.000268	***
	control1999.ed	-1.01E+07	1.26E+07	-0.803	0.422537	
	tuition1999.ed:control1999.ed	-3.47E-01	1.31E-01	-2.661	0.008323	**
	statelocapp1999.ed:control1999.ed	1.79E+00	2.72E+00	0.659	0.510372	
	contracts1999.ed:control1999.ed	-1.75E-01	1.56E-01	-1.126	0.261256	
	priv1999.ed:control1999.ed	3.14E-01	2.46E-01	1.277	0.202861	
	auxrev1999.ed:control1999.ed	-5.94E-02	4.83E-02	-1.23	0.219857	
ed2008	(Intercept)	-1.86E+06	1.67E+07	-0.112	0.9113	
	tuition2008.ed	1.02E+00	6.97E-02	14.673	<2E-16	***
	statelocapp2008.ed	-3.39E-01	5.15E-01	-0.659	0.5108	
	contracts2008.ed	6.30E-01	8.16E-02	7.722	3.24E-13	***
	priv2008.ed	3.13E-01	2.89E-02	10.841	<2E-16	***
	auxrev2008.ed	1.24E-01	2.66E-02	4.658	5.32E-06	***
	control2008.ed	-6.93E+06	2.26E+07	-0.307	0.7594	
	tuition2008.ed:control2008.ed	-2.57E-01	1.16E-01	-2.229	0.0268	*
	statelocapp2008.ed:control2008.ed	9.96E-01	5.23E-01	1.906	0.0579	.
	contracts2008.ed:control2008.ed	-2.22E-01	1.18E-01	-1.888	0.0602	.
	priv2008.ed:control2008.ed	-3.19E-01	1.47E-01	-2.169	0.031	*
	auxrev2008.ed:control2008.ed	-5.56E-02	4.06E-02	-1.369	0.1723	

Table 2: Large education regressions for 1999 and 2008. The asterisks refer to level of significance: . = .1, * = .05, ** = .01, *** = .001

Regression	Variable	Estimate	Std. Error	t value	Pr(>|t|)	α
ed.np	(Intercept)	9.87E+06	1.68E+07	0.587	0.55792	
	np.tuition.ed	1.05E+00	1.32E-01	7.924	2.05E-13	***
	np.statelocapp.ed	-1.04E+00	5.02E+00	-0.207	0.83655	
	np.contracts.ed	3.58E-01	1.62E-01	2.217	0.02781	*
	np.priv.ed	1.32E-01	5.92E-02	2.236	0.02657	*
	np.auxrev.ed	1.33E-01	6.62E-02	2.005	0.04647	*
	yearnp.ed	-1.17E+07	2.39E+07	-0.491	0.6242	
	np.tuition.ed:yearnp.ed	-2.52E-02	1.50E-01	-0.168	0.86682	
	np.statelocapp.ed:yearnp.ed	6.97E-01	5.04E+00	0.138	0.89019	
	np.contracts.ed:yearnp.ed	2.72E-01	1.82E-01	1.496	0.13645	
	np.priv.ed:yearnp.ed	1.81E-01	6.62E-02	2.734	0.00687	**
	np.auxrev.ed:yearnp.ed	-9.01E-03	7.15E-02	-0.126	0.89986	
ed.pub	(Intercept)	-2.48E+05	9.97E+06	-0.025	0.9802	
	pub.tuition.ed	7.01E-01	1.25E-01	5.611	4.74E-08	***
	pub.statelocapp.ed	7.56E-01	8.44E-02	8.958	<2E-16	***
	pub.contracts.ed	1.83E-01	1.48E-01	1.241	0.2156	
	pub.priv.ed	4.46E-01	2.79E-01	1.599	0.1109	
	pub.auxrev.ed	7.33E-02	3.70E-02	1.979	0.0488	*
	yearpub.ed	-8.54E+06	1.39E+07	-0.615	0.5391	
	pub.tuition.ed:yearpub.ed	6.47E-02	1.38E-01	0.469	0.6394	
	pub.statelocapp.ed:yearpub.ed	-9.91E-02	1.01E-01	-0.977	0.3292	
	pub.contracts.ed:yearpub.ed	2.25E-01	1.57E-01	1.437	0.1519	
	pub.priv.ed:yearpub.ed	-4.52E-01	2.94E-01	-1.54	0.1248	
	pub.auxrev.ed:yearpub.ed	-5.17E-03	4.18E-02	-0.124	0.9018	

Table 3: Large education regressions for non-profit and public institutions. The asterisks refer to level of significance: . = .1, * = .05, ** = .01, *** = .001

It also needs to be noted that the large regressions do not take into account the statistical significance or lack thereof of variables in the small regressions. They use dummy variables to measure the difference between coefficient estimates regardless of whether the coefficients are significant or not. Because of this, the following guidelines will be in effect. If a variable is not significant in two regressions that are being compared, then the assumption is that the corresponding coefficients are both zero, and thus not different. If both coefficients are significant, then the large regression is used to determine if the point estimates are significantly different. Any oddities or discrepancies are analyzed further by using the confidence intervals. If the coefficient is significant in one regression but not in the other, then the confidence intervals and the large regressions are used while keeping in mind that the coefficient is assumed to be zero in the regression where it is not significant.

Regression	Variable	2.5%	97.5%
np.edreg1999	(Intercept)	-1.24E+07	3.21E+07
	np.tuition1999.ed	8.73E-01	1.22E+00
	np.statelocapp1999.ed	-7.67E+00	5.60E+00
	np.contracts1999.ed	1.45E-01	5.72E-01
	np.priv1999.ed	5.41E-02	2.11E-01
	np.auxrev1999.ed	4.51E-02	2.20E-01
np.researchreg1999	(Intercept)	-2.56E+07	3.60E+05
	np.tuition1999.research	-7.33E-02	1.13E-01
	np.statelocapp1999.research	-6.41E-02	6.82E+00
	np.contracts1999.research	7.52E-01	9.74E-01
	np.priv1999.research	4.91E-02	1.30E-01
	np.auxrev1999.research	-3.92E-02	5.17E-02
pub.edreg1999	(Intercept)	-1.43E+07	1.38E+07
	pub.tuition1999.ed	5.25E-01	8.77E-01
	pub.statelocapp1999.ed	6.37E-01	8.75E-01
	pub.contracts1999.ed	-2.48E-02	3.91E-01
	pub.priv1999.ed	5.30E-02	8.39E-01
	pub.auxrev1999.ed	2.11E-02	1.26E-01
pub.researchreg1999	(Intercept)	-7.11E+06	1.49E+07
	pub.tuition1999.research	-2.13E-02	2.55E-01
	pub.statelocapp1999.research	-8.75E-02	9.92E-02
	pub.contracts1999.research	7.68E-01	1.09E+00
	pub.priv1999.research	2.38E-01	8.56E-01
	pub.auxrev1999.research	-6.02E-02	2.18E-02

Table 4: Confidence intervals for the coefficient estimates for the 1999 small regressions

First consider non-profits in 1999 and 2008. The only statistically significant change over time occurs for private donations and endowments. For the 1999 regression the coefficient is .132, and for the 2008 regression the coefficient is .313. This translates into a roughly 18 cents education spending increase per dollar of private donations and endowments. For tuition, the coefficient is roughly 1.00 in both regressions. This one to one relationship makes sense because tuition is revenue from the sale of an educational institution's main product, education. Since non-profits are subject to the non-distribution constraint, this revenue must go back into

Regression	Variable	2.5%	97.5%
np.edreg2008	(Intercept)	-4.39E+07	4.02E+07
	np.tuition2008.ed	8.47E-01	1.20E+00
	np.statelocapp2008.ed	-1.64E+00	9.62E-01
	np.contracts2008.ed	4.24E-01	8.36E-01
	np.priv2008.ed	2.40E-01	3.86E-01
	np.auxrev2008.ed	5.66E-02	1.91E-01
np.researchreg2008	(Intercept)	-2.62E+07	2.15E+07
	np.tuition2008.research	-1.15E-01	6.77E-02
	np.statelocapp2008.research	-1.60E-01	1.15E+00
	np.contracts2008.research	9.95E-01	1.20E+00
	np.priv2008.research	5.64E-02	1.30E-01
	np.auxrev2008.research	-1.80E-02	4.98E-02
pub.edreg2008	(Intercept)	-3.21E+07	1.46E+07
	pub.tuition2008.ed	6.25E-01	9.06E-01
	pub.statelocapp2008.ed	5.21E-01	7.92E-01
	pub.contracts2008.ed	2.79E-01	5.37E-01
	pub.priv2008.ed	-2.26E-01	2.15E-01
	pub.auxrev2008.ed	2.12E-02	1.15E-01
pub.researchreg2008	(Intercept)	-1.75E+07	1.61E+07
	pub.tuition2008.research	6.29E-02	2.65E-01
	pub.statelocapp2008.research	-1.01E-01	9.36E-02
	pub.contracts2008.research	7.19E-01	9.04E-01
	pub.priv2008.research	3.26E-02	3.49E-01
	pub.auxrev2008.research	-3.66E-02	3.08E-02

Table 5: Confidence intervals for the coefficient estimates for the 2008 small regressions

university spending in some manner. Spending a dollar on education for each dollar of education related revenue (i.e. tuition) is consistent with the education driven mission of a non-profit university. Auxiliary revenues offer a similarly uncomplicated comparison. In both years, approximately 13 cents of spending on education occurred for each dollar of auxiliary revenue.

Since state and local appropriations were insignificant in both regressions, the last comparison of interest is for contracts. According to the non-profit large education regression, there was no change over time for contracts. However, the coefficient estimates show an almost .30 spread at .358 and .630. Looking at the confidence intervals in Table (4) and Table (5), it can be seen that the overlap is relatively small. It is not enough to declare a statistically significant difference, but it is worth noting. Assuming that the true coefficients in each year are the same, that shared value will likely be somewhere between .424 and .572.

For public institutions in 1999 and 2008, there are no statistically significant differences. For tuition, the coefficients are both between .70 and .77. For auxiliary revenues, both coefficients are around .07. This means public institutions in 1999 and 2008 spent just over 70 cents on education for each dollar of tuition and around seven cents per dollar of auxiliary revenues. For the other three variables, it is more informative to look at the confidence intervals because the point estimates are fairly different despite being statistically similar. We will look at the areas of overlap. For state and local appropriations, this range is from .637 to

.792. The range for contracts is .279 to .391, and the range for private donations and endowments is .053 to .214. Assuming that the true coefficients really are the same in 1999 and 2008, the above intervals give the likely range of values for the true coefficients.

Next, we use the 1999 large education regression to compare non-profit and public institutions in 1999. The only significant difference occurs for tuition. Non-profits spend about 35 cents more on education per dollar of tuition than public institutions. The point estimates for the auxiliary revenues coefficient are similar and fall between seven to thirteen cents of spending per dollar of revenue. For the other coefficients, we turn to the confidence intervals again. The first trend to note is that some confidence interval estimates are very wide and entirely contain their counterparts. For example, the state and local appropriations interval for non-profits entirely contains the one for public institutions. In addition, the non-profit interval is very wide, ranging from -7.67 to 5.60. These trends indicate that the true coefficient estimates are likely different, even though the large regression indicates otherwise. It should also be noted that the point estimate for public institutions is .756 while the non-profit coefficient is assumed to be zero since it is not significant.

For private donations and endowments, the public confidence interval contains the non-profit one. Unlike state and local appropriations, this variable is significant in both regressions. Also, the public interval is not incredibly wide. This leads me to conclude that the true shared value for this coefficient likely lies in the non-profit interval of .054 to .211. The contracts variable, on the other hand, is not significant in the public regression. The assumption is that its value is zero. The large regression does not take this into account, so we turn to the confidence intervals. The non-profit interval is .145 to .572. This interval does not contain zero, so we conclude that the coefficient is actually different in the two regressions. Additionally, I will use the point estimate of .358 to describe the non-profit coefficient.

For the 2008 large education regression, most of the 1999 trends apply. The tuition coefficient is still significantly different, by roughly the same amount. The auxiliary revenues coefficient is similar in both regressions and the values are similar to those in 1999. State and local appropriations exhibit the same trends as in 1999. The differences from 1999 occur in the contracts coefficient and the private donations and endowments coefficient. The private donations coefficient is now statistically different between public and nonprofit. Public institutions do not base education spending on private donations and endowments while non-profits spend between 42 and 57 cents per dollar of revenue. Finally, the contracts coefficient is technically not significantly different between public and non-profit at the five percent level, but it is close. Looking at the confidence intervals we see that the non-profit interval is .424 to .836 and the public interval is .279 to .537. There is some overlap, but it is very small. If the coefficients really are the same, then the true value will most likely be between .424 and .537.

4.2 Research Regressions

Next, we will look at the research regressions. We begin with the small regressions. These can be seen in Table (6). An interesting trend is immediately apparent. Both the private donations and endowments variable and the contracts variable are significant in every regression regardless of year or control type. In fact, the 2008 public regression is the only one with another significant variable, tuition. This leads to two observations. First, non-profit institutions' research spending is entirely explained by donations, endowments, investments, and government contracts, and this trend has not changed over time. Second, something likely occurred in public, but not non-profit, institutions over the decade that led to tuition becoming an important factor in research spending.

The first observation is not too surprising. Government contracts are restricted revenues that must be put largely toward a pre-specified purpose. This purpose is typically research or public service. For non-profits, public service contracts are less common than they are for public institutions. (Desrochers, et. al, 2009) This means that the majority of contracts revenues must go toward research. As for endowments and donations, I will return to the argument made for education spending. Donations and endowments are typically restricted to particular purposes, but those purposes can be just about anything. It is not unwarranted to think that part of these revenues would have been given for the sake of conducting research. For example, a former doctoral recipient or a business may donate to further a specific type of research.

The second observation is more open to interpretation. My theory is that a major change in revenue structure occurred over the past decade at most public institutions. That change was a decrease in state and local government funding for public schools. At the same time, tuition increased at the majority of higher education institutions. This means that tuition revenues have become a larger proportion of public institution budgets. (Desrochers et. al, 2010) With the combination of increasing promotion of research and shifting budget structures, it is feasible that public institutions tried to make up the difference in research funding by using tuition revenues. This is supported by the trend seen earlier. That is, not all tuition revenue at public universities is put toward education. This leaves extra for other spending categories, such as research.

Regression	Variable	Estimate	Std. Error	t value	Pr(>|t|)	α
np.researchreg1999	(Intercept)	-1.26E+07	6.51E+06	-1.935	0.0566	.
	np.tuition1999.research	1.97E-02	4.67E-02	0.421	0.6749	
	np.statelocapp1999.research	3.38E+00	1.73E+00	1.953	0.0543	.
	np.contracts1999.research	8.63E-01	5.58E-02	15.464	<2E-16	***
	np.priv1999.research	8.98E-02	2.04E-02	4.395	3.37E-05	***
	np.auxrev1999.research	6.22E-03	2.28E-02	0.272	0.7862	
pub.researchreg1999	(Intercept)	3.91E+06	5.58E+06	0.702	0.484103	
	pub.tuition1999.research	1.17E-01	6.99E-02	1.672	0.096796	.
	pub.statelocapp1999.research	5.84E-03	4.72E-02	0.124	0.901792	
	pub.contracts1999.research	9.32E-01	8.25E-02	11.288	<2E-16	***
	pub.priv1999.research	5.47E-01	1.56E-01	3.503	0.000614	***
	pub.auxrev1999.research	-1.92E-02	2.07E-02	-0.925	0.35654	
np.researchreg2008	(Intercept)	-2.34E+06	1.20E+07	-0.195	0.846	
	np.tuition2008.research	-2.35E-02	4.58E-02	-0.512	0.61	
	np.statelocapp2008.research	4.97E-01	3.30E-01	1.505	0.136	
	np.contracts2008.research	1.10E+00	5.25E-02	20.934	<2E-16	***
	np.priv2008.research	9.33E-02	1.85E-02	5.03	2.95E-06	***
	np.auxrev2008.research	1.59E-02	1.70E-02	0.936	0.352	
pub.researchreg2008	(Intercept)	-7.13E+05	8.48E+06	-0.084	0.93318	
	pub.tuition2008.research	1.64E-01	5.11E-02	3.208	0.00165	**
	pub.statelocapp2008.research	-3.91E-03	4.93E-02	-0.079	0.93698	
	pub.contracts2008.research	8.11E-01	4.69E-02	17.286	<2E-16	***
	pub.priv2008.research	1.91E-01	8.01E-02	2.384	0.01844	*
	pub.auxrev2008.research	-2.90E-03	1.71E-02	-0.17	0.86506	

Table 6: Small research regressions. The asterisks refer to level of significance: . = .1, * = .05, ** = .01, *** = .001

Next we will consider the coefficients themselves. First note that all significant coefficients are positive. As with the education regressions, this implies that increases in revenue will lead to no change in research spending or an increase in spending. This result is somewhat different from the education regressions, however, since far fewer coefficients are significant. Three of the four regressions only have two significant (i.e. conclusively nonzero) coefficients. The economic model that was developed in the theory section does not account for this. One possible explanation for this is that the assumption that research and education are complementary is incorrect. If education and research were actually substitutes, then this would allow for zero-valued and even negative coefficients. Another explanation is that the model was too simple to capture some of the subtleties, but still captures the overall idea. Notice that there were no significant negative coefficients. The model captured this idea, but perhaps was too simple to account for zero-valued coefficients.

Now we look at the values of coefficients and simultaneously consider differences in coefficient values by year and control type. In order to do this, the large research regressions must be utilized. These can be seen in Table (7) and Table (8). We begin by considering non-profits in 1999 and 2008. For private donations and endowments, there is no statistically significant change in the coefficient estimates. The estimate in both years is around .09, or roughly nine cents of research spending for each dollar of private donations and endowments. For contracts, there is a significant increase over time. For 1999 the coefficient is .863, and for 2008 the coefficient is 1.10. This is an increase of over twenty cents of spending per dollar of revenue. This increase can likely be attributed to the increasing importance of research. (Desrochers et. al, 2009)

Regression	Variable	Estimate	Std. Error	t value	Pr(>|t|)	α
research1999	(Intercept)	-1.26E+07	6.54E+06	-1.926	0.05538	.
	tuition1999.research	1.97E-02	4.69E-02	0.419	0.67556	
	statelocapp1999.research	3.38E+00	1.74E+00	1.944	0.05313	.
	contracts1999.research	8.63E-01	5.61E-02	15.394	<2E-16	***
	priv1999.research	8.98E-02	2.05E-02	4.375	1.86E-05	***
	auxrev1999.research	6.22E-03	2.30E-02	0.271	0.78669	
	control1999.research	1.65E+07	8.59E+06	1.923	0.05578	.
	tuition1999.research:control1999.research	9.72E-02	8.41E-02	1.156	0.24883	
	statelocapp1999.research:control1999.research	-3.37E+00	1.74E+00	-1.94	0.05363	.
	contracts1999.research:control1999.research	6.83E-02	9.96E-02	0.686	0.49371	
	priv1999.research:control1999.research	4.57E-01	1.57E-01	2.911	0.00397	**
	auxrev1999.research:control1999.research	-2.54E-02	3.09E-02	-0.822	0.41193	
research2008	(Intercept)	-2.34E+06	1.10E+07	-0.213	0.83138	
	tuition2008.research	-2.35E-02	4.20E-02	-0.559	0.57664	
	statelocapp2008.research	4.97E-01	3.03E-01	1.643	0.10182	
	contracts2008.research	1.10E+00	4.81E-02	22.852	<2E-16	***
	priv2008.research	9.33E-02	1.70E-02	5.491	1.09E-07	***
	auxrev2008.research	1.59E-02	1.56E-02	1.021	0.30818	
	control2008.research	1.63E+06	1.42E+07	0.115	0.90867	
	tuition2008.research:control2008.research	1.88E-01	6.85E-02	2.738	0.00668	**
	statelocapp2008.research:control2008.research	-5.01E-01	3.07E-01	-1.632	0.10416	
	contracts2008.research:control2008.research	-2.88E-01	6.92E-02	-4.165	4.45E-05	***
	priv2008.research:control2008.research	9.77E-02	8.64E-02	1.13	0.25983	
	auxrev2008.research:control2008.research	-1.88E-02	2.39E-02	-0.79	0.43039	

Table 7: Large research regressions for 1999 and 2008. The asterisks refer to level of significance: . = .1, * = .05, ** = .01, *** = .001

Regression	Variable	Estimate	Std. Error	t value	Pr(>|t|)	α
research.np	(Intercept)	-1.26E+07	9.58E+06	-1.315	0.19031	
	np.tuition.research	1.97E-02	6.87E-02	0.286	0.7751	
	np.statelocapp.research	3.38E+00	2.55E+00	1.328	0.18618	
	np.contracts.research	8.63E-01	8.21E-02	10.513	<2E-16	***
	np.priv.research	8.98E-02	3.01E-02	2.988	0.00325	**
	np.auxrev.research	6.22E-03	3.36E-02	0.185	0.85345	
	yearnp.research	1.03E+07	1.36E+07	0.754	0.45211	
	np.tuition.research:yearnp.research	-4.31E-02	7.80E-02	-0.553	0.58119	
	np.statelocapp.research:yearnp.research	-2.88E+00	2.56E+00	-1.126	0.26178	
	np.contracts.research:yearnp.research	2.36E-01	9.24E-02	2.555	0.01156	*
	np.priv.research:yearnp.research	3.48E-03	3.36E-02	0.104	0.91747	
	np.auxrev.research:yearnp.research	9.73E-03	3.63E-02	0.268	0.78914	
research.pub	(Intercept)	3.91E+06	7.34E+06	0.533	0.59411	
	pub.tuition.research	1.17E-01	9.19E-02	1.271	0.20471	
	pub.statelocapp.research	5.84E-03	6.21E-02	0.094	0.92517	
	pub.contracts.research	9.32E-01	1.09E-01	8.584	5.96E-16	***
	pub.priv.research	5.47E-01	2.05E-01	2.664	0.00816	**
	pub.auxrev.research	-1.92E-02	2.73E-02	-0.703	0.48239	
	yearpub.research	-4.63E+06	1.02E+07	-0.453	0.65112	
	pub.tuition.research:yearpub.research	4.72E-02	1.01E-01	0.465	0.64241	
	pub.statelocapp.research:yearpub.research	-9.74E-03	7.46E-02	-0.131	0.89619	
	pub.contracts.research:yearpub.research	-1.20E-01	1.15E-01	-1.042	0.29835	
	pub.priv.research:yearpub.research	-3.56E-01	2.16E-01	-1.649	0.10034	
	pub.auxrev.research:yearpub.research	1.63E-02	3.08E-02	0.529	0.59744	

Table 8: Large research regressions for non-profit and public institutions. The asterisks refer to level of significance: . = .1, * = .05, ** = .01, *** = .001

Repeating the same analysis for public institutions, a surprising trend arises. There are no significant changes over time. However, the point estimates do appear different. The estimates dropped for 2008. The value dropped by 12 cents for contracts and 35 cents for private donations and endowments. This calls for an investigation of the confidence intervals. Looking at Table (4) and Table (5), it can be seen that the 2008 confidence intervals are lower than the 1999 intervals. There is some overlap of the intervals, which explains why the point estimates are not statistically different. With contracts, the overlap is fairly large, so the true coefficient values could feasibly be similar. With private donations and endowments, however, caution should be taken. The overlap is relatively small. Its range is roughly .11, while the ranges of the entire confidence intervals are approximately .61 and .32.

Now let's compare non-profit and public institutions. For 1999, the private donations and endowments coefficient is statistically different for non-profit and public institutions. The difference is fairly stark at nine cents of research spending per dollar of revenue for non-profits versus about 55 cents per dollar for public schools. This can partly be attributed to the aforementioned difference in revenue structure at public and non-profit universities. Non-profits receive a hefty proportion of their budgets from private donations and endowments while public institutions receive a proportionally much smaller amount of this revenue source. Because of this, non-profits use private donations and endowments to cover some operating costs. This means that they will have less left over for research. In 1999, public institutions still received much of their operating budgets from state and local appropriations. This left donations and endowments revenues open for use in research spending.

Over the past decade, the above relationship changed. By 2008, public institutions received more donations and were victim to funding cuts by government. This likely explains the fact that in the 2008 large research regression, the private donations and endowments coefficients are no longer statistically different. Instead, the contracts coefficients became significantly different for public and non-profit universities. In particular, the non-profit coefficient is higher. Contracts have a roughly one to one relationship with research spending for non-profits while public institutions only spend about 81 cents on research per dollar of contract revenues. This trend can be coupled with the increase in the contracts coefficient for non-profits between 1999 and 2008. Public institution spending patterns for this particular relationship did not change while non-profit spending patterns did change in the positive direction.

The final pattern in the 2008 large research regression is the significant difference between the tuition coefficients. For non-profits, this coefficient is not statistically significant, so the assumption is that the coefficient is not different from zero. For public institutions, the coefficient is .164. This means that roughly sixteen cents of research spending results from each dollar of tuition revenue. The reasons for this trend were discussed previously. In short, public institutions have some tuition revenue that does not go to education

while non-profits put most of their tuition revenue back into education.

5 Consequences and Implications

In order to fully appreciate the results above, some context is needed. In particular, the implications of the cost-revenue relationships above need to be described. I will first consider research and education spending separately. Then I will analyze both in the context of changing revenue structures.

I will begin by recapping the revenue structure changes. In the past decade, most revenue categories have increased in magnitude. (Desrochers et. al, 2010) Tuition, private donations and endowments, and auxiliary revenues have increased fairly steadily. Contracts have been more volatile, but have generally increased. State and local appropriations are the notable exception. These have decreased for public institutions and have remained almost negligible for non-profits. (Desrochers et. al, 2010)

For non-profit education spending, this means a general increase in education spending. For public institutions, results are more mixed. Depending on the magnitude of the state and local appropriations decrease, a particular public institution might experience a decrease in education spending. This is not unlikely given that the tuition coefficient in 1999 and 2008 is similar to the state and local appropriations coefficient in both years. This also has an interesting implication. That is, as far as education spending goes, tuition revenue and state and local appropriations affect spending in the same way at public institutions. This may be one reason why public schools tend to replace lost government funding using tuition increases. For research spending, the aforementioned trends imply a general increase in spending for both institution types. One important trend to discuss is the significance of tuition in the 2008 public regression. This means public schools will now spend some money on research for each additional dollar of tuition revenue. In other words, education now directly fights research for tuition funds.

Now I will consider research and education together. In particular, I am interested in how slight changes in revenue structure will affect education and research spending at non-profit and public institutions in 1999 and 2008. Let's first consider 1999 as the baseline. For non-profits, education spending can be increased by increases in tuition, contracts, private donations and endowments, and auxiliary revenues. Research spending can be increased by increases in contracts and private donations and endowments. In 1999, the best way to increase education spending was to increase tuition. Each dollar of tuition translated into a dollar of education spending and no increase in research. As expected, the best way to increase research spending was to increase contracts. Here, an additional dollar of contracts revenue led to about 86 cents of research spending.

It can be seen that in 1999, the non-profit education-research tension was not incredibly strong. In two of the revenue categories, auxiliary revenues and tuition, increases do not affect research but increase

education spending. For private donations and endowments, the education coefficient is slightly higher than the research one, indicating that increases in this revenue source would not heavily favor research spending. In fact, education spending would increase about four cents more than research spending for each additional dollar of private donations and endowments. For contracts, the research coefficient is higher. However, since most contract revenues have to go toward specific purposes, usually research or public service, this is not particularly surprising. In fact, it is interesting that contracts actually generate between 42 and 57 cents of education spending despite not being intended for that purpose.

Now let's consider research and education at non-profits in 2008. The significant revenue sources for both spending categories have not changed. In addition, tuition is still the best way to increase education spending, and contracts are the best way to increase research spending. Tuition still exhibits a one to one relationship with education. Contracts now also exhibit a one to one relationship with research, implying an even stronger relationship than in 1999. Somewhat surprisingly, this trend is the only one that is favorable to research. The relationships for education and research spending and auxiliary revenues and state and local appropriations remained unchanged. The private donations and endowments coefficient actually increased for education but did not change for research. Now instead of a four cent difference, there is a roughly 21 cent difference.

These trends seem to indicate that education actually made gains versus research. The reality is that research spending increases outpaced education spending increases. (Desrochers et. al, 2010) This means that contracts are being more favored as a revenue source. This is compounded by the fact that the contract-research relationship increased between 1999 and 2008. Still, this is not all bad news. Education spending still rises between 42 and 57 cents for each dollar of contract revenues. In addition, contracts are very rigid as a revenue source and are dependent on government funding. This is promising for education at non-profits since all other revenue sources either favor education spending, or in the case of state and local appropriations, lead to no change in either expenditure category.

For public institutions in 1999, education spending could be increased by increases in tuition, state and local appropriations, private donations and endowments, and auxiliary revenues. Research spending could be increased by increases in contracts and private donations and endowments. Like for non-profits, research spending is best improved by increasing contracts. A little less than a dollar of research spending is generated with each dollar of contract revenues. Education spending is best increased by raising tuition revenues or state and local appropriations. A dollar increase in either translates to about 70 cents of education spending.

For public institutions, the education-research tension in 1999 is stronger than for non-profits. On the one hand, tuition, state and local appropriations, and auxiliary revenues improve education spending but not research. At the same time, contracts do not affect education spending but greatly increase research

spending. Also, private donations and endowments contribute between 24 and 35 cents per dollar to research spending but only 5 to 21 cents to education. Still, at this time private donations and endowments were very low in public institutions, and state and local appropriations were on the rise. (Desrochers et. al 2009 and Desrochers et. al, 2010)

Now we look forward to 2008. For education, not much has changed. Tuition and state and local appropriations are still the most important revenue sources for increasing education spending. One new trend is that private donations and endowments are no longer significant and contracts now are. The new contracts contribution is comparable to the 1999 private donations and endowments contribution. For research, the contracts and private donations and endowments coefficients are the same, but tuition is now significant. Each dollar of tuition translates into about 16 cents of research spending.

This has mixed consequences for research and education. On the one hand, education spending is now boosted by contracts, diminishing the effect of increased contracts revenue on the education-research tension. On the other hand, tuition increases now increase research spending, and private donations and endowments no longer contribute to education. This could be a problem for two reasons. The first is that state and local appropriations are falling in public schools due to the recent recession. (Desrochers et. al, 2010) As noted previously, public institutions tend to increase tuition when this occurs. Tuition now supports research spending as well while state and local appropriations only boost education spending. This tradeoff means more research spending increases relative to education. The second reason is that donations, endowments, and investments at public institutions may increase as public schools seek new funding sources. This potential increase in alternate funding for public schools would mean more spending on research with no increase in education spending. In short, the pursuit of alternatives to state and local appropriations will lead to increased importance of research relative to education at public institutions.

6 Conclusion

The education-research tension in the field of higher education is an interesting example of mission drift in an entitre industry. It is also a prime display of differences between public and non-profit institutions. In particular, public institutions have more greatly suffered mission drift due to a combination of decreased state and local appropriations, tuition hikes, and an increasing tendency to invest tuition revenue in research as well as education. Non-profits, on the other hand, have faired better in sticking to the higher education mission of education.

In this paper, I focused in on education and research spending as they relate to revenue sources. This led to linear regressions that model these relationships. The tension between research and education was highlighted by these models. For public institutions, private donations and endowments and contracts favor

research spending, and tuition contributes to research spending. For non-profits, research spending is only favored by contracts. For both institution types, if the goal is increased education spending, tuition revenue increases are highly important. Public institutions also receive large education gains from increased state and local appropriations, while non-profits receive large gains from increased private donations and endowments.

The are a wide variety of directions for future research. In particular, the analysis in this paper could be repeated for the other three spending categories. This would allow for a more complete discussion of revenue-cost trends. In addition, more years could be considered and non-research institutions could be included. It might be interesting to consider the effect of institution focus (i.e. research, liberal arts, community college, vocational, etc.) on spending and revenue relationships. My hope is that this paper will promote further conversation and research on how revenues and spending are intimately linked in higher education and how these relationships differ based on institution types.

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