DISSERTATION

ASSOCIATIONS AMONG SOURCES OF REVENUE AND EXPENSES AT PUBLIC BACHELORS AND MASTERS LEVEL HIGHER EDUCATION INSTITUTIONS

Submitted by

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ABSTRACT

ASSOCIATIONS AMONG SOURCES OF REVENUE AND EXPENSES AT PUBLIC BACHELORS AND MASTERS LEVEL HIGHER EDUCATION INSTITUTIONS

Understanding how changes in revenue are associated with changes in spending at public higher educational institutions may have significant practical implications for policy makers. Finance data were drawn from the Integrated Post Secondary Data System (IPEDS) for bachelors and master-level institutions from 2003 to 2012. Fixed effects regression models were constructed to estimate the effect of changes in revenue on spending. Time effects (lagged models, fixed year effects, and time trends) were examined. Several institutional characteristics were considered for inclusion in the model: size of enrollment, institutional discount rate, selectivity, Carnegie classification, and state tuition policy. In addition to revenue and spending variables, the final regression model included year effects and enrollment.

A large number of statistically significant effects of revenue changes on spending variables were observed, generally consistent with previous research focused on research universities (Leslie, Slaughter, Taylor, & Zhang, 2012). The effects of changes in revenue from tuition and appropriations on spending for instruction were notable. Within an institution, a one dollar change in tuition revenue was associated with a 33 cent change in spending on instruction (2012 dollars). A similar one-dollar change in revenue from appropriations was associated with a 32 cent change in instructional spending. For spending on institutional support, a one-dollar change in revenue from appropriations had a slightly larger effect (β=.18, p<.001) compared to a one-dollar change in revenue from tuition (β=.07, p<.001).

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CHAPTER 1: INTRODUCTION

The financial environment in which higher education institutions in the United States operate has changed and continues to change. Since 1980, tuition at both public and private four-year institutions has outpaced inflation and median family income (Kirshstein, 2012). Private master's institutions have become more reliant on net tuition and fee revenue, deriving 89% of revenue from tuition and fees in 2000-01 and 95% in 2010-11. Private bachelor's institutions increased reliance on net tuition and fee revenue from 88% of revenue in 2000-01 to 94% in 2010-11 (Baum & Ma, 2013, p. 26).

Revenue changes at public institutions are even more noteworthy. (See Figure 1.1.) Public doctoral institutions derived 48% of their revenue from state and local appropriations in the 2000-01 academic year. That proportion dropped to 29% by the 2010-11 year. Over the same period, revenue from tuition and fees rose from 25% of revenue to 36% of revenue (Baum & Ma, 2013). A similar trend can be observed among public master's and bachelor's institutions. This trend reached a milestone at public research and master's institutions in 2010, when revenue from tuition exceeded revenue from state and local appropriations (Kirshstein & Hurlburt, 2012).

These changes have been the subject of much commentary and some research. The starting point for these discussions is often an expression of concern about the rising cost of higher education, as the price of higher education has grown at a rate above general inflation for many years (Archibald & Feldman, 2010; Bowen, 1980; Christensen & Eyring, 2011; Clotfelter, 1996; Lewis & Dundar, 2001). Kirshstein (2012) describes a history of public concern about higher education price stretching back at least 45 years and spawning two national commissions

in as many decades (Commission on the Future of Higher Education, 2006; Harvey, Williams, Kirshstein, O'Malley, & Wellman, 1998).

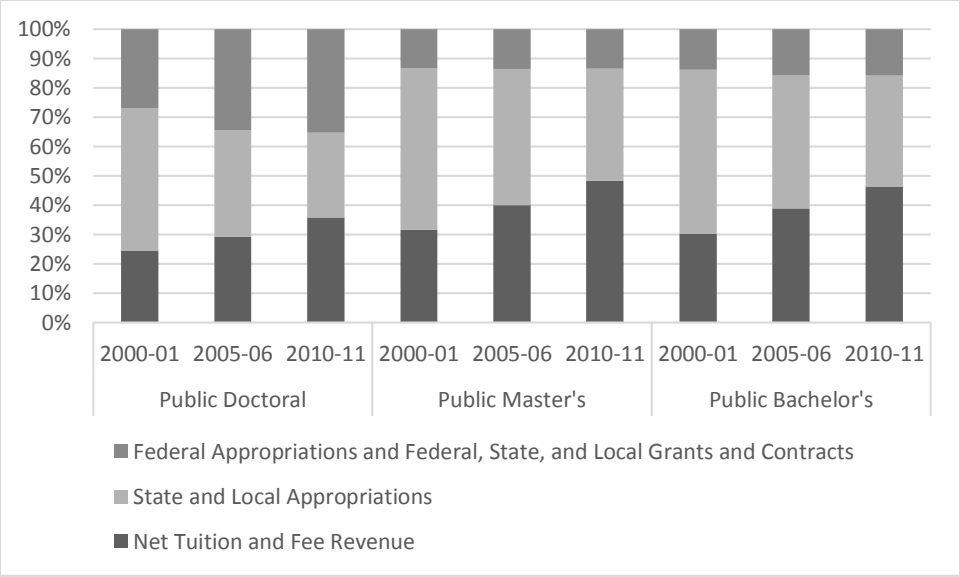

Figure 1.1 Sources of revenue over time among public higher education institutions in constant dollars (Baum & Ma, 2013)

From this starting point, some have sought to illuminate the factors driving the cost of higher education (Archibald & Feldman, 2010; Bowen, 1980). Reformers have proposed ways to control costs by increasing the productivity and efficiency of institutions (Christensen & Eyring, 2011; Zemsky, 2009). Some have focused on how these costs are shared by students, their families, and the public (Johnstone & Marcucci, 2010; Marcucci & Johnstone, 2007). Some have focused attention on the entrance of for-profit institutions into the market (Kirp, 2004). Some commentators express a concern about the privatization of higher education, as public institutions become less reliant on public appropriations (Ehrenberg, 2006; Lyall & Sell, 2005; National Center for Postsecondary Improvement, 1999; Travis, 2012). Some have expressed concern that changing patterns of revenue will lead public institutions to change or deemphasize aspects of their missions that produce the greatest public good in favor of activities

that are more likely to attract fee-paying students and other sources of private support (Ehrenberg, 2006; Lyall & Sell, 2005; Travis, 2012).

As the literature review presented in Chapter 2 shows, quantitative research tracing the effects of revenue changes on higher education can take at least three approaches. First, to the extent that these changes in revenue reflect increases in the price paid by students and their families, these changes suggest a focus on issues of access, affordability, and student debt. Consequently, some research focuses on the association between changes in institutional revenues and changes in student choices (Buss, Parker, & Rivenburg, 2004; Heller, 1997; Jung Cheol & Milton, 2008; Noorbakhsh & Culp, 2002; Zhang, 2007). Second, some researchers focus on links between changes in revenue and educational outcomes (Titus, 2006a, 2006b, 2009; Volkwein & Tandberg, 2008; Zhang, 2009). The importance of these approaches for public policy is clear. If changes in revenue affect access to higher education or the quality of educational outcomes, that information should be part of the public policy discussion.

To the extent that changes in institutional revenue are associated with changes in educational outcomes, a third approach to understanding the effects of revenue changes is suggested. Perhaps changes in educational outcomes reflect the fact that, faced with changes in revenue, institutions emphasize some activities and deemphasize or eliminate others. This suggests an examination of the associations between changes in institutional revenue and changes in spending. Such associations may have implications for public policy debates about state appropriations to universities and state tuition policies. A few researchers have taken this approach (Hasbrouck, 1997; Leslie et al., 2012). This study proposes to extend that work by examining the relationship between revenue and spending at public bachelor's and master's institutions.

Statement of Research Problem

The general research problem this study addresses is the need to understand how changes in revenue at higher education institutions may be associated with changes in institutional spending. Recognizing previous work done on this problem, this study focuses on understanding this association at public bachelor's and master's institutions from 2003 to 2012, the most recent decade for which data are available. In addition, the literature suggests several factors that may help explain any observed association between revenue and spending changes. These include the type of institution, the size of institution, institutional selectivity, the institution's tuition discount rate, and policies of the state in which the institution is located.

Research Questions

The purpose of this study is to measure associations among sources of revenue and expenditures at public bachelor's and master's institutions. Initially, this can be addressed in a manner similar to the approach taken by Leslie et al. (2012). Several categories of spending are identified: instruction, research, public service, academic support, student services, institutional support, and scholarships. Similarly, several categories of revenue are identified: tuition and fees, appropriations, grants and contracts, sales, gifts, and other revenue. An estimate is then made of the association between changes in each category of spending and the changes in revenues. This approach can be expressed as one overarching research question and several sub-questions. The first research question is:

Q1: To what extent are changes in sources of revenue at public bachelor's and master's institutions associated with changes in expenditures?

For each type of expenditure, a sub-question naturally follows:

Q1.1: To what extent are changes in sources of revenue at these institutions associated with changes in expenditures *on instruction*?

Q1.2: To what extent are changes in sources of revenue at these institutions associated with changes in expenditures *on research*?

Q1.3: To what extent are changes in sources of revenue at these institutions associated with changes in expenditures *on public service*?

Q1.4: To what extent are changes in sources of revenue at these institutions associated with changes in expenditures *on academic support*?

Q1.5: To what extent are changes in sources of revenue at these institutions associated with changes in expenditures *on student services*?

Q1.6: To what extent are changes in sources of revenue at these institutions associated with changes in expenditures *on institutional support*?

Q1.7: To what extent are changes in sources of revenue at these institutions associated with changes in expenditures *on scholarships*?

Institutional characteristics may partly explain any association between changes in revenue and changes in expenditure. For instance the size of the institution and its type (public/private, research/masters/bachelors) may affect the relationship. Some evidence suggests an institution's selectivity may affect its spending decisions (Jacob, McCall, & Stange, 2013), as may an institution's discount rate (Martin, 2002). Resource dependency theory suggest that, especially for public institutions, the regulatory environment and governance structure of the state in which the institution operates may materially affect any relationship between revenue and expenditure (Berger & Kostal, 2002; Pfeffer & Salancik, 1978).

Including such variables in the analysis would add to the knowledge developed by previous, published work in this area (Hasbrouck, 1997; Leslie et al., 2012). Five such characteristics will be examined: institutional size, type (bachelors or masters), selectivity, tuition discount, and state tuition policy. This in turn leads to five sub-questions:

This leads to a second research question and five sub-questions:

Q2: To what extent do institutional characteristics help to explain the associations between institutional revenues and expenses?

- Q2.1: To what extent does an institution's size help to explain the relationship between revenues and expenditures?
- Q2.2 To what extent does an institution's discount rate help to explain the relationship between revenues and expenditures?
- Q2.3: To what extent does an institution's selectivity help to explain the relationship between revenues and expenditures?
- Q2.4: To what extent does an institution's type (bachelors or masters) help to explain the relationship between revenues and expenditures?
- Q2.5 To what extent does state tuition policy help to explain the relationship between revenues and expenditures?
- Q2.6 To what extent do the variables above collectively help to explain the relationship between revenues and expenditures?

Definition of Terms

Brief definitions of the terms used in the research questions are offered here. An expanded discussion of how the variables are derived from IPEDS and other others sources is offered in Chapter 3.

Institutional characteristics in the research questions include selectivity, discount rate, and, and tuition policy. Selectivity refers to the percentage of applicants who are admitted to the institution. In this study, discount is the amount of institutional grant aid directed to first-year students expressed as a percentage of the gross tuition revenue expected if all first-year students paid the published tuition rate. Tuition policy in this context refers to the governing body that has the authority to set tuition rates for the institution.

Definition of the revenue variables used in the research questions necessarily derives from the definitions used in the IPEDS survey from which the data are derived. The *Tuition and Fees* variable measured the net revenue from tuition and mandatory fees after any discounts are applied. *Appropriations* measured general operating revenue from federal, state, and local governments. This variable excluded grants, contracts, and capital appropriations. *Grants and contracts* measured revenue from public and private grants and contracts that were classified as operating revenue. *Sales* measured operating revenue generated by auxiliary enterprises, net of any discounts. Typical auxiliary enterprises include residence halls, food services, student health services, intercollegiate athletics, and bookstores. *Gifts* measured revenue from private donors. This variable included gifts received by affiliated organizations, such as the private non-profit foundations that many public universities maintain, excluding gifts to capital projects and permanent endowments. Finally, the *other revenue* variable included any sources of operating revenue that are not otherwise accounted for in the IPEDS data collection.

The definition of terms for expenses also follows the definitions in the IPEDS survey instruments. *Instruction* and *Research* are self-explanatory. *Public Service* expenses are those attributable to non-instructional services for the benefit of people external to the in institution, for instance, conferences, institutes, and reference bureaus. *Academic Support* measures expenses that support the institution's instruction, research, and public service programs. For instance, expenses associated with an institution's library would be reported here, as would certain administrative expenses directly associated with academic programs. *Student Services* measures operating expenses associated with admissions, registration, and programs intended to benefit students outside of regular instructional activities, for instance intramural athletics, student clubs, counseling, and financial aid administration. *Institutional Support* measures operating expenses associated with general administration, including "central executive-level activities concerned with management and long range planning, legal and fiscal operations, space management, employee personnel and records, logistical services such as purchasing and printing, and public relations and development" (National Center for Education Statistics, 2014a). Finally, *scholarships* measures operating expenses associated with scholarships and fellowships that can be treated as expenses because the institution incurs an incremental cost for the provision of services. This does not include discounts where no such incremental costs are identifiable.

Study Delimitations

The study was delimited by the types of institutions included in the analysis. This study examined public bachelors and masters institutions in the United States, as defined by the Carnegie classification system (Carnegie Foundation for the Advancement of Teaching, 2005).

In the Carnegie classification system, master's institutions are those that award at least 50 master's degrees and fewer than 20 research doctorates in a year. Bachelor's institutions are those where bachelor's degrees account for at least 10% of all undergraduate degrees and no more than 50 master's degrees are awarded in a year. The Carnegie bachelor's category includes institutions where the majority of degrees awarded are at the associate degree level. These institutions, designated as Associates/Bachelors institutions were included in this analysis. Excluded from the analysis were institutions designated in the Carnegie classification system as doctorate-granting institutions, associate's colleges, tribal colleges and special-focus institutions. Private and for-profit institutions were also excluded from the analysis, as were institutions outside the 50 states. Finally, the time period included in the analysis spanned the 2002-03 academic year through 2011-2012.

Study Limitations

The survey from which data were drawn for this study was nearly comprehensive in its coverage. In a few cases, however, data across several institutions was aggregated before they were reported. These institutions were necessarily excluded from the analysis, since this study focused on institution-level questions.

Perhaps the most significant limitation in the study concerned the period of time period included in the analysis. This time period was marked by a significant global economic crisis that affected many sectors of the national economy. This limited the extent to which associations observed during this time period could be generalized to other, less tumultuous times.

In addition, the institutions included in this dataset were all in the United States. Generalizations to other systems of higher education cannot be supported by the analyses presented here.

Study Significance

Understanding how changes in institutional revenue are associated with changes in spending may have important implications for public policy. For instance, suppose that an institution's increasing reliance on tuition revenue is likely to be associated with a reduction in spending on instruction. A better understanding of this relationship may contribute to better decision-making by practitioners within institutions who are responding to a changing funding environment and by public policy makers who shape that environment. Given the degree to which the funding environment for higher education institutions continues to change, it is important to understand the effects that these changes have on institutions.

This study adds to previous research addressing this research problem. The most recent work in this area focused on research institutions using panel data from 1985 to 2008 (Leslie et al., 2012). Older work, which included bachelor's and master's institutions, relied on a cross-sectional analysis of data from two years: 1983 and 1993 (Hasbrouck, 1997).

The present study extended this previous research in two ways. First, the panel data analysis that Leslie, Slaughter, Taylor, and Zhang (2012) performed for research institutions was performed for bachelor's and master's institutions. Second, several institutional characteristics, which a review of the literature suggested may help explain any observed association between revenues and expenditures, were added to the analysis.

Researcher's Perspective

I undertook this study from the perspective of a scholar-practitioner, working in public, masters-level institution that has rapidly become more dependent on tuition over the past decade. My initial work on this project stemmed from an interest in state-level public policy and higher education governance systems. A review of the literature in that area convinced me that, however important governance structures might be to higher education, their effects on institutions and students cannot be understood without taking into account fiscal policy.

CHAPTER 2: LITERATURE REVIEW

The literature on higher education finance is vast. To provide context for the present study, this review focuses on the effects of changing sources of revenue. The conceptual picture that emerges from the literature is displayed in Figure 2.1. Naturally, much of the literature focuses on associations between changes in revenue and educational outcomes. Observed relationships between revenues and outcomes suggest intermediate factors in the relationship. Perhaps outcomes change because the changes and revenue produce an alteration in student choices, either by constraining those choices (as rising net price makes some enrollment choices less attractive or attainable) or by changing incentives among available choices, for instance by discounting tuition for some students.

Alternately, outcomes may change because changes in revenue produce an alteration in institutional choices. Changes in revenue may be associated with changes in expenditures, which in turn may be associated with changes in outcomes. After briefly looking at literature on the ways in which changes in institutional revenue may affect student choices, this literature review concentrates on the main focus of the present study: how changes in institutional revenue are associated with changes in institutional choices.

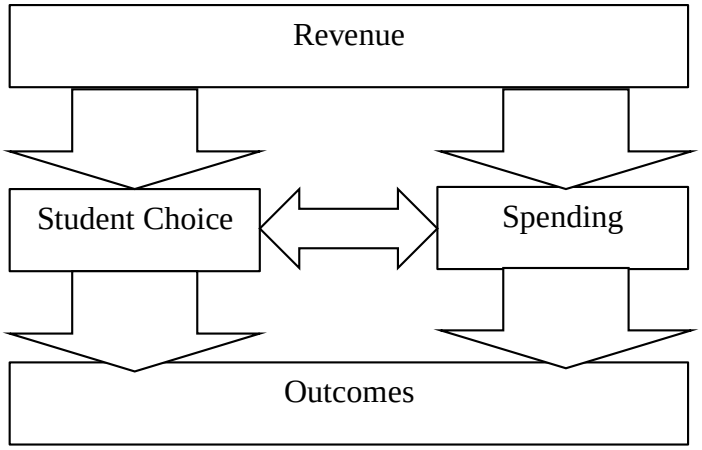

Figure 2.1. Relationships among revenue, price, spending, student choice and outcomes

Institutional Revenue and Student Choices

The main focus of the present study is on institutional responses to changing revenue, but as Figure 2.1 suggests, student choices may also be affected by institutional revenue. Kennamer (2009), for instance, found that the availability of local tax support for community colleges was associated with the level of enrollment by low-income students.

Most work in this area has focused on the relationship between the price of tuition and student demand. An inverse relationship between price and demand is axiomatic in the economic literature. Higher education markets are no exception. The relationship between the price of tuition and student enrollment has long been observed (Ostheimer, 1953). Estimating the amount of elasticity in that relationship (i.e., the degree to which changes in price produce changes in demand) has been the subject of extensive study. Two comprehensive meta-analyses of that research (Heller, 1997; Leslie & Brinkman, 1987), which between them encompass 45 studies published between 1967 and 1996 produced consistent estimates of elasticity. Leslie and Brinkman (1987) found that a $100 increase in tuition was associated with decline in college participation by 18-24-year-olds that ranged from -0.6% to -0.8%. Heller's follow-up meta-analysis a decade later confirmed that that result (Heller, 1997). Chang (1996) offered a methodological critique of the studies that these meta-analyses relied upon, arguing that static models, which assume the full response of changes in price can be observed over a short period of time, underestimate the size of that response.

Both meta-analyses noted some variation in elasticity based on type of institution (public, private, two-year, four-year) and on student income (Heller, 1997; Leslie & Brinkman, 1987). More recent work has more fully explored these factors. Buss, Parker, and Rivenbug (2004) examined student choices to attend liberal arts colleges, finding that for students who

demonstrated no need for financial aid, a 1% increase in price produced a 1% decrease in enrollment. The decrease in demand became greater as student financial aid increased. Similarly, student willingness to pay was found to vary by academic major, mostly according anticipated future income from the course of study (Jung Cheol & Milton, 2008). Zhang, focusing on elasticity for students paying non-resident tuition at out-of-state public universities found that estimates of elasticity depended on the level of analysis (2007). A national estimate, derived from all universities in the sample, showed a 1% reduction in non-resident enrollment for each 1% increase in tuition. At the institution-level, however, a 1% increase in tuition was associated with a much smaller (-0.2%) reduction in non-resident enrollment. A state-level analysis, where student migration was assumed to be constrained to nearby states, yielded an estimate of elasticity that was not statistically significant, with considerable variation across states.

The relationship between tuition and student demand is consistent enough that economic models of the relationship can be constructed to examine, for instance higher education supply and demand as functions of tuition and the regulatory environment (Berger & Kostal, 2002; Fethke, 2005). This largely theoretical work continues to be supported by empirical studies showing, for instance, that a 19.6% increase in non-resident tuition in the Pennsylvania system between 1991 and 1993 was associated with a 40% decline in non-resident enrollment (Noorbakhsh & Culp, 2002).

Colleges and universities have taken advantages of the price-demand relationship in student enrollment by employing tuition discounting strategies to increase revenue (Baum & Lapovsky, 2006; Baum & Ma, 2013; Hillman, 2012; Martin, 2002). A discounting strategy requires a tuition price that (combined with other sources of revenue) exceeds an institution's

costs per student. The price of tuition is then discounted in the form of grants paid for with foregone revenue. The reduction in price produces the expected increase in demand, persuading students who otherwise would not enroll at the institution to do so. Discounts can be targeted to entice students with particular characteristics, for instance exceptional athletic or academic ability. When used as a revenue enhancement strategy, the goal of discounting is to increase enrollment (and so increase tuition collections) without sacrificing so much revenue that costs are not covered (Martin, 2004).

The practice of tuition discounting has expanded in recent years. Originally associated primarily with private colleges, it is now commonly employed by public institutions as well (Baum & Lapovsky, 2006; Hillman, 2012). The financial calculus associated with discounting is different at public institutions compared to private institutions (Martin, 2002) for two reasons. The public subsidy available to public institutions changes the marginal costs associated with adding students who may be attracted by a lower price (Martin, 2002) and public and private institutions often compete for different groups of students who may have differed in their responsiveness to changes in price (McMillen, Singell, & Waddell, 2007).

As discounting has become more common, attention has turned to the potentially deleterious effects on institutions and on students. The marginal returns on a discounting strategy decrease as the discount rises so that a poorly implemented strategy may leave institutions with increased enrollment but decreased revenue per student (Baum & Lapovsky, 2006; Hillman, 2012). At the same time, discounting strategies focused solely on revenue maximization have been shown to adversely affect low-income students (Davis & Lumina Foundation for Education, 2003). Curs and Singell (2010), for instance, used data from the University of Oregon to focus on pricing and aid models at public flagship universities,

demonstrating that the high-tuition/high-aid model associated with discounting strategies is less favorable to low-income students than models with lower tuition and lower aid.

Associations Between Revenues and Institutional Outcomes

Some researchers have focused on the associations between resources available to institutions and institutional productivity. Zhang (2009), for instance, found a positive association between levels of state support for public higher education institutions and graduation rates. Drawing on IPEDS data from 1997 to 2004, Zhang (2009) used six-year graduation rates as the dependent variable and public appropriations over the first four-years of the cohorts' enrollment as the independent variable, controlling for tuition levels, age, residency status, underrepresented populations, gender, full-time status, and SAT scores. Examining differences between institutions, Zhang found that 10% more public funding was associated with a 7% improvement in graduation rates. Within-institution changes in funding showed a similar association. However, the size of the effect is much reduced when Zhang's model is adjusted to control for time-trends over the eight years of observation. A 10% change in public funding within an institution is associated with a two percent change in graduation rates. Ignoring time-tend effects and analyzing the association between public support and graduation rates by type of institution, Zhang (2009) found that the effect at master's institutions was half that of research/doctoral institutions, and the effect at baccalaureate institutions was not statistically significant.

Titus (2006a, 2006b) examined associations between institutional graduation rates and state funding, tuition reliance, and state financial aid policies. Titus (2006b) investigated relationships between student persistence and institutional revenue. That study examined a

random sample of 4,951 first-time, full-time students attending four-year institutions from the Department of Education's 1996-1998 Beginning Postsecondary Students (BPS) database, weighted to adjust for overrepresentation of students from large universities. The dependent variable was *persistence*, defined as graduation or continued enrollment in the same institution three years after initial enrollment. Titus used a hierarchical model that included student-level variables (pre-college academic performance, socio-economic status, gender, and race/ethnicity) and institution-level variables (including percent of revenue from tuition and from appropriations and percent of expenditures on instruction). Titus found that including revenue and expenditure variables improved his model considerably (increasing the variance in persistence explained from 26% to 36%) and that the chances of student persistence increased with the percent of revenue derived from tuition (odds-ratio 6.32, $p<.01$).

Titus (2006a) also examined the relationship between institutional revenue and completion. Drawing data from the Beginning Postsecondary (BPS) surveys from 1996-2001, Titus (2006a) constructed a hierarchical model that included variables at the student-level (including gender, SAT scores, race/ethnicity, working on campus, declaring a major, living on campus, GPA, unmet financial need, satisfaction with campus climate, and socio-economic status), the institution-level (including measures of gender distribution, racial and ethnic diversity, average SES, public or private control, size, average SAT score, selectivity, sources of revenues, and expenditures), and the state-level (including the percentage of the state's population with bachelor's degree, unemployment rate, number of institutions per student, appropriations, tuition, need-based aid, and region). The model found that the percentage of an institution's revenue derived from tuition was very slightly associated with completion (odds-ratio 1.002, $p<.001$).

Several researchers have focused on associations between funding and measures of productivity and performance at the state-level. Taking a state-level measure of degree productivity (number of bachelor's degrees awarded per undergraduate enrollment) as a dependent variable, Titus (2009) examined associations between productivity and state-level policies between 1992 and 2004. The independent variables measured included tuition at two-year institutions in the state, tuition at four-year institutions, state need-based aid, state non-need-based aid, and per capita state appropriations for higher education. The analysis controlled for scale using variables that measured the size of the first-year entering class lagged six-years to the measure for degree production, the percentage of undergraduate enrollment in four-year institutions, and the tuition charged in the state's private four-year institutions. A fixed effect for the year of the measurement was also included to control for exogenous factors such as changes in federal financial aid policies from year to year. Among other findings, Titus (2009) notes a positive association between bachelor's degree production and state appropriations such that a 10% increase in per capita investment in higher education predicts a three percent increase in degree production (β=.032, p<.001).

Volkwein and Tandberg (2008) found similar positive associations between state-level resources available for higher education and higher education system performance. They draw data from IPEDS, aggregated at the state level, and pair those data with state-level higher education performance data from the *Measuring Up* surveys conducted in 2000, 2002, 2004, and 2006. They use a regression model to consider whether states with certain governance and regulatory practices differ from states with other governance and regulatory practices as measured by *Measuring Up* survey's performance data. For instance, do states with centralized governance systems perform better on affordability measures? Based on a non-significant

Hausman test, they chose to use a random effects model to examine their panel data. They then developed two regression models. One model sought to explain variability on performance measures using the independent variables associated with demographic and economic characteristics. The second model explains the same variability using the variables for governance and regulatory practices. The regression model that relies on state demographic and economic variables is more successful (R^2=.60, .57, .43, .45, and .60 on affordability, benefits, completion, participation, and preparation respectively) than the regression model that relies on governance and regulatory variables (R^2=.08, .03. 0, 0, and 0).

Taken together, these studies suggest, not surprisingly, that funding plays a significant role in determining outcomes. Volkwein and Tandberg (2008) provide some reason to think that at the state-level, funding differences are far more influential than differences in governance and regulatory schemes in determining outcomes. This provides a strong rationale for further research on institutional funding.

Associations Between Expenditures and Outcomes

Several researchers have examined associations between institutional patterns of expenditure and student outcomes. Astin (1993), for instance, noted a small, positive effect on student outcomes at institutions that devoted a comparatively larger proportion of their expenditures toward instruction. Porter (2000) found a significant, positive association between institutional expenditures and graduation rates. Focusing on student leadership abilities as an outcome, Smart, Ethington, Riggs, and Thompson (2002) found a negative association with institutional expenditures on instruction and a positive association with expenditures on student services. Not all researchers have found a relationship. Belfield and Thomas (2000), for

instance, found no significant relationship between expenditures and student outcomes in their study of universities in the United Kingdom.

Empirical work in this area includes economic modeling intended to illuminate the economic incentives that less selective institutions may have for preferring to invest in "country club" amenities for students rather than expenses more directly related to their educational mission (Jacob et al., 2013) and the internal processes that lead institutions to invest a disproportionate share of their resources to administrative salaries and infrastructure (Leslie & Rhoades, 1995).

Associations Between Revenues and Expenditures

Most directly relevant to this study is the literature that focuses on the associations between institutional sources of revenue and institutional decisions on spending those resources. Research that examines resource allocation within institutions at the departmental or program level is necessarily limited to a small number of cases. Volk, Slaughter, and Thomas (2001) examined decisions about allocating resources among departments within a single research university. Santos (2007) made a similar inquiry focused on a small group of research universities. Garrett and Poock (2011) attempted to take this line of inquiry beyond the case study method, surveying senior administrators on their preferred strategies for responding to fiscal constraint.

Others have examined a larger number of cases by focusing on associations at the institution-level. In National Bureau of Economic Research working paper, Jacob, McCall and Strange (2013) explore how institutions respond to student demand in making expenditure decisions. They began by noting a wide variability among institutions in the ratio of spending on

instruction to spending on recreational amenities (which they measure as spending on student services and auxiliaries using IPEDS data) relative to spending on instruction. They then consider whether that variability might plausibly be explained as a response to student demand. They find evidence that high-achieving students respond favorably to institutional investments in academic quality. Using a panel of data derived from IPEDS for four-year institutions reporting from 1992 through 2007, they construct a regression model that predicts the ration of spending on instruction to spending on recreational amenities based on type of institution (public or private), selectivity (mean SAT scores), enrollment, and wealth (total spending on instruction and recreational amenities). That model explains 29% of the variation in the spending ration (R^2=0.288). When differences in price elasticity based on academic preparation are added to the model (i.e., when the observation that less qualified students are more motivated by institutional investments in campus amenities is accounted for), the explanatory value of the model improves (R^2=.346).

Jacob, McCall, and Strange conclude that institutional decisions about spending on recreational amenities can be partially explained as a response to student demands, which differ according to level of academic preparation. It should be noted that their measure of spending on recreational amenities (spending on student services and auxiliaries) includes spending on student advising and counseling services that might not be generally regarded as recreational. Also, in both models, the size of the effect for institutional selectivity (measured as mean SAT scores) is quite small (ß=-0.002, *SE*=0.001, p<0.001 for both models).

In a doctoral dissertation for the University of Arizona, Hasbrouck (1997) examined survey data from the Integrated Postsecondary Education Data System (IPEDS) surveys for 1982-83 and 1992-93 for associations between revenues and expenditures. In addition to

revenue variables, the model included type of institution (Carnegie classification) as an independent variable. That analysis found numerous associations between revenues and expenses. Among the principal associations found:

- Expenses on instruction were significantly predicted by revenues from appropriations, tuition; gifts, grants and contracts; and by type of institution.
- Expenses on research were predicted by type of institution and by gifts, grants, and contracts.
- Expenses on public service were predicted by revenue from appropriations; gifts, grants, and contracts; and type of institution.
- Expenses on student services were predicted by revenues from appropriations, tuition, and type of institution.
- The IPEDS expenditure data for academic support and institutional support were combined to create a variable for overall expenses on administration. That derived variable was predicted by revenues from appropriations; gifts, grants, and contracts; and type of institution.

Given the similarity between the research questions examined by Hasbrouck (1997) and the questions that that will be examined in the study proposed here, it is worthwhile to note a few details regarding Hasbrouck's design and methods. Hasbrouck's sample included research universities as well as masters and baccalaureate institutions. The sample was drawn from IPEDS data for just two years (1982-83 and 1992-93). With two years' data, panel data analytical techniques were not necessary. Multiple regression analyses were performed on each year separately and on the two years' data pooled. The significance of change over time was determined by comparing the regression coefficients in each year with a Chow test.

Hasbrouck (1997) calculated the revenue and expense variables in two ways. First, the variables were calculated as inflation-adjusted per student dollars. Second, each variable was calculated as a percent share of overall institutional revenues or expenses. Each regression analysis was performed twice, once with each set of variables. In general, the two approaches yielded similar results, although there were a few differences. For instance, revenues from appropriations were a statistically significant predictor of spending on student services and public service when the dollars per student variables were used, but not when the share of revenues and spending variables were used.

One of Hasbrouck's dissertation advisors later returned to the topic of the relationship between revenues and expenditures (Leslie et al., 2012). Leslie, Slaughter, Taylor, and Zhang (2012) extended Hasbrouck's project to include the annual IPEDS surveys for a 23-year period from 1984-85 to 2007-08 and narrowed the sample of institutions to focus on 96 public and private research universities, again finding significant associations between the sources of institutional revenues and the allocation of expenses. For public research institutions, they found that revenues from tuition, appropriations, grants and contracts, and gifts were statistically significant predictors of expenses on instruction, research, public service, academic support, student services, and institutional support. Among the larger effects they note: a dollar increase in tuition was associated with a 0.46 dollar increase in spending on instruction ($p<0.001$) and 0.08 dollar increase in student services spending ($p<0.001$). A dollar increase in gifts was associated with a 0.56 dollar increase in research ($p<0.001$). They note that, given the large number of observations in the panel, statistical significance on many measures is not surprising.

Again, given the similarity between the study conducted by Leslie, Slaughter, Taylor, and Zhang (2012) and the study proposed here, it is worthwhile to comment on their methods. They

use the inflation-adjusted, per-student method for calculating revenue and expense variables. Unlike Hasbrouck (1997), they have a full set of panel data with repeated observations over 23 years to analyze. They construct a two-way fixed effect model (rejecting a random effects model based on a significant Hausman test), including fixed effect terms for both institution and year. Given the long period of time their panel covers, they consider the possibility that the relationship between revenues and expenditures may change over that time, so they provide a second analysis that includes an interaction term between each revenue variable and the year variable to estimate the degree of this change.

Leslie, Slaughter, Taylor, and Zhang deal with institutional characteristics somewhat differently than Hasbrouck. Because they restricted the group of institutions to research universities, unlike Hasbrouck, they do not need to consider Carnegie classification in their model. They deal with the difference between public and private control by running separate analyses for the two types of institutions and avoiding direct comparisons. They assume that the calculation of variables on a per student basis adequately deals with variations in institutional size.

Theory

The empirical work described above found some relationship between changes in institutional revenue and changes in expenditures (Hasbrouck, 1997; Leslie et al., 2012). From a practical perspective, these findings are perhaps not surprising. From a theoretical perspective, the finding suggests something about how higher education organizations adjust goals in response to changes in their environments.

At least two divergent theoretical frameworks can be discerned in the literature: institutional theories and resource dependency theories. Classical institutional theories begin with the premise that organizations are rational actors making decisions that best achieve institutional goals (Clotfelter, 1996; DiMaggio & Powell, 1983; James, 1990; Lane & Kivisto, 2008; Santos, 2007). Understanding institutional behavior and the decisions regarding the allocation of resources under this framework necessarily begins with a discussion of the institution's mission and goals. Bowen's well-known "revenue theory of cost" (Bowen, 1980, pp. 17-20) is an example of institutional theory applied to higher education. Bowen argued that the goals of higher education institutions are excellence, prestige, and influence, that there is no limit to the amount of money that institutions can spend in pursuit of these goals, and that therefore a higher education institution will raise and spend all the money that it can.

Others have followed Bowen in identifying prestige maximization as the central goal of higher education that explains much institutional behavior (Clotfelter, 1996; James, 1990). Neo-institutionalist theories extend the classical framework to take into account the multiple missions of modern universities and to conceive of higher education institutions as multi-product corporations in which an institution's behavior may be the product of competing constituent priorities (Lane & Kivisto, 2008; Tuckman & Chang, 1990). When institutional theories are extended in this way, they highlight the potential for cross-subsidies in universities where revenues associated with one activity or department may be used to underwrite unrelated expenses (Ehrenberg, Rizzo, & Jakubson, 2007; James, 1978).

Although neo-institutionalist theories recognize the political and contingent nature of organizational priorities, they nevertheless continue to emphasize the centrality of the institution's goals to understanding the behavior of institutions. This goal-centeredness can be

criticized for failing to give adequate weight to political forces outside the organization and other external factors that may influence organizational decision-making (Lane & Kivisto, 2008; Pfeffer & Salancik, 1978; Santos, 2007; Winston, 1999).

Resource dependency theory, first named by Pfeffer and Salancik (1978), provides an alternative framework for analyzing institutional decisions about resource allocation. Rather than place institutional goals at the center of analysis, resource dependency theory assumes that institutional goals are a function of the resources available to institutions and the interests of those who supply resources. In this framework, organizations "alter their purposes and domains to accommodate new interests, sloughing off part of themselves to avoid some interests, and when necessary, becoming involved in activities far afield from their stated central purposes" (Pfeffer & Salancik, 1978, p. 24). Resource dependency theory provides a framework for understanding the public policy concerns noted above, which argue that reduced public support and increased dependence on tuition revenue will lead to changes in the mission and priorities of public higher education institutions (Jaquette, 2013). As institutions reprioritize expenditures, those allocation decisions may affect student-level outcomes.

CHAPTER 3: METHODOLOGY

Research Design and Rationale

The purpose of this study was to measure associations among sources of revenue and expenditures at public masters- and baccalaureate-level, higher education institutions. This led to two research questions.

Q1: To what extent are changes in sources of revenue at public bachelor's and master's institutions associated with changes in expenditures?

For each type of expenditure, a sub-question naturally follows:

Q1.1: To what extent are changes in sources of revenue at these institutions associated with changes in expenditures *on instruction*?

Q1.2: To what extent are changes in sources of revenue at these institutions associated with changes in expenditures *on research*?

Q1.3: To what extent are changes in sources of revenue at these institutions associated with changes in expenditures *on public service*?

Q1.4: To what extent are changes in sources of revenue at these institutions associated with changes in expenditures *on academic support*?

Q1.5: To what extent are changes in sources of revenue at these institutions associated with changes in expenditures *on student services*?

Q1.6: To what extent are changes in sources of revenue at these institutions associated with changes in expenditures *on institutional support*?

Q1.7: To what extent are changes in sources of revenue at these institutions associated with changes in expenditures *on scholarships*?

Q2: To what extent do institutional characteristics help to explain the associations between institutional revenues and expenses?

Q2.1: To what extent does an institution's size help to explain the relationship between revenues and expenditures?

Q2.2 To what extent does an institution's discount rate help to explain the relationship between revenues and expenditures?

Q2.3: To what extent does an institution's selectivity help to explain the relationship between revenues and expenditures?

Q2.4: To what extent does an institution's type (bachelors or masters) help to explain the relationship between revenues and expenditures?

Q2.5 To what extent does state tuition policy help to explain the relationship between revenues and expenditures?

Q2.6 To what extent do the variables above collectively help to explain the relationship between revenues and expenditures?

Understanding the associations between sources of revenue and expenditures at higher education institutions called for a quantitative design. Where such associations were found, a future qualitative design might shed light on the decision-making processes within institutions that translate changes in revenue into changes in expenditure.

The general approach for this study, which is described in some detail in what follows, required measurement of revenue and expenditures at higher education institutions in conceptually meaningful categories. Measures of institutional characteristics that might help explain the relationship between revenues and expenditures were also required. The resulting

panel data was analyzed to estimate the associations between sources of revenue and expenditures. Revenue variables and institutional characteristics were used as independent variables to explain variation among dependent expense variables.

Measurement Validity and Reliability

Most of the data used in this study came from the Integrated Post Secondary Data System (IPEDS) maintained by the National Center for Education Statistics (NCES). All institutions participating in federal financial aid programs are required to participate in the annual IPEDS survey. Consequently, the survey's coverage of accredited institutions was nearly perfect, with only a very small number of institutions excluded. At the time the analysis was conducted, data were available from annual surveys from 1980 through 2012.

This study, therefore, relied on secondary data analysis, i.e. the analysis of data that was not specifically collected to address the research questions in this study. Much has been written on the advantages and disadvantages of secondary data analysis (Church, 2002; Doolan & Froelicher, 2009; Smith, 2008; Trzesniewski, Donnellan, & Lucas, 2011; Vartanian, 2011). In the present case, the obvious advantage of relying on secondary data was that it made available for analysis a large, multi-year survey, collected by a team of survey researchers using methods developed and refined over many years. No solitary researcher could replicate work on this scale. This advantage and the availability of national data sets makes secondary data analysis a staple of research in international public administration, education, and other similar fields (O'Sullivan & Rassel, 1995; Smith, 2008).

Consequently, evidence for the measurement validity and reliability of this study relied heavily on the work that NCES has done to document and test their data collection methods.

Data collection techniques for IPEDS are well-documented and publicly available (National Association of College and University Business Officers, 2010; National Center for Education Statistics, 2013). Evidence for measurement validity and reliability for the key variables came from work the NCES has done to validate the survey and ensure the quality of data collection. The IPEDS finance survey was revamped to align data collection with institutional general purpose financial statements in 1997 for private institutions and in 2002 for public institutions. NCES conducted a pilot study of the revised version of the finance survey which compared revenue data collected with data from institutional general purpose financial statements. The pilot study sought to validate revenue data collected in IPEDS by matching the data with the audited financial statements and other financial records from a sample of institutions. Although the report of the pilot study does not provide a statistical measure of validity based on this review, several recommendations for improvement were made. Most of these recommendations concern efforts to provide a method for making that data collected in earlier surveys comparable to data collected in the revised survey. Of the survey items used in the study presented here, the only one that proved problematic in the 1997 pilot study was the "other revenue" item. The pilot study found that some institutions reported revenue in this category that should have been reported elsewhere or should not have been reported at all (National Center for Education Statistics, 1997). Revisions to the survey instructions were recommended to address this issue.

IPEDS data collection methods take advantage of the longitudinal nature of survey to check the reliability of measurements over time. The survey designers assume that year-to-year variations within institutions for most financial variables will be small. When data are entered into the survey, responses that deviate significantly from data collected in previous years are flagged (Knapp, Kelly-Reid, & Ginder, 2012).

Although IPEDS data on institutional revenues and expenses are widely used, it is reasonable to ask whether the data provide an adequate view of the costs of higher education. Winston (1998) identified three difficulties in calculating the costs of higher education:

"Three things cause major problems:

- the costs of using buildings, equipment, and land are both large (25-40% of total cost) and badly reported in college accounts
- it's not at all clear whether financial aid grants are a cost of education or a simple price-discount
- since colleges and, especially, universities do other things than educate undergraduates, there are major questions of cost allocation and joint costs that have to be worked through to get to undergraduate costs (p. 1.)"

To the extent possible, these issues were addressed in the research design of the study presented here. By focusing on current operating revenues and expenses, the problem of accounting for capital expenses was placed outside the frame of the study. By focusing on bachelor's and master's institutions, the problem of accounting for cross-subsidies among programs at large research and land grant institutions was avoided.

The problem of accounting for financial aid was more difficult. In general, institutional aid grants in this study were treated as a simple price discount. (This is described more fully below in the discussion of variables used in the study.) This decision was driven by the data definitions used in IPEDS surveys. It had the advantage of being the same approach used by others doing similar research (Hasbrouck, 1997; Leslie et al., 2012), making this study more directly comparable to previous work in the field

Identifying Specific Variables

Variables used in this study fell into three categories: revenue variables, expense variables, and institutional characteristic variables. Appendix A provides a complete list of

variables mapped to items in the IPEDS survey, including calculations used for variables derived from multiple items in the IPEDS survey. Key design decision about these variables are described here.

Institutional Characteristics

The two institutional characteristic variables used in the analysis – enrollment and Carnegie Classification – have already been described. *Enrollment* was measured as the 12-month, full-time equivalent enrollment for the year prior to the IPEDS survey. This provided a broad measure of enrollment, including part-time students as well as any graduate or professional students. This variable was used in two ways. First, enrollment was used to adjust revenue and expense variables on a "per FTE" basis. Second, because some of the between-institution variation may be due to economies of scale, enrollment was included as an independent variable in some regression models as an institutional characteristic, representing the scale of the institution.

Table 3.1

Variables Used in the Analysis

Institutional characteristics	Revenues	Expenditures
Enrollment	Tuition and fees	Instruction
Discount	Appropriations	Research
Selectivity	Grants and contracts	Public services
Carnegie Classification	Sales	Academic support
State Tuition Policy	Gifts	Student services
	Other	Institutional support
		Scholarships

Selectivity. Selectivity was calculated from two items on the IPEDS survey: number of first-time degree-seeking student applying for admission and the number of first-time degree-seeking students admitted. The ratio of those two items is used as a selectivity variable, which could range from 0 (no students who applied were admitted) to 1 (all students who applied were admitted).

Discount. Discount represented an institution's practice of charging a reduced tuition and fee rate for some students. The variable used here was the discount rate for first-year students. More than one definition of discount rate exists (Baum & Lapovsky, 2006). The discount variable used here was calculated following the method proposed by Duggan and Mathews (2005). Discount was defined as gross tuition revenue divided by total institutional grant aid. Gross tuition revenue was calculated by multiplying the number of students in the first-year cohort by the published rate for in-state tuition and fees. The total institutional grant aid was estimated by multiplying the number of students receiving institutional aid by the average size of institutional aid awards.

State tuition policy. For public institutions, the state in which the institution is located might substantially affect any observed relationship between changes in revenue and changes in expenditure. Governance structures vary among the states (McGuinness, 2003) as do policies governing tuition and the allocation of revenue (Bell, Carnahan, & L'Orange, 2011; Boatman & L'Orange, 2006; Rasmussen, 2003). Including geographical location in the model, for instance by adding dummy variables for the 50 states, would have produced an analysis that would be difficult to interpret meaningfully. Instead, a variable measuring state tuition policy was included in the model. The State Higher Education Executive Officers Association has occasionally surveyed its membership on state governance structures and policies (Bell et al.,

2011; Boatman & L'Orange, 2006; Rasmussen, 2003). The surveys included an item that indicated where tuition-setting authority in each state lies: with the legislature, with a state-wide governing board that has authority across all systems in the state, coordinating boards that have authority for individual systems in the state, or with the local institution. This survey was conducted three times during the period examined in this study, in 2003, 2006 and 2011, allowing a categorical variable for tuition policy to be included for these three years in the panel.

Revenue Variables

The *Tuition and Fees* variable measured the net revenue from tuition and mandatory fees after any discounts are applied. *Appropriations* measured general operating revenue from federal, state, and local governments. This variable excluded grants, contracts, and capital appropriations. *Grants and contracts* measured revenue from public and private grants and contracts that were classified as operating revenue. *Sales* measured operating revenue generated by auxiliary enterprises, net of any discounts. Typical auxiliary enterprises include residence halls, food services, student health services, intercollegiate athletics, and bookstores. *Gifts* measured revenue from private donors. This variable included gifts received by affiliated organizations, such as the private non-profit foundations that many public universities maintain. This variable excluded gifts to capital projects and additions to permanent endowments and contributions to capital projects. However, following the same procedure as Leslie et al. (2012), revenue from investment income, including endowment investments, was included here. Finally, the *other revenue* variable included any sources of operating revenue that are not otherwise accounted for in the IPEDS data collection.

Expense Variables

Operating expenses in the IPEDS survey are classified according guidelines developed by the National Association of College and University Business Officers (National Association of College and University Business Officers, 2010, 2014). *Instruction* and *Research* are self-explanatory. *Public Service* expenses are those attributable to non-instructional services for the benefit of people external to the in institution, for instance, conferences, institutes, and reference bureaus. *Academic Support* measures expenses that support the institution's instruction, research, and public service programs. For instance, expenses associated with an institution's library would be reported here, as would certain administrative expenses directly associated with academic programs. *Student Services* measures operating expenses associated with admissions, registration, and programs intended to benefit students outside of regular instructional activities, for instance intramural athletics, student clubs, counseling, and financial aid administration. *Institutional Support* measures operating expenses associated with general administration, including "central executive-level activities concerned with management and long range planning, legal and fiscal operations, space management, employee personnel and records, logistical services such as purchasing and printing, and public relations and development" (National Center for Education Statistics, 2014a). Finally, *scholarships* measures operating expenses associated with scholarships and fellowships that can be treated as expenses because the institution incurs an incremental cost for the provision of services. This does not include discounts where no such incremental costs are identifiable.

Defining the Sample of Institutions

This study narrowed the IPEDS dataset to focus on selected institutions. The most consequential narrowing was the focus, noted above, on bachelors and masters level institutions. The complex, multiple missions of research institutions can make it difficult to accurately classify expenses. For instance, at doctoral degree granting institutions, a faculty member's research may be concomitant with the instruction of graduate students. Additionally, the opportunities for cross-subsidization at a research universities, where revenues generated in one activity may be used to underwrite activities in another area, may make associations between revenues and expenditures at research universities of a different kind than at less complex institutions. These issues were noted by Leslie et al. (2012) in their examination of associations between changes in revenue and changes in expenditures at 96 research-intensive institutions.

To identify the bachelors and masters level institutions of interest in this study, the classification system developed by the Carnegie Commission on Higher Education was used (Carnegie Foundation for the Advancement of Teaching, 2005). Although that classification system was revised in 2005, the revision did not affect the general definition of bachelors and masters level institutions that is used in this study. In the Carnegie classification system, institutions are considered bachelors institutions if bachelors' degrees represent at least 10% of all degrees awarded and fewer than 50 masters degrees and 20 doctoral degrees are awarded in a year. Institutions are considered master's level if they award at least 50 master's degrees and fewer than 20 doctoral degrees in a year. Associate/Bachelors institutions, which in the Carnegie system meet the definition for bachelors institutions noted above but award most degrees at the associate level were included in analysis but coded separately. Special focus institutions and tribal colleges were excluded. Institutions that met these criteria in 2012 were eligible to be

included in the present study. There were 409 public, four-year institutions that meet these criteria.

The dataset was further narrowed by excluding a small number of institutions that report IPEDS data but lie outside the 50 states and the District of Columbia. Twelve institutions in US territories (i.e., in Guam, Puerto Rico, or the Virgin Islands) were excluded from the analysis on this basis, leaving 397 institutions in the dataset.

The IPEDS survey permits some groups of institutions to report financial data together. In the terminology of IPEDS, these institutions are said to have a "parent-child" relationship. Thirty-one institutions, that otherwise meet the criteria for this study, are not included because they are "child" institutions. Consequently their financial data is grouped with a "parent" institution and cannot be clearly disaggregated for analysis. For instance, several campuses in the Pennsylvania State University system report data through the main campus. When data are reported in this way, it becomes impossible in some cases to limit the analysis to baccalaureate and masters level institutions or to control for institution-level variables such as selectivity and institutional size. Based on reporting in the 2012 IPEDS survey, 31 institutions were excluded from this analysis, leaving 366 institutions in the sample.

Investigation and Disposition of Suspect Cases

The dataset was further narrowed through the investigation and disposition of suspect cases. An initial calculation of descriptive statistics revealed some variables with unexpectedly large, small, or missing values. These suspect cases were flagged for further investigation.

In Ordinary Least Squares regression, post-estimation casewise diagnostics are available to identify outliers that may have an outsized influence on the regression model. Such tools are

generally unavailable in the analysis of panel data, where a single observation may be an outlier within the context of pooled data, but may fall neatly within the expected range of observations for the unit from which the observation is drawn.

This can be illustrated with an example drawn from the current study. In 2003, the University of Arkansas at Pine Bluff (UAPB) reported per FTE tuition revenue of $1082.72, well below the first percentile of the overall sample. In the context of the overall sample, this report might appear suspect, but within the context of UAPB, it is surprising. Over the ten-year period in this study, UAPB consistently reported comparatively low tuition revenue. The mean for this variable at UAPB was $1766.04 (min = 1082.72, max=2,307.72, sd = 429.04).

In the absence of the post-estimation casewise diagnostic tools, it was especially important to deal with potential outliers before running the regression analyses. Ideally, each suspect case might be investigated to determine the accuracy of the report. In the present study, such investigation was impractical. The nature of secondary data analysis, in which the researcher relies on the data collection efforts of others, makes follow-up inquiries with respondents difficult at best (Smith, 2008; Vartanian, 2011). Furthermore, the large number of cases in the panel (366 institutions x 10 years) made case by case investigation impractical.

For the purposes of the present study, all data were included in the analysis except in a handful of cases where the data provided a strong reason to suspect the validity of the measurement and where the data could be rejected according to rule developed prior to running the regression analyses. This process is described below.

Missing and zero values. Cases with unexpectedly missing or zero-values were examined. Although it would not be surprising to find a small, teaching-focused baccalaureate institution reporting no expenses related to research, it would be expected that all institutions in

this sample would report expenses related to instruction and revenue from both tuition and appropriations. Cases that reported no revenue from tuition or appropriations or no expenses on instruction were examined. Based on this examination, the US military academies were dropped from the sample. In addition one institution (Thomas Edison State College) that reported no expenditures on instruction during the survey period was dropped.

One institution that reported no enrollment for part of the survey period (Southern University at New Orleans, probably due to the aftermath of Hurricane Katrina) was also dropped from the sample. Finally, seven institutions reported no public appropriations in one or more years of the survey. These omissions appear to be associated with transitions in governance and reporting structures between statewide and local governing boards. Data from these institutions was eliminated from the analysis for those years in which no public appropriations were reported. The 354 institutions remaining in the sample are listed in Appendix B.

Very large and very small values. Given the number of institutions in the sample, variability between the institutions was expected. Large variances within a single institution over time may be more revealing. Although revenue from grants and from gifts may vary widely from year-to-year, wide variations in income from tuition or from appropriations called for further examination. Similarly, abrupt, significant changes in enrollment or in spending on instruction suggested some additional scrutiny. Such cases may not represent measurement or reporting errors; they may be a consequence of a change in policy or programs. There may be large cuts in public appropriations in a given year, large increases in tuition, or programs may be added or dropped affecting enrollment and spending on instruction.

On the other hand, changes in these variables that are both large and abrupt may represent errors or anomalies in reporting. For instance, some year-to-year changes may be artifacts of the necessarily arbitrary nature of reporting deadlines. A change in the date that tuition payments are due, for instance, may cause a revenue collection that would have previously occurred in one fiscal year to appear instead in the following fiscal year.

Inquiry into very large and very small values focused on a limited number of variables and cases in which a possibly anomalous value was reported by an institution in a single year, with more typical values reported in adjacent years. These cases were identified and dealt with in two ways.

First, institution-specific means and standard deviations were calculated for enrollment, tuition revenue per FTE, appropriation revenue per FTE, and instruction expense per FTE. Cases where an institution reported a value in a single year that varied from the institutional mean for these variables by more than 2.5 standard deviations were marked as suspect. For instance, Western Connecticut University reported revenue from tuition in 2007 at $10,959 per FTE (z=2.6), well above the level reported in adjacent years ($5726 in 2006 and $6106 in 2008) or any other year (*M*=6881, *SD*=1561). Data from those institutions for those years were marked as suspect and excluded from further analysis. These cases are listed in in Appendix C.

Second, cases where an institution reported year-to-year changes in tuition revenue per FTE, appropriations per FTE, or instructional expense per FTE that were >|25|% over the prior year were noted and examined. In some of those cases, the change appeared to be reversed in the next year, suggesting that the change represented an artifact of a reporting deadline rather than a genuine change in the financial condition of the institution. For instance, Alabama A&M University reported changes in tuition revenue per FTE of -33.6% in 2011 and +31.8% in 2012.

Such cases were marked as suspect and data from those institutions in those years were excluded from further analysis. These cases are listed in Appendix C.

Some cases were marked as suspect based on multiple criteria. In total, 122 unique records (out of 3,396) were dropped from the data analysis due to very large or very small values that were judged to be of suspect validity.

Selecting the Time Period

This study proposed to examine the most recent ten-year period available from IPEDS surveys: 2002-2003 through 2011-2012. Although it would be possible to draw on earlier IPEDS surveys, the proposed study was limited to a decade. As a practical matter, the data definitions used in the IPEDS finance surveys have changed enough over time that a longer period of analysis would have presented problems in measurement reliability. Most significantly, the finance survey was redesigned in 2002 to reflect changes in the underlying accounting standards for governmental organizations (Delta Cost Project, 2011; National Center for Education Statistics, 2014b). Although some researchers have constructed crosswalks for the purpose of analyzing data from IPEDS finance surveys that span this change (Delta Cost Project, 2011), makes understanding time-effects more difficult. This study therefor focused on estimating the relationship between a set of revenue variables and selected expense variables, taking into account relevant institutional characteristics.

Data Preparation

Units of Change

The research questions posed in this study involve change, i.e., are changes in revenue associated with changes in expenses? Before the data can be analyzed, some additional work is necessary to more carefully define the unit of change to be analyzed.

The unit of change can be defined in at least two ways: as a change in constant dollars per student FTE or as a change in the proportion of revenue or expense at a given institution. In the former case, each revenue and expense variable is converted into inflation-adjusted constant dollars and divided by the institution's FTE to produce a set of variables that can be fairly compared over time. The unit of change in this case is a change in dollars per FTE. Alternately, a proportional method could be used. A calculation could be made to determine what portion of an institution's total revenue derives from, say, tuition in each year. Similar calculations would made for expense variables, so that, for instance, the proportion of an institution's total expenses that are devoted to instruction would be calculated in each year. The unit of change in this case would be a change in the percentage of revenue or expense.

Hasbrouck (1997) used both units of change in the analysis and found few differences. It is more difficult, however, to interpret the results when the proportional method is used. For instance, in a year of budget cuts, an institution might reduce expenditures in all categories, but take deeper cuts in student services than in instruction. In such circumstances, the proportional method might show a positive change for expenses on instruction even though actual spending is cut. For this study, the revenue and expense variables were denominated as per-student dollar amounts, adjusted for inflation.

Adjusting for Inflation

Adjusting the revenue and expense data for inflation required selecting an inflation measure to use in converting real dollars to constant dollars. Several inflation indices are available, including some specific to higher education inflation. For instance, the Commonfund Institute maintains the Higher Education Price Index. Gillen and Robe (2011) described a potential problem with using inflation indices specific to higher education for some purposes. Such indices are constructed by measuring the costs of goods and services that a higher education institution must purchase in order to provide an education to students. In other words, they help explain the costs of higher education. When these indices are then applied to tuition, a measure of the cost of higher education, the underlying logic may become circular. Consequently, a more general measure of inflation, the national Consumer Price Index (CPI-U) from the Bureau of Labor Statistics was used here, following the recommendations of Gillen and Robe (2011).

Data Analysis

Fitting a Regression Model

The resulting dataset was a longitudinal array in the "person-period" format (Singer & Willett, 2003). Such datasets have four types of variables: a subject identifier (in this case, the institution's ID), a time indicator (in this case, the academic year in which the survey was conducted), outcome variables (the expense variables), and predictor variables (the revenue and institutional characteristic variables).

Analysis of data structured in this way requires statistical tools appropriate for longitudinal panel data. Simple multiple regression using Ordinary Lease Squares (OLS) cannot

be used. The observations made at any given institution in one year are likely to be highly correlated with the observations made at that institution in other years. This clustering of observation violates the assumptions of ordinary regression and risks producing biased estimates of regression model parameters. Although it is possible to solve this problem by aggregating the clustered observations (for instance, by using the mean values for each institution over a period of time), this approach sacrifices a great deal of information.

Fortunately, other statistical techniques are available for analyzing panel data that do not require an assumption that each observation is independent. Most commonly, this is done by fitting a Fixed Effects Model or a Random Effects Model. (Allison, 2009; Andreß, Golsch, & Schmidt, 2013; Baltagi, 2013).

A Fixed Effects Model could be written, using the notation suggested by Allison (2009), as:

$$y_{it} = \mu_t + \beta x_{it} + \alpha_i + \varepsilon_{it}.$$

Taking the first research question as an example, y_{it} represents the change in per student spending on instruction for institution *i* measured in year *t*; μ is the intercept of the regression line; *x* is one of the revenue variables (of which there are several); α accounts for variability between institutions; and ε is an error term that is different for each institution at each point in time.

It is the addition of α, the institution-specific variance, that distinguishes the Fixed Effects Model from an OLS model. One simple (although tedious) way of fitting a Fixed Effects Model is to add a dummy variable for each unit in the panel, in this case a dummy variable for each institution in the sample (Andreß et al., 2013). In essence, between-institution variance is treated as a constant for each institution, the fixed effect that gives this approach its name (Andreß et al., 2013). The addition of so many dummy variables necessarily affects the degrees

of freedom, which in turn affects the calculation of standard errors for the model's regression coefficients.

In the Random Effects Model the institution-specific variance term, α, is treated as a random observation of some underlying distribution. This provides a more efficient way of calculating standard errors in the model. The Random Effects Model provides an additional benefit compared to the Fixed Effects Model. In the Fixed Effects Model, all between-unit variability is swept into the unit-specific error term α. Consequently, the model is incapable of yielding separate estimates of regression parameters that do not vary over time. For instance, in this study, the Fixed Effect Model would be unable to estimate between-institution variance due to the state in which an institution is located. That variance, and all other variance due to observed and unobserved time-invariant variables, is included in the estimate of α. The Random Effects Model, in contrast, can provide estimates for time-invariant explanatory variables.

The Random Effect Model, however, requires that more restrictive assumptions be met. Both the Fixed Effects and Random Effects model (like OLS regression) require an assumption of homoskedasticity, which in this context means that the variance in the error term, ε, should be constant across all units. This can be checked visually by plotting values for ε. Where heteroskedasticity appears to be a problem, methods of calculating standard errors that are more robust to this problem can be employed. Stata, the statistics program used in this study, uses the method developed by Huber (1967) and White (1980, 1982).

The Random Effect Model requires an additional assumption for α, the institution-specific variance term. It assumes that α will be independent of the model's explanatory variables (Andreß et al., 2013, p. 163). This assumption can be problematic. In the present study, for instance, it implies that none of the between-institution variance is explained by the

policies of the state in which an institution is located, an assumption that seems implausible on its face.

The usual method for choosing between a Fixed Effect and Random Effects model involves calculating the parameters for both models and comparing them with the Hausman test (Andreß et al., 2013; Baltagi, 2013). If the Random Effects Model's more restrictive assumptions are met, the Hausman test is non-significant, and the Random Effects Model is preferred for its more efficient estimation of standard errors and its ability to estimate coefficients for time-invariant explanatory variables.

Some authors (Allison, 2009; Andreß et al., 2013) describe a Hybrid Model that combines features of a Fixed Effects and Random Effects Model. The Hybrid Model is essentially the Fixed Effects Model with some additional independent variables added in. The Hybrid Model does not require the more restrictive assumptions of the Random Effects Model and, unlike the Fixed Effects Model, it yields estimates for time-invariant parameters. The Hybrid Model is calculated by adding the unit-level mean of each independent variable to the regression model. In the present study, for instance, the mean revenue that each institution reports from tuition, appropriations, gifts, etc. would be calculated. A Hybrid Model with a single independent variable could be written as:

$$y_{it} = \mu_t + \beta_1 x_{it} + \beta_2 \bar{x}_i + \alpha_i + \varepsilon_{it}.$$

For instance, if *y* is spending on instruction at institution *i* in year *t*, *x* might be revenue from tuition at that institution in that year, and $\bar{x}_i$ would be the mean of spending on instruction at that institution over all years *t*. The panel is then analyzed as a Fixed Effects Model. It can be shown that when the means of independent variables are added in this way, the Fixed Effects Model will yield an estimate of s of β_1 that is identical to the estimate from a Random Effects Model

(Andreß et al., 2013). In addition, the variance in *y* that is attributable to between-institution variance in *x*, which otherwise would be swept up with all other sources of between-institution variance into α, is estimated as β_2.

These three panel data regression models were used to address the research questions in this study. The first research question and the associated sub-questions examined the associations between each expense variable and the revenue variables. Fixed Effects and Random Effects Models were fitted for each of the sub-questions in first research question. Hausman tests were performed to determine which model was more appropriate. The estimates produced by the preferred model are reported in Chapter 4.

The second research questions added additional variables to the model related to institutional characteristics (size, type of institution, selectivity, discount, and location). Some of these variables do not change over time or change very little. Fixed Effects and Random Effects Models were fitted for each of these sub-questions. If a Hausman test shows that the Fixed Effects Model was preferred, the Hybrid Model was also fitted in order to yield estimates for the time invariant predictor variables. Tools for analyzing panel data vary across statistical software packages (Park, 2009). Stata Version 13 was used to perform these analyses.

CHAPTER 4: RESULTS

To understand how changes in revenue at higher education institutions may be associated with changes in institutional spending at public bachelor's and master's institutions, several regression analyses were performed using IPEDS data from 2003 to 2012. After calculating descriptive statistics for key variables, assumptions for linearity and collinearity were checked. The initial regression analyses, following closely the work of Leslie et al. (2012), focused on the financial variables and time effects. Next several institutional characteristics were added to the regression model in an effort to better explain variation in the spending variables. One of these, size of enrollment, added value to the model, so a final set of regression models including this addition was calculated.

Descriptive Statistics

After setting aside cases with suspect validity, as described above, descriptive statistics for the variables to be used in the regression analyses were re-calculated. These are shown in Tables 4.1 through 4.5.

Table 4.1

Means and Measurements of Variability for Institutional Characteristics

	N	*M*	*SD*	min	max	skewness
enrollment	3277	6671.25	5126.82	181.40	32622.00	1.62
selectivity	2006	67.17	17.41	11.00	100.00	-0.42
discount	3155	0.19	0.16	0.00	1.15	1.56

Table 4.2

Carnegie Classification (N=3,158)

	N	%
Masters level	2,340	74.1
Baccalaureate level	657	20.8
Associate/Baccalaureate	161	5.1

Table 4.3

Tuition Policy Control (N=891)

	N	%
Legislature	90	10.10
Statewide board	149	16.72
System board	334	37.49
Local district board	9	1.01
Individual institution	212	23.79
Multiple responses	97	10.89

Table 4.4

Means and Distribution for Revenue Per FTE (N=3275)

	M	*SD*	min	Max	skewness
Tuition/FTE	4826.57	1880.04	353.08	14907.01	1.01
Appropriation/FTE	6656.62	3015.72	638.12	38959.46	2.41
Grants/FTE	2091.41	2590.18	0.00	57674.79	10.44
Sales/FTE	2266.36	1824.93	0.00	10849.19	1.28
Gifts/FTE	238.18	655.75	-1153.98	11075.51	11.36
Other revenue/FTE	686.07	907.66	-5877.19	20384.27	6.30

The large skewness values for a few of the financial variables suggested that they might be candidates for log transformation or could be treated as categorical variables. Following Leslie et al. (2012), they were left untransformed.

Table 4.5

Means and Distribution for Expenditure Per FTE (N=3275)

	M	*SD*	min	Max	skewness
Instruction/FTE	6513.51	1708.32	2157.16	18463.44	1.23
Research/FTE	451.84	2308.71	0.00	66652.00	22.83
Public service/FTE	579.87	738.54	0.00	7934.15	2.90
Academic support/FTE	1553.61	692.51	7.06	6131.68	1.21
Student services/FTE	1534.43	753.45	307.32	8255.41	1.96
Institutional support/FTE	2188.30	1183.46	331.38	12373.75	2.52
Scholarships/FTE	1092.44	754.04	0.00	7553.94	1.30

In understanding the descriptive statistics for revenue and expenses, it is helpful to know the underlying trends. As expected, revenue from tuition increased over the survey period, with a mean annual increase of $180 per FTE. Revenue from appropriations declined on an annual per FTE basis (*M*=-195, *SD* = 1061). Expenditures per FTE increased in all categories except public service.

Notwithstanding the process described above for identifying and dealing with outliers, some very small and very large values remain. For instance, the minimum value reported for tuition revenue/FTE was $353. Given that the overall mean for revenue from tuition is $4827 this report is striking. This report comes from Coppin State University's 2012 survey response. Although it is notably lower than the institution's mean response for the survey period ($1942) and lower than the previous year's response ($1096), data from the following year are unavailable for comparison, so it is possible that the change represents a genuine change in condition. It therefore passes the screen and was included in the regression analysis.

The summary statistics displayed above were derived by pooling the observations from all institutions in all years. In describing the pooled data, no distinction was made between variance due to changes within an institution over time and variance due to differences between

institutions. Tables 4.6 and 4.7 show these two kinds of variance. The "between" variance reported in these tables shows the variance in each institution's mean from the overall mean of the pooled data. The "within" variance statistic summarizes the variance of observations within an institution from that institution's mean, centered on the overall sample mean ($SD^{between} = x_{it} - \bar{x_i} + \bar{\bar{x}}$). Adding the overall mean back into the "within" calculation makes it possible to directly compare the "within" and "between" variances. When this is done, not surprisingly, it is apparent that the variance during this period between institutions is greater than the variance within institutions.

Table 4.6

Means and Distribution for Revenue Per FTE (N=3275, groups=354)

	mean	SD between	SD within
Tuition/FTE	4826.57	1767.75	685.94
Appropriation/FTE	6656.62	2842.78	1238.94
Grants/FTE	2091.41	2780.95	938.65
Sales/FTE	2266.36	1761.07	397.33
Gifts/FTE	238.18	602.71	207.22
Other revenue/FTE	686.07	695.44	635.96

Table 4.7

Means and Distribution for Expenditure Per FTE (N=3275, groups=354)

	mean	SD between	SD within
Instruction/FTE	6513.51	1458.97	924.55
Research/FTE	451.84	2684.62	725.37
Public service/FTE	579.87	688.16	272.67
Academic support/FTE	1553.61	630.22	316.44
Student services/FTE	1534.43	674.48	317.04
Institutional support/FTE	2188.30	1091.08	494.72
Scholarships/FTE	1092.44	659.43	382.45

Assumptions Regarding Linearity and Collinearity

Linear regression assumes a linear relationship or no relationship between the dependent variable and each of the independent variables in the regression model. A non-linear relationship would suggest that transformation be performed before running the regression analysis. In the present study, a linear relationship seems plausible on its face. For instance, change of x dollars in revenue would not be expected to produce a change of x^2 dollars in expense. To test this assumption, each independent variable was plotted against each dependent variable and the resulting graphs examined for evidence of non-linearity. This procedure was performed for the pooled variables. Because the large mass of pooled data might obscure relationships within institutions over time, the procedure was repeated for a randomly chosen subsample of 36 institutions. No evidence of any non-linear relationship was detected.

Table 4.8

Correlations Among Independent Variables (N=1976)[a]

	1	2	3	4	5	6	7	8
1. Enrollment	–							
2. Selectivity	-0.06*	–						
3. Discount	-0.10***	0.10***	–					
4. Tuition	0.19***	0.02	-0.12***	–				
5. appropriations	-0.04	0.02	-0.05*	-0.07**	–			
6. grants	-0.16***	-0.09	0.02	-0.10***	0.11***	–		
7. sales	-0.19***	-0.10***	-0.03	0.21***	0.02	0.01	–	
8. gifts	-0.17***	0.13***	0.07**	0.04	-0.03	-0.12***	0.13***	–
9. other	0.03	0.15***	0.10***	0.19***	0.09***	0.10***	0.01*	0.05*

[a]Spearman's *rho*
*p<.05 **p<.01 ***p<.001

The regression analysis is vulnerable to multicollinearity among the independent variables. If two or more of the independent variables in the model are highly correlated, the

regression model may fail to distinguish between any independent effects of those variables, producing inefficient estimates of those regression coefficients. As a preliminary check, correlations among the continuous independent variables were calculated and are presented in Table 4.8. Although there were some statistically significant values, the effects were small enough to support accepting the assumption of no multicollinearity.

Regression Analyses

Addressing the first research question requires regressing each expenditure variable on the set of revenue variables. The steps are fully described for the first regression and then, because they are largely identical for the subsequent regressions, more briefly described after that. To provide a convenient place for side-by-side comparisons, these regressions are summarized again in Table 4.16.

Q1.1: To what extent are changes in sources of revenue at these institutions associated with changes in expenditures *on instruction*?

Instruction was regressed on the revenue variables using a fixed effects and a random effects model. The two models were compared with a Hausman test. The significant result (χ^2=376.73, p<0.001) indicated that the fixed effects model was preferred. Heteroskedasticity is a common problem in fixed effects regression models as the variance in the regression equation's error term is likely to be partly attributable to repeated measures from single units (in this case, higher education institutions). A post-estimation Wald test (χ^2=34000, p<0.001) confirmed the presence of group-wise heteroskedasticity. Consequently, the standard errors of the regression

coefficient were recalculated using a robust sandwich estimator. This model is presented in Table 4.9.

Finally, panel data models, which attempt to account for both within unit and between unit variance, provide several choices for calculating goodness-of-fit. An R^2 can be calculated for the extent to which the model explains the within-unit variance, the between-unit variance, or the overall variance in the dependent variable. Because fixed effects models are estimated based on within-unit variance, it is the within-institution R^2 that is presented here, unless otherwise noted.

Moreover, for a fixed effects model, a decision needs to be made about whether the R^2 calculation will incorporate the model's fixed effects. In this case, the between-institution variance is explained by the institutional fixed effect, which is treated as a constant. To provide a clearer focus on the revenue variables that are the focus of these research questions, the institutional fixed effects are excluded from the R^2 calculations presented here. It should be noted, however, that because a large proportion of the variance in the dependent variables is due to difference between institutions, the R^2 estimates would be notably higher if the institutional fixed effects were included in R^2. For instance, the R^2 in Table 4.9 would be .81 rather than .36 if the institutional effects were included in the calculation.

Table 4.9

Instruction Expenditures Predicted by Changes in Revenue

	ß	*SE ß*	*t*	*p*
tuition	0.63	0.04	16.84	<0.001
appropriations	0.22	0.03	7.57	<0.001
grants	-0.12	0.03	-3.88	<0.001
sales	0.37	0.08	4.39	<0.001
gifts	0.03	0.11	0.27	0.786
other	-0.05	0.04	-1.32	0.186

Note. $R^2 = .36$, $F(6, 353) = 94.21$, $p<.001$

In summary, R^2 statistics presented here describe the extent to which the variance in the expenditure variables is predicted by variance in the revenue variables within institutions, unless otherwise noted.

The unstandardized regression coefficients presented in Table 4.9 can be understood as changes in 2012 constant dollars predicted by a one dollar change in the independent variable if all other variables in the model are held constant. In other words, a one dollar increase in tuition, would be associated with a 63 cent increase in spending on instruction.

This process was repeated for each of the revenue change variables. The results of those models are presented below. The Hausman tests in all cases, with one exception, were significant, indicating that a fixed effects model was preferred. The sole exception was the regression of public service expenses (χ^2=3.91, p<0.689). For the sake of consistency, and following Leslie et al. (2012), the more conservative fixed effects model was used throughout.

Q1.2: To what extent are changes in sources of revenue at these institutions associated with changes in expenditures *on research*?

Question 1.2 was treated in a manner identical to Question 1.1. The fixed effects regression model is presented in Table 4.10. Variables contributing significantly to a prediction of expenditures on research were revenue from tuition (*ß*=0.19, *p*<.04*)* and appropriations (*ß*=0.09, *p*<.04*)*. The combined revenue variables explained only 19% of the within-institution variance in spending on research.

Q1.3: To what extent are changes in sources of revenue at these institutions associated with changes in expenditures *on public service*?

Table 4.10

Research Expenditures Predicted by Changes in Revenue

	ß	*SE ß*	*t*	*p*
tuition	0.19	0.09	2.09	0.038
appropriations	0.09	0.04	2.14	0.033
grants	0.29	0.21	1.37	0.17
sales	0.09	0.04	1.93	0.054
gifts	0.07	0.08	0.86	0.389
other	-0.11	0.12	-0.89	0.376

Note. $R^2 = .19$, $F(6, 353) = 2.77$, $p<.05$

Question 1.3 was treated in a manner identical to the previous questions. The fixed effects regression model is presented in Table 4.11. This is the first non-significant F-test in the analysis and provides an opportunity for comment on this statistic. The degrees of freedom in this case indicate that the model has six predictor variables and includes data from 354 institutions. The F-statistic tests the null hypothesis that all of the regression coefficients in the model are equal to zero. In this case, the null hypothesis survives the test. Revenue variables do not appear to predict spending on public service in this model.

Table 4.11

Public Service Expenditures Predicted by Changes in Revenue

	ß	*SE ß*	*t*	*p*
tuition	0.01	0.02	0.79	0.428
appropriations	0.00	0.02	0.26	0.794
grants	0.07	0.04	1.89	0.059
sales	0.03	0.03	1.14	0.257
gifts	0.04	0.07	0.51	0.611
other	-0.01	0.01	-0.46	0.647

Note. $R^2 = .05$, $F(6, 353) = 1.17$, $p=.321$

Q1.4: To what extent are changes in sources of revenue at these institutions associated with changes in expenditures *on academic support*?

Question 1.4 was treated in a manner identical to the questions above. The fixed effects regression model is presented in Table 4.12. Variables contributing significantly to a prediction of expenditures on academic support were revenue from tuition (*ß*=0.15, *p*<.001*)*, appropriations (*ß*=0.05, *p*<.001*)*, grants (*ß*=-0.04, *p*<.001*)*, and sales (*ß*=0.08, *p*<.01*)*. The combined revenue variables explained only 19% of the within-institution variance in spending on research.

Table 4.12

Academic Support Expenditures Predicted by Changes in Revenue

	ß	*SE ß*	*t*	*p*
tuition	0.15	0.01	10.77	<0.001
appropriations	0.05	0.01	5.97	<0.001
grants	-0.04	0.01	-4.19	<0.001
sales	0.08	0.03	3.01	0.003
gifts	0.00	0.03	-0.04	0.971
other	-0.01	0.01	-1.11	0.268

Note. R^2 = .19, $F(6, 353) = 35.6$, $p<.001$

Q1.5: To what extent are changes in sources of revenue at these institutions associated with changes in expenditures *on student services*?

Question 1.5 was treated in a manner identical to the questions above. The fixed effects regression model is presented in Table 4.13. Variables contributing significantly to a prediction of expenditures on student services were revenue from tuition (*ß*=0.19, *p*<.001*)*, appropriations (*ß*=0.04, *p*<.05*)*, grants (*ß*=--0.03, *p*<.01*)*, and sales (*ß*=0.12, *p*<.001*)*. The combined revenue variables explained 25% of the within-institution variance in spending on research.

Q1.6: To what extent are changes in sources of revenue at these institutions associated with changes in expenditures *on institutional support*?

Table 4.13

Student Services Expenditures Predicted by Changes in Revenue

	ß	*SE ß*	*t*	*p*
tuition	0.19	0.02	11.36	<0.001
appropriations	0.04	0.02	2.51	0.013
grants	-0.03	0.01	-2.72	0.007
sales	0.12	0.03	3.73	<0.001
gifts	0.01	0.05	0.26	0.797
other	-0.01	0.01	-0.42	0.676

Note. $R^2 = .25$, $F(6, 353) = 42.21$, $p<.001$

Question 1.6 was treated in a manner identical to the questions above. The fixed effects regression model is presented in Table 4.14. Variables contributing significantly to a prediction of expenditures on institutional support were revenue from tuition (*ß*=0.19, *p*<.001*)*, appropriations (*ß*=0.14, *p*<.001*)*, and sales (*ß*=0.20, *p*<.01*)*. The combined revenue variables explained 22% of the within-institution variance in spending on research.

Table 4.14

Institutional Support Expenditures Predicted by Changes in Revenue

	ß	*SE ß*	*t*	*p*
tuition	0.19	0.03	6.67	<0.001
appropriations	0.14	0.02	6.17	<0.001
grants	-0.03	0.02	-1.96	0.051
sales	0.20	0.06	3.14	0.002
gifts	0.07	0.07	0.98	0.33
other	0.02	0.02	0.87	0.384

Note. $R^2 = .22$, $F(6, 353) = 19.13$, $p<.001$

Q1.7: To what extent are changes in sources of revenue at these institutions associated with changes in expenditures *on scholarships*?

Question 1.7 was treated in a manner identical to the questions above. The fixed effects regression model is presented in Table 4.15. Variables contributing significantly to a prediction

of expenditures on scholarships were revenue from tuition (ß=0.19, $p<.001$) and sales (ß=0.06, $p<.05$). The combined revenue variables explained 13% of the within-institution variance in spending on research.

Table 4.15

Scholarship Expenditures Predicted by Changes in Revenue

	ß	*SE ß*	*t*	*p*
tuition	0.19	0.02	8.5	<0.001
appropriations	-0.01	0.01	-0.94	0.349
grants	0.03	0.02	1.31	0.192
sales	0.06	0.03	2.24	0.026
gifts	0.02	0.06	0.43	0.668
other	-0.01	0.01	-0.93	0.355

Note. $R^2 = .13$, $F(6, 353) = 17.66$, $p<.001$

To aid in making comparisons among models, the seven regression models above are summarized in Table 4.16.

Table 4.16

Expenditures Predicted by Revenues (N=3275)

	Instruction		Research		Public Services		Academic Support		Student Services		Institutional Support		Scholarships	
	ß	*ß SE*	*ß*	*ß SE*	*ß*	*ß SE*	*ß*	*ß SE*	*ß*	*ß SE*	*ß*	*ß SE*	*ß*	*ß SE*
Tuition	0.63‡	0.04	0.19*	0.09	0.01	0.02	0.15‡	0.01	0.19‡	0.02	0.19‡	0.03	0.19‡	0.02
Approp.	0.22‡	0.03	0.09*	0.04	0.00	0.02	0.05‡	0.01	0.04†	0.02	0.14‡	0.02	-0.01	0.01
Grants	-0.12‡	0.03	0.29	0.21	0.07	0.04	-0.04‡	0.01	-0.03†	0.01	-0.03	0.02	0.03	0.02
Sales	0.37‡	0.08	0.09	0.04	0.03	0.03	0.08†	0.03	0.12‡	0.03	0.20†	0.06	0.06*	0.03
Gifts	0.03	0.11	0.07	0.08	0.04	0.07	0.00	0.03	0.01	0.05	0.07	0.07	0.02	0.06
Other	-0.05	0.04	-0.11	0.12	-0.01	0.01	-0.01	0.01	-0.01	0.01	0.02	0.02	-0.01	0.01
R^2	.36		.19		.05		.19		.25		.22		.13	
F(6,353)	94.21‡		2.77*		1.17, *p*=.321		35.6‡		42.21‡		19.33‡		17.66‡	

*p<.05 †p<.01 ‡ p<.001

Time Effects

Before moving to the second set of research questions, which add additional variables to regression models, additional models were fitted for each dependent variable to consider the effects of time. First, the regression models above were recalculated with a one-year lag in the expenditure variables. In the analysis above, revenue reported in one year was used to predict expenditures in that year. It is possible that the model could be improved if revenue in a given year was used to predict expenditures in the following year.

The resulting models are not directly comparable. The introduction of a one-year lag meant that nine years of observations were included in the models rather than the ten years in the unlagged models. In general, however, the lagged models explained less variance than the unlagged models. The effect of several variables was reduced in the lagged model or became statistically non-significant. For instance, the effect of tuition on instruction fell from 0.63 (p<.001) to 0.54 (p<.001). The effect of appropriations on instruction changed from 0.22 (p<.001) to 0.07 (p=.14). The unlagged instruction model yielded R^2 of .36 F=94.21 p<.001). In the lagged model, this fell to R^2=.19 (F=49.78 p<.001). Consequently, the unlagged models were preferred.

Next, time trends in the data were examined. In the present study, the coefficients estimated are estimated from the whole, 10-year period of sample. It is possible, however, that the strength of the effect changed over time. To examine this possibility, the regression analyses above were repeated with additional variables measuring the interaction between time and each predictor variable. Following the procedure described by Leslie et al. (2012), the first year in the sample was coded as 0, the second year was coded as 1, and so on. Table 4.17, therefore, can be read as showing the effect of each predictor variable in the first year of the survey and the annual

Table 4.17

Expenditures Predicted by Revenues and Time (N=3275)

	Instruction		Research		Public Services		Academic Support		Student Services		Institutional Support		Scholarships	
	ß	*ß SE*	*ß*	*ß SE*	*ß*	*ß SE*	*ß*	*ß SE*	*ß*	*ß SE*	*ß*	*ß SE*	*ß*	*ß SE*
Tuition	0.17*	0.07	0.08*	0.03	-0.02	0.02	0.02	0.02	0.03	0.02	0.02	0.04	0.13‡	0.03
x time	0.02‡	0.01	0.00	0.00	0.00	0.00	0.01‡	0.00	0.01‡	0.00	0.01†	0.00	0.00*	0.00
Approp	0.26‡	0.05	0.11	0.06	0.00	0.02	0.06‡	0.01	0.05*	0.02	0.15‡	0.03	-0.01	0.01
x time	0.01‡	0.00	0.00	0.00	0.00	0.00	0.00†	0.00	0.00	0.00	0.00	0.00	0.00*	0.00
Grants	0.07*	0.03	0.10	0.06	0.10	0.05	0.00	0.01	0.02	0.02	0.01	0.03	0.07*	0.03
x time	-0.01†	0.00	0.04‡	0.01	0.00	0.00	0.00	0.00	0.00*	0.00	0.00	0.00	-0.01	0.00
Sales	-0.02	0.08	0.03	0.08	0.01	0.03	-0.02	0.03	0.08*	0.04	0.13*	0.06	0.11†	0.04
x time	0.02‡	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01†	0.00
Gifts	0.03	0.09	0.04	0.07	0.04	0.07	-0.02	0.03	0.00	0.05	0.05	0.06	0.04	0.05
x time	-0.02†	0.01	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	-0.01†	0.00
Other	0.08	0.06	-0.16*	0.08	0.03	0.03	0.08‡	0.02	0.02	0.02	0.06	0.04	-0.01	0.03
x time	-0.01	0.01	0.01	0.02	-0.01	0.01	-0.02‡	0.00	0.00	0.00	0.00	0.01	0.00	0.01
R^2	.53		.44		.08		.31		.38		.28		.16	
F(12,353)	105.07‡		49.05‡		1.34, *p*=.19		38.19‡		43.30‡		17.60‡		14.59‡	

*p<.05 †p<.01 ‡ p<.001

change in that effect over the course of the survey. For instance, in 2003, a one dollar increase in tuition revenue was associated with 17 cent increase in spending on instruction (ß=0.17, *SE*=0.07, $p<.05$). The effect grew stronger by approximately two cents in each year of the survey (ß=0.02, *SE*=0.07, $p<.001$).

If the overall effect of increases in tuition revenue on instruction spending, disregarding the effect of time, is 0.63 (see Table 4.16), the two-cent per year trend shown in Table 4.17 is insufficient to explain the size of the overall effect. This analysis points toward the final time effect that may be of interest: the effect that individual years may have on the dependent variable. It is possible, for instance, that events in a particular year may affect the relationship between the dependent and independent variables in the model so that the relationship in one year is quite different than the relationship in the next. Given the economic shock and global recession that occurred during this survey period, it is perhaps especially important to look for this effect in the present study.

To do so, the regression models above were recalculated with the addition of "year" as a nominal variable. The results are displayed in Table 4.18 which includes estimates of the change in the dependent variable in a given year, compared to the base year (2003) if all other variables are held constant. The analysis shows that the several of the years of observation had a significant effect on several of the dependent variables. Most striking is the statistically significant effect of 2009, 2010, 2011, and 2012 years on expenditures for instruction, academic support, student services, and institutional support. For scholarship expenditures, the year of observation is significant for all year except 2012.

Table 4.18

Expenditures Predicted by Revenues and Year (N=3275)

	Instruction		Research		Public Services		Academic Support		Student Services		Institutional Support		Scholarships	
	ß	*SE*	*ß*	*SE*	*ß*	*SE*	*ß*	*SE*	*ß*	*SE*	*ß*	*SE*	*ß*	*SE*
Year														
2003	(base)		(base)		(base)		(base)		(base)		(base)		(base)	
2004	-59.06	34.22	107.08	92.83	-34.45	21.96	-19.19	25.76	-21.07	13.85	15.22	40.56	-60.01*	27.50
2005	-107.80*	48.01	168.34	132.13	-42.47	23.05	-2.82	29.68	-28.07	24.14	-30.84	49.90	-162.22‡	35.69
2006	-140.04*	56.58	177.42	157.78	-22.45	22.06	-5.59	31.30	-34.41	27.29	-30.68	56.27	-224.08‡	40.08
2007	-117.88	65.68	169.59	183.63	-47.06	31.51	-8.37	33.93	-34.22	31.37	-56.17	60.32	-247.89‡	41.98
2008	89.55	84.54	379.44	316.80	5.69	40.45	51.82	39.70	65.50	36.13	66.88	73.36	-201.02‡	45.93
2009	393.31‡	106.22	546.33	417.13	35.66	48.49	186.46‡	48.23	160.09‡	40.88	232.19*	95.10	-154.80†	52.54
2010	1206.20‡	112.10	612.72	384.36	66.66	48.41	381.51‡	48.67	376.91‡	42.00	457.94‡	89.72	121.35*	55.08
2011	1277.47‡	116.62	668.52	427.52	49.74	52.43	373.93‡	50.92	394.45‡	44.03	471.03‡	93.94	188.35†	56.13
2012	1242.68‡	129.22	701.74	435.46	50.50	63.01	400.75‡	56.85	421.12‡	49.89	564.39‡	108.09	42.37	64.69
Tuition	0.35‡	0.04	0.03	0.04	0.00	0.02	0.06†	0.02	0.10‡	0.02	0.08*	0.04	0.18‡	0.03
Approp	0.33‡	0.03	0.12*	0.05	0.01	0.02	0.08‡	0.01	0.07‡	0.02	0.18‡	0.02	0.02†	0.01
Grants	0.02	0.05	0.36	0.24	0.08	0.04	0.00	0.02	0.02	0.02	0.03	0.03	0.05*	0.02
Sales	0.13*	0.06	-0.02	0.08	0.01	0.03	0.01	0.02	0.04	0.02	0.10	0.05	0.03	0.03
Gifts	0.00	0.08	0.04	0.06	0.03	0.07	-0.01	0.03	0.00	0.04	0.05	0.06	0.03	0.05
Other	0.06	0.04	-0.07	0.10	0.00	0.02	0.02	0.01	0.03	0.02	0.06*	0.03	0.02	0.01
R^2	.59		.24		.07		.35		.44		.33		.25	
F(15,353)	78.10‡		2.56†		2.61‡		26.25‡		41.94‡		20.42‡		26.17‡	

*p<.05 †p<.01 ‡ p<.001

Incorporating Institutional Characteristics

The next set of research questions supplements the revenue variables with institutional characteristics that, based on a review of the research literature, might be expected to affect the relationship between revenues and expenditures.

Q2.1: To what extent does an institution's size help to explain the relationship between revenues and expenditures?

To some extent, institutional size has already been considered in the regression models calculated above. The per-FTE change variables were calculated by dividing the financial numbers by enrollment, a measure of institutional size. Nevertheless, economies of scale may be operative. By including enrollment as an independent variable in the model, the effects of revenue changes can be seen when controlling for enrollment. The resulting models are presented in Table 4.19.

The coefficient for enrollment is statistically significant for the models predicting spending on instruction, academic support, student services, and scholarships. The size of the effect ranges from ß=0.05 for academic support and student services to ß =0.12 for instruction. Controlling for enrollment has little effect on the relationship between revenue variables and expenditures, suggesting that the enrollment effects operate independently of the revenue effects. This can be seen by comparing Table 4.16 and Table 4.19. For the regression on instruction expenditures, the comparison is presented visually in Figure 4.1.

Table 4.19

Expenditures Predicted by Revenues and Enrollment (N=3275)

	Instruction		Research		Public Services		Academic Support		Student Services		Institutional Support		Scholarships	
	ß	*ß SE*	*ß*	*ß SE*	*ß*	*ß SE*	*ß*	*ß SE*	*ß*	*ß SE*	*ß*	*ß SE*	*ß*	*ß SE*
Enroll.	0.12†	0.04	0.11	0.06	-0.01	0.01	0.05‡	0.01	0.05‡	0.01	0.06*	0.03	0.07‡	0.01
Tuition	0.62‡	0.04	0.18*	0.08	0.01	0.02	0.15‡	0.01	0.19‡	0.02	0.19‡	0.03	0.19‡	0.02
Approp.	0.24‡	0.03	0.10*	0.05	0.00	0.02	0.06‡	0.01	0.05†	0.02	0.14‡	0.02	0.00	0.01
Grants	-0.11‡	0.03	0.30	0.21	0.07	0.04	-0.04‡	0.01	-0.03*	0.01	-0.03	0.02	0.03	0.02
Sales	0.36‡	0.08	0.08	0.04	0.03	0.03	0.08†	0.03	0.11‡	0.03	0.19†	0.06	0.06*	0.03
Gifts	0.02	0.11	0.06	0.07	0.04	0.07	0.00	0.03	0.01	0.05	0.06	0.07	0.02	0.06
Other	-0.04	0.04	0.11	0.06	-0.01	0.01	-0.01	0.01	0.00	0.01	0.02	0.02	-0.01	0.01
R^2	.37		.20		.05		.20		.26		.22		.15	
F(7,353)	83.25‡		2.51*		2.52*		32.15‡		39.22‡		18.23‡		22.20‡	

*p<.05 †p<.01 ‡ p<.001

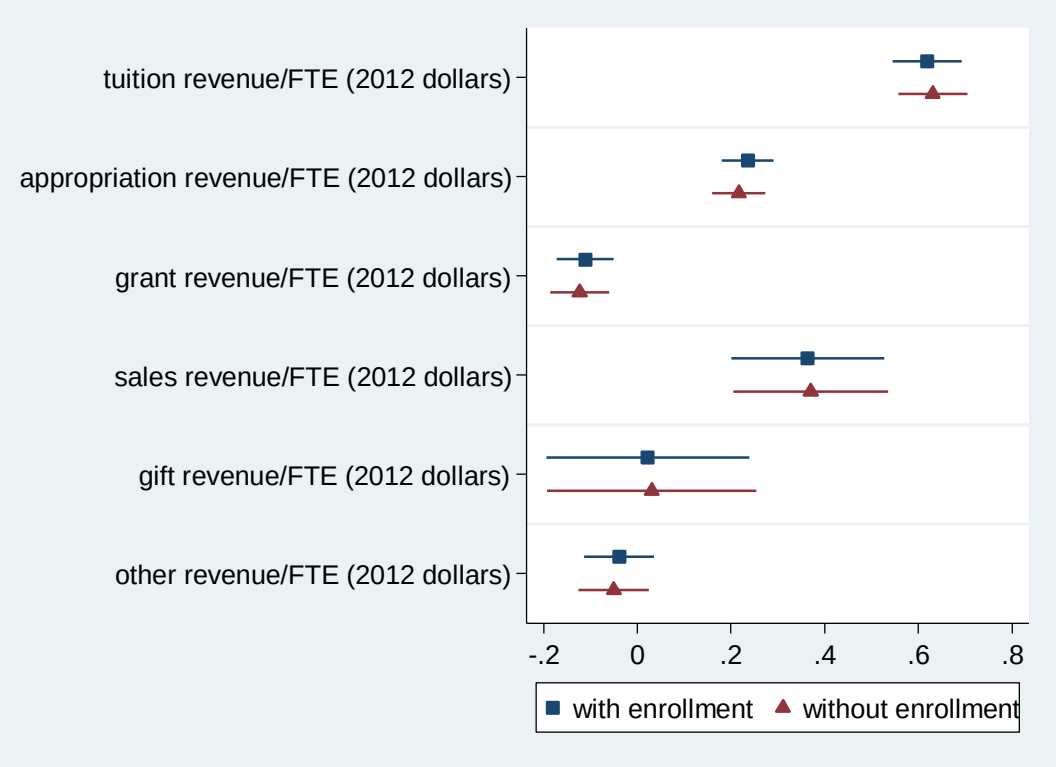

Figure 4.1. Estimates of coefficients for regression of revenue variables on instruction, with and without controlling for enrollment (with 95% confidence intervals shown).

Q2.2 To what extent does an institution's discount rate help to explain the relationship between revenues and expenditures?

Adding institutional discount rates to the regression model adds little predictive value. When institutional discount rates are included with revenue variables in the regression models, discount rate has a statistically significant effect on the prediction of expenditures only for instruction (ß=7.00, $p<.05$). An increase of 1% in an institution's discount rate is associated with a $7.00 increase in spending on instruction. The full model is presented in Table 4.20. Once again, comparing the models with and without discount rates, the coefficients for revenue variables change very little.

Table 4.20

Expenditures Predicted by Revenues and Discount (N=3154)

	Instruction		Research		Public Services		Academic Support		Student Services		Institutional Support		Scholarships	
	ß	*ß SE*	*ß*	*ß SE*	*ß*	*ß SE*	*ß*	*ß SE*	*ß*	*ß SE*	*ß*	*ß SE*	*ß*	*ß SE*
Disc.	7.00*	2.70	-1.30	3.38	-0.80	1.68	-1.86	1.57	4.35	1.26	4.30	2.16	2.63	1.00
Tuition	0.63‡	0.04	0.20*	0.10	0.01	0.02	0.16	0.01	0.19	0.02	0.19	0.03	0.20	0.01
Approp	0.21‡	0.03	0.09*	0.04	0.00	0.02	0.05	0.01	0.04	0.02	0.14	0.02	-0.01	0.01
Grants	-0.12‡	0.03	0.29	0.21	0.07	0.04	-0.04	0.01	-0.03	0.01	-0.03	0.02	0.02	0.02
Sales	0.38‡	0.08	0.09	0.05	0.03	0.03	0.08	0.03	0.11	0.03	0.20	0.06	0.06	0.02
Gifts	0.02	0.11	0.06	0.08	0.04	0.07	0.00	0.04	0.00	0.05	0.07	0.07	0.02	0.05
Other	-0.05	0.04	-0.11	0.13	0.00	0.01	-0.02	0.01	0.00	0.01	0.02	0.02	-0.01	0.01
R^2	.36		.19		.06		.19		.27		.23		.15	
F(7,347)	80.14‡		2.47*		0.98, *p*=.45		31.87‡		38.09‡		18.18‡		16.31‡	

*p<.05 †p<.01 ‡ p<.001

Q2.3: To what extent does an institution's selectivity help to explain the relationship between revenues and expenditures?

Table 4.21 presents fixed effects regression models predicting expenditures from revenue variables and institutional selectivity (measured as rate of admission). Selectivity has a statistically significant, negative effect on spending on instruction, research, student services, institutional support, and scholarships. Given the way the selectivity variable is constructed, this means that as institutions admit higher proportions of applicants, spending in these categories decreases, all other things being equal. On first impression, it appears that when the model controls for selectivity, the effect of appropriations largely disappears. For instance, without controlling for selectivity, a one dollar change in appropriations was associated with a 22 cent change in spending on instruction (SE=.03, $p<.001$). After controlling for selectivity, no statistically significant association is found. (Compare Tables 4.16 and 4.21).

A closer examination, however, shows that this apparent change may be the result of missing data and time effects. The observations available in the panel that includes the selectivity variable are fewer than in the panel that does not include selectivity (N=2006 compared to N=3275). This is because the data from which the selectivity variable was derived were not collected in IPEDS prior to 2006. In other words, the two models are based on overlapping but distinct periods of time.

The analysis of time effects above showed that the year of data collection could have a notable effect on the regression model. The change in the effect of appropriations when selectivity is introduced in the model may be due to the time effects. To explore this possibility further, both models were calculated for the 2006-2012 period for which selectivity data are

Table 4.21

Expenditures Predicted by Revenues and Selectivity (N=2006)

	Instruction		Research		Public Services		Academic Support		Student Services		Institutional Support		Scholarships	
	ß	*ß SE*	*ß*	*ß SE*	*ß*	*ß SE*	*ß*	*ß SE*	*ß*	*ß SE*	*ß*	*ß SE*	*ß*	*ß SE*
Select.	-9.82‡	2.79	-1.51*	0.66	0.31	0.78	-1.33	1.10	-3.06‡	0.83	-4.95†	1.57	-1.16	1.20
Tuition	0.63‡	0.06	0.06†	0.02	0.03	0.02	0.17‡	0.02	0.20‡	0.02	0.17‡	0.03	0.27‡	0.03
Approp.	0.00	0.04	0.03	0.04	0.02†	0.01	0.00	0.01	-0.03	0.01	0.01	0.02	-0.04†	0.01
Grants	-0.14†	0.05	0.15	0.10	0.03	0.02	-0.04	0.02	-0.03†	0.01	-0.01	0.02	-0.04	0.02
Sales	0.27*	0.12	0.01	0.04	0.04	0.02	0.04	0.03	0.05	0.04	0.13†	0.05	0.02	0.03
Gifts	0.03	0.15	0.02	0.05	0.16	0.10	0.06	0.04	0.03	0.04	0.00	0.08	0.01	0.04
Other	-0.16†	0.05	-0.17	0.16	-0.02	0.02	-0.06‡	0.02	-0.04†	0.01	-0.01	0.02	-0.01	0.02
R^2	.27		.11		.06		.16		.26		.09		.27	
F(7,310)	37.70‡		3.48†		3.50†		24.71‡		45.6‡		10.61‡		24.42‡	

*p<.05 †p<.01 ‡ p<.001

available. As seen in Figure 4.2, when both models are exposed to identical time effects, the difference in the effect of revenue from appropriations largely disappears.

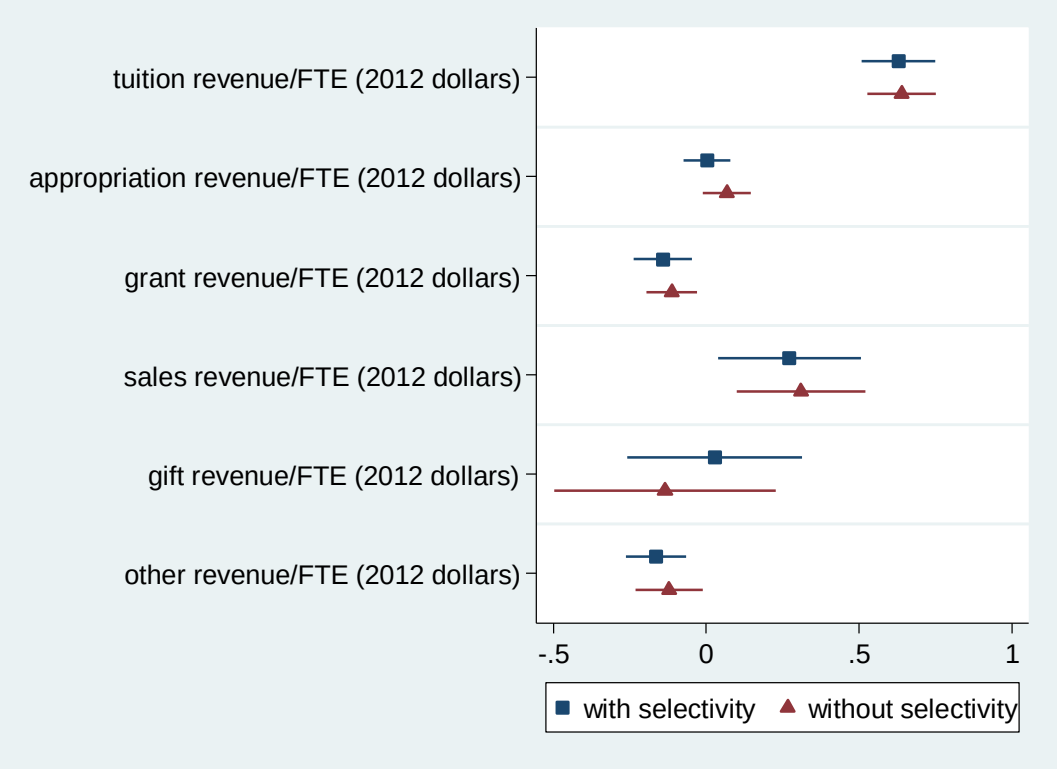

Figure 4.2. Estimates of coefficients for regression of revenue variables on instruction, with and without controlling for selectivity (with 95% confidence intervals shown), for years 2006-2012.

Q2.4: To what extent does an institution's Carnegie classification help to explain the relationship between revenues and expenditures?

Turning next to adding the Carnegie classification of institutions to the regression model, a somewhat different approach is required. Although institutional classifications change occasionally, the year-to-year variation is quite modest. The sample of institutions included in this study includes three classifications: Masters-level, Bachelors-level, and Associate/Bachelors

level. As seen in Table 4.22, the probability that a Masters-level institution will change Carnegie classifications in any given year is less than 1%.

Table 4.22

Transition Probabilities for Carnegie Classifications

	Subsequent Classification		
Initial Classification	Masters	Bachelors	Associate/Bachelors
Masters	99.37	0.63	0.00
Bachelors	3.45	96.37	0.17
Associate/Bachelors	0.73	5.11	94.16

Fixed effects models rely on within-unit variance over time and do not produce estimates of the effect of time-invariant variables. They are therefore not suitable for this question. Instead, a set of hybrid regression models were fitted, shown in Table 4.23. Carnegie classification had a statistically significant effect on spending for all categories of expenditure except for public service. Taking spending on instruction as an example, a baccalaureate-level institution would be expected to spend $733.27 less on instruction than a masters-level institution (p<.001).

When controlling for Carnegie classification, the effects of the revenue variables change only slightly. Without controlling for Carnegie classification, a dollar's increase in tuition per FTE within an institution was associated with a 63 cent increase in spending on instruction per FTE (SE=.04, p<.001). Controlling for Carnegie classification, the effect was reduced to a 61 cent increase (SE=.02, p<.001).

In addition to providing an estimate of the effect of time-invariant variables, the hybrid models provide some insight into between-institution variance. An institution that collected a dollar more in tuition per FTE compared to another institution would be expected to spend 30

Table 4.23

Expenditures Predicted by Revenues and Carnegie Classification (N=3158)

	Instruction		Research		Public Services		Academic Support		Student Services		Institutional Support		Scholarships	
	ß	*ß SE*	*ß*	*ß SE*	*ß*	*ß SE*	*ß*	*ß SE*	*ß*	*ß SE*	*ß*	*ß SE*	*ß*	*ß SE*
Class														
Masters	(base)		(base)		(base		(base)		(base)		(base)		(base)	
Bachel.	-733.27‡	78.16	-291.54‡	50.53	9.65	33.71	-68.08*	33.33	-136.25‡	31.92	-123.37*	50.60	29.05	41.56
A/B	-766.67‡	147.52	-272.52†	100.83	-81.21	66.62	-158.67*	64.78	-266.53‡	62.45	-41.49	98.23	-188.46*	80.17
Diff from Mean														
Tuition	0.61‡	0.02	0.09‡	0.01	0.02*	0.01	0.14‡	0.01	0.19‡	0.01	0.20‡	0.01	0.19‡	0.01
Approp	0.19‡	0.01	0.08‡	0.01	0.00	0.00	0.04‡	0.00	0.03‡	0.00	0.11‡	0.01	-0.01*	0.01
Grants	-0.10‡	0.02	0.09‡	0.01	0.09‡	0.01	-0.04‡	0.01	-0.03‡	0.01	-0.01	0.01	0.03†	0.01
Sales	0.42‡	0.04	0.08‡	0.02	0.03*	0.01	0.10‡	0.01	0.14‡	0.01	0.22‡	0.02	0.06†	0.02
Gifts	0.03	0.07	0.06	0.04	0.01	0.03	0.04	0.03	0.06*	0.03	0.04	0.04	0.01	0.04
Other	-0.06†	0.02	-0.06‡	0.01	-0.01	0.01	-0.01	0.01	-0.01	0.01	0.01	0.01	-0.01	0.01
Mean														
Tuition	0.30‡	0.03	0.14†	0.04	-0.01	0.02	0.10‡	0.02	0.08‡	0.02	0.16‡	0.03	-0.07†	0.02
Approp	0.37‡	0.02	0.04	0.03	0.00	0.01	0.12‡	0.01	0.11‡	0.01	0.25‡	0.02	0.04†	0.01
Grants	0.03	0.02	0.85‡	0.03	0.05†	0.02	-0.03*	0.01	-0.04†	0.01	0.03	0.02	0.05‡	0.01
Sales	0.05	0.03	-0.08	0.04	0.00	0.02	-0.01	0.02	0.01	0.02	0.04	0.03	-0.10‡	0.02
Gifts	0.27†	0.09	0.10	0.11	0.04	0.06	0.19‡	0.05	0.13†	0.05	0.01	0.07	0.03	0.06
Other	-0.26†	0.08	0.62‡	0.10	0.14*	0.06	-0.09*	0.04	0.11*	0.05	-0.15*	0.07	-0.06	0.05
R^2	.53		.71		.13		.30		.30		.44		.20	
χ^2 (14)	2266.17‡		2353.26‡		246.52‡		807.80‡		1319.08‡		1086.83‡		543.55‡	

*p<.05 †p<.01 ‡ p<.001

cents more on instruction per FTE (*SE*=.03, *p*<001). Because the hybrid model includes both within-institution and between-institution effects, the calculation of R^2 can also take into account these two sources of variance. This additional information contributes to the higher R^2 for the hybrid models compared to the simpler fixed effects models.

Q2.5 To what extent does an institution's tuition policy help to explain the relationship between revenues and expenditures?

Next, a fixed effect regression model was calculated adding a measure of tuition policy to the revenue variables used to predict expenditures. The data for tuition policy came from a survey occasionally published by SHEEO, the State Higher Executive Education Officers Association (Bell et al., 2011; Boatman & L'Orange, 2006; Rasmussen, 2003). During the survey period under examination here, the SHEEO survey was conducted three times, in 2003, 2006 and 2011. The survey asked state higher education executive officers where tuition-setting authority rested in their states. There were five possible responses: with the legislature, with a statewide board, with a system board with authority for less than the full state system, with a local district board, or with individual institutions. Multiple responses were allowed. When multiple responses and missing data were eliminated, 794 observations at 347 institutions in 47 states remained.

The addition of tuition policy into the model added little explanatory value. Differences in tuition policy authority were statistically significant in only a few instances, as can be seen in Table 4.24. For instance, institutions where tuition is set by a system board spent about $860

Table 4.24

Expenditures Predicted by Revenues and Tuition Policy (N=794)

	Instruction		Research		Public Services		Academic Support		Student Services		Institutional Support		Scholarships	
	ß	*ß SE*	*ß*	*ß SE*	*ß*	*ß SE*	*ß*	*ß SE*	*ß*	*ß SE*	*ß*	*ß SE*	*ß*	*ß SE*
Policy Leg.	(base)		(base)		(base)		(base)		(base)		(base)		(base)	
State	364.58	247.11	180.30	210.45	2.50	122.52	91.29	90.77	168.28	89.25	-88.94*	132.72	405.99	174.29
System	209.23	267.04	860.91*	395.25	-41.86	125.21	149.30	95.88	242.11*	109.76	-121.64	151.26	83.66	166.29
District	579.07	386.23	4878.39	2775.32	-143.72	264.57	182.64	165.93	51.94	155.87	-59.24	182.66	102.15	465.41
Institut.	133.93	298.51	774.82*	366.49	-56.21	129.28	81.26	105.90	175.32	109.93	-227.26	179.87	106.72	172.15
Tuition	0.61‡	0.05	0.25*	0.12	0.00	0.02	0.15‡	0.02	0.18‡	0.02	0.25‡	0.03	0.19‡	0.03
Approp	0.33‡	0.03	0.07	0.06	0.00	0.03	0.06†	0.02	0.07‡	0.02	0.16‡	0.03	0.00	0.01
Grants	-0.18‡	0.05	0.63	0.36	0.08	0.05	-0.05†	0.02	-0.04*	0.02	-0.03	0.03	0.02	0.03
Sales	0.38‡	0.10	0.08	0.10	0.03	0.04	0.10†	0.04	0.12†	0.04	0.20	0.06	0.08	0.05
Gifts	-0.01	0.11	0.04	0.10	0.05	0.06	-0.03	0.05	-0.03	0.06	-0.03†	0.05	0.11	0.08
Other	-0.12	0.11	-0.30	0.18	-0.02	0.06	-0.03	0.04	-0.05	0.04	0.01	0.06	-0.13	0.05
R^2	.46		.46		.07		.27		.36		.36		.17	
F(10,346)	44.88‡		1.04, p=.41		1.07, p=.38		12.06‡		21.21‡		16.01‡		6.77‡	

*p<.05 †p<.01 ‡ p<.001

more per FTE on research than institutions where the legislature set tuition, all other variables being equal.

Once again, keeping in mind that the year of observation had notable effects on the regression model, a comparison was made using only the three years for which tuition policy data were available. The coefficients of the revenue variables in the two models were indistinguishable. This is shown visually for the regression on instructional expenditures in Figure 4.3.

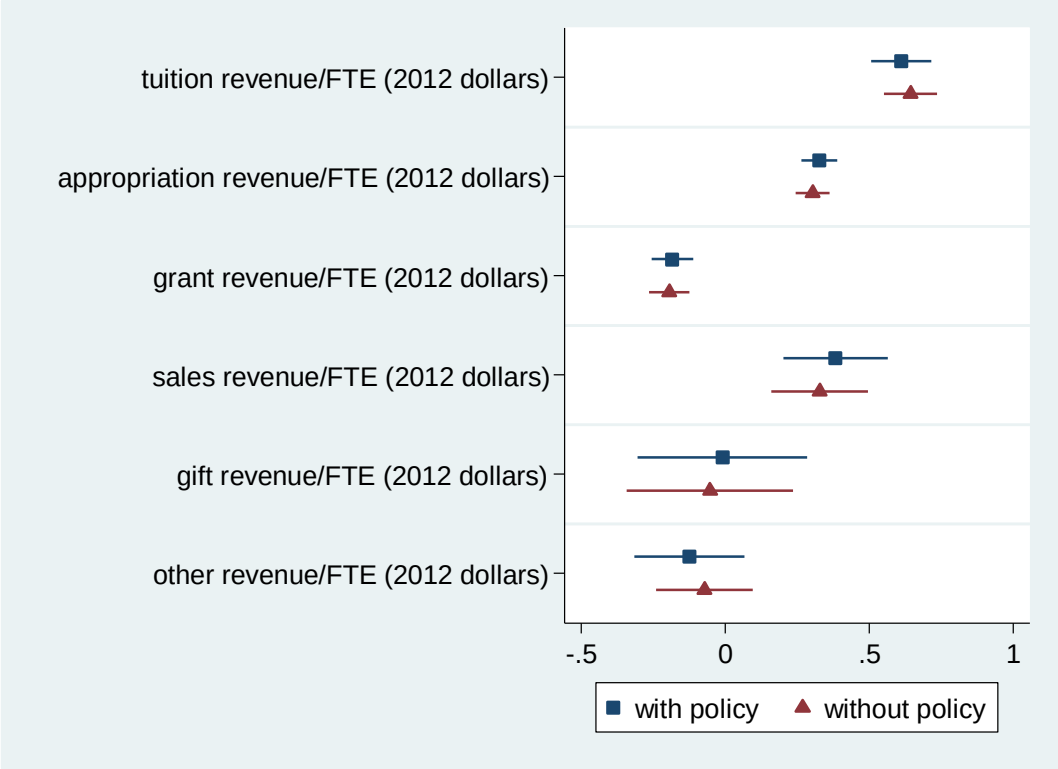

Figure 4.3. Estimates of coefficients for regression of revenue variables on instruction, with and without controlling for tuition policy (with 95% confidence intervals shown) for years 2003, 2006, and 2011.

Q2.6 To what extent do the variables above collectively help to explain the relationship between revenues and expenditures?

A set of final regression models were fitted combining some of the variables introduced in the forgoing analyses. Enrollment, selectivity, and Carnegie classification, all appeared to be statistically significant predictors of institutional expenditures. (See Tables 4.19, 4.21, and 4.23). In addition, the year of observation was an important factor (Table 4.18). Institutional discount rate and tuition policy, which made few contributions to the model (Table 4.20 and 4.24), were not included in the final models.

The institutional characteristics that were candidates for inclusion along with the revenue variables in the final models were enrollment, selectivity, Carnegie classification, and year effects. As these variables were combined into a single regression model, however, two collinearity problems arose. A one-way ANOVA for selectivity and year revealed a notable association ($F(6, 1999) = 2.20$, $p<.05$). It appeared that institutions in the sample became generally more selective, admitting smaller proportions of applicants, over the course of the survey. This trend is shown in Table 4.25. This collinearity made it impossible for a regression model to distinguish between the effects of selectivity and the effects of time. Given the evident importance of time effects for the model, selectivity was dropped from the final model.

Table 4.25

Selectivity (admission rate) by year

Year	M	SD
2006	69.84	16.78
2007	67.77	17.39
2008	67.94	17.14
2009	67.18	17.37
2010	66.72	17.95
2011	65.56	17.85
2012	65.42	17.13

Perhaps not surprisingly, Carnegie classification and enrollment were also significantly associated. Bachelors-level institutions were significantly smaller than Masters-level institutions, with Associate/Bachelors-level institutions tending to fall somewhere in between. (See Table 4.26)

Table 4.26

Enrollment by Carnegie Classification

Classification	N	M	SD
Masters	2340	8088.51	5110.48
Bachelors	657	2722.60	2246.51
Associate/Bacc	161	4773.22	4336.61

$F(2,3155)=362.01$ $p<.001$

To some extent, Carnegie classification and enrollment may represent two measures of the same underlying phenomenon. Given this association, Carnegie classification was not included in the final model. The final set of models, therefore, used year, enrollment, and revenues as predictors of expenditures. In order to capture information from both the within-institution and between-institution variance, hybrid models were calculated. These models are presented in Table 4.27 and are discussed in Chapter 5.

Table 4.27

Expenditures Predicted by Revenues, Year, Enrollment (N=3275)

	Instruction		Research		Public Services		Academic Support		Student Services		Institutional Support		Scholarships	
	ß	*ß SE*	*ß*	*ß SE*	*ß*	*ß SE*	*ß*	*ß SE*	*ß*	*ß SE*	*ß*	*ß SE*	*ß*	*ß SE*
Year														
2003	(base)		(base)		(base)		(base)		(base)		(base)		(base)	
2004	-47.16	51.22	109.62	58.62	-32.41	23.2	-17.22	22.32	-17.98	20.73	18.71	35.56	-61.97*	28.93
2005	-80.78	52.06	166.63†	59.57	-36.66	23.6	1.91	22.69	-21.25	21.07	-23.10	36.14	-167.48‡	29.40
2006	-86.13	53.48	173.51†	61.17	-10.27	24.2	3.34	23.31	-21.97	21.65	-15.24	37.13	-236.17‡	30.21
2007	-30.99	55.09	163.78†	63.01	-27.93	25.0	6.36	24.01	-13.27	22.30	-29.55	38.25	-269.31‡	31.12
2008	193.94†	57.27	362.30‡	65.49	29.27	26.0	70.14†	24.97	91.74‡	23.19	100.71*	39.77	-225.76‡	32.35
2009	517.80‡	61.34	527.73‡	70.11	63.90*	27.8	208.79	26.75	192.31‡	24.85	275.32‡	42.60	-185.67‡	34.65
2010	1351.45‡	62.38	593.17‡	71.29	99.38‡	28.3	407.35	27.21	414.71‡	25.28	507.77‡	43.33	85.61*	35.25
2011	1437.68‡	64.30	648.90‡	73.47	85.89†	29.2	402.27	28.05	436.44‡	26.06	525.62‡	44.66	148.23‡	36.33
2012	1411.24‡	69.60	679.36‡	79.52	88.95†	31.6	430.75	30.37	465.69‡	28.21	623.29‡	48.35	0.37	39.33
Within (diff. from institutional mean)														
Enroll.	-0.14‡	0.02	0.01	0.02	-0.03†	0.01	-0.02†	0.01	-0.04‡	0.01	-0.04†	0.01	0.04‡	0.01
Tuition	0.33‡	0.02	0.03	0.02	-0.01	0.01	0.06‡	0.01	0.09‡	0.01	0.07‡	0.01	0.18‡	0.01
Approp	0.32‡	0.01	0.12‡	0.01	0.01	0.00	0.08‡	0.00	0.07‡	0.00	0.18‡	0.01	0.02‡	0.01
Grants	0.02	0.01	0.34‡	0.02	0.08‡	0.01	0.00	0.01	0.02†	0.01	0.03†	0.01	0.05‡	0.01
Sales	0.11‡	0.03	-0.02	0.03	0.01	0.01	0.00	0.01	0.04†	0.01	0.10‡	0.02	0.03	0.02
Gifts	0.00	0.05	0.04	0.06	0.04	0.02	-0.01	0.02	0.00	0.02	0.05	0.04	0.02	0.03
Other	0.05†	0.02	-0.08‡	0.02	0.00	0.01	0.02*	0.01	0.03‡	0.01	0.06‡	0.01	0.02	0.01
Between (diff. among institutional means)														
Enroll.	0.03*	0.01	0.04‡	0.01	0.00	0.01	0.00	0.01	-0.02†	0.01	-0.02†	0.01	0.01*	0.01
Tuition	0.33‡	0.03	0.12‡	0.03	0.00	0.02	0.11‡	0.02	0.10‡	0.02	0.18‡	0.02	-0.07‡	0.02
Approp	0.37‡	0.02	0.05†	0.02	0.00	0.01	0.12‡	0.01	0.11‡	0.01	0.25‡	0.01	0.05‡	0.01

(continued on next page)

Table 4.27(continued from previous page)

	Instruction		Research		Public Services		Academic Support		Student Services		Institutional Support		Scholarships	
	ß	*ß SE*	*ß*	*ß SE*	*ß*	*ß SE*	*ß*	*ß SE*	*ß*	*ß SE*	*ß*	*ß SE*	*ß*	*ß SE*
Grants	0.04	0.02	0.75‡	0.02	0.05‡	0.01	-0.03*	0.01	-0.04†	0.01	0.03*	0.02	0.05‡	0.01
Sales	0.04	0.03	-0.05	0.03	0.00	0.02	-0.01	0.02	0.01	0.02	0.03	0.02	-0.10‡	0.02
Gifts	0.21*	0.08	0.08	0.07	0.04†	0.05	0.18‡	0.05	0.09	0.05	-0.03	0.07	0.05	0.05
Other	-0.19*	0.08	0.53‡	0.07	0.14	0.05	-0.08	0.04	0.13†	0.05	-0.13*	0.06	-0.05	0.05
R^2	.61		.72		.13		.35		.39		.50		.24	
χ^2 (23)	4888.23‡		4097.29‡		269.05‡		1729.66‡		2486.87‡		1871.55‡		1114.32‡	

*p<.05 †p<.01 ‡ p<.001

CHAPTER 5: DISCUSSION

Discussion of the results above focuses first on comparing the results presented here to the results reported by Leslie et al. (2012) for a different group of institutions over a different period of time. For these purposes, the models presented in Table 4.18 most useful. Next, the discussion turns to focus on the final set of models presented in Table 4.27, predicting expenditures based on revenue and enrollment, controlling for year effects. That discussion can be approached in several ways. First, each category of spending is examined. Second, the same models are examined with a focus on the categories of expenditure. If the first approach involves focusing on the major column headings in Table 4.27, this second approach involves a focus on the rows in the table. This approach lends itself to a discussion of the practical as well as the statistical significance of the findings. Finally, the discussion concludes with comment on the implications for the theory described in Chapter 2 and suggestions for future research.

Comparison to Research Institutions

Findings for the first set of research questions presented above can be directly compared to the findings of Leslie et al. (2012). As described in Chapter 2 above, Leslie et al. (2012) examined the associations between revenues and expenditures at 96 research universities between 1984 and 2008. This provides an opportunity to examine how the relationships between revenues and expenditures at the 63 public research universities in their sample compare to the relationships at public bachelors and masters institutions. For this purpose, Table 4.18, which regresses spending on revenues controlling for year effects, is the relevant point of reference. The comparisons shows some striking similarities and some important differences.

In general, the largest statistically significant associations presented in Table 4.18 were also evident for the public research universities included in the sample of Leslie et al. (2012). For masters and bachelors institutions, the largest associations concerned spending on instruction, where revenue from tuition (*ß*=.35, *SE*=.04, *p*<.001) and revenue from appropriations (*ß*=.33, *SE*=.03, *p*<.001) had large effects. For research universities, Leslie et al. (2012) found similar associations for both tuition (*ß*=.46, *SE*=.02, *p*<.001) and appropriations (*ß*=.32, *SE*=.01, *p*<.001). Table 5.1 presents the statistically significant regression coefficients from Table 4.18 that were greater or equal than .10 and compares them to the parallel estimates from Leslie et al. (2012).

Table 5.1

Bachelors/Masters Institutions Compared to Research Institutions

	Bachelors/Masters		Research[a]	
	ß	*SE*	*ß*	*SE*
Instruction on Tuition	.35[†]	.04	.46[†]	.02
Instruction on Appropriations	.33[†]	.03	.32[†]	.01
Instruction on Sales	.13[†]	.06	.01[*]	.01
Research on Appropriations	.12[*]	.05	.11[†]	.01
Student Services on Tuition	.10[†]	.02	.08[†]	.01
Institutional Support on Appropriations	.18[†]	.02	.09[†]	.01
Scholarships on Tuition	.18[†]	.03	.11[†]	.01

[a]Leslie et al. (2012)
[*]*p*<.05, [†]*p*<.001

If the statistically significant predictors of spending at masters and bachelors institutions are also evident at research institutions, this is partly because nearly every predictor that Leslie et al. (2012) proved to be statistically significant in their analysis. Of the 42 coefficients they estimated (seven spending variables regressed on six revenue variables), only seven were not statistically significant, although many of the effect sizes were quite small. As Leslie et al.

(2012) noted, the large number of observations included in their modelling (96 institutions over 24 years) partly explains the plethora of statistically significant associations they found. Nevertheless, statistically significant associations were much more common in the modeling Leslie et al. (2012) did for research institutions than in the modeling for bachelors and masters institutions presented above.

One of the notable differences between research universities and bachelors/masters institutions concerns predictors for spending on research. Of the six revenue variables in the model, only revenue from appropriations was a statistically significant predictor at bachelors/masters universities (*ß*=.12, *SE*=.05, $p<.05$). At research universities, Leslie et al. (2012) found large effects for revenue from grants and contracts (*ß*=.50, *SE*=.01, $p<.001$) and revenue from gifts (*ß*=.56, *SE*=.03, $p<.001$). These differences are not surprising. Research plays a smaller role in the mission of bachelors and masters institutions, where research is perhaps more likely to be conducted in service to the institution's instructional mission. This kind of activity is perhaps less likely to attract grant funding and more likely to depend on public appropriations.

The fact that Leslie et al. (2012) found more statistical significance in their modeling explains another notable difference that is evident when the bachelors and masters institutions are compared to research institutions. The amount of variation explained in the regression models for research institutions is greater than that explained in the parallel models for bachelors and masters institutions. In other words, knowing about the sources of revenue at an institution is more useful in predicting spending at research universities than it is at public bachelors and masters universities. Table 5.2 compares the values for the two sets of models.

A likely explanation for this difference is that the 96 research institutions included in the

Table 5.2

Coefficients of Determination for Bachelors/Masters and Research Institutions

	Bachelors/Masters	Research[a]
	R^2	R^2
Instruction	.59	.80
Research	.24	.85
Public services	.07	.38
Academic support	.35	.54
Student services	.44	.56
Institutional support	.33	.47
Scholarships	.25	.52

[a]Leslie et al. (2012)

analysis of Leslie et al. (2012) were likely more homogeneous than the 354 institutions included in the analysis presented here. It may also be the case that IPEDS finance surveys do a better job of measuring revenue at research universities than they do at bachelors and masters institutions. As will be seen in the discussion that follows, the "other revenue" variable is an important consideration in understanding the revenue-spending relationship at bachelors and masters institutions.

Categories of Expenditure

The discussion up to this point has focused on Table 4.18, which displays an analysis directly comparable to that performed by Leslie et al. (2012). At this point, the focus of discussion shifts to Table 4.27, which offers some advantages over the simpler analysis. Specifically, Table 4.27 includes enrollment as an independent variable and models within-institution and between-institution effects separately.

Spending on Instruction

Overall, as Table 4.27 shows, the independent variables explain 61% of the variance in spending on instruction (R^2=.61, χ^2(23)=4888.23, p<.001). For this group of institutions over this period of time, spending on instruction was predicted most strongly by changes in tuition and appropriations. A one dollar change in tuition was associated with a 33 cent change in instructional spending (p<.001). This was true when looking at changes over time within institutions and when comparing differences between institutions. For appropriations, within-institution and between-institution effects were similar; β =.32 (*SE*=.01, p<.001 for the within-institution effects and β =.37 (*SE*=.02, p<.001) for the between-institution effects. This means that, all other things being equal, a dollar's difference in revenue from instruction has roughly the same effect on spending on instruction, regardless of whether that difference is between two institutions or within a single institutions from one year to the next.

For comparison, the within-institution effects and between-institution effects for revenue from gifts were quite different. Within institutions, a change in revenue from gifts appeared to have no relationship to changes in spending on instruction. Comparing differences between institutions, however, a dollar of additional gift revenue was associated with a 21 cent increase in spending on instruction (*SE*=.08, p<.05). This suggests a conclusion that is perhaps intuitively obvious: some of the variance in spending on instruction among these institutions is a consequence of the heterogeneity of the group. For some, income from gifts is an important part of the budget; for others it is not.

Finally, among the expenditure variables, the level of enrollment had the greatest effect on spending for instruction, although even here that effect was modest. Here again, it is interesting to compare the within-institution and between-institution effects. Within institutions,

increases in enrollment are associated with decreases in spending on instruction per student (β =-.14, *SE*=.02, p<.001). This may represent an economy of scale available to institutions. The marginal costs associated with adding additional students, at least up to a point, may be less than the marginal gain in revenue. The between-institutional effect, though small, is notably in the opposite direction. An institution serving more students is likely to spend more on instruction per student than a smaller institution (β =.03, *SE*=.01, p<.05). The association between Carnegie classification and institutional size noted earlier may explain this between-institution effect, as larger institutions are more likely to be masters-level institutions and incurring additional instructional expenses associate graduate-level instruction.

Spending on Research

Overall, the independent variables explain 72% of the variance in spending on research (R^2=.72, $\chi^2(23)$=4097.29, p<.001). Not surprisingly, revenue from grants was the best predictor of spending in research. Within institutions, a dollar increase in revenue from grants was associated with a 34 cent increase in spending on research (*SE*=.02, p<.001). Between institutions, the association was stronger. An institution with a dollar more revenue from grants would be expected to spend 75 cents more on research compared to an institution with a dollar less such revenue (*SE*=.02, p<.001).

In comparison, the other statistically significant effects are comparatively small. It might be expected, for instance, that larger institutions would be more likely to spend money on research. For these institutions over this period of time, the evidence for an independent effect is quite modest. Increases in enrollment within an institution showed no statistically significant effect for spending on research when controlling for year effects and other sources of revenue.

When making the comparison between institutions, the effect of larger enrollment is statistically significant, but quite small (β =.04, *SE*=.01, p<001).

It is important to insert a note of caution in interpreting this model for spending on research. The effect of "other revenue" is quite large in explaining the difference in research spending between institutions (β =.53, *SE*=.07, p<.001). This suggests that there is some information in this catch-all category of revenue that is important to understanding the differences between institutions for spending on research.

Spending on Public Service

Spending on public service is not well predicted by the independent variables in the models presented in Chapter 4. In the final model, seen in Table 4.27, although a few of the variables are statistically significant, the practical significance is quite low and the amount of variance explained by the variables collectively is low (R^2=.13). The largest observed effect was associated with revenue from grants. An additional dollar of grant revenue within an institution was associated with an 8 cent increase in spending on public service (*SE*=.01, p<.001). The between-institution effect was just 5 cents (*SE*=.01, p<.001).

Spending on Academic Support

The independent variables explain 35% of the variance in spending on academic support (R^2=.35, $\chi^2(23)$=1729.66, p<.001). Several variables in the model contributed at a statistically significant level; three made more than 10 cents' difference for a one dollar change in revenue. An institution with an additional dollar in tuition revenue was associated with an 11 cent increase in spending on academic support compared to an institution that lacked that additional dollar

(*SE*=.02, *p*<.001). Changes in revenue from tuition had a smaller within-institution effect (β =.06, *SE*=.01, *p*<.001). An institution with an additional dollar in appropriations revenue was associated with an 12 cent increase in spending on academic support compared to an institution that lacked that additional dollar (*SE*=.01, *p*<.001). Changes in revenue from appropriations had a smaller within-institution effect (β =.08, *SE*<.001, *p*<.001). Finally, an institution with an additional dollar in gift revenue was associated with an 18 cent increase in spending on academic support compared to an institution that lacked that additional dollar (*SE*=.05, *p*<.001). Changes in revenue from gifts had a very small within-institution effect (β =.02, *SE*=.01, *p*<.05).

Spending on Student Services

The independent variables explain 39% of the variance in spending on student services (R^2=.39, χ^2(23)=2486.87, *p*<.001). Several variables in the model contributed at a statistically significant level; three made more than 10 cents' difference for a one dollar change in revenue. An institution with an additional dollar in tuition revenue was associated with an 10 cent increase in spending on student services compared to an institution that lacked that additional dollar (*SE*=.02, *p*<.001). Changes in revenue from tuition had a smaller within-institution effect (β =.09, *SE*=.01, *p*<.001). An institution with an additional dollar in appropriations revenue was associated with an 11 cent increase in spending on academic support compared to an institution that lacked that additional dollar (*SE*=.01, *p*<.001). Changes in revenue from appropriations had a smaller within-institution effect (β =.07, SE<.001, *p*<.001). Finally, an institution with an additional dollar in other revenue was associated with a 13 cent increase in spending on student services compared to an institution that lacked that additional dollar (*SE*=.05, p<.01).

Spending on Institutional Support

The independent variables explain half of the variance in spending on institutional support (R^2=.50, χ^2(23)=1871.55, p<.001). Several variables in the model contributed at a statistically significant level; three made more than 10 cents' difference for a one dollar change in revenue. An institution with an additional dollar in tuition revenue was associated with an 18 cent increase in spending on institutional support compared to an institution that lacked that additional dollar (*SE*=.01, p<.001). Changes in revenue from tuition had a smaller within-institution effect (β =.07, *SE*=.01, p<.001). An institution with an additional dollar in appropriations revenue was associated with an 25 cent increase in spending on institutional support compared to an institution that lacked that additional dollar (*SE*=.01, p<.001). Changes in revenue from appropriations also had a within-institution effect (β =.18, *SE*=.01, p<.001). Finally, an institution with an additional dollar in other revenue was associated with a 13 cent decrease in spending on institutional support compared to an institution that lacked that additional dollar (*SE*=.06, p<.01).

Spending on Scholarships

The independent variables explain 24% of the variance in spending on scholarships (R^2=.24, χ^2(23)=1114.32, p<.001). Several variables in the model contributed at a statistically significant level; just two made more than 10 cents' difference for a one dollar change in revenue. Within an institution, a dollar increase in *tuition* revenue was associated with an 18 cent increase in spending on scholarships (*SE*=.01, p<.001). Changes in revenue from tuition had a smaller between-institution effect in the opposite direction (β=-.07, *SE*=.02, p<.001). An institution with an additional dollar in revenue from sales revenue was associated with an 10 cent

decrease in spending on scholarships compared to an institution that lacked that additional dollar (*SE*=.02, *p*<.001).

Practical Significance: Categories of Revenue

The discussion above focused on identifying variables that significantly contributed to explaining the variance in spending. From a policy-making point-of-view, it is perhaps more instructive to focus instead on the revenue variables in order to understand how a policy change that results in a change in a certain kind of revenue might be predicted to affect spending. This discussion concentrates on revenue from tuition and public appropriations, the categories likely to be most directly affected by policy making.

Enrollment

Seen from this point-of-view, changes in enrollment have a limited, modest effect. As might be expected, there appear to be economies of scale available to institutions at the margins as enrollment increases. Increasing enrollment within an institution reduces per-FTE spending on instruction (β=-.14, *SE*=.02, *p*<.001). The effect between institutions is smaller and in the opposite direction as larger institutions spend a bit more on instruction than smaller institutions, all other variables being equal (β=.03, *SE*=.01, *p*<.05). It was noted above that this between-institution effect may be associated with the costs of graduate instruction, as institutions with larger enrollments are more likely to be masters-level universities. For policy makers, this suggests that growing institutions is economically attractive only so long as that growth does not lead to an expanded, more costly instructional mission.

Tuition

Changes in tuition revenue had a large and significant effect for spending on instruction. The size of the effect was essentially the same whether examining changes within institutions (*ß*=.33, *SE*=.02, *p*<.001) or between institutions (*ß*=.33, *SE*=.03, *p*<.001).

Although there are several statistically significant within-institution effects associated with changes in tuition revenue, the only other effect that is larger than .10 is the effect for spending on scholarships. A one dollar increase in tuition revenue per FTE within an institution is associated with an 18 cent increase in spending on scholarships (*SE*=.01, *p*<.001). This is likely evidence of tuition discounting. As institutions increase price, they offer institutional financial aid in an effort to support demand.

It is notable that the between-institution effect of changes in tuition revenue on spending on scholarships, though small, is in the opposite direction (*ß*=-.07, *SE*=.02, *p*<.001). Institutions in the sample that collect more tuition revenue per FTE, offer less institutional aid compared to institutions that collect less tuition revenue. This finding would be consistent with a higher education system in which institutions serving fewer low-income students are less constrained in increasing revenue from tuition and feel less need to offset increases in tuition with increases in institutional financial aid.

The between-institution differences associated with revenue from tuition are larger than the within-institution differences with several at or above ±.10. This is to be expected, as differences between institutions are greater than differences within institutions over time. Changes in revenue from tuition are associated with changes in spending on research (*ß*=.12, *SE*=.03, *p*<.001), academic support (*ß*=.11, *SE*=.02, *p*<.001), student services (*ß*=-.07, *SE*=.02, *p*<.001), and institutional support (*ß*=.18, *SE*=.02, *p*<.001).

The practical significance of these findings for policy makers depends, of course, on the goals of those policy makers. If the goal is to provide support for an institution's academic programs (instruction and academic support) without encouraging growth in administrative overhead (i.e., institutional support), increasing tuition revenue may be an attractive option, recognizing that some significant portion of that new revenue will be directed toward scholarships. Of all sources of revenue, changes in tuition had the largest effect on changes in instructional spending when the focus is on changes within institutions.

Appropriations

Changes in per-FTE revenue from public appropriations had a strong effect on changes in spending on instruction, both within-institutions over time (*ß*=.32, *SE*=.01, $p<.001$) and between institutions (*ß*=.37, *SE*=.02, $p<.001$). Within institutions, changes in appropriation had several other statistically significant effects on spending categories above the .10 level: spending on research (*ß*=.12, *SE*=.01, $p<.001$) and spending on institutional support (*ß*=.18, *SE*=.01, $p<.001$). The additional between-institution effects at that level were for academic support (*ß*=.12, *SE*=.01, $p<.001$), student services (*ß*=.11, *SE*=.01, $p<.001$), and institutional support (*ß*=.25, *SE*=.01, $p<.001$).

From a policy-making point-of-view the effect of changes on appropriations are perhaps especially important. Here again, it is within-institution effects that are most revealing. Over time, as an institution experiences changes in levels of public financial support, changes in appropriations are strongly associated with changes in spending on instruction and moderately associated with changes in institutional support, a category including many items that would be regarded as administrative overhead. The within-institution effects for spending on institutional

support are stronger for changes in appropriation (ß=.18) than were observed for changes in tuition (ß=.07).

The first impression, therefore, is that a policy maker interested in supporting spending on academic programs without building up administrative overhead might prefer to support tuition increases rather than increases in public appropriation. The within-institution effects on instructional spending are very similar for both sources of revenue (β=.33 for tuition and β=.32 for appropriation), but the effects on institutional support are quite different (β=.07 for tuition and β=.18 for appropriation). Alternately, this hypothetical policy maker might support an increase in public appropriation but direct that the new revenue be devoted to instruction rather than administration.

This initial impression, however, may be misleading. When examining the effects of changes in appropriations, it is important to note that the regression model is agnostic about the direction of the change. In other words, a one dollar decrease in appropriation revenue, which is perhaps a more likely scenario, would be associated with a 32 cent decrease in spending on instruction, controlling for the other variables in the model. The larger effect on institutional support from appropriation compared to tuition, therefore, may reflect a budget-cutting strategy. It would be equally legitimate to conclude that administrative spending is targeted for reduction when appropriations fall.

Other Categories of Revenue

Not surprisingly, changes in revenue from grants were strongly associated with spending on research both within institutions over time (ß=.34, *SE*=.02, $p<.001$) and between institutions (ß=.75, *SE*=.02, $p<.001$). Of greater concern for understanding the findings presented here is the

"other revenue" variable. It is difficult to say with any certainty what is included in this catch-all variable, except that it apparently does not fit within the other six revenue variables. This uncertainty is concerning because the other revenue variable has a large effect on the between-institution variability in some of the spending models. For spending on research, for instance, an institution with an additional dollar in "other revenue" would be expected to spend an additional 53 cents (*SE*=.07, *p*<.001) on research compared to an institution without that dollar, controlling for enrollment, year, and other sources of revenue. The between-institution effect is not as large but nevertheless notable for other categories of spending (for instruction ß=.19, *SE*=.08, *p*<.05; for student services ß=.13, *SE*=.05, *p*<.01; for institutional support ß=-.13, *SE*=.06, *p*<.05).

Other Institutional Characteristics

The second set of research questions examined here focused on institutional characteristics that, based on previous research, might be thought to have a measurable effect on the relationship between institutional revenue and spending. The fact that only one of the characteristics examined survived to the final models presented in Table 4.27 deserves some comment.

As noted earlier, Carnegie classification was excluded from the final model because the variable closely tracked enrollment size, which was included in the final model. Although tuition policy did not contribute to the predictive value of the regression models, the data available for this variable was limited to only three years, so the absence of evidence for an effect may reflect weaknesses in the underlying data.

The lack of a statistically significant finding for effects of selectivity and discount rate is perhaps more interesting. Both variables reflect the competition among institutions for students.

Jacob et al. (2013) found that high-achieving students have different preferences than students with less distinguished records of academic achievement. In their work, high achieving students were drawn to institutions spending comparatively more on instruction and academic support, while low achieving students more likely to be drawn to institutions with comparatively high spending on student services, which the authors associated with "country club" amenities.

The analysis in this study did not directly examine student achievement, instead looking at institutional selectivity, measured as the percentage of applicants who were admitted. If selectivity roughly tracks achievement (an assumption that was not tested), so that institutions admitting a large proportion of applicants are admitting comparatively lower-achieving students, this analysis failed to support the findings of Jacob et al. (2013). Although institutions admitting a higher proportion of students were spending less on instruction, they were also spending less on student services. This finding, however, should be treated with caution. The data available for selectivity did not span the whole period of time under examination, and time effects appeared to play an important role in this relationship. Because of these limitations, selectivity was not included in the final set of regression models presented in Table 4.27.

If selectivity reflects institutional competition for high achieving students, discount rate may reflect institutional competition for students able to pay premium prices. Others have found evidence that tuition discounting strategies adversely affect low-income students (Curs & Singell, 2010; Davis & Lumina Foundation for Education, 2003). If that effect exists, it could not be detected in the institutional spending behavior that was the focus of the research presented here. Discount rate had a small effect for spending on instruction (β=7.00, SE = 2.70, p<.05), meaning that an institution increasing its discount rate by one percent would be expected to increase spending on instruction by seven dollars per FTE. There was no other statistically

significant effect for any other category of spending, so this variable was also excluded from the final set of regression models. The lack of an effect for discount effect on spending should not be interpreted as a negation of the deleterious effects found in previous research (Curs & Singell, 2010; Davis & Lumina Foundation for Education, 2003), as those finding focused on issues of access to higher education, not the services offered to students who had access or the spending associated with those services.

Further Research

The findings presented here extend previous research on the relationship between revenues and spending at higher education institutions by examining bachelors and masters institutions, by including an additional independent variable (enrollment) in the analysis, and by modeling within-institution and between-institution effects separately. Further research in this area might advance the understanding of these research questions in several ways, some of which involve additional quantitative work and some of which would require mixed methods.

The study presented here attempted to take into account state-level variations in higher education policy that might reasonably be expected to affect the relationship between institutional revenue and spending. The variable chosen focused on the authority to set tuition policy. The variable was drawn from a survey administered only occasionally, had five levels, and the survey allowed multiple responses. These factors limited the utility of that variable for the analysis. It appeared to contribute little predictive power to the regression models and was dropped from the final models. Given the evident limitations in the data, it is premature to reject the idea that state-level factors may influence the institution-level relationships between revenue and spending. More work in this area is needed.

A hierarchical regression model might be constructed that would use state-level variables to better explain the relationship. Volkwein and Tandberg (2008), for instance, used a set of state-level demographic and economic variables to examine state-level higher education performance data. These or similar variables, used in the second level of a hierarchical regression model, might be useful in understanding institution-level finances.

The second area of further research that would be amenable to quantitative methods concerns the time effects that were important in the models presented here. As was true for Leslie et al. (2012), year effects were important in the regression models developed for this study. Although the selectivity variable ultimately contributed little to the regression models and was dropped from the final set of models, the results for Question 2.3, presented in Chapter 4, highlighted an unresolved question related to time effects. The range of years included in the model appeared to make a notable difference in some relationships between revenue and expenditure. The statistically significant association between revenue appropriations and spending on instruction disappeared when the analysis was limited to 2006-2012. More research is needed to understand this. One possible explanation centers on the global economic crisis that began in 2008. As more years of data become available, it may be valuable to model the relationships between revenue and spending before, during, and after the Great Recession. The years of economic crisis may be anomalous or may represent an important and lasting change in public higher education finances.

Further research is also needed to understand whether the relationships between revenue and spending that are described in the regression models developed here function bi-directionally. It is possible to imagine, for instance, that the increased spending associated with growing revenue might be distributed differently than the spending reductions associated with

falling revenue. If there are enough institutions in the sample that have experienced both increases and decreases in revenue, additional regression modelling might reveal whether the relationships between revenues and spending change depending on whether revenues are rising or falling.

Underlying the relationships between revenue and spending that are described by regression models are a set of management decisions reflecting the goals and constraints faced by administrators and policy makers. Following the further quantitative work described thus far, a set of qualitative case studies could further explain the relationships and perhaps suggest further refinements of the quantitative models.

The close examination of a small number of institutions in a case study design would also provide an opportunity for a final area of further research: understanding the "other revenue" variable. As noted in the discussion above, this catch-all IPEDS variable contributed notably to explaining the between-institution variance on several spending variables. This suggests that there is information captured by this variable that may be important to understanding the relationships between revenue and spending. A close examination of how a small, carefully chosen set of institutions constructs this variable may be enlightening. It may also suggest ways in which IPEDS data collection could be improved.

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APPENDIX A: SOURCES OF VARIABLES USED IN THE ANALYSES

Table A.1 displays the IPEDS survey items from which the variables used in the regression analyses in Chapter 4 are derived. This information is provided in the interest of reproducibility of the results presented.

Table A.1

Derivation of the Variables in this Study from IPEDS Survey Items

Variables in this study	IPEDS survey items
Revenue Variables	
Tuition	(f1b01/fte12mn)*CPI-U 2012 factor
Appropriation	((f1b10 + f1b011+f1b12)/fte12mn)*CPI-U 2012 factor
Grants and Contracts	((f1b02+f1b03+f1b04a+f1b04b)/fte12mn)*CPI-U 2012 factor
Sales	(f1b05/fte12mn)*CPI-U 2012 factor
Gifts	((f1b016+f1b17)/fte12mn)*CPI-U 2012 factor
Other	(f1b08/fte12mn)*CPI-U 2012 factor
Expenditure Variables	
Instruction	(f1c011/fte12mn)*CPI-U 2012 factor
Research	(f1c021/fte12mn)*CPI-U 2012 factor
Public Services	(f1c031/fte12mn)*CPI-U 2012 factor
Academic Support	(f1c051/fte12mn)*CPI-U 2012 factor
Student Services	(f1c061/fte12mn)*CPI-U 2012 factor
Institutional Support	(f1c071/fte12mn)*CPI-U 2012 factor
Scholarships	(f1c101/fte12mn)*CPI-U 2012 factor
Institutional Characteristics	
Enrollment	fte12mn
Discount	(scfa1n*chg2ay2)/(distuit*disaid)
Selectivity	dvic01
Carnegie Classification	carnegie (2003-2005) or ccbasic (2006-2012)

APPENDIX B: INSTITUTIONS INCLUDED IN THE ANALYSES

Three hundred fifty-four bachelors and masters institutions were included in this study. Chapter 3 describes the criteria and procedure used to select the sample. The institutions in the sample are listed in Table B.1.

Table B.1

Institutions Included in the Analyses

State	Institution
AK	University of Alaska Anchorage
AK	University of Alaska Southeast
AL	Alabama A & M University
AL	Alabama State University
AL	Athens State University
AL	Auburn University at Montgomery
AL	Jacksonville State University
AL	Troy University
AL	University of Montevallo
AL	University of North Alabama
AL	University of West Alabama
AR	Arkansas State University-Main Campus
AR	Arkansas Tech University
AR	Henderson State University
AR	Southern Arkansas University Main Campus
AR	University of Arkansas at Monticello
AR	University of Arkansas at Pine Bluff
AR	University of Arkansas-Fort Smith
AR	University of Central Arkansas
CA	California Maritime Academy
CA	California Polytechnic State University-San Luis Obispo
CA	California State Polytechnic University-Pomona
CA	California State University-Bakersfield
CA	California State University-Channel Islands
CA	California State University-Chico
CA	California State University-Dominguez Hills
CA	California State University-East Bay
CA	California State University-Fresno
CA	California State University-Fullerton
CA	California State University-Long Beach
CA	California State University-Los Angeles
CA	California State University-Monterey Bay

CA	California State University-Northridge
CA	California State University-Sacramento
CA	California State University-San Bernardino
CA	California State University-San Marcos
CA	California State University-Stanislaus
CA	Humboldt State University
CA	San Francisco State University
CA	San Jose State University
CA	Sonoma State University
CO	Adams State University
CO	Colorado Mesa University
CO	Colorado State University-Pueblo
CO	Fort Lewis College
CO	Metropolitan State University of Denver
CO	University of Colorado Colorado Springs
CO	Western State Colorado University
CT	Central Connecticut State University
CT	Charter Oak State College
CT	Eastern Connecticut State University
CT	Southern Connecticut State University
CT	Western Connecticut State University
DE	Delaware State University
FL	Florida Gulf Coast University
FL	New College of Florida
FL	St Petersburg College
FL	University of North Florida
FL	University of South Florida Sarasota-Manatee
FL	University of South Florida-Polytechnic
FL	University of South Florida-St. Petersburg Campus
GA	Albany State University
GA	Armstrong Atlantic State University
GA	Augusta State University
GA	Clayton State University
GA	Columbus State University
GA	Dalton State College
GA	Fort Valley State University
GA	Georgia College & State University
GA	Georgia Gwinnett College
GA	Georgia Southwestern State University
GA	Kennesaw State University
GA	Macon State College
GA	North Georgia College & State University
GA	Savannah State University
GA	Southern Polytechnic State University
GA	University of West Georgia
GA	Valdosta State University

HI	University of Hawaii at Hilo
HI	University of Hawaii-West Oahu
IA	University of Northern Iowa
ID	Boise State University
ID	Lewis-Clark State College
IL	Chicago State University
IL	Eastern Illinois University
IL	Governors State University
IL	Northeastern Illinois University
IL	Southern Illinois University Edwardsville
IL	University of Illinois at Springfield
IL	Western Illinois University
IN	Indiana University-East
IN	Indiana University-Kokomo
IN	Indiana University-Northwest
IN	Indiana University-Purdue University-Fort Wayne
IN	Indiana University-South Bend
IN	Indiana University-Southeast
IN	Purdue University-Calumet Campus
IN	Purdue University-North Central Campus
IN	University of Southern Indiana
KS	Emporia State University
KS	Fort Hays State University
KS	Pittsburg State University
KS	Washburn University
KY	Eastern Kentucky University
KY	Kentucky State University
KY	Morehead State University
KY	Murray State University
KY	Northern Kentucky University
KY	Western Kentucky University
LA	Grambling State University
LA	Louisiana State University-Alexandria
LA	Louisiana State University-Shreveport
LA	McNeese State University
LA	Nicholls State University
LA	Northwestern State University of Louisiana
LA	Southeastern Louisiana University
LA	Southern University at New Orleans
LA	University of Louisiana-Monroe
MA	Bridgewater State University
MA	Fitchburg State University
MA	Framingham State University
MA	Massachusetts College of Liberal Arts
MA	Massachusetts Maritime Academy
MA	Salem State University

MA	University of Massachusetts-Dartmouth
MA	Westfield State University
MA	Worcester State University
MD	Coppin State University
MD	Frostburg State University
MD	Salisbury University
MD	St Mary's College of Maryland
MD	Towson University
MD	University of Baltimore
MD	University of Maryland Eastern Shore
MD	University of Maryland-University College
ME	Maine Maritime Academy
ME	University of Maine at Augusta
ME	University of Maine at Farmington
ME	University of Maine at Fort Kent
ME	University of Maine at Machias
ME	University of Maine at Presque Isle
ME	University of Southern Maine
MI	Eastern Michigan University
MI	Ferris State University
MI	Grand Valley State University
MI	Lake Superior State University
MI	Northern Michigan University
MI	Saginaw Valley State University
MI	University of Michigan-Dearborn
MI	University of Michigan-Flint
MN	Bemidji State University
MN	Metropolitan State University
MN	Minnesota State University Moorhead
MN	Minnesota State University-Mankato
MN	Saint Cloud State University
MN	Southwest Minnesota State University
MN	University of Minnesota-Crookston
MN	University of Minnesota-Duluth
MN	University of Minnesota-Morris
MN	Winona State University
MO	Harris-Stowe State University
MO	Lincoln University
MO	Missouri Southern State University
MO	Missouri State University-Springfield
MO	Missouri Western State University
MO	Northwest Missouri State University
MO	Southeast Missouri State University
MO	Truman State University
MO	University of Central Missouri
MS	Alcorn State University

MS	Delta State University
MS	Mississippi University for Women
MS	Mississippi Valley State University
MT	Montana State University Billings
MT	Montana State University-Northern
MT	The University of Montana-Western
NC	Appalachian State University
NC	Elizabeth City State University
NC	Fayetteville State University
NC	North Carolina Central University
NC	University of North Carolina Wilmington
NC	University of North Carolina at Asheville
NC	University of North Carolina at Pembroke
NC	Western Carolina University
NC	Winston-Salem State University
ND	Dickinson State University
ND	Mayville State University
ND	Minot State University
ND	Valley City State University
NE	Chadron State College
NE	Peru State College
NE	University of Nebraska at Kearney
NE	Wayne State College
NH	Granite State College
NH	Keene State College
NH	Plymouth State University
NH	University of New Hampshire at Manchester
NJ	Kean University
NJ	Montclair State University
NJ	New Jersey City University
NJ	Ramapo College of New Jersey
NJ	Rowan University
NJ	The College of New Jersey
NJ	The Richard Stockton College of New Jersey
NJ	William Paterson University of New Jersey
NM	Eastern New Mexico University-Main Campus
NM	New Mexico Highlands University
NM	New Mexico Institute of Mining and Technology
NM	Northern New Mexico College
NM	Western New Mexico University
NV	Great Basin College
NV	Nevada State College
NY	Buffalo State SUNY
NY	CUNY Bernard M Baruch College
NY	CUNY Brooklyn College
NY	CUNY City College

NY	CUNY College of Staten Island
NY	CUNY Hunter College
NY	CUNY John Jay College of Criminal Justice
NY	CUNY Lehman College
NY	CUNY Medgar Evers College
NY	CUNY New York City College of Technology
NY	CUNY Queens College
NY	CUNY York College
NY	Farmingdale State College
NY	Fashion Institute of Technology
NY	Morrisville State College
NY	SUNY College at Brockport
NY	SUNY College at Cortland
NY	SUNY College at Geneseo
NY	SUNY College at Old Westbury
NY	SUNY College at Oneonta
NY	SUNY College at Oswego
NY	SUNY College at Plattsburgh
NY	SUNY College at Potsdam
NY	SUNY College of Agriculture and Technology at Cobleskill
NY	SUNY College of Technology at Alfred
NY	SUNY College of Technology at Canton
NY	SUNY College of Technology at Delhi
NY	SUNY Empire State College
NY	SUNY Institute of Technology at Utica-Rome
NY	SUNY Maritime College
NY	SUNY at Fredonia
NY	SUNY at Purchase College
NY	State University of New York at New Paltz
OH	Central State University
OH	Ohio State University-Lima Campus
OH	Ohio State University-Mansfield Campus
OH	Ohio State University-Marion Campus
OH	Ohio State University-Newark Campus
OH	Shawnee State University
OH	Youngstown State University
OK	Cameron University
OK	East Central University
OK	Langston University
OK	Northeastern State University
OK	Northwestern Oklahoma State University
OK	Oklahoma Panhandle State University
OK	Rogers State University
OK	Southeastern Oklahoma State University
OK	Southwestern Oklahoma State University
OK	University of Central Oklahoma

OK	University of Science and Arts of Oklahoma
OR	Eastern Oregon University
OR	Oregon Institute of Technology
OR	Southern Oregon University
OR	Western Oregon University
PA	Bloomsburg University of Pennsylvania
PA	California University of Pennsylvania
PA	Cheyney University of Pennsylvania
PA	Clarion University of Pennsylvania
PA	East Stroudsburg University of Pennsylvania
PA	Edinboro University of Pennsylvania
PA	Kutztown University of Pennsylvania
PA	Lock Haven University
PA	Mansfield University of Pennsylvania
PA	Millersville University of Pennsylvania
PA	Shippensburg University of Pennsylvania
PA	Slippery Rock University of Pennsylvania
PA	West Chester University of Pennsylvania
RI	Rhode Island College
SC	Citadel Military College of South Carolina
SC	Coastal Carolina University
SC	College of Charleston
SC	Francis Marion University
SC	Lander University
SC	University of South Carolina-Aiken
SC	University of South Carolina-Beaufort
SC	University of South Carolina-Upstate
SC	Winthrop University
SD	Black Hills State University
SD	Dakota State University
SD	Northern State University
TN	Austin Peay State University
TN	Tennessee Technological University
TN	The University of Tennessee at Chattanooga
TN	The University of Tennessee-Martin
TX	Angelo State University
TX	Midwestern State University
TX	Prairie View A & M University
TX	Stephen F Austin State University
TX	Sul Ross State University
TX	Tarleton State University
TX	Texas A & M International University
TX	Texas A & M University-Galveston
TX	Texas A & M University-Texarkana
TX	Texas State University-San Marcos
TX	The University of Texas at Brownsville

TX	The University of Texas at Tyler
TX	The University of Texas of the Permian Basin
TX	The University of Texas-Pan American
TX	University of Houston-Clear Lake
TX	University of Houston-Downtown
TX	University of Houston-Victoria
TX	West Texas A & M University
UT	Dixie State College of Utah
UT	Southern Utah University
UT	Utah Valley University
UT	Weber State University
VA	Christopher Newport University
VA	James Madison University
VA	Longwood University
VA	Norfolk State University
VA	Radford University
VA	The University of Virginia's College at Wise
VA	University of Mary Washington
VA	Virginia Military Institute
VA	Virginia State University
WA	Central Washington University
WA	Eastern Washington University
WA	The Evergreen State College
WA	University of Washington-Bothell Campus
WA	University of Washington-Tacoma Campus
WA	Western Washington University
WI	University of Wisconsin-Eau Claire
WI	University of Wisconsin-Green Bay
WI	University of Wisconsin-La Crosse
WI	University of Wisconsin-Oshkosh
WI	University of Wisconsin-Parkside
WI	University of Wisconsin-Platteville
WI	University of Wisconsin-River Falls
WI	University of Wisconsin-Stevens Point
WI	University of Wisconsin-Stout
WI	University of Wisconsin-Superior
WI	University of Wisconsin-Whitewater
WV	Bluefield State College
WV	Concord University
WV	Fairmont State University
WV	Glenville State College
WV	Marshall University
WV	Shepherd University
WV	West Liberty University
WV	West Virginia State University
WV	West Virginia University at Parkersburg

APPENDIX C: CASES EXCLUDED FROM THE ANALYSES

Chapter 3 describes the criteria used to identify and the process used to investigate and, in some cases exclude from the analysis, suspect cases. Excluded cases are shown in Table C.1.

Table C.1.

Cases Excluded from the Analyses

Institution	Year
Alabama A & M University	2011
Alabama A & M University	2012
Bluefield State College	2005
Bluefield State College	2006
Bluefield State College	2007
Bluefield State College	2008
California State University-Channel Islands	2003
California State University-Channel Islands	2004
California State University-Long Beach	2011
California State University-Long Beach	2012
California State University-Sacramento	2006
California State University-Sacramento	2007
California State University-Sacramento	2008
Charter Oak State College	2005
Charter Oak State College	2006
Charter Oak State College	2007
Chicago State University	2003
Chicago State University	2004
Chicago State University	2005
Coppin State University	2004
Coppin State University	2005
Eastern Oregon University	2008
Eastern Oregon University	2009
Ferris State University	2003
Ferris State University	2004
Fort Valley State University	2008
Fort Valley State University	2009
Fort Valley State University	2010
Governors State University	2004
Governors State University	2005
Great Basin College	2010
Great Basin College	2011
Henderson State University	2004
Henderson State University	2005

Louisiana State University-Shreveport	2003
Louisiana State University-Shreveport	2004
Louisiana State University-Shreveport	2005
Maine Maritime Academy	2005
Maine Maritime Academy	2006
Minnesota State University Moorhead	2004
Minnesota State University Moorhead	2005
Minnesota State University Moorhead	2006
Minot State University	2003
Minot State University	2004
Minot State University	2005
Mississippi University for Women	2003
Mississippi University for Women	2004
Mississippi University for Women	2005
Missouri Southern State University	2007
Missouri Southern State University	2008
Missouri Southern State University	2009
Nevada State College	2005
Nevada State College	2006
Nevada State College	2010
Nevada State College	2011
Nevada State College	2012
New Mexico Institute of Mining and Technology	2005
New Mexico Institute of Mining and Technology	2006
New Mexico Institute of Mining and Technology	2007
New Mexico Institute of Mining and Technology	2008
Northeastern Illinois University	2003
Northeastern Illinois University	2004
Northeastern Illinois University	2005
Northern Kentucky University	2003
Northern Kentucky University	2004
Northern New Mexico College	2008
Northern New Mexico College	2009
Northern State University	2003
Northern State University	2004
Oklahoma Panhandle State University	2006
Oklahoma Panhandle State University	2007
Plymouth State University	2007
Plymouth State University	2008
Plymouth State University	2009
Prairie View A & M University	2004
Prairie View A & M University	2005
Prairie View A & M University	2006
Radford University	2003
Radford University	2004
Ramapo College of New Jersey	2003

Ramapo College of New Jersey	2004
Southern Oregon University	2008
Southern Oregon University	2009
Texas A & M International University	2004
Texas A & M International University	2005
Texas A & M University-Galveston	2009
Texas A & M University-Galveston	2010
The University of Texas of the Permian Basin	2010
The University of Texas of the Permian Basin	2011
Troy University	2007
Troy University	2008
Troy University	2009
Troy University	2010
Troy University	2011
Truman State University	2003
Truman State University	2004
University of Arkansas at Monticello	2009
University of Arkansas at Monticello	2010
University of Arkansas at Monticello	2011
University of Baltimore	2004
University of Baltimore	2005
University of Baltimore	2006
University of Central Missouri	2008
University of Central Missouri	2009
University of Central Missouri	2010
University of Colorado Colorado Springs	2010
University of Colorado Colorado Springs	2011
University of North Florida	2008
University of North Florida	2009
University of North Florida	2010
University of Wisconsin-Stout	2011
University of Wisconsin-Stout	2012
West Virginia University Institute of Technology	2003
West Virginia University Institute of Technology	2005
West Virginia University Institute of Technology	2006
West Virginia University Institute of Technology	2007
Western Connecticut State University	2006
Western Connecticut State University	2007
Western Connecticut State University	2008
Western Illinois University	2004
Western Illinois University	2005