AN INVESTIGATION INTO THE RELATIONSHIPS BETWEEN HIGHER EDUCATION FACILITY SQUARE FOOTAGE AND STUDENT ENROLLMENTS, UNIVERSITY ENDOWMENTS, AND STUDENT TUITION

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ABSTRACT

America's colleges and universities have expanded campus facilities by renovating and increasing square footage. This is in contrast to general construction activity during the same time period. This quantitative study investigates the relationship between university and college campus facility square footage per FTE and university enrollments, institution endowments, and tuition and fees. Dummy variables were created for Carnegie classification and whether the college or university was private or public. Literature documents concern that these increased and upgraded facilities may become overbuilt and thus become liabilities to the institutions. Square footage data gathered over a five-year period from college and university administrators were regressed against enrollment, endowment, tuition, and fees for the same time period (2002-2007). Results show a relationship between university square footage per FTE and endowments per FTE and tuition. The relationship between enrollment and square footage per FTE indicates that total square footage increases with enrollment, however at a lower rate than enrollment. This indicates that administrators may act rationally using this empirical data as suggested in teleological theory. However, the results also show that this theory cannot explain all the increases in campus square footage. It leaves room for such theories as the arms race and public choice theory. This study adds to the body of knowledge regarding the motivation of administrators to increase campus facility square footage and creates a predictor model for administrators to compare institutions.

CHAPTER I

INTRODUCTION

This quantitative research study investigates the relationships between university campus facility square footage (dependent variable) to student enrollment, institution endowment, and student tuition and fees (independent variables) controlling for Carnegie classification and type of institution by institutional control – private or public (control variables). This chapter provides the background for the study, the research problem, purpose statement, hypothesis, overview of the methodology, significance of the study, delimitations, role of the researcher, and definition of terms.

Background of the Study

The economy in the United States was characterized by a rising stock market in the 1990s. The increase was followed by one of the largest stock market collapses in history (Cassidy, 2002; Mahar, 2003). The rate of increase and the subsequent fall in the stock market between 1998 and 2000, referred to as the dot-com bubble, eventually led to a financial crisis in the United States (Ofek & Richardson, 2003). In 2000, as a response to the falling stock market, the U.S. Federal Reserve cut its key lending rate, known as the federal funds rate, to prevent recession and deflation (United States Federal Reserve, n.d.). This monetary policy of reducing the borrowing rate and loosening borrowing

requirements led to record-setting expansion and rapid price increases in real estate markets in the United States from 2000 to 2005 (Iacoviello, 2005). This real estate boom, characterized by significant expansion and rapid price increases, caused a real estate bubble that many economists say contributed substantively to the 2007 financial crisis in the United States. Most economists agree that the United States officially entered into recession in 2007 (National Bureau of Economic Research, 2007). Just as the increase in the volume of money and credit resulted in increased demand for real estate, thereby elevating prices, the subsequent tightening of the monetary policy and lending requirements resulted in a decline in demand and the ensuing reduction in real estate prices (Shiller, 2008). The number of people employed in the construction industry and the value of commercial construction projects underway by dollar volume confirmed the realities of the real estate bubble. As of 2009, the U.S. Bureau of Labor estimated that 6 million Americans were employed in the construction industry, down from 7.2 million in 2008 and 7.6 million in 2007 (United States Department of Labor, 2009). Approximately $846.2 billion in new construction was recorded at a seasonally-adjusted annual rate as of February 2010, according to the U.S. Bureau of the Census. This was down from the 2006 yearly peak of $1.16 trillion (United States Bureau of the Census, 2010). Bucking this downward trend in commercial and residential construction and considered by many economists as the bright spot in the construction industry, higher education construction enjoyed an increase in both the number of projects and the dollar amount per project, and was second only to health care in terms of construction and real estate development activity from 1994 to 2011 (Abramson, 2007; Baker, 2009; Haughey, 2010). As shown

in figure 1.0, since 1994 higher education construction was on an upward trend, whereas residential and commercial construction slightly decreased (Abramson, 2011).

This development activity was a continuation of what occurred during the first six years of the 21st century as college construction increased from less than $10 billion in 2001 to more than $15 billion in 2006 (Abramson, 2007).

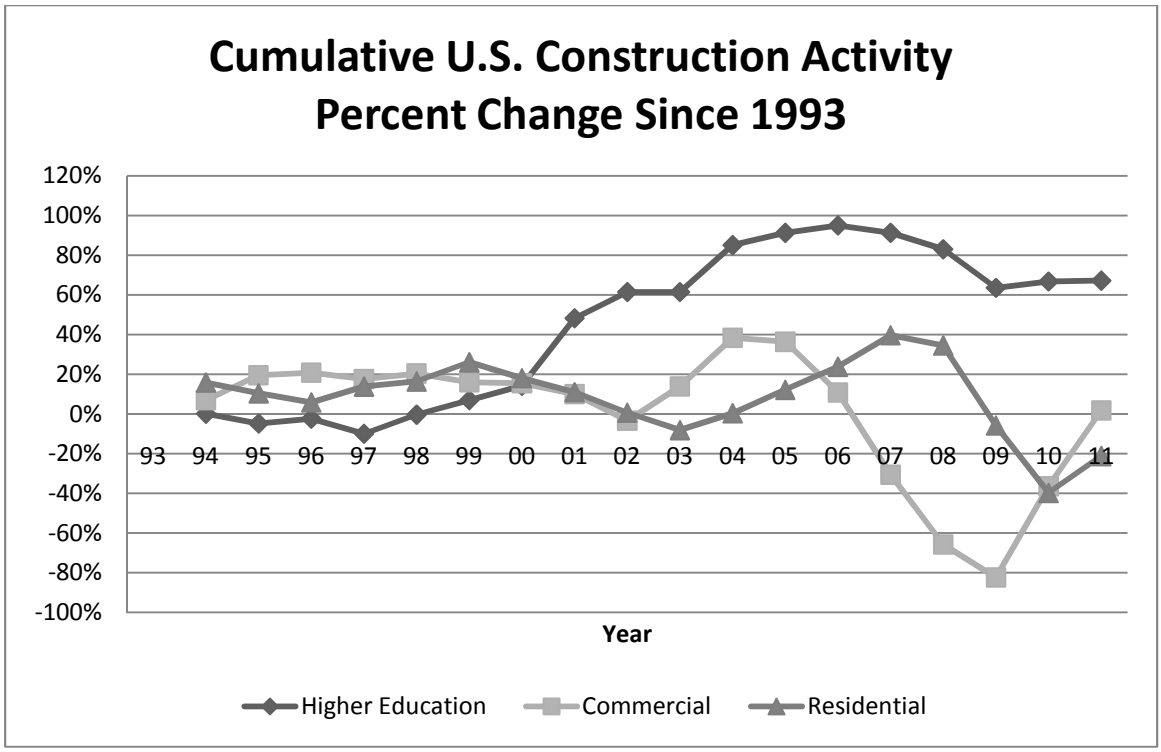

Figure 1.0. Cumulative percentage change in higher education, residential, and commercial construction activity from 1993 to 2011. Adapted from data provided by The College Construction Report by P. Abramson, 2011, *College Planning & Management.*

Construction and real estate development on university campuses in the United States are generally regarded as creating a nonproductive competition in which each side expends significant amount of resources to maintain its relative standing (Ehrenberg, 2001; Frank, 2008; Hirsch, 1976; Winston, 1999, 2000). Frank and Cook (1995) describe this pressure to expand facilities and upgrade campus amenities in higher education as an

arms race. In the arms race scenario, any gains on one side are forfeited because they are matched or exceeded by the competition.

One condition facilitating the higher education arms race is the changing expectations of students. For example, students' expectations for housing have far surpassed the dormitories of old and now include apartment-style living accommodations (Reeves La Roche, Flanigan, & Copeland, 2010). Colleges and universities stock their campuses with luxuries and amenities in a fierce competition for students (Ehrenberg, 2001; Frank, 2007; Hill, 2004). As validation, Bulls and Greenberger stress the importance of modern facilities, describing a campus' physical presence as the "front door for key audiences and important constituencies, creating an initial – and often enduring – image within the community from which it hopes to attract students, faculty, and staff" (p. 18, 1998). This additional spending increases the cost burden for universities and creates new financial hurdles for middle and lower-income students and their families (Frank & Cook, 1995). Consequently, scarce educational resources are consumed and important services and programs are jeopardized (Winston, 2000; Zemsky, Wegner, & Massy, 2005).

A logical explanation for the changes in facility square footage of U.S. college and university campus facilities would be a corresponding increase in demand driven by student enrollment. Another plausible rationale justifying construction and development might be increases in university endowments (NACUBO-COMMONFUND, 2009), thereby presenting administrators with available funds for expansion (Selingo & Brainard, 2006). A third possibility worth consideration might be increases in tuition and fees, which also create additional resources for the improvements (Ehrenberg, 2001).

Adding to the credibility of these scenarios, the literature review in Chapter Two presents a theoretical case that supports campus facility expansion by university and college administration based on empirical data produced from increases in enrollment, endowments, and tuition to make campus square footage decisions. Teleological theory provides a lens to view campus facility square footage decisions and is discussed in the literature review.

Research Problem

American colleges and universities are expanding campus facilities with the construction of new buildings and renovation of older facilities (Abramson, 2011; Agron, 2004; Baker, 2009; Haughey, 2010). It is evident that when demand, in the form of enrollment, surpasses physical capacity universities must increase the size of their facilities. It is also logical that university administrators feel pressure to expand campus facilities as burgeoning endowments, provide resources and expectations from alumni and donors (Selingo & Brainard, 2006). Recent increases in tuition might also provide a reasonable explanation for facility square footage changes as student expectations grow to match student investments (Ehrenberg, 2001). The literature indicates that facilities may in fact be expanded for reasons other than increases in enrollment, endowments, and tuition. Consequently, universities may need internal controls based on empirical data, including facility capacity inventories and supply and demand studies, to minimize the square footage risks.

Purpose Statement

The purpose for this non-experimental quantitative research study is to investigate the relationships between student enrollment, institutional endowments, and tuition

(independent variables) on campus facility square footage (dependent variable), controlling for Carnegie classification and whether the institution is private or public (control variables).

Hypotheses

1. There is a positive correlation between university facility square footage and student enrollment.
2. There is a positive correlation between university facility square footage and university endowments.
3. There is a positive correlation between university facility square footage and student tuition.

Null Hypotheses

1. There is no relationship between university facility square footage and student enrollment.
2. There is no relationship between university facility square footage and university endowments.
3. There is no relationship between university facility square footage and student tuition.

Significance of the Study

This study potentially contributes to theory, research, and practice. Colleges and universities own billions of dollars in real estate and spend millions of dollars in annual operating budgets maintaining those assets. The literature supports the importance of quality facilities in recruiting efforts (Bulls & Greenberger, 1998; Hill, 2004; Price, Matzdorf, Smith, & Agahi, 2003; Reeves La Roche, Flanigan, & Copeland, 2010;

Reynolds, 2007) and gives ample support to predicting future enrollments based on demographics and population (Gerald & Hussar, 2003; National Center for Education Statistics, 2009). Yet empirical data aiding administrators in specific areas of facility expansion, as measured in dollars or square footage, and mathematical modeling relating to the funding of these square footage changes, is scarce (Society of College and University Planning, 2003).

The implications of studying university facility square footage issues may be considerable in that while there are some seminal texts and journal articles regarding the theoretical reasons why administrators might be incented to overbuild facilities, there is a paucity of peer-reviewed articles explaining the square footage issues of campuses in the United States. There are, however, many anecdotal industry articles, white papers, and governmental resources that express concern regarding the overbuilding of campus facilities based on current projections of enrollment. Implications for practice involve the assimilation into higher education of commercial real estate models and procedures based on internal controls. Utilizing internal controls and empirical data might lead to the adoption of commercial real estate models, ratios, and calculations for higher education facility square footage decisions. The implementation of these models could institutionalize internal controls for quantifying and justifying facility square footage decisions. Implications for theory are based on the application of teleological theory discussed in Chapter Two as applied to administrative decision-makers in the arena of higher education.

This gap in the body of knowledge dictates that research should be conducted on why and how colleges and universities expand facilities and to determine possible

relationships to increases in enrollments, endowments, and tuition. The motivations suggested by teleological theory may aid this research. With the resulting data, administrators may have substantive tools to make strategic decisions regarding campus facility square footage for the purpose of mitigating unnecessary risks in making expansion decisions. The public appetite for funding higher education is not infinite (Ehrenburg, 2006). It is therefore critical that the dollars allocated for higher education be spent prudently to produce the maximum benefit for students, to further educational goals and objectives in the community, and to support individual institutional missions.

Overview of the Methodology

Data were obtained for this study from the Society of College and University Planning (SCUP). SCUP is a community of higher education leaders from academia and industry responsible for the integration of planning on college and university campuses. SCUP promotes successful integration of the institution's mission into the respective academic plan (SCUP, n.d.). Starting in 2003, SCUP developed a survey to fill a significant gap of information relating to the total amount of square footage allocated to higher education in the United States. The data were gathered over a 5-year period resulting in a robust dataset of responding colleges and universities. The data were entered into spreadsheets and disseminated to participating institutions as a peer group for administrators' comparisons. While the data were summarized and compared year-to-year, they were never analyzed or regressed among other variables. With the permission of SCUP, data from the aforementioned surveys provided the basis for this research.

The study is a correlational relationship study designed to examine the strength and directionality of the hypothesized relationships between university campus square

footage (dependent variable) and the independent variables of student enrollment, endowments, and tuition. The nature of the relationship was determined through the use of ordinary least squares (OLS) regression. Statistical analysis was conducted on the data utilizing descriptive statistics and multiple regression methods using STATA. Square footage results in both core educational space and total campus space were regressed on undergraduate and graduate enrollment, endowment, undergraduate and graduate tuition, undergraduate and graduate fees, institutional control - private or public (dummy), and Carnegie classification (dummy). A *t*-test was used to determine a statistically significant difference between the means of the variables. The number of respondents was considered and response bias was taken into account. Possible estimates of how non-respondents could have potentially changed the results, had they responded to the survey, were considered (Creswell, 2003).

Role of the Researcher

In an effort of full disclosure, the researcher is personally and professionally involved in the process of university expansion. He is a real estate instructor at the University of Central Oklahoma and owns a real estate brokerage, a mortgage brokerage, and a property management company. His interest in understanding how educational institutions make decisions regarding square footage and real estate acquisitions is derived from an understanding of the academy and his work in the real estate industry. His career, like this topic of study, is a blend of higher education and the real estate profession.

Delimitations of the Study

While being careful not to declare any causation, this study should be able to note any relationship between the variables. A significant *t*-score for an independent variable in a regression does not prove causation. However, the absence of a significant score does demonstrate that factors other than enrollment, endowments, and tuition might impact facility square footage (Pedhazur, 1997). Limitations of this study include the potential for unrecognized ambiguity in the research questions and uncorrected internal and external threats to validity. As with all ex-post-facto studies, selection bias and spurious correlation can be issues (Mohr, 1995). Omitted variable bias may also be a limitation (Pedhazur, 1997). If the response rate is low, there may be reason to suspect a significant amount of error that might not accurately reflect the sample population.

This study utilized secondary data for analysis. Educational research utilizing secondary datasets has numerous methodological, theoretical, and pedagogical benefits (Smith, 2008). However, the literature also documents the pitfalls and drawbacks of using secondary data, suggesting that the data be treated with appropriate skepticism and respect for its limitations and assumptions regarding reliability and bias as with other types of data (Doolan, 2009).

Peer-reviewed articles and seminal texts are used in this paper when possible. Brewerton and Millward (2001) give advice on the evaluation of research resources judging it for reliability, accuracy, and utility. Peer-reviewed journals, books, and periodicals are significantly more likely to have the reliability, accuracy, and utility needed for scholarly work. While an effort was made to use peer-reviewed publications, many anecdotal industry articles, white papers, and governmental resources were also

utilized. The risk of author bias, reliability, and accuracy in using non-peer-reviewed publications is understood and considered in every circumstance.

Definition of Terms

The following terms are definitions primarily derived from the researcher's use and understanding rather than from particular references. When terms are derived from the literature, however, references are provided.

Bailout Provisions – During the financial crisis of 2007, 2008 and 2009, the U.S. government provided monetary concessions in the form of tax benefits, loans, and grants. These provisions have become known as bailouts.

Capital Project – This term is used to indicate physical construction projects that will produce long-term benefits to the university, such as buildings, roads, or utilities.

Carnegie Classification – The Carnegie Classification of higher education institutions places comparable colleges and universities in the United States into categories. A full explanation can be found in Appendix A.

Deflation – A decline in general price levels, often caused by a reduction in the supply of money or credit.

Dot-Com Bubble – In the two-year period from early 1998 through February 2000, the internet sector earned more than 1000% returns on public equity. The returns completely disappeared by the end of 2000. This time period is referred to as the dot-com era or bubble (Ofek & Richardson, 2003).

Echo-Boom – The term is used in this paper to describe a demographic and socioeconomic effect on enrollment in schools. The echo-boom consists of school-aged children of the original baby boomers (Bare, 1997).

Edifice Complex – The tendency of politicians and administrators to have large buildings and stadiums built as concrete reminder of the person's legacy (Sudjic, 2005).

Eminent Domain – The right of government to take privately held land for public use provided just compensation is paid (Jacobus, 2010).

Externalities – Positive or negative effects that one economic agent's actions have on the welfare of another (Milgrom & Roberts, 1992).

Federal Funds Rate – The interest rate that banks charge each other for the use of federal funds. The rate changes daily and is a sensitive indicator of general interest rate trends. The rate is controlled by the U.S. Federal Reserve.

Gross Square Feet (GSF) – The sum of all areas on all floors of a building included within the outside faces of exterior walls, including floor penetration areas, however insignificant, for circulation and shaft areas that connect one floor to another. Gross Area = Net Usable Area + Structural Space

Net Assignable Square Footage (NASF) – The sum of all areas on floors of a building assigned to, or available for assignment to, occupant or specific use. NASF is computed by physically measuring or scaling measurements from the inside faces of surfaces that form the boundaries of the designated areas (National Center for Education Statistics, 2009).

Physical Expansion – In this paper the term physical expansion is interchangeable with facilities expansion.

Physical Plant – In this paper the term physical plant is interchangeable with campus facilities.

Positional Arms Race – The race among competing nations to obtain the most powerful weaponry.

Profit-Maximizing Firm – A profit-maximizing firm chooses both its inputs and its outputs with the sole goal of achieving maximum economic profits (Nicholson, 1998).

Real Estate Boom – Significant expansion and rapid price increases in real estate markets.

Real Estate Bubble – Characterized by rapid increase in valuations of real property until they reach unsustainable levels relative to incomes and other economic indicators.

Recession – A period of general economic decline in Gross Domestic Product for two or more consecutive quarters.

Square Footage – The term square footage is used in real estate as a measure of area. One square foot is 144 square inches.

Summary

This chapter introduced the subject of university and college campus facility expansion. Due to the financial crisis that plagued the United States in 2007, the development projects of commercial construction industry slowed tremendously. Many higher education institutions in the United States, however, expanded campus facilities to the point that some literature compares this university campus expansion to an escalating arms race. Springing from this conjecture, the research problem was stated in context with the hypotheses that consider the relationships between physical campus square footage and enrollment, endowments, and tuition. The significance of the study to theory, research, and practice was discussed, focusing on the significant resources spent

on facility assets, importance of the facilities in recruiting efforts, and the gap in the body of knowledge regarding why and how colleges and universities are expanding facilities. A brief overview of the methodology used in the study was provided. In an effort of full disclosure, the role of the researcher was discussed and possible delimitations of the study were identified. Finally, key terms used throughout the study were identified and defined.

Chapter Two presents a review of the literature that shaped the foundation of the study. The chapter describes the literature review search process before discussing the literature relating to college and university facility square footage. The chapter focuses and reviews literature in six areas: campus facility expansion, theoretical concepts, economic realities to campus facility expansion, enrollment, endowments, and tuition.

CHAPTER II

REVIEW OF THE LITERATURE

In Chapter One a brief synopsis of the real estate boom of the early 2000s and resulting 2008 financial crisis in the United States was described and the effect the economy had on commercial real estate projects was explored. While a myriad of real estate projects were postponed, or cancelled, higher education construction enjoyed an upward trend, as shown in figure 1.0, in both the number of construction projects and the dollar amount per project, and was considered a bright spot in an otherwise depressed construction market (Abramson; 2011; Agron, 2004; Baker, 2009; Haughey, 2010). Multiple rationales were posited as to why this expansion occurred, with the simplistic and most obvious answer being increased demand as a result of increased enrollment. Other reasons, such as rising endowments and increases in tuition, were also proposed as possibilities (Ehrenberg, 2001; Selingo & Brainard, 2006).

Theory provides options that may elucidate the topic of higher education facility square footage changes in relation to increases in enrollment, endowments, and tuition. Teleological theory takes a logical, rational appraisal of empirical data and decision consequences into consideration and is cited as a possible explanation. The positional arms race concept may expose a potential failure of teleological theory, as an arms race mentality causes a non-productive competition and pressure to expand facility campuses

for other purposes (Ehrenberg, 2001; Frank, 2008; Frank, 1999; Frank & Cook, 1995; Hirsch, 1976; Sedlacek & Clark, 2003; Winston, 2000).

There is no shortage of literature detailing the challenges university administrators face regarding facility management and square footage decisions for their campuses. Scholars, politicians, and administrators alike have offered their perceptions of the current status of campus facilities, predictions for future facility expansion, and prescriptions for both (Winston, 2000; Zemsky, Wegner, & Massy, 2005). The following literature review examines a portion of the literature available, concentrating on that which is thought to most closely affect the relationships between student enrollment, institution endowments, and tuition on campus facility square footage, controlling for size and type of institution. This chapter reviews the literature in four areas: economic realities to facility square footage decisions and associated risk, campus facility square footage measurement, the theoretical framework, and the research study variables of enrollment, endowments, and tuition.

The literature review begins with a broad view of higher education and the role it plays in the American economy and culture. Even though there is sufficient evidence in the literature that higher education provides significant value, it is not without risk and concern. The stakeholders in higher education do not have an infinite appetite for funding facility expansions (Ehrenburg, 2006), and ramifications of expanding facilities without justification is worth consideration. The primary risk exposure comes in the growth and expansion of the higher education system and particularly the facilities needed to accommodate the expectations of students and society. The literature documenting the extent of the expansion of higher education institutions is reviewed with consideration of the Annual Official Education Construction Reports (Abramson, 2011;

Agron, 2009) and the Annual Campus Facilities Inventory Report (SCUP, 2003). After confirmation of expansion at higher education institutions, the chapter explores a theoretical rationale by considering teleological theory as motivation for the facility square footage decisions. By evaluating the square footage decision through the lens of teleological theory (Van de Ven & Poole, 1995), the study analyzes the role and motivations of the firm (the university) and of the individual actors (administrators) who make these decisions. Finally, the literature and statistics discussing the variables of enrollments, endowments, and tuition are presented.

Search Process

The literature review process for this study incorporated a multi-faceted approach searching for relevant journal articles, books, and association and industry publications that encompassed an 18 month period. A process documented by Glatthorn and Joyner, and described in three parts as a "broad scan, focused review, and comprehensive critique", was utilized (2005, p. 85). First, a broad scan of less scholarly publications—primarily from education, facility management, and college and university administration planner's organizations and associations—was conducted to understand and evaluate the issues surrounding campus facility square footage as experienced by several different stakeholders. As presented by Brewerton and Millward (2001), there is a risk of author bias, reliability, and accuracy in using these non-scholarly, non-peer-reviewed publications and their use must be considered and carefully evaluated. Next, a focused review of the literature utilizing Boolean descriptors in the digital library of education literature, Education Resources Information Center (ERIC), was conducted. Also during this focused review portion of the literature review, a search for applicable dissertations

concerning campus facility expansion was conducted utilizing the Digital Dissertations/Dissertation Abstracts database.

Early in the literature review process it was discovered that the topic of college and university facility expansion was prevalent in educational publications and articles, and also in management and planning publications. These publications were instrumental in discovering the issues that concern administrators and facility managers responsible for implementing expansion plans for these institutions. Bibliographies of the above resources were combed for additional resources that may have been missed by the initial searches. After compiling a list of relevant resources, a comprehensive critique of all sources was conducted utilizing Brewerton and Millward's model listing the author, publication date, title of article, and overall evaluation with substantive comments. This comprehensive critique process was continually utilized throughout the entire dissertation project (Brewerton & Millward, 2001).

Economic Realities to Campus Facility Expansion and Associated Risks

American higher education is recognized as a critical component to economic growth in our economy (Aschauer, 1989; Ehrenberg, 2004; Gottlieb & Fogarty, 2003; Hoenick, 1994; Howe, 1994; Jorgensen & Stiroh, 2000; King & Smith, 1988; Moretti, 2004; Pencavel, 1991; Perry & Wiewel, 2005; Wang, 2004) and as an efficient route to economic advancement for citizens (Baum & Payea, 2005; Baum & Ma, 2007; Black & Smith, 2004; Card, 2002; Johnstone, 1999; Monks, 2000; United States Government Accountability Office, 2007). Higher education institutions are expected to evoke critical thinking skills in individuals (Halpern, 2001; McMillan, 1987) and produce an engaged citizenry (Colby, Ehrlich, Beaumont, & Stephens, 2003; Torney-Purta, 2002). The impact of higher education institutions on local communities includes a cultural mission

where the impact is even more pronounced (Aronowitz, 2000; Doyle, 2010; Mortenson, 2000; Perry & Wiewel, 2005). The literature demonstrates advantages of higher education for American society, however, recent growth in the number of college educated citizens and expansion of higher education institutions evidenced by increasing construction activity shown in figure 1.0 is a cause of concern (Deer, 2001). Weighing the documented advantages of higher education to society against citations of risk when administrators miscalculate the equilibrium between supply and demand, it is evident that calculation of this equilibrium requires exploration. While the advantages to individuals, local communities, and society as a whole demonstrated above offer a partial explanation for understanding the demand side of expansion in education, it is of little help in terms of supply. Education, unlike most other goods, has a significant lag time in adjusting supply to demand. Machin (1999) states that time-series patterns indicate a decrease in incomes in response to increased supply. Deer (2001) agrees and credits the oversupply of degreed individuals and the devaluations of diplomas as an explanation for the shift some economists are utilizing to propose that university campuses and programs are in danger of overexpansion. A second concern is the possibility of the physical campus facilities becoming an operational burden to institutions, students, and society if the supply and demand is miscalculated. The literature documents the challenge higher education administrators face in accomplishing the societal demand for increased access of students (Tierney & Hagedorn, 2002) while controlling for the risk associated with expanding programs and campus facilities (Sedlacek & Clark, 2003).

A college or university's investment in physical plant, buildings, and real estate is normally the single largest asset on the university's balance sheet, and the annual operating expenses for the institution's facilities matches the amount spent for faculty and

staff salaries (Daigneau, 1994). This investment includes renovating current campus buildings as well as building new facilities. Concern was expressed in the 1990s that American university physical plants had the capability to go from significant assets to serious liabilities raising concerns about facility obsolescence, increasing inefficiencies, failure to keep up with classroom and building technologies, and antiquated economic modeling in the university physical plants (Douglas, 1996; Daigneau, 1994; Weller, 1995). Nearly ten years later, Sedlacek and Clark express concern that the upgrades to contend with degrading facilities and "expansion of American university campuses, financed primarily with debt, had created an ever-increasing annual liability stream that would have to be funded year after year" (2003, p.7).

Whether these issues are allowed to impact the academy's mission and goals depends on the institution's ability to plan and implement strategically (Kotler & Murphy, 1981; Rowley, Lujan, & Dolence, 1997). There is an important differentiation made between institutional strategic plans and facility master plans with a significant concern that these facility master plans assume for growth, and "no one yet has developed a master plan on how to 'shrink' or change a campus in response to obsolescence, efficiency, technology, and economics" (Daigneau, 1994, p. 374). Although this article is dated, it appears that college and university administrators could face a very similar situation to the one described by Daigneau starting in 2014 when the echo-boom students complete their degrees as college and university enrollments could potentially decline (Kennedy, 2011). Daigneau criticizes higher education for viewing facilities with an entitlement mentality that is "reflected not only in attitude, but also in the tools and methods used to account for and manage these assets" (1994, p. 25). Whetten (1980) concurs, stating that organizations have placed improper emphasis and

preoccupation on growth that has prevented preparation for needed retrenchment in times of decline. Daigneau compares the physical plant endowment to that of the financial endowment. Administrators must report on the return of their financial endowments, but are rarely questioned on the return of their physical endowment – that of the physical plant and buildings. Daigneau claims this comparison is logical, citing evidence that the capital invested in the physical endowment is typically the same amount as that invested from the financial endowment (1994).

Although it is prudent to evaluate the value of campus expansions and the possible liability of those assets if not supported by increasing enrollments, it is also practical to evaluate the changing landscape of funding the expansions. One of the most difficult issues for higher education institutions is finding available funding to mount these aggressive building projects. Public higher education institutions have traditionally depended on state-appropriated money to fund operations. In the last decade, higher education lost ground in the competition for state monies which are increasingly being funneled to Medicaid, elementary and secondary education, and the states' criminal justice systems (Ehrenberg, 2006; Zusman, 2005). Ehrenberg describes a situation where public universities failed to receive the necessary approval from state legislatures to raise tuition; however, the same legislatures are also unable to provide the needed funding for expansions because of deficits in state budgets. This funding constraint led some public higher education institutions to consider changing their status to private, thereby becoming ineligible to receive public funding (Breneman, Pusser, & Turner, 2006; Zusman, 2005). Private universities are described as "high-tuition" universities because of their reliance on increased educational fees and limited or no public funding (Ehrenberg, 2006). In contrast, public universities count on cash-strapped state coffers

for funding, causing budget reductions on public campuses nationwide and making much-needed expansion difficult, leading to what Ehrenberg refers to as the "perfect storm" (p. 47).

Chief financial officers of private and public universities grew accustomed to drawing on endowment revenue streams to accomplish or augment campus expansion projects. Endowments, although increasing long-term, incurred huge losses in the collapse of the stock market due to the financial crisis of 2007 (NACUBO, 2009). Much was made of the 2008-2009 bailout provisions created by the U.S. government to aid banks, financial institutions, and automakers. Less publicized was the 2009 request from 31 state universities asking the president for 5% of any economic stimulus package approved by Congress. The money was proposed to go to public university systems that had campus renovations and expansions in progress, or slated to begin, and considered shovel-ready (Genevieve, 2008). According to a study released by the New America Foundation's Federal Education Budget Project, money from the State Fiscal Stabilization Fund, a program created by the American Recovery and Reinvestment Act of 2009, provided monies to 39 states for education spending (Cohen, 2011). Decreasing endowments and reduced state funding served as motivation for public institutions to request help from the federal government in bailouts.

There are three major financing structures for higher education expansion projects: fundraising, public debt, and grants. The majority of the projects (59%) between 1998 and 2005 were constructed with gift and grant money. Sixteen percent of the projects were funded through a mixture of fundraising and public debt and 25% were funded solely with public debt, primarily through tax-exempt government bonds (Wiewel, Kunst, & Dubicki, 2007). However, selling bonds to finance building projects

is difficult and problematic (Kennedy, 2011). Many bond issues require increases in taxes of the constituents to repay the bond. This became more difficult with the reduction in property values during the economic downturn starting in 2006. Likewise, the traditional avenue of fundraising became unreliable; therefore, the role of strategic planning as utilized by administrators in higher education facility expansion is critical.

College and University Facility Square Footage Measurement

Because the purpose of this research study was to investigate the relationships between student enrollment, institution endowments, and tuition and campus facility square footage, it was necessary to review the literature pertaining to the measurement of campus facility expansion. There are two fundamental ways to measure college and university facility expansion. The first method documents the construction activity taking place on campuses by either number of projects or dollar cost of projects. The second is to take actual campus facility inventories and compare the amount of square footage to the previous year. In this section of the literature review, both techniques are explored.

In 1950, the *American School & University* magazine began an annual survey documenting education construction activity. Issuing their first report detailing the amount of construction taking place in education institutions for the 1949 school year, the report was issued sporadically from 1950 to 1974. The report focused on dollar amount of construction rather than increases in square footage (but these two metrics are frequently highly correlated). In 1975, the magazine made a stronger commitment to the report and became the bellwether report documenting construction activity in K-12 school districts and on college and university campuses until 2008. Administrators were surveyed about the type of construction being conducted, completion dates and the

amount of investment in the projects. Responses were separated by institutional type, region of the country, and institutional size. The last *American School & University* school construction report was published in 2008.

Paul Abramson also researches and reports annual higher education construction in *The College Planning & Management* magazine. Abramson's research supports Argon's findings with similar methodology. Figure 2.0 shows higher education construction activity growth from $6,410,000 in 1993 to $11,100,000 in 2011. While Argon and Abramson's studies may lack the rigorous peer-review preferred by academics, they provide a valuable dataset showing the general trend of the American college campus construction and validating much of the peer-reviewed literature.

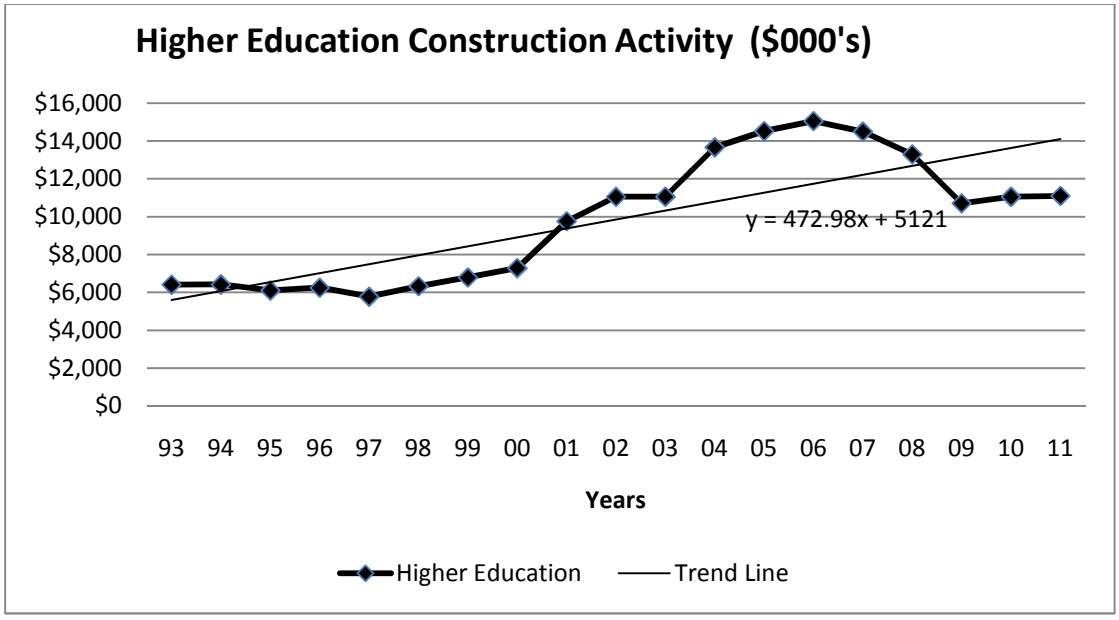

Figure 2.0. Higher Education Construction from 1993 to 2011. Adapted from data provided by The College Construction Report by P. Abramson, 2011, *College Planning & Management.*

The second method of measuring higher education campus facility expansion is accomplished by comparing square footage year-to-year, is more widely accepted, and

has a better documented history. Because data gathered utilizing this method is used in this study, a more in-depth history is detailed. After World War II, college and university administrators in the United States made their desires known regarding comprehensive data and analysis of current and prospective accommodations in higher education facilities. The Campus Facility Inventory (CFI) was the first attempt at studying higher education facilities. This study was a 5-part survey of enrollment and planned facilities of colleges and universities in the United States. Part one of the study was titled *Cost and Financing of College and University Buildings, 1951 – 1955*. The 5-year duration included a period of transition for institutions as they moved from the pragmatism of the postwar period to building permanent facilities for long-range programs. Part two of the study was titled *Planning for College and University Physical Plant Expansion, 1956 – 1970*. This portion focused on collecting and presenting data on types of buildings planned, estimated costs, and proposed methods of financing the necessary expansion (Bokelman & Rork, 1956). Part three of the study is the first reference found in the literature of any type of higher education facility inventory and titled the *1957 Office of Education College and University Survey, Part 3: Inventory of College and University Physical Facilities, December 31, 1957, OE-51007*. The purpose of this section of the study was to establish a perpetual inventory, building by building, of existing facilities on every campus throughout the United States. Data were collected indicating primary functions of the buildings, year of initial occupancy, cost and value of building and equipment, type of construction, assignable area and capacity of space by function. A preliminary report, based on a selected sampling of slightly more than 100 institutions, was published in the report (D'Amico & Iliggins, 1959). Part four was titled *College and University Enrollment and Facilities Survey, 1961 – 1965*. This section emphasized

planned enrollment of higher education institutions in the United States and plans for construction of additional facilities to accommodate the expansion. This section also covered various methods available to finance these facility expansions. Part five of the study was titled *New Colleges and Universities Planned*, and as the name implies shared plans among college administrators for the construction of entirely new campuses.

Part three of the study, which was a building-by-building analysis, was next updated by Dahnke and Mertins (1970) with a study and publication called the *Inventory of Physical Facilities in Institutions of Higher Education: Fall 1968*. The data for this study were gathered with the survey form, "Inventory of College and University Physical Facilities," which was mailed to 2,491 institutions as part of the Higher Education General Information Survey package for 1968. Completed questionnaires were received from 2,050 institutions, making the response rate 82.3% (1970).

The National Center for Education Statistics produced the most comprehensive and complex physical facilities inventory to date called the Higher Education General Information Survey (HEGIS). In preparation for the survey, a classification manual was written called the *Facilities Inventory and Classification Manual (FICM), 1973*. This manual instructed higher education administrators on how to classify campus facilities when preparing inventories. The intent of the manual was to provide a very accurate and consistent labeling of types of facilities and measurements of square footage (Peterson, 1974). In 2003, NCES published an updated edition of the *Postsecondary Education Facilities Inventory and Classification Manual (FICM)*. The data for this survey were published and still exist in the EDSTAT system in tape format. This survey was issued to 3,038 public and private higher education institutions in the United States, with 2,794 returned, yielding a 92% response rate. Of the 3,038 colleges and universities, 1,889

were four-year institutions (62%) and 1,149 were two-year institutions (38%) (National Center for Education Statistics, n.d.). Neither this survey, nor any of its predecessors, provided any differentiation for public or private colleges or universities as for-profit. The survey's researcher utilized two methods to gather data from institutions that did not respond. Under the parallel school method, the data from another institution with approximately the same enrollment and program offerings as listed in the *Education Directory, Higher Education, 1974-1975*, was used. Secondly, using the derived-data method, tables were constructed for each of the four types of institutions (public and private universities, 4-year and 2-year) showing the percentages of space in each cell. Source data for these tables came from a group of institutions whose facility data was known to be accurate. From these estimated data, a form was created for each non-responding institution, using its enrollment and the appropriate table. The research study conducted by HEGIS was replaced by the Integrated Postsecondary Educational Data System (IPEDS), which continued to survey institutions and collect data such as enrollment, finances, and faculty profiles, but eliminated facilities inventory collection. In 1974, the 3,038 colleges and universities had a combined total of 1.3 billion net assignable square feet (NASF), an increase of 300 million NASF since the study and publication by Dahnke and Mertins.

The years between the 1974 inventory survey and the next comparable effort in 2003 represented a significant gap in college and university facility inventory information. In 2003, the Society for College and University Planning (SCUP) recognized this gap of information and committed to an annual survey to collect comprehensive data and produce statistical reports about the physical size and growth patterns of colleges and universities. SCUP compiled this data and reported results from

the year 2003 to 2007. These data were used in this research study. The CFI produced a common space dataset, on an annual basis, using standardized use classifications (Society of College and University Planning, 2003).

Theoretical Framework: Teleological Theory

American colleges and universities are expanding campus facilities with the construction of new buildings (thereby increasing campus square footage) and the renovation of older facilities (Agron, 2004; Baker, 2009; Haughey, 2010; Sadovi, 2009). When demand in the form of enrollment surpasses physical capacity, administrators must increase the size of their facilities. In addition, university administrators feel pressure to expand campus facilities as burgeoning endowments provide resources and expectations from supporters and alumni (King, 2005; Selingo & Brainard, 2006). Increases in tuition might also be a reasonable explanation for facility expansion and renovation as students' expectations grow to match their investments in higher education (Ehrenberg, 2001). The higher education administrator's actions and decision-making process might be enhanced by an explicit awareness of the theoretical framework underpinning the practices of the administrator with regard to campus facility square footage (Bush, 2003).

Van de Ven and Poole (1995) explained the value of incorporating theories from different disciplines to encourage a more comprehensive understanding of the decision-making process. This research study explores the relationships of enrollment, endowments, and tuition and their relationship, if any, to campus facility square footage. Campus facility square footage decisions, justified by increases in the independent variables of enrollment, endowment, and tuition, might be a rational decision based on analysis of empirical data. To provide insight into the motivations and rationale of college and university facility expansion, teleological theory provides a lens through

which to view the actions of the administrators. Teleological theory posits an end state for an entity and proposes transition to that result through concentration of goal formulation, execution, assessment, and modification of goals based on feedback, making adjustments and corrections (Burke, 2002; Van de Ven & Poole, 1995). Van de Ven and Poole describe administrators in a teleological theory framework as having freedom to enact whatever goals they prefer, but the actors have limits on their actions. The institution's environment and resources may provide constraints or limits on their actor's decisions. College and university administrators have a great deal of flexibility and autonomy in their decisions; however, they are certainly confined to some degree by financial resources and outside environmental constraints. Teleological theory incorporates some aspects of systems theory such as strategic planning modeling and the goal of equilibrium (Van de Ven & Poole, 1995). This equilibrium achievement is influenced by the external environment and possibly even by internal politics, making it difficult to specify in advance which path or decision will be chosen (Brunsson, 1982). Van de Ven and Poole's (1995) approach of examining interplay between theories is observed as a guide in this research, specifically by employing teleological theory as the theoretical framework and therefore viewing institutions as rational actors seeking to maximize their core goals (De Alessi, 1983; Van de Ven & Poole, 1995; Varian, 1992). While firms, for example, are focused on maximizing profits, universities are viewed as rational institutions seeking to fulfill their educational missions (Takayama, 1991). When viewing the campus facility square footage decisions through the lens of teleological theory, an argument can be made that in a frictionless decision-making process, a university would only seek to expand if and when that expansion would further the university's educational and outreach mission. The theory downplays or ignores the

possibility that goals may be contested or that individuals may have purposes conflicting with the formal goals of the organization (Bush, 2003). Therefore, higher education administrators should only expend financial resources on facility square footage if the expansion achieves their institution's stated goals or objectives. Coase (1960) demonstrated effectively that in the absence of any distorting influences, such as imperfect information or perverse incentives, a rational actor will choose the most efficient outcome. However, friction and distortion can cause a maximizing institution to make choices that, while individually rational, are socially undesirable (Furubotn, 1999).

Teleological theory gives a theoretical perspective that can be used to analyze the drive to expand campus facilities. The theory posits that higher education administrators will act rationally and might expand campus facilities when experiencing increases in enrollment, endowments, or tuition. The positional arms race perspective, however, as described in the subsequent paragraph, may provide a rationale on why facility square footage may be driven by something other than increases in enrollment, endowments, and tuition.

Economists develop theories to explain and predict how changes in situations affect economic behavior. There are obvious risks in applying theory to elucidate the expansion of campus facilities. De Alessi (1983) posits that the relationship asserted by theory predicts behavior considering idealized variables under theoretical conditions. Due to this theoretical construct, it is imperative to consider applicable theories and alternative hypotheses that affect relationships to real world phenomena (Milgrom & Roberts, 1992; Furubotn, 1999). In the vernacular of economic theory, consideration must be given for friction, distorting influences, or externalities that might cause otherwise rational actors to make choices that deviate from theoretical expectations.

Some economists refer to the actions taken that are counterproductive or inefficient as market failures (Viscusi, Vernon, & Harrington, 2000). Although not considered a formal theory, the concept known as a positional arms race may be one of the distorting influences attributing to market failures in higher education (Frank, 2008; Winston, 2000). In this type of construct, all parties would benefit by opting out of the competition to expand campus facilities to attract larger enrollments. However, if all parties except one opt out of the competition, the party that continues to make the expenditures will benefit greatly. Frank (1999) argues that much of the competition between universities, especially nationally ranked universities, assumes arms race characteristics that waste scarce educational resources. In the end, gains are minimized and expenditures are substantial in paying for the added facility square footage and upgrades. Given the propensity of actors in organizations to operate contrary to the principles described in teleological theory and their potential tendency to be drawn into unproductive positional arms race in higher education, other perspectives should be considered to elucidate decision-makers' motivation and pursuit of campus facility expansion.

Research Variables: Enrollment, Endowments, and Tuition

Enrollment. Thus far the literature review documented and discussed key literature, research, and studies that scholars, governments, organizations, and associations produced regarding the facility expansion of university and college campuses. The review offered theoretical perspectives as to why expansion may occur. This section reviews the simplest and most obvious explanation for facility expansion, namely, increased demand as a result of increased enrollment.

History. Higher education expansion started as far back as the colonial period. The Puritans' emphasis on a learned clergy and educated civil leaders produced centers

of learning (Geiger, 2005). This dedication produced the Harvard College in 1636. Colonial colleges effectively educated a literate, fluent, and responsible American elite. Between 1800 and 1850, the United States experienced a higher education institution building boom in which more than 200 degree-granting institutions were established. Most of these institutions were church affiliated and taught Bible, Latin, Greek, and English literature. The majority of these institutions were also restricted to men and, more specifically, to the sons of the professional class who could afford the experience (Nevins, 1962). Although tuition to these universities was not too expensive, the opportunities lost while at school were significant to the families of the student. For this reason, most of those attending universities were still considered elite (Altbach, 2005; Nevins, 1962).

The mid-nineteenth century saw an expansion focused around church-affiliated colleges and special interest institutions for advanced studies. This created variety as well as growth to higher education in the United States (Riesman, 1956). A proliferation of agricultural colleges, law schools, engineering schools, and medical schools added to the liberal arts dominated landscape of the time. The Morrill Act of 1862 created an elaborate financial program that provided financing for new engineering and agriculture schools (Geiger, 2005; Williams, 1991). These land-grant colleges gained support and political strength changing the scope and purpose of the university (Florer, 1968).

The end of World War II started what has been referred to as America's golden age of higher education. The Servicemen's Readjustment Act of 1944 (GI Bill) motivated large numbers of World War II veterans to pursue higher education (Archibald, 2002). The unfettered access to higher education was initiated by the passing of the GI Bill, but it quickly spread into scholarships unrelated to military service

(Gladieux, King, & Corrigan, 2005). The enthusiasm for public higher education shown by the federal government was shared by governors of growing states and their legislatures which produced master plans aimed at accommodating mass access to more affordable higher education with tiered institutions ranging from junior colleges to research institutions. These multiple historical developments resulted in sustained enrollment growth. The following section of the literature review concentrates on how enrollment is measured, and the possible effect enrollment has on campus facility square footage.

Enrollment Measurement: Integrated Postsecondary Education Data System (IPEDS). The U.S Department of Education fulfills a congressional mandate through the National Center for Education Statistics (NCES) to collect, analyze, and report enrollment data from America's higher education institutions. Much of these NCES data is based on findings from the Integrated Postsecondary Education Data System (IPEDS). National Participation in IPEDS is a requirement for colleges and universities that receive Title IV federal student financial aid programs, such as Pell Grants or Stafford Loans. A brief history of IPEDS is needed because this agency is critical for the gathering of information on higher education.

IPEDS superseded the Higher Education General Information survey (HEGIS) and began collecting data from all postsecondary institutions in 1986. Postsecondary institutions are defined as any institution open to the public that provides education or training beyond the high school level. IPEDS goes far beyond what the HEGIS survey data provided because HEGIS was directed only at institutions of higher education. This distinction is important to recognize when comparing data gathered by the two different organizations. Each institution designates a keyholder who is responsible for ensuring

that survey data are submitted by the institution in a correct and timely manner. Some institutions that collect data for multiple sites or campuses have a coordinator responsible for the entire system. Some states now collect the data on a state-wide basis and have individuals responsible for these data for all institutions in the state (Knapp, Kelly-Reid, Whitmore, Huh, Levine, Berzofsky, & Broyles, (2005).

The components of the survey are enrollment, student financial aid, finance, and graduation rates. IPEDS collects these data via a web-based data collection system containing special editing features that responding institutions may use to modify or customize their screens. A feedback mechanism is built into the software for immediate help in the event a problem is encountered by an institution. Due to the digital nature of the process the results are compiled more quickly and released via the IPEDS Peer Analysis System and College Opportunities On-Line System.

Current trends in higher education enrollment. Four significant issues in the literature pertain to current trends in higher education enrollment and its effect on campus facilities. All four issues could potentially create declining enrollment situations. The first, shown in figure 2.1, is a shift in type of enrollment to two-year programs from four-year institutions, which disguises what is essentially a market share dilemma. The second is an end to what is termed the echo-boom. The echo-boom generation, the children of baby-boomers, populated American colleges and universities for numerous years causing increased enrollment (Dordai & Rizzo, 2006). The echo-boom students will graduate and leave colleges and universities circa 2014 (Bare, 1997; Kennedy, 2011; Roach, 2008). The third issue is that fewer students will graduate from American high schools. The fourth issue is the potential for a significant student preference away from

classroom on-site learning to distance on-line learning. All four issues are examined in subsequent paragraphs.

Higher education experienced significant shifts in enrollment in recent decades. The proportion of total higher education enrollment in the public sector steadily increased, but a significant portion of the growth was at two-year colleges, as shown in Figure. 2.1 (United States Government Accountability Office, 2007).

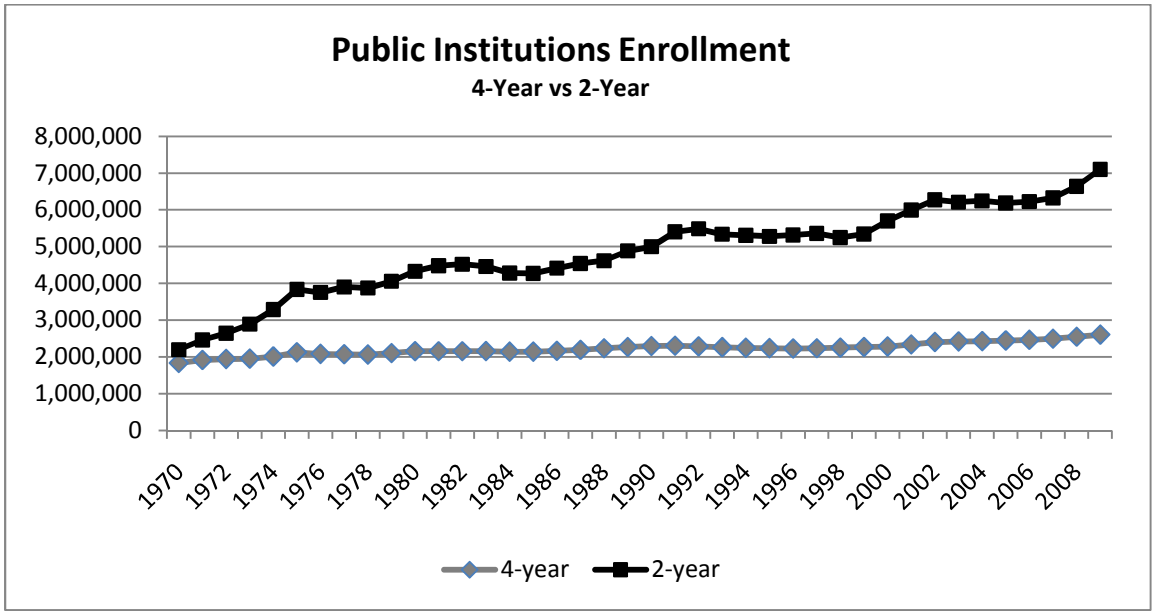

Figure 2.1. Adapted from data obtained from the U.S. Department of Education, National Center for Education Statistics, Integrated Postsecondary Education Data System (IPEDS).

The proportion of higher education enrollment at four-year public and private universities declined as compared to the higher education industry as a whole. Figure 2.2 reveals the declining market share at not-for-profit, four-year public and private universities. Both public and private four-year not-for-profit universities lost approximately 10% in market share during the period addressed in the figure. The market share loss was tolerable, however, because it came at a time when the entire market grew significantly, from 5.9 million in 1965 to 15.9 million in 2001. Every sector grew substantially: public four-year

universities by 113%, private four-year institutions by 82%, and two-year public schools by 366% (United States Government Accountability Office, 2007).

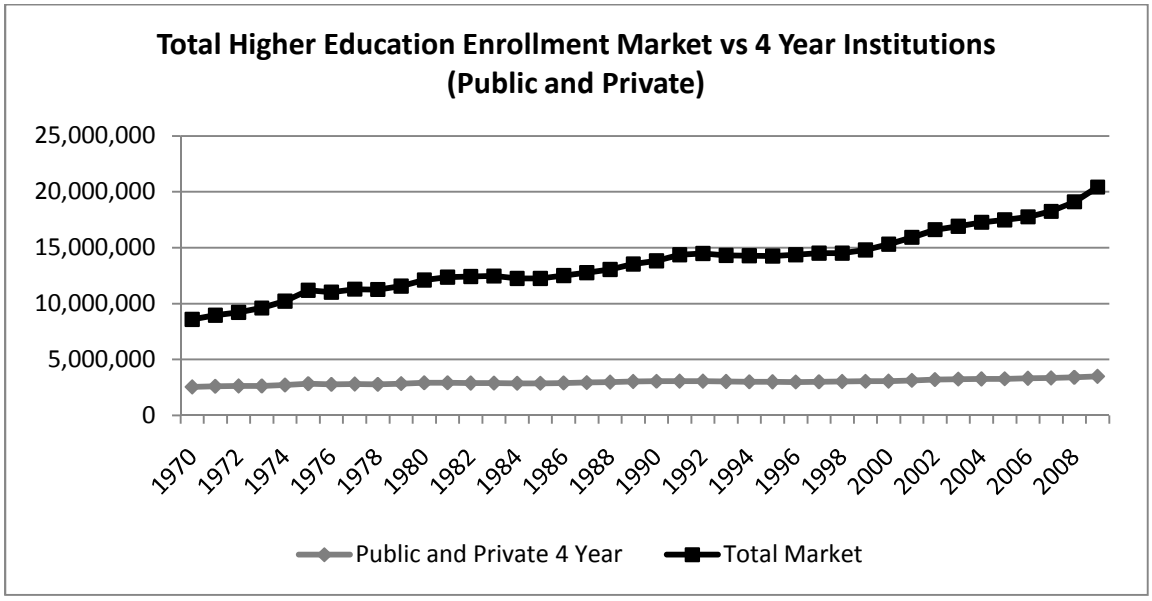

Figure 2.2. Adapted from data obtained from the U.S. Department of Education, National Center for Education Statistics, Integrated Postsecondary Education Data System (IPEDS).

Simply put, loss of market share was easier to tolerate in a rapidly growing market. The danger was that institutions losing market share while enrollment was growing might fail to recognize that the shift in students' preferences away from their institutions could be destructive to these institutions.

The Western Interstate Commission for Higher Education (WICHE) projects that the total number of high school graduates in 2022 will be roughly 1% larger than in 2009, but the overall figure masks dramatic changes in high school demographics. Caucasians, who currently attend college in higher numbers, are projected to decline by 14.6%, while Hispanics, who currently attend college in significantly low percentages, will increase by 62.5%. Enrollment in K-12 schools in the United States reached 55.3 million in 2006, and began a declining trend for the first time in 20 years. These data suggest that

postsecondary enrollment will decline dramatically if historic university attendance patterns remain unchanged (National Center for Education Statistics, 2006). If higher education is unsuccessful at increasing enrollment patterns of Hispanics, as well as Caucasians and African-Americans, the years described by the commission could witness a declining market for higher education. The institutions that have market shares reduced may well see absolute declines in enrollments (Western Interstate Commission for Higher Education, 2008). Buildings and infrastructure built without consideration to the declining enrollment possibilities could become a significant liability to American higher education. Reduction in the number of high school graduates and the demographic makeup of those graduates would be prudent considerations when expanding campus facilities.

The literature points to another complication that suggests higher education administration should go beyond looking at the numbers enrolled and look to the types of enrollment. Commercial real estate leaders are currently worried that technology might be a formidable competitor and impair its future economic viability. The concern stems from a fear that businesses operating in brick and mortar buildings would be able to utilize technology to operate virtually, or without physical places, leaving empty retail, industrial, and office space. A comparable situation may be present in higher education. The possibility exists that higher education enrollment could continue to increase, but less square footage of campus facilities could be needed to accommodate the increase. This dichotomy could be caused by the emergence of students' preference for institutions offering on-line learning (Porter, 2001).

The potential shift to on-line learning initiatives may have a substantive effect on the demand for higher education campus facilities. Ambient Insight Research (AIR)

released a market forecast predicting that 25 million post-secondary students in the United States will take classes online by 2015. The predicted number of students who take classes exclusively on physical campuses will go from 14.4 million in 2010 to just 4.1 million five years later (Ambient Insight Research, 2011). While the exact numbers of students who attend classes physically on American college and university campuses may certainly be debated, the trend for a growing percentage of students using online learning in lieu of attending classes on physical campuses is nearly certain (Allen & Seaman, 2010). Although there is limited agreement among experts that online learning will strategically change the current higher education landscape, there is very little literature predicting or discussing the impact on higher education campus facilities.

Meyer (2008) suggests that the capital for the creation of the online learning curriculum could come by capitalizing on cost-efficiencies of online learning. In a concept called capital-for-capital substitution, many institutions count on online learning to use existing buildings more efficiently and save classroom space; some institutions are even eliminating the physical building altogether and saving 15% of the cost of traditional courses (Campbell, Bourne, Mosterman, Nahvi, Brodersen, & Danwant, 2004; Farmer, 1998; Meyer, 2006; Milam, 2000).

Endowment

The following paragraphs explore changes in endowments as a second possible explanation for growth in facility square footage.

History. A financial endowment is a transfer of money or property to an institution. Typically established as a trust, private foundation, or charity, the intent is to encourage perpetual status by providing a constant provision of cash flow to the institution. Generally, the assets of the endowment are invested with the intent that the

interest earned on the principal will provide the cash flow for some type of funding or operations (Arnett, 1922). College and university endowments are important funding vehicles for the institutions and are significant to society as a whole. For the college or university, they play a role in maintaining academic excellence with income frequently funding a portion of the operating or capital requirements of the institution. Endowments are also commonly used for a number of restricted uses such as chaired professorships, scholarships, and building projects. For society, endowments are a significant benefit because they potentially offset some of the budget-reduction activity seen in state-funded institutions. Many universities are able to use endowments to increase admissions and reduce effective tuition rates, thereby broadening access to education (Lerner, Schoar, & Wang, 2008).

In a seminal article on why universities have endowments, Hansmann (1990) surveyed eleven possible endowment theories evaluating strengths and weaknesses in each. The findings issued by Hansmann state that university administrators maintain large capital reserves in endowments for reasons other than pure economic motivation. Ultimately, the conclusion is that universities use the size of their endowment as a symbol of prestige and element of competitive advantage in recruitment (Hansmann, 1990). Providing analysis after the 2008 financial crisis, Conti-Brown (2011) researched university endowments analyzing the reluctance of university administrators to liquidate endowment funds to maintain pre-crisis finances. He found a cultural theory to endowment accumulation, including legacy costs that university presidents, deans, and administrators extract from their institutions. Endowment growth of an institution is seen as a measurement of success by these actors. The cultural theory to endowment accumulation gives a bias toward solving financial budgetary problems without utilizing

endowment funds for fear that intentional spending of the endowment could cast a negative view on the university president's legacy (Conti-Brown, 2011).

When considering endowments used for building and construction projects, the literature points to what is known as an edifice complex, or the frequent preference among major donors to put their names on newly constructed buildings (Bassett, 1983; King, 2005). These buildings do, however, require additional capital outlay for long-term maintenance costs beyond construction. The building of these new facilities fuels the positional competition arms race articulated earlier in this study and ultimately could have a devastating effect on university costs leading to significantly higher tuition rates.

The size of an institution's endowment is often now integral to the evaluation of the financial health of the institution by bond underwriters and stakeholders. Along with the amplified dependence on the incomes from endowments comes increased pressure on college and university administrations for higher expected performance of returns on the invested assets. Figure 2.3 indicates that the financial performance of endowments may have a significant relationship to the economy, and, specifically to indexes such as the S&P 500 in which at least some of these assets are invested.

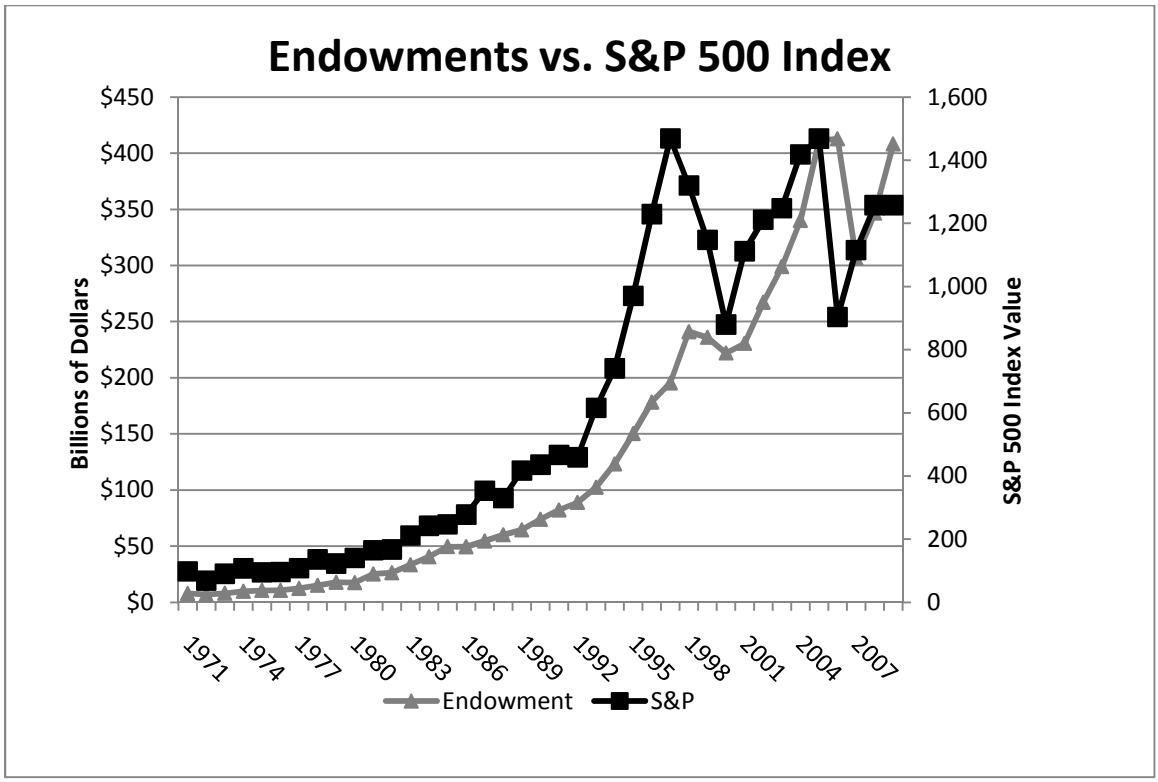

Figure 2.3. NACUBO member Endowments vs. S&P 500 Index from 1971 to 2011. Compiled with data from NACUBO-Commonfund Study of Endowments and The S&P 500 Index.

Endowments of universities not only gain attention from underwriters and stakeholders but also from the U.S. Congress, industry, media, and general society as a whole. The U.S. Senate Finance Committee held hearings in 2006 and 2007 evaluating how college and universities use their 501(C)(3) status and the ability of donors to deduct gifts to educational institutions (United States Senate Committee on Finance, 2006). Industry publications and popular press such as *The Chronicle of Higher Education* and *The New York Times* discuss university endowment investments, tuition in relation to endowments, the growing wealth gap between institutions of higher education, and scrutiny over the endowment-to-expense ratio of universities. The endowment-to-expense ratio compares the endowment to an institution's actual costs and is subjective

with some analysts considering more than a 2:1 ratio as evidence of an excessive endowment. Still others suggest that under certain circumstances, an endowment exceeding a ratio of 5:1 would be considered justifiable (Schneider, 2006). There is evidence suggesting that Congress may consider establishing tax-deductibility criteria based on endowment-to-expense ratios (Waldeck, 2009). No matter what ratio is utilized to justify the amount of endowment held by a university, and whether the long-term increases are from increased giving or increased market returns, it is apparent that administrators will be under increasing pressure to spend those revenues and could justify campus facility expansion projects to artificially and strategically fall into a beneficial endowment-to-expense ratio (Waldeck, 2009). Table 2.0 illustrates the annual spending rate for U.S. higher education endowments from 2000 to 2009.

Table 2.0

Annual Reported Spending Rates for U.S. Higher Education Endowments and Affiliated Foundations, Fiscal Years 2000-2009.

	Year									
Size of Fund	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000
Over $1B	4.6	4.2	4.4	4.6	4.7	5.2	5.3	4.9	4.2	4.2
$501M - $1B	4.9	4.5	4.4	4.5	4.8	5.2	5.3	5.1	4.5	4.5
$101M - $500M	4.4	4.2	4.5	4.6	4.7	4.9	5.2	5.1	4.9	4.6
$51M - $100M	4.7	4.6	4.8	4.7	4.7	4.9	5.2	5.3	5.3	5.1
$25M - $50M	4.3	4.3	4.8	4.8	4.7	4.8	5.0	4.9	4.9	4.7
Under $25M	3.9	4.1	4.6	4.6	4.8	4.6	4.8	4.7	4.9	4.6
Average	4.4	4.3	4.7	4.7	4.9	5.1	5.0	4.9	4.6	4.5

Note: Equal-weighted. Fiscal Years 2000-2007, NACUBO Endowment Study, 2008: Fiscal Years 2008-2009, NACUBO-COMMONFUND Study of Endowments 2009.

Current trends in college and university endowments. Finally, there are indications that changes in college and university endowments impact campus facility square footage. Table 2.1 shows the reduction in endowment returns of The National Association of College and University Business Officers (NACUBO) member universities. According to NACUBO and the COMMONFUND Institute, Harvard, which held the honor of the largest American university endowment, lost 30% of its asset value, from $36.5 billion to $26.6 billion from 2008 to 2009. In response to the endowment loss Harvard cut 275 jobs in 2009 and suspended a $1 billion campus facility expansion project. Further highlighting the relationship between facility square footage and endowments, when Duke's endowment return dropped over 24% in 2008 through 2009 the administration postponed a major construction project (NACUBO-COMMONFUND, 2009).

Table 2.1

NACUBO Member Annual Total Net Returns in Percentage: 2000-2009.

Annual Total Net Returns in Percentage

	Fiscal Years Ending June 30 2009 – 2000									
	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000
Avg	-18.7	-3.0	17.2	10.8	9.3	15.3	3.2	-6.2	-3.5	12.1
Median	-19.1	-3.3	17.5	10.8	9.1	16.0	2.9	-6.4	-3.7	10.8

Note. Equal-weighted. *Fiscal Years 2000-2008. NACUBO Endowment Study 2008; Fiscal Year 2009, NACUBO-COMMONFUND Study of Endowments 2009.*

Tuition

We now examine tuition as a possible explanation for growth in facility square footage.

History. Traditionally, campus facility expansion was financed predominately by state governments and less by student tuition and fee increases. Funding for higher education institutions evolved in recent decades though and now relies less on state support and more on student payment in the form of tuition and fees (Altbach, 2005). But the sources for student payment evolved as well, shifting from grants to loans. This contributed to questions of social equity regarding who benefits from, and who pays for, higher education.

Current trends in higher education tuition. Considering the importance of a college education to the success of individuals in the United States (Baum & Payea, 2005; Baum & Ma, 2007; Black & Smith, 2004; Card, 2002; Johnstone, 1999; Monks, 2000; United States Government Accountability Office, 2007) and the significance of the degreed individual to society (Colby, Ehrlich, Beaumont, & Stephens, 2003; Torney-Purta, 2002) the issue of college affordability is paramount. College affordability is a complex issue and cannot be captured by simply analyzing tuition and fee increases; however, there is a substantive value in considering trends and issues surrounding tuition. Tuition and fees constitute 67% of the total budget for full-time students enrolled in four-year private colleges and universities and 36% of the budget for in-state residential public students. Figure 2.4 shows tuition and fees data comparing types of institutions from the period 1981 to 2012, indicating robust increases in all but two-year public colleges (The College Board, 2006).

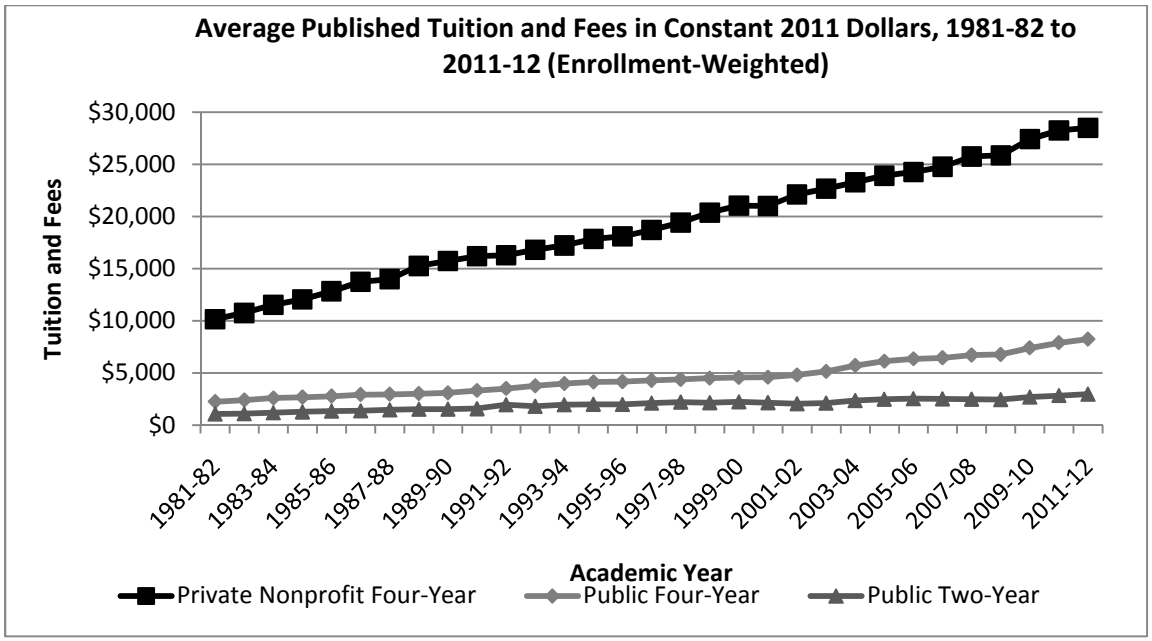

Figure 2.4. 1987-88 and after were generated from The College Board's Annual Survey of Colleges weighted by full-time undergraduate enrollment data; 1986-87 and prior were generated from the U.S. Department of Education, National Center for Education Statistics' Integrated Postsecondary Education Data System (IPEDS) weighted by full-time equivalent enrollment data.

The College Board also tracks trends in room and board expenses. Figure 2.5 includes average tuition and fees documenting the increase with room and board expenses added for both four-year public and four-year private institutions. Like tuition and fees, the cost to the student of room and board is also increasing considerably (Baum, Payea, & McCracklin, 2003; Baum & Payea, 2004; Baum, Payea, Steele, McCrackin, & Goldman, 2005; Baum & Ma, 2007). Although the literature attributes college room and board cost increases paid by students as a function of increased university operational cost of providing campus housing, it does not specifically attribute the increase to new facilities or added amenities.

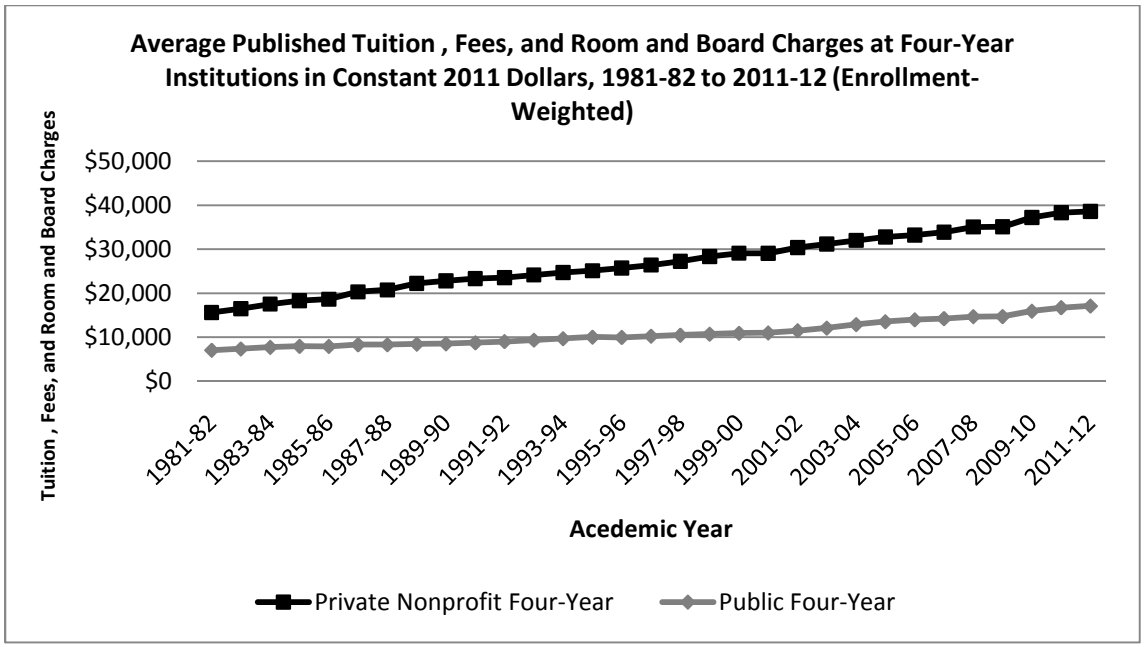

Figure 2.5. 1987-88 and after were generated from The College Board's Annual Survey of Colleges weighted by full-time undergraduate enrollment data; 1986-87 and prior were generated from the U.S. Department of Education, National Center for Education Statistics' Integrated Postsecondary Education Data System (IPEDS) weighted by full-time equivalent enrollment data.

Geometric mean of college costs compared to inflation. Table 2.2 shows the geometric mean of college costs and general inflation from 1958 through 1996, as well as the ten-year periods ending in 1986 and 1996. The inflation rate statistics are based on the annual *Consumer Price Index* (United States Department of Labor, Bureau of Labor Statistics, n.d.) and the college cost inflation rates are based on the Digest of Education Statistics data. The table indicates that during the period from 1958 to 2005 the average annual tuition inflation rate ranged from 4.77% to 9.85% (United States Department of Education, n.d). The geometric mean, however, is more meaningful because it takes into consideration the effect of inflation on the increase, producing the real increase in tuition during the period. The rate of inflation facing college students during this period is nearly twice the general inflation rate.

Table 2.2

Geometric Mean of College Costs Compared to Inflation

Year	College Inflation	General Inflation	Rate Ratio
1958-1996	7.24%	4.49%	1.61
1977-1986	9.85%	6.72%	1.47
1987-1996	6.68%	3.67%	1.82
1958-2001	6.98%	4.30%	1.62
1979-2001	7.37%	3.96%	1.86
1992-2001	4.77%	2.37%	2.01
1985-2001	6.39%	3.18%	2.01
1958-2005	6.89%	4.15%	1.66
1989-2005	5.94%	2.99%	1.99

Figure 2.6 shows the college tuition inflation compared to general inflation in a graphical format for the period of 1958 to 2007. In figure 2.6, the area between the two lines on the graph illustrates the geometric mean of college tuition to general inflation, demonstrating the real percentage of increase in tuition.

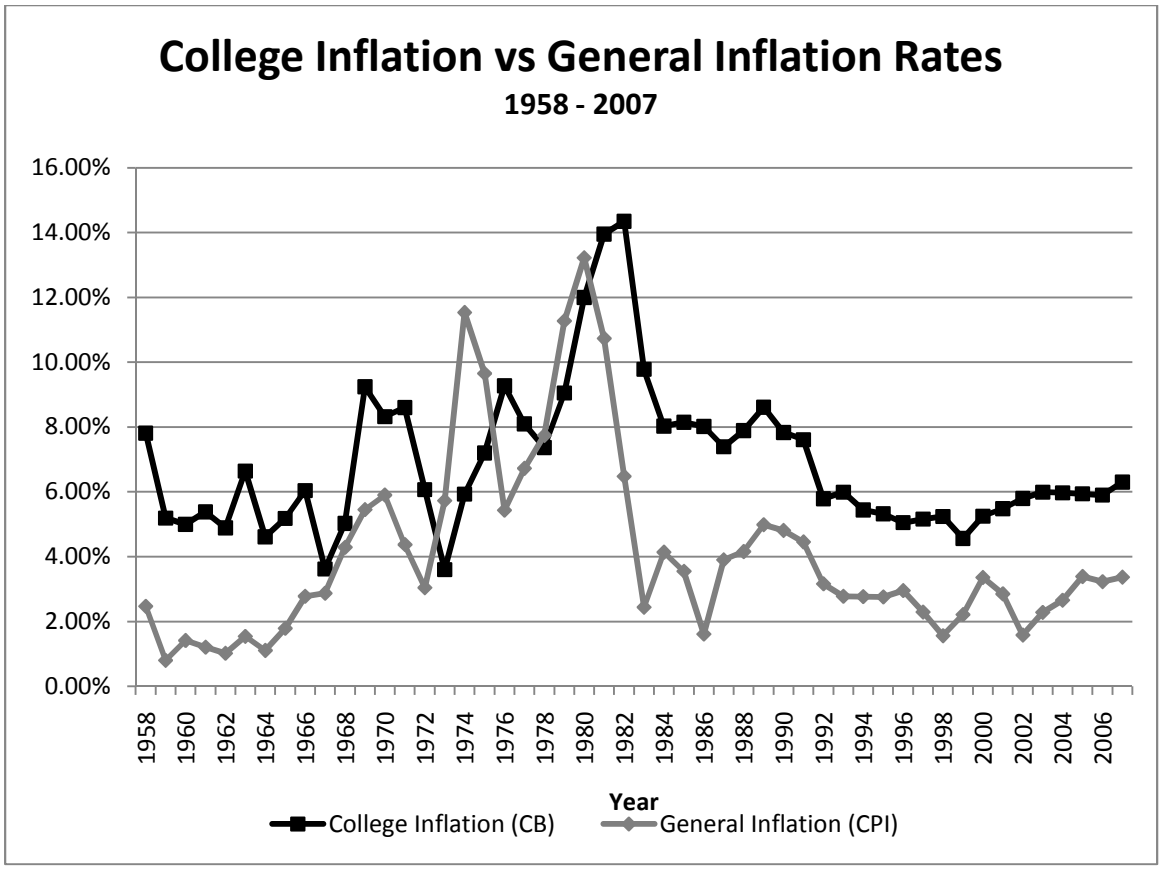

Figure 2.6. Graph comprised from data obtained from The College Board's Annual Survey of Colleges New York, NY and the general inflation rate reported by The Bureau of Labor Statistics.

The student loan dilemma. There was a significant change in the past 40 years in the way in which society financed higher education. The relationship between tuition prices and a family's ability to pay tuition, and how the relationship changed over time, is represented in figure 2.7. The graph shows that the proportion of a family's income spent to educate a student increased significantly. In a period of declining revenue from state funding, greater financial burden was placed on students. In 1980, student tuition provided roughly 20% of the operating funds of universities, but by 2006 that figure was 43%. A greater portion of operating costs was transferred to students, their parents, and their loans (Geiger, 2004). Johnstone (1999) documented this shift and predicted that the government would try to solve the problem of student debt with pre-paid tuition and tax-

exempt savings plans. This was, in fact, what happened after Johnstone's prediction, but these measures did not prevent the student debt issue, which still prevails as one of higher education's most significant contemporary issues.

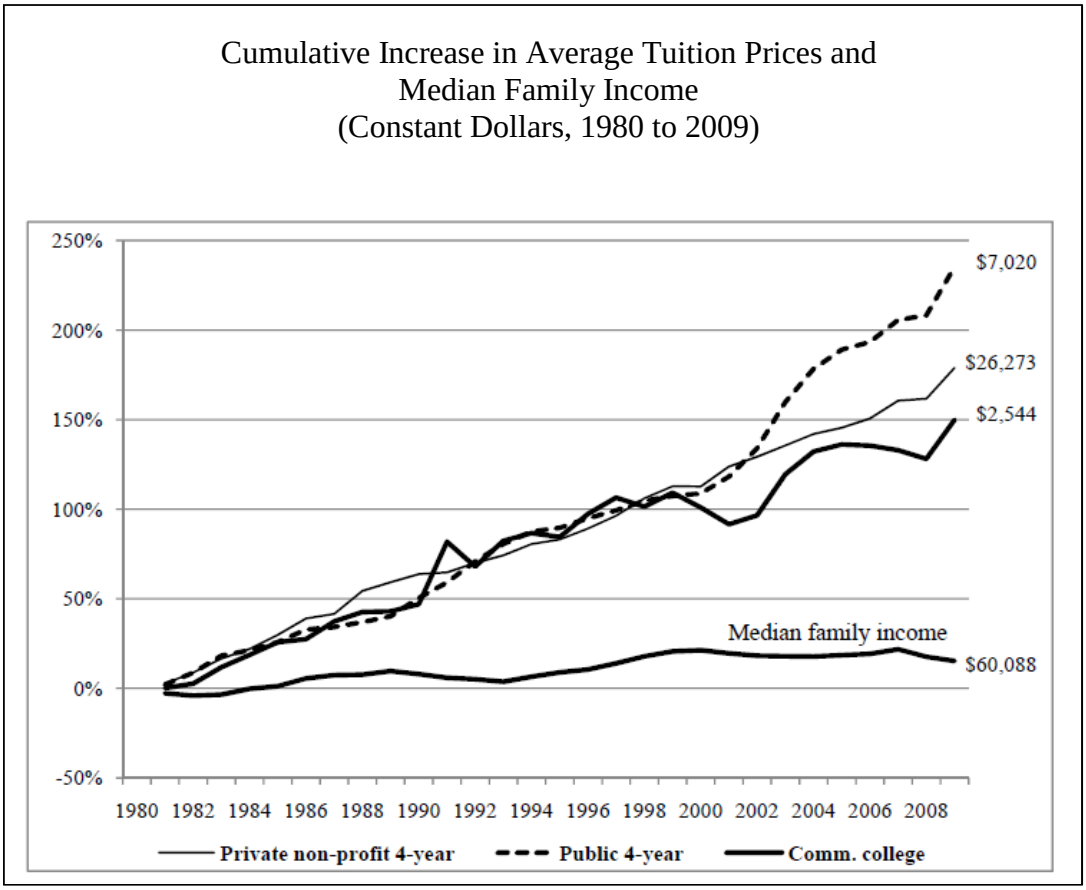

Figure 2.7. Cumulative increase in average tuition prices and median family income (constant dollars, 1980 to 2009. Created with data from The College Board (2009a) and The U.S. Census Bureau (2010).

In recent decades the cost of a college education continued to increase at twice the rate of general inflation (United State Department of Education, n.d.). This occurred in spite of the efforts of business professionals, scholars, and politicians who offered prescriptions to mitigate the increases (Ehrenberg, 2004; Ehrenberg, 2001). As tuition increased, federal and state financing of student funding diminished causing students to become more reliant on student loans (The College Board, 2006) and creating concern

about unmanageable debt burdens (Harrast, 2004; King & Bannon, 2002). Likewise, the federal government decreased block grant funding for higher education and emphasized programs that require repayment from the student. Because of this shift to a more student-responsible system and continuing increases in the cost of education, few students were able to pay for college without some form of financial aid. In the 2007-08 school year, over 65% of all four-year undergraduate students graduating with a bachelor's degree started their careers with education-related debt, and the average debt among graduating seniors was $23,186 (The College Board, 2008). New federal data show another alarming statistic. The percentage of all undergraduate students who received student loans increased from 5% in 2003-04 to 14% in 2007-08, a 9% increase in just four years (The College Board, 2008).

Borrowing became even more prevalent at the graduate degree level. The median additional debt is now $25,000 for a master's degree, $52,000 for a doctoral degree, and $79,836 for a professional degree. Twenty five percent of graduate and professional students borrow more than $42,898 for a master's degree, more than $75,712 for a doctoral degree, and more than $118,500 for a professional degree. At the 90th percentile, cumulative debt for graduate and professional degrees exceeds $59,869 for a master's degree, $123,650 for a doctoral degree, and $159,750 for a professional degree.

Summary

This chapter examined the literature related to college and university facility square footage. The chapter reported the search process and focused on four considerations: economic realities to facility square footage and associated risk, campus facility square footage measurement, the theoretical framework, and the research study

variables of enrollment, endowments, and tuition. The following chapter discusses in depth the methodology employed in this dissertation.

CHAPTER III

METHODOLOGY

The following pages explain the methodology for the study. The format is that of Creswell (2003). The chapter begins with the general design strategy, research problem statement, purpose statement, and hypothesis. The theoretical perspective for the study is given, followed by the methodology, including the context and access, description of the participants and survey instrument, data collection techniques, and data analysis procedures.

General Design Strategy

This quantitative study utilized campus facility inventory data to investigate the relationship between facility square footage (dependent variable) and the independent variables of student enrollment, endowments, and tuition. Based on the review of the literature, it was hypothesized that higher education administrators consider empirical data such as enrollment, endowments, and tuition in decisions regarding building and expanding campus facilities. Higher education administrators that act rationally in response to empirical data follow the principles of teleological theory. Because the hypotheses in the study state that there are positive correlations between university and college facility square footage and three independent variables—enrollment,

endowments, and tuition—the study was a correlational relationship study. The study was not intended to establish causality, but to explore the relationship between the variables (Gay, Mills, and Airasian, 2006).

Research Problem

American institutions of higher education expand their campus facilities by the renovation of existing outmoded facilities and the construction of new buildings, housing, and technology (Agron, 2004; Baker, 2009; Haughey, 2010). When institutional demand, driven by enrollment, exceeds facility capacity, colleges and universities react by increasing the size of, and updating, their campus facilities. Typically, higher education administrators feel pressure to expand campus facilities as increasing endowments provide resources and expectations from alumni and donors grow (Selingo & Brainard, 2006). Recent tuition increases, possibly based on facility expansion, also provide resources for facility expansion as student expectations grow to match their investments (Ehrenberg, 2001). A review of the literature, however, suggests that facilities may actually be expanded for reasons other than increases in enrollment, endowments, and tuition. Consequently, college and university administrators may need to utilize internal controls based on empirical research data, which include facility capacity inventories and supply and demand studies, to minimize the risks inherent in campus facility expansion.

Purpose Statement

The purpose for this non-experimental quantitative research study was to investigate the relationships between student enrollment, institution endowments, and tuition (independent variables) on measured campus facility square footage (dependent

variable), controlling for type of institution [research or not research, and private or public] (control variables).

Hypotheses

1. There is a positive correlation between university facility square footage and student enrollment.
2. There is a positive correlation between university facility square footage and university endowments.
3. There is a positive correlation between university facility square footage and student tuition.

Null Hypotheses

1. There is no relationship between university facility square footage and student enrollment.
2. There is no relationship between university facility square footage and university endowments.
3. There is no relationship between university facility square footage and student tuition.

Theoretical Framework

To provide insight into the rationale for campus square footage decisions being performed across the United States, teleological theory provided a lens through which to view the motivations of the administrators. Higher education administrators acting within the framework of teleological theory would only expand college or university campuses when required to meet the goals or achieve the missions of the institutions. In the teleological construct, administrators should expand campus facilities only when

relying on empirical data from research based on enrollment, endowments, and tuition. Teleological theory ignores or downplays the possibility that individuals within the organization might act from alternative motives conflicting with those of the organization.

Methods

Data were obtained from the Society of College and University Planning (SCUP). Starting in 2003, SCUP developed a survey to fill a significant gap in information relating to the total amount of square footage allocated to higher education in the United States. The data were gathered over a 5-year period resulting in a robust dataset of responding colleges and universities. The data were entered into spreadsheets and disseminated to participating institutions as peer groups for administrators' comparisons. Although the data were summarized and compared year-to-year, they were never analyzed or regressed among other variables. With permission of SCUP, the data from these surveys provided the basis for this study.

The study was a correlational relationship study designed to examine the strength and directionality of the hypothesized relationships between university campus facility square footage (dependent variable) and the independent variables of enrollment, endowments, and tuition. The nature of the relationship was determined through the use of ordinary least squares (OLS) regression.

Instrument, Campus Facilities Inventory (CFI).

The quantitative research study utilized existing datasets (Campus Facilities Inventory) obtained by surveys performed by the Society of College and University Planning (SCUP). Because it used existing data, the study can be classified as a

correlational study using a secondary dataset. Educational research utilizing secondary datasets have numerous methodological, theoretical, and pedagogical benefits (Smith, 2008). The literature documents the advantages and disadvantages of using secondary data suggesting that the data be treated with appropriate skepticism and respect for its limitations and assumptions regarding reliability and bias, as with other types of data (Doolan, 2009; Thomas & Heck, 2001).

The data were collected by survey. Accordingly, the study conducted by SCUP could be considered a survey design and the data obtained through random sampling by survey (Creswell, 2003; Patton, 2002). Ary, Jacobs, Razavieh & Sorensen (2009) describe information-gathering surveys of entire populations such as this study as a census. University administrators in charge of facility expansions on campuses at every college and university in the United States received the survey asking for a detailed campus facilities inventory, reporting square footage by room/building use. Because every administrator had the same opportunity to participate and it was left to chance as to which ones participated, randomness was preserved in the survey process. To motivate participation, administrators that participated and returned the inventory received access to the resulting inventory data and report.

A copy of the instrument used in the survey can be found in appendix B. This instrument used a web-interface and was e-mailed directly to the administrator tasked with campus expansions at the college or university. The instrument was designed expressly for the purpose of gathering inventory data from institutions in higher education.

The National Center for Education Statistics (NCES) Institute of Educational Sciences (IES) publishes the Postsecondary Education Facilities Inventory and Classification Manual (FICM). The manual was first published in 1973 and revised in 1994 and 2006. The FICM became the standard for collecting and reporting higher education facility data. Practitioners and scholars throughout the United States served as reviewers and testers of the processes over the years, refining the structure and layout. The 200 page manual gave copious details on inventory creation as well as detailed instructions on database design and report analysis (NCES, 2006). Aware of issues dealing with validity and reliability in the creation of the inventory survey of higher education institutions, SCUP used the FICM to gather the input from colleges and universities. The instrument itself asked the administrator to produce the campus facility inventory in accordance with FICM procedures.

Context and Access.

The study utilized datasets (Campus Facilities Inventory) obtained by surveying college and university administrators. The surveys were performed by SCUP. SCUP was established in 1965 to aid higher education leadership responsible for the integration of planning on university campuses and the professionals who support them. SCUP hoped to fill a significant gap in the body of knowledge by ascertaining the total amount of space utilized on college and university campuses in the United States. The data from the 5-years of surveys provided the basis for this dissertation.

Participants

College and university administrators that voluntarily participated in the survey disseminated by SCUP in the 5-year survey process are the participants in this dataset.

Although the survey was e-mailed to all colleges and universities in the United States, the sample was comprised of administrators that responded. Table 3.0 lists the total number of colleges and universities in the United States to which surveys were sent for the respective years.

Table 3.0

Number of Colleges and Universities (Source: HEGIS Survey and The National Center for Education Statistics)

Type	1974	2002 -03	2003-04	2004-05	2005-06	2006-07
Pub 4-Yr Institutions	552	631	634	639	640	643
Pvt 4-Yr Institutions	1,337	1538	1546	1525	1534	1533
Pub 2-Yr Institutions	901	1081	1086	1061	1053	1045
Pvt 2-Yr Institutions	248	127	118	112	113	107
Subtotals	3,038	3,377	3384	3337	3340	3328
Pvt, For-profit 4-Yr	NA	297	350	369	408	453
Pvt, For-profit 2-Yr	NA	494	502	510	528	533
Subtotals	NA	808	852	879	936	986
Totals	3,038	4,185	4,236	4,216	4,276	4,314

Data Collection

This study focused on the years 2003 to 2007, inclusive. Raw data from the 2003, 2004, 2005, 2006, and 2007 CFI surveys were obtained and permission was received to use and analyze the data for this study (see appendix C). While these data acted as the basis for the study, a set of Microsoft Excel spreadsheets were created to store data from other sources. Tuition for every responding institution was sourced for the 5-year period along with enrollment numbers and endowment amounts for the same timeframe. Demographic information was also obtained and reported in the survey, as shown in appendix B.

Data Analysis

Statistical analysis was conducted utilizing descriptive statistics and multiple regression methods using STATA. Both total campus square footage and core educational square footages were regressed on institution enrollment, institution endowment, undergraduate and graduate institution tuition, undergraduate and graduate fees, institutional control [private or public] (dummy), and whether or not the institution was designated as a research institution (dummy). The nature of the relationship was determined through the use of OLS regression (Gay, Mills, & Airasian, 2006; Pedhazur, 1997). A *t* test was used to determine statistically significant differences between the means of the variables. The number of respondents was analyzed and compared to those that did not return the survey. Response bias was considered, as were possible estimates of how non-respondents could have potentially changed the results had they responded to the survey (Creswell, 2003).

Carnegie Classification.

The Carnegie Classification of higher education institutions is a method of grouping comparable colleges and universities in the United States. This classification includes all accredited, degree-granting higher education institutions in the United States that are represented by the National Center for Education Statistics Integrated Postsecondary Education Data Systems (The Carnegie Foundation for the Advancement of Teaching, n.d.). The Carnegie classification was used to designate the responding institutions as research or not research. For the purposes of this study, respondents from the Doctoral/Research Institutions were classified as Research. All other respondents

were considered non-research. This Research/Non-research variable was used as a dummy variable in the regression.

Table 3.1

Carnegie Classifications

Carnegie Classification Categories
Doctoral/Research University
Master's College and Universities
Baccalaureate Colleges
Associate's Colleges
Specialized Institutions

Models.

An ordinary least square multiple regression model was used to determine the independent variables that impact campus facility square footage (Long, 1997). Two separate models were considered. The first square footage considered was total gross square feet of education core space and the second was total campus square footage.

Where:

Y_i is the total area of space reported by institution i per FTE,

$UgENR_i$ is the full time equivalent undergraduate enrollment reported by institution i,

$GrENR_i$ is the full time equivalent graduate enrollment reported by institution i ,

$UgTN_i$ is the undergraduate tuition for a student enrolled full time in institution i,

$GrTN_i$ is the graduate tuition for a student enrolled full time in institution i,

$UgFe_i$ is the fees for an undergraduate student enrolled full time in institution i,

$GrFe_i$ is the graduate fees for a student enrolled full time in institution i,

EDM_i is the endowment of institution i per FTE,

DP is a dummy variable equal to 1 if public, 0 otherwise,

DC is a dummy variable equal to 1 if Carnegie Classification Research, 0 otherwise, and

e_{ij} is the error term, the mathematic model below was considered:

$$Y_i = b_0 + b_1UgENR_i + b_2GrENR_i + b_3UgTN_i + b_4GrTN_i + b_5UgFe_i + b_6GrFe_i + b_7EDM_i + b_8DP + b_9DC + e_i.$$

Limitations

While being careful not to declare any causation, this study noted any correlational relationship between the variables. A significant *t* score for an independent variable in a regression did not prove causation. However, the absence of a significant score did demonstrate that factors other than enrollment, endowment, and tuition might impact facility square footage (Ary, Jacobs, Razavieh & Sorensen, 2009). Because the data was limited to a five-year period time series analysis was not utilized. Limitations of this study included the potential for unrecognized ambiguity in the research questions and uncorrected internal and external threats to validity; as with all (ex post facto) studies, selection bias and spurious correlation could be issues (Mohr, 1995). Omitted variable bias could also be a limitation (Pedhazur, 1997). If the response rate was low, there could be reason to suspect a significant amount of error which might not accurately reflect the population. Likewise, all administrators were not expected to answer all questions, which likely resulted in missing data. The data points for missing data were removed through the statistical software package.

Summary

The quantitative study analyzed college and university campus facility square footage data in relation to enrollment, endowments, and tuition at the universities. A positive relationship was hypothesized between the increase in higher education campus facility square footage and the variables. The existence of a relationship between the campus facility square footage and the variables could support the claim that administrators make decisions in accordance to principles seen in teleological theory. A *t* test was utilized to analyze the statistical significance between the means of the variables. Ordinary Least Squares Regression was employed to determine what factors or independent variables impact campus facility square footage. The results of the study utilizing the methodology described in this chapter are presented in Chapter Four.

CHAPTER IV

RESULTS

As stated in Chapter One, the study examined the relationships between college and university campus facility square footage and enrollments, endowments, and tuitions. Higher education construction enjoyed an increase in both the number of construction projects and the dollar amount per project (Agron, 2004; Baker, 2009; Haughey, 2010). The literature review in Chapter Two posited multiple rationales as to why this expansion may occur, with the simplistic and most obvious answer being increased demand as a result of increased enrollment. Other reasons, such as rising endowments and increases in tuition, were also proposed as possibilities (Ehrenberg, 2001; Selingo & Brainard, 2006). Theory provided options that may elucidate the topic of higher education facility square footage in relation to increases in enrollment, endowments, and tuition. Teleological theory takes a logical, rationale appraisal of empirical data and decision consequences into consideration and was cited as a possible explication. The positional arms race concept may be an example of a potential failure of the theory, conceivably causing a non-productive competition and possible pressure to expand

facility campuses (Ehrenberg, 2001; Frank, 2008; Frank, 1999; Frank & Cook, 1995; Hirsch, 1976; Sedlacek & Clark, 2003; Winston, 2000).

This non-experimental quantitative research study investigated the relationships between campus facility square footage of both core education space and total campus space (dependent variable) and student undergraduate and graduate enrollment, institutional endowments, undergraduate and graduate tuition, undergraduate and graduate fees (independent variables), controlling for type of institution [research or not research, and private or public] (control variables).

In this chapter, a brief description of the participants is provided as well as the results of the statistical analyses. The results are organized in terms of the three research hypotheses and null hypotheses for both core educational space and total educational space.

Hypotheses

1. There is a positive correlation between university facility square footage and student enrollment.
2. There is a positive correlation between university facility square footage and university endowments.
3. There is a positive correlation between university facility square footage and student tuition.

Null Hypotheses

1. There is no relationship between university facility square footage and student enrollment.

2. There is no relationship between university facility square footage and university endowments.
3. There is no relationship between university facility square footage and student tuition.

Description of Participants

As stated in the previous chapter, college and university administrators who voluntarily participated in the survey disseminated by SCUP in the five-year survey process are the participants in this dataset. Although the survey was e-mailed to all colleges and universities in the United States, the sample is comprised of all administrators that responded. Table 4.0 lists the demographics of the 360 college and universities that responded. Of 360 respondents, 35.28% were research universities and 64.72% were non-research colleges or universities. Public colleges and universities comprised 79.17% and private 20.83%. Of the respondents, 82.22% were four-year universities and 17.78% were two-year institutions. Table 4.1 lists the descriptive statistics for the institutions.

Table 4.0

Colleges and Universities Response Demographics

Research or Non-Research		Institutional Control		4-Year or 2-Year School	
Research	Non-Research	Private	Public	4-Year	2-Year
127	233	75	285	296	64

Table 4.1

Descriptive Statistics

Characteristic	Mean	Std. Dev.
Undergraduate Tuition	$7,681.23	$8,704.46
Undergraduate Fees (Annual)	$787.45	$930.73
Undergraduate Enrollment	9,112.11	8,040.18
Graduate Tuition (Annual)	$7,637.70	$7,010.97
Graduate Fees	$2,138.00	$1,109.00
Undergraduate & Graduate Enrollment	10,091.05	9,773.53
Institutional Endowment per FTE	$42.58	$140.76
Institutional Total Gross SF per FTE	201.22	824.12
Institutional Core Education Gross SF	113.75	207.78

Model Specification

This section describes the methodology for choosing the specific models that were regressed. As indicated in Tables 4.2 and 4.3, six different models were considered. Two regressions were run for each model. The equations and variables remained the same, with the exception of the dependent variable. The first regression in each model utilized educational core square footage as the dependent variable and the second regression used total campus square footage as the dependent variable. This distinction was reflected in the columns within Table 4.2 and Table 4.3, respectively. In the description of each new model the new model was compared to the previous model. Models were designed with the results and diagnostics of the regressions to track goodness of fit.

Table 4.2. Core Education Square Footage Regression Summary Table for all Six Models.

Variable	Units	Core Education Square Footage Models					
		1	2	3	4	5	6
Intercept		-67.43 -1.41*	439.93 6.60***	422.59 6.55***	42.07 1.18	202.19 3.582***	5.45 0.17
UG Enrollment	UG FTE	-.0053 -4.39***	N/A	N/A	-.0055 -5.40***	N/A	N/A
Grad Enrollment	Grad FTE	.0172 4.21***	N/A	N/A	.0248 6.381***	N/A	N/A
Ln(UG Enroll)	Nat log of UG Enrollment	N/A	-92.73 -11.80***	-94.36 -12.08***	N/A	N/A	N/A
Ln(Gr Enroll)	Nat log of Gr Enrollment	N/A	36.67 8.07***	37.40 8.27***	N/A	N/A	N/A
Total Enroll	UG &Grad	N/A	N/A	N/A	N/A	N/A	-.0006 -0.860
Ln(total enroll)	Nat Log of UG & Grad Enrollment	N/A	N/A	N/A	N/A	-26.65 -4.25***	N/A
UG Tuition	$ per FTE per yr	.0039 1.51*	.0044 2.04**	N/A	N/A	N/A	N/A
Gr Tuition	$ per FTE per yr	.0025 1.33	.0016 1.04	N/A	N/A	N/A	N/A
UG Fees	$ per FTE per yr	-.0193 -1.52*	-.0181 -1.56*	N/A	N/A	N/A	N/A
Gr Fees	$ per FTE per yr	.0250 1.85**	.0160 1.30	N/A	N/A	N/A	N/A
Weighted Avg UG & Gr Tuition	$ per FTE per yr	N/A	N/A	.0070 4.12***	.0008 0.51	N/A	N/A
Weighted Avg UG & Gr Fees	$ per FTE per yr	N/A	N/A	-.0046 -0.87	.0116 2.09**	N/A	N/A

Variable	Units	Core Education Square Footage Models					
		1	2	3	4	5	6
Weighted Avg All Tuition & Fees	$ per FTE per yr	N/A	N/A	N/A	N/A	.0031776 2.31**	.0028 2.04**
Endowment	$ per FTE	.0223 0.52	.1797 4.45***	.1823 4.64***	.2733 7.04***	.2981885 7.75***	.3050 7.88***
Carnegie	1 if Research; 0 if other	-1.230 -0.083	38.61 2.77**	38.55 2.79**	2.61 0.17	59.97 4.30***	30.51 2.12**
Support/Control	1 if Public; 0 if Private	170.24 3.99***	227.49 5.89***	251.85 7.19***	65.17 2.04**	104.63 3.65***	82.93 2.89**

Note: Estimated regression value *, **, and *** indicating statistically significant difference from zero at the 10, 5, and 1 percent level of significance.

Table 4.3. Total Campus Square Footage Regression Summary Table for all Six Models.

Variable	Units	Total Campus Square Footage Models					
		1	2	3	4	5	6
Intercept		-208.91 -2.17**	718.17 5.23***	707.86 5.32***	-50.36 -0.34	114.37 0.50	-54.51 -0.41
UG Enrollment	UG FTE	-.0103 -4.25***	N/A	N/A	-.0037 -0.87	N/A	N/A
Grad Enrollment	Grad FTE	.0347 4.29***	N/A	N/A	.0228 1.43*	N/A	N/A
Ln(UG Enroll)	Nat log of UG Enrollment	N/A	-167.09 -10.31***	-168.37 -10.45***	N/A	N/A	N/A
Ln(Gr Enroll)	Nat log of Gr Enrollment	N/A	66.31 7.08***	67.03 7.19***	N/A	N/A	N/A
Total Enroll	UG & Grad Enrollment	N/A	N/A	N/A	N/A	N/A	.0006 0.22

Variable	Units	Total Campus Square Footage Models					
		1	2	3	4	5	6
Ln(total enroll)	Nat Log of UG & Grad Enrollment	N/A	N/A	N/A	N/A	-22.95 -0.90	N/A
UG Tuition	$ per FTE per yr	.0121 2.32**	.0133 2.96***	N/A	N/A	N /A	N/A
Gr Tuition	$ per FTE per yr	-.0004 -0.10	-.0007 -0.22	N/A	N/A	N/A	N/A
UG Fees	$ per FTE per yr	-.0464 -1.84**	-.0191 -0.81	N/A	N/A	N/A	N/A
Gr Fees	$ per FTE per yr	.0664 2.47**	.0147 0.58	N/A	N/A	N/A	N/A
Weighted Avg UG & Gr Tuition	$ per FTE per yr	N/A	N/A	.0143 4.09***	.0079 1.25	N/A	N/A
Weighted Avg UG & Gr Fees	$ per FTE per yr	N/A	N/A	-.0076 -0.69	.0143 0.62	N/A	N/A
Weighted Avg All Tuition & Fees	$ per FTE per yr	N/A	N/A	N/A	N/A	.0088 1.571*	.0085 1.51*
Endowment	$ per FTE	.3335 3.855***	.3164 3.80***	.2970 3.66***	.3986 2.45**	.4230 2.69**	.4334 2.75**
Carnegie (Research)	1 if Research; 0 if other	-48.36 -1.544	47.52 1.65*	44.45 1.56*	-41.01 -0.66	26.82 0.47	-13.80 -0.24
Support/Control (Private or Public)	1 if Public; 0 if Private	394.02 4.602***	468.92 5.89***	480.23 6.65***	214.16 1.623*	231.05 1.971*	203.66 1.75*

Note: Estimated regression value *, **, and *** indicating statistically significant difference from zero at the 10, 5, and 1 percent level of significance.

Model 1 – The Base Model and Equation.

The first model created was considered the base model and utilized all the variables without any weight or logging present. Table 4.2 and 4.3 show the results of the regressions for both educational core square footage and total campus square footage using the following equation:

$$Y_i = b_0 + b_1UgENR_i + b_2GrENR_i + b_3UgTN_i + b_4GrTN_i + b_5UgFe_i + b_6GrFe_i + b_7EDM_i + b_8DP + b_9DC + e_i.$$

The variables utilized in the equation for model one are defined below.

$UgENR_i$ – This variable is undergraduate enrollment and is measured in full-time equivalent undergraduate students per year.

$GrENR_i$ – This variable is graduate enrollment and is measured in full-time equivalent graduate students per year.

$UgTN_i$ – This variable is undergraduate tuition and is measured in dollars per year.

$GrTN_i$ – This variable is graduate tuition and is measured in dollars per year.

$UgFe_i$ – This variable is undergraduate student fees measured in dollars per year.

$GrFe_i$ – This variable is graduate student fees measured in dollars per year.

EDM_i – This variable is university endowment per FTE and is measured in dollars.

DP – This variable is whether the university is private or public (institutional control).

DC – This variable is whether the university is considered a research university according to Carnegie classification.

Model 2 – Adding the Natural Log to Enrollment.

The second model considered was the same as the first model, with the exception that a new variable was added, the natural log of both undergraduate and graduate

enrollment. Adding the natural log of the enrollment variable was made in an attempt to make the enrollment variable linear. Tables 4.2 and 4.3 show the results of the regression for the following equation:

$Y_i = b_0 + b_1Ln(UgENR_i) + b_2Ln(GrENR_i) + b_3UgTN_i + b_4GrTN_i + b_5UgFe_i + b_6GrFe_i + b_7EDM_i + b_8DP + b_9DC + e_i.$

The variables utilized in the equation were:

$Ln(UgENR_i)$ – This variable is the natural log of undergraduate enrollment and is measured in full-time equivalent undergraduate students per year.

$Ln(GrENR_i)$ – This variable is the natural log of graduate enrollment and is measured in full-time equivalent graduate students per year.

Model 3 – Adding a Weighted Average for Tuition and Fees.

This model was similar to model two except for the replacement of a weighted average for tuition and fees. The weighting on the tuition and fees variables was accomplished to capture the influence of both undergraduate and graduate tuition and fees, but deal with the issue of mulitcollinearity. This gave one variable for each instead of two. The weight was applied with the following mathematical equation:

Weighted average tuition = {[UG FTE / (Grad FTE + UG FTE)] * UG tuition} + {[Grad FTE / (Grad FTE + UG FTE)] * Grad tuition)}.

Tables 4.2 and 4.3 show the results of the regression for the following equation:

$Y_i = b_0 + b_1Ln(UgENR_i) + b_2Ln(GrENR_i) + b_3Wt(UgGrTN_i) + b_4Wt(UgGrFe_i) + B_5EDM_i + b_6DP + b_7DC + e_i.$

The variables utilized in the equation were:

$Wt(UgGrTN_i)$ – This variable is the weighted average of undergraduate tuition and graduate tuition and is measured in dollars per year.

$Wt(UgGrFe_i)$ – This variable is the weighted average of undergraduate fees and graduate fees and is measured in dollars per year.

Model 4 – Removing the Natural Log of Enrollments.

This model was similar to model three except the natural log of enrollment was removed and undergraduate and graduate enrollments were inserted. All the variables used in this model were previously defined in this chapter. Tables 4.2 and 4.3 show the results of the regression for the following equation:

$$Y_i = b_0 + b_1UgENR_i + b_2GrENR_i + b_3Wt(UgGrTN_i) + b_4Wt(UgFe_i) + B_5EDM_i + b_6DP + b_7DC + e_i.$$

Model 5 – Adding the Enrollments Together and Using the Natural Log of Total.

Model five was similar to model four except the undergraduate and graduate enrollments were added together and the natural log of total enrollments was substituted for both undergraduate and graduate enrollments. Another change in this model was the weighted average of undergraduate tuition, graduate tuition, undergraduate fees and graduate fees single variable. Tables 4.2 and 4.3 show the results of the regression for the following equation:

$$Y_i = b_0 + b_1Ln(Ug\&GrENR_i) + b_2Wt(Ug\&GrTN_i \ \& \ Ug\&GrFe_i) + B_3EDM_i + B_4D_i + b_5DP + b_6DC + e_i.$$

The new variables utilized in the equation for model five were:

$Ln(Ug\&GrENR_i)$ – This variable is natural log of undergraduate and graduate enrollment and is measured in full-time equivalent undergraduate students per year.

$Wt(Ug\&GrTN_i$ & $Ug\&GrFe_i)$– This variable is the weighted average of undergraduate tuition, graduate tuition, undergraduate fees and graduate fees measured in dollars per year.

Model 6 – Removing the Log of Enrollments and Using the Total Enrollment.

This model was similar to model five except the natural log of enrollment variable was removed and the undergraduate and graduate enrollments were added together and used. Tables 4.2 and 4.3 show the results of the regression for the following equation:

$$Y_i = b_0 + b_1 Ug\&GrENR_i + b_2 Wt(Ug\&GrTN_i \& Ug\&GrFe_i) + B_3 EDM_i + b_4 DP + b_5 DC + e_i.$$

The only new variable utilized in the equation for model six was the variable of total enrollment, which was undergraduate and graduate enrollments added together as defined:

$Ug\&GrENR_i$ – This variable is the undergraduate and graduate enrollment added together to give total enrollment measured in full-time equivalent undergraduate students per year.

Diagnostics

Diagnostic tests validated the data and results in the study. Attention was given not only to the reliability of the data but also to fit for the models. Added to the quest to find the model with the best fit was a search for a tool to evaluate the sensitivity of each model to the variables. A spreadsheet was created to enable square footage prediction using each model. The prediction model was effective evaluating the sensitivity of each model to the variables used. The following diagnostic tests were performed with STATA statistics software on all six models and Tables 4.4 through 4.9 display the individual model results. Heteroscedasticity was checked with the Cook-Weisberg test.

Multicollinearity was checked with the variance inflation factor (vif) command in STATA. Model specification was checked with the use of the ovtest command performing the Ramsey regression specification error test (RESET) for omitted variables. Finally, scatterplots were generated to analyze the relationships between the variables specifically looking for outliers.

Heteroscedasticity.

The ordinary least squares (OLS) statistical technique used in the analysis of the data in this study assumes that the error term has a constant variance. If heteroscedasticity is present in the data analyzed, OLS regression can bias the estimate of variance and standard error of the coefficients, above or below the true population variance (Pedhazur, 1997). One cause of heteroscedasticity can be a large difference among the sizes in observations. Because of the nature of the study, a large difference among the sizes in observations is present in the dataset. To test for heteroscedasticity, the Cook-Weisberg test for heteroscedasticity using fitted values was accomplished in STATA. By running this diagnostic test the data were found to contain heteroscedasticity. Two common corrections for heteroscedasticity are to use logged data and apply weighted least squares. As evident in the regressions and variables created, both techniques were used to try to find goodness of fit. Using these techniques did not entirely eliminate heteroscedasticity, however, they did reduce the Chi^2 to a manageable number in several models as indicated in Tables 4.4 through 4.9.

Multicollinearity.

Collinearity diagnostics speak to the potential adverse effects of correlated independent variables on the estimation of regression statistics (Pedhazur, 1997). The

concern is that as the degree of multicollinearity increases, the regression model estimates of the coefficients become unstable and the standard errors for the coefficients may become inflated. In STATA the variance inflation factor (vif) command is used to test for multicollinearity. The results of the vif test are shown in Tables 4.4 through 4.9 for all variables in all models. As a rule of thumb, a variable whose VIF value is greater than 10 may merit further investigation. In this test the undergraduate tuition variable was over 10 on models one and two and warranted further investigation. This multicollinearity arises because undergraduate and graduate tuition and fees measure a very similar indicator in several models. To make sure this high degree of collinearity, which could cause the standard error to be inflated, did not change the significance of any variables, other models were developed and explored. As expected, the techniques used (including adding variables together, taking the natural log of variables, and adding weighted variables) corrected the inflated vif and brought the indicator within tolerance.

Model Specification Error.

Model specification error can occur when one or more relevant variables are omitted from the model or one or more irrelevant variables are included in the model. These model specification errors may substantially affect the estimate of regression coefficients. As shown in Tables 4.4 through 4.9, the ovtest command in STATA confirmed that none of the models in the study omitted variables, so there was no evidence of mis-specification in the models.

Table 4.4

Model 1 (Diagnostics for Model 1)

	Total SF		Core SF	
R^2	0.0763		0.0499	
hettest (Chi^2)	1237.67		519.14	
ovtest	No Omitted Variables		No Omitted Variables	
Variable	VIF	1/VIF	VIF	1/VIF
UGTuition	17.14	0.058343	17.09	0.058505
Pri or Pub	9.59	0.104316	9.5	0.105262
Gr Tuition	5.86	0.170608	5.92	0.168844
Gr Fees	5.14	0.194424	5.20	0.192487
UG Fees	5.07	0.197397	5.13	0.195071
UG Enrl	3.21	0.311147	3.18	0.314933
Gr Enrl	2.74	0.364895	2.71	0.368364
Research	1.91	0.538117	1.92	0.521774
Endowment	1.33	0.750907	1.33	0.751659
Mean VIF	5.78		5.77	

Table 4.5

Model 2 (Diagnostics for Model 2)

	Total SF		Core SF	
R^2	0.1238		0.1619	
hettest (Chi^2)	3882.30		2656.45	
ovtest	No Omitted Variables		No Omitted Variables	
Variable	VIF	1/VIF	VIF	1/VIF
UGTuition	14.50	0.068987	14.50	0.068987
Pri or Pub	9.21	0.108537	9.21	0.108537
Gr Fees	5.23	0.191326	5.23	0.191326
UG Fees	5.05	0.197845	5.05	0.197845
Gr Tuition	4.61	0.217037	4.61	0.217037
Ln UG Enrl	2.47	0.405113	2.47	0.405113
Ln Gr Enrl	2.19	0.457561	2.19	0.457561
Research	1.90	0.526397	1.90	0.526397
Endowment	1.31	0.760517	1.31	0.760517
Mean VIF	5.16		5.16	

Table 4.6

Model 3 (Diagnostics for Model 3)

	Total SF		Core SF	
R^2	0.1265		0.1642	
hettest (Chi^2)	3824.41		2682.10	
ovtest	No Omitted Variables		No Omitted Variables	
Variable	VIF	1/VIF	VIF	1/VIF
Weighted Tuition	7.90	0.126605	7.90	0.126605
Pri or Pub	7.61	0.131321	7.61	0.131321
Ln UG Enrl	2.45	0.407800	2.45	0.407800
Ln Gr Enrl	2.18	0.459564	2.18	0.459564
Research	1.88	0.533304	1.88	0.533304
Endowment	1.25	0.798182	1.25	0.798182
Weighted Fees	1.08	0.928623	1.08	0.928623
Mean VIF	3.48		3.48	

Table 4.7

Model 4 (Diagnostics for Model 4)

	Total SF		Core SF	
R^2	0.0096		0.0837	
hettest (Chi^2)	85.19		1174.44	
ovtest	No Omitted Variables		No Omitted Variables	
Variable	VIF	1/VIF	VIF	1/VIF
Weighted Tuition	6.88	0.145322	6.69	0.149419
Pri or Pub	6.44	0.155377	6.36	0.157190
Grad Enrl	2.97	0.336208	2.68	0.372836
UG Enrl	2.85	0.351399	2.77	0.360581
Research	2.17	0.460466	2.13	0.469484
Endowment	1.25	0.798263	1.29	0.773011
Weighted Fees	1.10	0.912000	1.08	0.928425
Mean VIF	3.38		3.48	

Table 4.8

Model 5 (Diagnostics for Model 5)

	Total SF		Core SF	
R^2	0.0087		0.0658	
hettest (Chi^2)	35.12		1,109.03	
ovtest	No Omitted Variables		No Omitted Variables	
Variable	VIF	1/VIF	VIF	1/VIF
Tuition & Fees	5.45	0.183483	5.45	0.183483
Pri or Pub	5.17	0.193531	5.17	0.193531
Ln Enrl	1.92	0.519567	1.92	0.519567
Research	1.87	0.534825	1.87	0.534825
Endowment	1.21	0.824816	1.21	0.824816
Mean VIF	3.12		3.12	

Table 4.9

Model 6 (Diagnostics for Model 6)

	Total SF		Core SF	
R^2	0.0083		0.0561	
hettest (Chi^2)	0.27		708.66	
ovtest	No Omitted Variables		No Omitted Variables	
Variable	VIF	1/VIF	VIF	1/VIF
Tuition & Fees	5.43	0.184117	5.43	0.184117
Pri or Pub	5.11	0.195881	5.11	0.195881
Total Enrollment	2.00	0.500732	2.00	0.500732
Research	1.96	0.509713	1.96	0.509713
Endowment	1.21	0.823105	1.21	0.823105
Mean VIF	3.14		3.14	

Scatterplots.

Two separate types of scatterplots were developed for each model dataset. The first, the residual-verse-fitted plots provided a one-graph plot overview of the regression residuals. Any obvious pattern in this plot might indicate a problem. No apparent pattern was noted from any of the models. The second sets of plots on the dataset were the leverage-verses-squared-residuals plot graphs. As the name implies, a leverage-versus-squared-residuals plot graphs leverage against the residuals squared. Leverage indicates how much potential an observation has to influence the regression, based on its specific combination of x values; extreme x values or unusual combinations give observations high leverage. Large squared residuals indicate observations with *y* values much different than those predicated by the regression model (Hamilton, 1998). The leverage-verses-squared-residuals plots did not indicate any obvious issues.

The Model as a Predictor

The mean values of each regressed variable and the corresponding coefficient value were entered into an Excel spreadsheet. Equations were then generated to compute the predicted value using the following equation: $y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots \beta_3 X_3$, where β_0 is the intercept, β_1,β_2, & β□ are the variables, and X_1,X_2, & X_3 are means of those variables. Table 4.10 shows the resulting square footage predictor for each model.

Table 4.10

Results of Core Education and Total Campus Facility Predicators (SqFt/FTE)

	Regression Model					
Facility Square Footage Predictor	1	2	3	4	5	6
Core Education (SqFt/FTE)	158.38	232.79	213.95	110.69	169.40	147.31
Total Campus (SqFt/FTE)	286.38	377.52	357.01	198.91	255.89	225.11

This predictor model was used to develop "what if" scenarios with the variables to further confirm the validity of the models. For example, based on the mean values reported in the study, and based on model 4, the predicted value at the means for core educational square footage was 110.69 square feet per FTE. That means that the model predicted that an institution with average levels of each variable (enrollment, endowment, and tuition) could be expected to have 110.69 square feet of space per student. If the same observations were used per model, relatively consistent results would be expected across models. Although there were obvious variations reported in Table 4.10 based on the specifics of each model, the values were not outside of the expected variance confirming, with reasonable certainty, that the models did not contain data entry-type

errors. The predictor model is also used in Chapter Five to draw conclusions pertaining to the variable sensitivity of the models.

Summary

Six separate models were developed to consider the relationship between enrollment, endowments, and tuition to college and university facility square footage. Two regressions were performed for each model. The first regression utilized core educational square footage and the second regression in each model used the square footage of the entire campus. The models were developed in a process of improving goodness of fit. To capture the influence of both undergraduate and graduate tuition and fees, a mathematical formula was used to weight these variables to deal with multicollinearity. The natural log of the enrollment variable was added in order to obtain a better fit. Results of statistical significance were recorded in Tables 4.2 and 4.3. The institutional support variable indicated whether a college or university was private or public. This variable showed positive, statistical significance across all six models for total campus square footage, as well as for core educational square footage. The enrollment variable showed inconsistent results depending upon which model was regressed. Tuition and fees showed significant consistency across models, especially once the weighting technique was employed. Endowment proved to be another variable with consistency across all six models. The Carnegie variable, indicating whether or not an institution was a research university, did not show significant consistency across models.

Results of regression diagnostics were also presented in this chapter in Tables 4.4 through 4.9. Tests for heteroscedasticity were accomplished using the Cook-Weisbert

test. Tests for multicollinearity were accomplished using the variance inflations factor command in STATA. Model specification was checked with the use of the ovtest command performing the Ramsey regression specification error test (RESET) for omitted variables. Finally, scatterplots were generated to analyze the relationships between the variables, specifically looking for outliers. The conclusions drawn from the results in this chapter are presented in Chapter Five.

CHAPTER V

CONCLUSIONS

The final chapter restates the research problem and summarizes the research methods utilized in the study. Results are interpreted and implications for theory, research, and practice are discussed. The chapter concludes with recommendations for additional research.

Problem Statement

When American higher educational institutions expand their campus facilities they do so mainly through two avenues. One is the renovation of existing outmoded facilities. The second is construction of new buildings, housing, and technologies (Agron, 2004; Baker, 2009; Haughey, 2010). As enrollments increase, student populations may exceed facility capacity. Consequently, increasing the size of and updating campus facilities may logically result from increased enrollments. However, other factors may exist. Due to pressure on administrators to maintain endowment spending ratios, facilities square footage may increase without consideration of enrollment numbers (Selingo & Brainard, 2006). In addition, increasing tuition may result in greater student expectations. Students demanding accessible and modern

facilities may also affect square footage at university and college campuses. The literature details the significant liability that increased square footage can become after construction. Therefore, the need to utilize internal controls based on empirical research data, to minimize the risks of overbuilding campus facilities, becomes more obvious. These internal controls may include facility capacity inventories and supply and demand studies.

Purpose Statement

The purpose for this quantitative research study was to investigate potential correlations between the independent variables of student enrollment, institutional endowments, and tuition and the dependent variable of university and college campus facility square footage, controlling for Carnegie Classification [research or not research], and private or public (control variables).

Review of Methodology

The study was a correlational relationship study designed to examine the strength and directionality of the hypothesized relationships between university campus facility square footage (dependent variable), obtained from the Society of College and University Planning (SCUP), and the independent variables of student enrollment, endowments, and tuition. The nature of the relationships was determined through the use of ordinary least squares (OLS) regression. Using STATA, statistical analysis was conducted on the data utilizing descriptive statistics and multiple regression methods. Square footage results in both core educational space and total campus space were regressed on undergraduate and graduate enrollment, endowment, undergraduate and graduate tuition, undergraduate and graduate fees, institutional control [private or public] (dummy), and Carnegie

classification (dummy), as shown in Tables 4.2 and 4.3. A *t*-test was used to determine a statistically significant difference between the means of the variables.

The developed models utilized a regression equation to analyze the relationship between college and university square footage, where:

Y_i is the total area of space reported by institution i per FTE,

$UgENR_i$ is the full time equivalent undergraduate enrollment reported by institution i,

$GrENR_i$ is the full time equivalent graduate enrollment reported by institution i,

$UgTN_i$ is the undergraduate tuition for a student enrolled full time in institution i,

$GrTN_i$ is the graduate tuition for a student enrolled full time in institution i,

$UgFe_i$ is the fees for an undergraduate student enrolled full time in institution i,

$GrFe_i$ is the graduate fees for a student enrolled full time in institution i,

EDM_i is the endowment of institution i,

DP is a dummy variable equal to 1 if public, 0 otherwise,

DC is a dummy variable equal to 1 if Carnegie Classification Research, 0 otherwise,

e_i is the error term, then:

$$Y_i = b_0 + b_1UgENR_i + b_2GrENR_i + b_3UgTN_i + b_4GrTN_i + b_5UgFe_i + b_6GrFe_i + b_7EDM_i + b_8DP + b_9DC + e_i.$$

Summary of Results

As expected, the different models employed in this study provided differing results in statistical significance of the variables. The institutional support variable, indicating whether a college or university was private or public, showed positive, statistical significance across all six models. The enrollment variable showed inconsistent results depending upon which model was regressed. Tuition and fees

showed significant consistency across models, especially once the weighting technique was employed. Endowment proved to be another variable with consistency across all six models. The Carnegie variable, indicating whether or not an institution was a research university, did not show significant consistency across models.

Interpretation of the Results

Enrollment.

Enrollment proved to be an interesting variable. Enrollment showed inconsistent results depending upon which model was used, but tended to be negative when statistically significant. The base model, model one, shown in Table 4.2 and 4.3, produced significant results for both undergraduate and graduate enrollments. The undergraduate enrollment variable was negative and the graduate enrollment variable was positive. The variable also produced inflated VIF scores indicating issues with multicollinearity. This was not unexpected, and to correct the issue the natural logs were taken of undergraduate and graduate enrollment and the regressions were run. Eventually undergraduate and graduate enrollments were added together and the log of total enrollments was used. According to the diagnostic tests, adding the variables and taking the natural log produced the most reliable variable reducing the VIF from 17.4 to 1.92. The results of adding the undergraduate and graduate enrollments together and using the natural log of the total enrollment was negative when significant. This regression result is confirmed in the predictor model indicating that square footage, while increasing with enrollment, does not do so at the same rate. As shown in figure 5.0, at enrollment levels of 5,046 students there are 150.34 square feet per student. At 20,182 students enrolled each student has 141.26 square feet which is a total increase over previous square

footage. Although the ratio is lower per student, the total square footage is increased significantly. This is not too surprising, since total square footage includes athletic facilities, wellness centers, and other square footage that appear to be less dependent upon how many students are actually on campus. This was more surprising in the core educational square footage, which includes classrooms and laboratories. Logically, student enrollment increases more quickly than campus facility square footage increased. To a point, administrators have the ability to hold more sections of classes and add more students to existing classrooms in lieu of adding additional space. In this context, the enrollment variable tended to support the arm race research (Ehrenberg, 2001; Frank, 2008; Frank & Cook, 1995; Hirsch, 1976; Sedlacek & Clark, 2003; Winston, 2000), indicating that some campus expansion was due to competitive pressure and not necessary to accommodate growing enrollments.

The lack of consistent statistical significance in enrollment as a variable in the regression equation was also supported with the predictor model described in the Chapter Four. To analyze the sensitivity of the variables, the mean total enrollment variable of 10,091 students was changed by 50%, 75%, 150%, and 200% of the mean. As figure 5.0 represents, campus square footage tended to decrease in the predictor as the enrollment variable was increased. This result indicated that campus square footage was not too sensitive to increases in enrollment and was negative based on the models in this study.

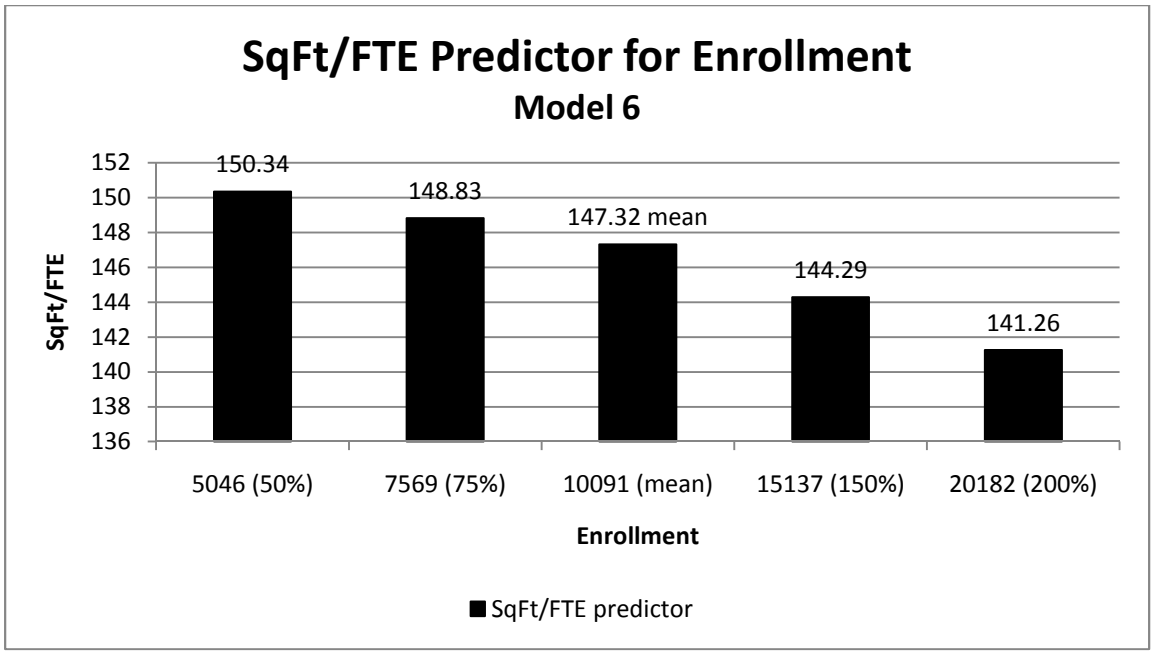

Figure 5.0. SqFt/FTE Predictor for Enrollment for Model 6.

Endowments.

The fact that the estimated coefficient for endowments is statistically significantly different from zero supports much of the literature in Chapter Two. Conti-Brown (2011) analyzed higher education institution endowments and documented a cultural theory that the university President's legacy is a strong consideration to how endowment proceeds are invested and spent. The correlation between endowments and campus square footage gives support for the edifice complex concept, indicating that donors might prefer to donate money for buildings with naming rights (Bassett, 1983; King, 2005). Administrators understand that naming rights to buildings allow donors to leave lasting legacies. Also documented in the literature review was the pressure administrators feel to spend the endowment proceeds to achieve a beneficial endowment-to-expense ratio. The conjecture that administrators spend endowment proceeds on campus facility expansion projects to fall strategically into a beneficial endowment-to-expense ratio was consistent

with the findings in this study. Each of the considerations addressed in this paragraph are developed more fully in the implication sections of this chapter.

The fact that endowments were significant and highly correlated to the square footage of American college and university as a variable in the regression equation was also supported with the predictor model. Figure 5.1 graphically illustrates the sensitivity of square footage as endowments per student were reduced by 50%, dropping the square footage per student to 140.82 from the mean of 147.32 and to 160.31 square feet per student when the endowment was doubled. This result indicated that campus square footage was sensitive to increases in endowments, supporting the results of the regression analysis for the variable of endowments.

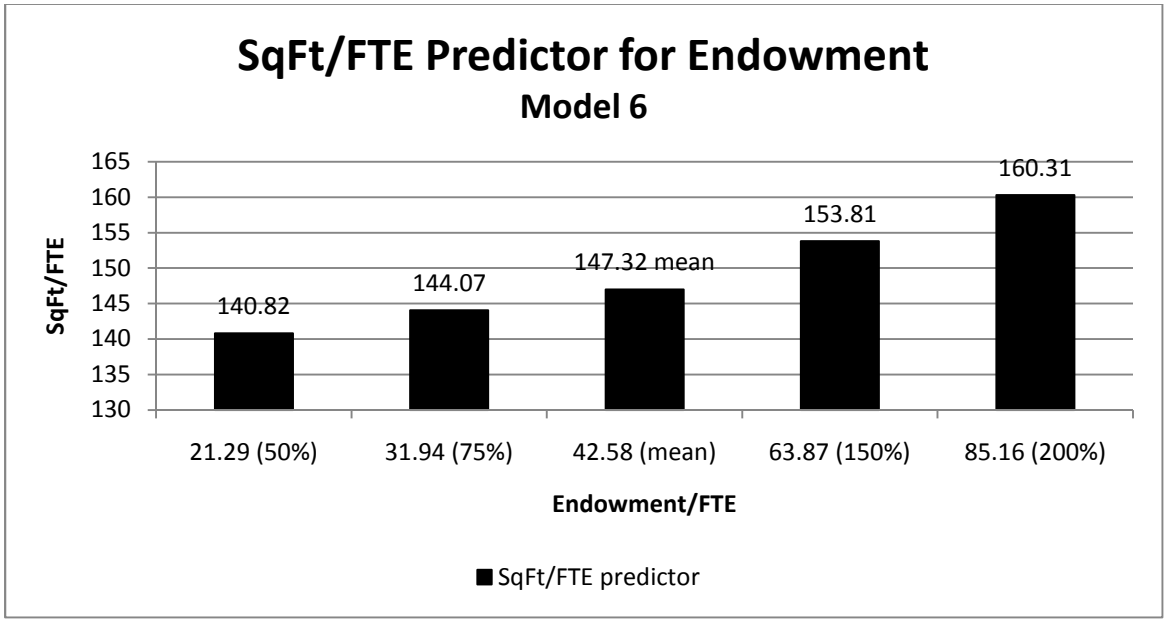

Figure 5.1. SqFt/FTE Predictor for Endowment for Model 6.

Tuition.

Like enrollment, tuition provided opportunities to improve goodness of fit in alternative models. In the base model tuitions appeared to have a strong correlation to square footage. However, testing for heteroscedasticity suggested that applying weighted

averages to the variables might capture the influence of the variables while dealing with reliability issues. Adding both undergraduate and graduate fees to undergraduate and graduate tuition, and appropriately weighting the variables, appeared to be the best-fit model. Results in Table 4.2 and 4.3 showed that models five and six, where weighted average techniques were applied, produced statistically significant *t* scores in both total campus square footage and core educational square footage.

Based on these results it is reasonable to conclude that higher tuition and fees at the sample institutions provided more square footage in both categories. Not evident in the results of this research study, however, is whether increased tuitions are a result of changes in campus square footage or the cause of changes in campus square footage. The cost of a college degree is increasing at twice the rate of general inflation (United States Department of Education, n.d.). As these costs increase there has been a significant decrease in federal and state funding and more reliance on the student to fund the education with student loans (The College Board, 2006). Chapter Two documents the impact that student choice plays for campus facilities.

The statistically significant results indicating a high correlation of square footage and tuition and fees in the regression equation was also supported with the predictor model. Figure 5.2 graphically illustrates the sensitivity of square footage as tuition and fees were reduced by 50%, dropping the square footage per student to 136.57 from the mean of 147.32 and to 168.81 square feet per student when the tuition and fees variable was doubled. This result indicated that campus square footage was sensitive to increases in the weighted tuition and fees variable. This supported the results of the regression equation, showing a correlation between tuition and square footage on college and

university campuses. Students want new and expanded facilities with state-of-the-art amenities (Ehrenberg, 2001; Frank, 2007; Hill, 2004; Reeves La Roche, Flanigan, & Copeland, 2010). What was also not evident, either from the results of this study or the literature, is whether students fully understand that the costs of these amenities are being shifted to them and less on the federal and state funding sources.

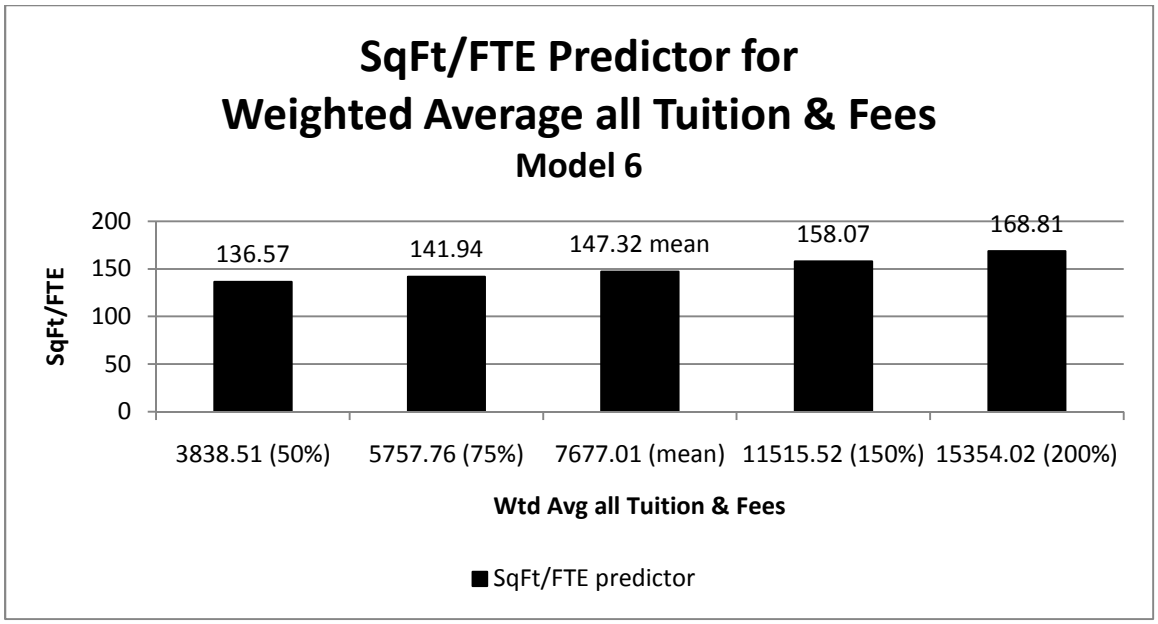

Figure 5.2. SqFt/FTE Predictor for Weighted Average of Undergraduate and Graduate Tuitions and Undergraduate and Graduate Fees for Model 6.

Fees.

Student fees in both graduate and undergraduate programs were separated from tuition in models one and two. This provided statistically significant *t* score results, however, as with tuition there was suspicion that the results might have heteroscedasticity issues. Because of reliability issues in the diagnostics, the fee variables were weighted and added to tuition.

The lack of correlation in some models could be explained in the nature of fees charged to the student. Many student fees are specifically designated to an organization

or activity on campus. Programs and activities are highly dependent on these fees to function and are not easily diverted to building projects unless designated as such.

Fees were then added to tuition in models five and six shown in Table 4.2 and 4.3. The new variable containing the weighted average of tuition and fees provided statistically significant results.

Institutional Control

The institutional control variable, indicating whether a university is private or public, provided the most consistent results of all variables and was positive and statistically significant in every model, whether regressed against total campus square footage or core educational square footage. This indicated that public colleges and universities in the sample had more square footage per student than private colleges and universities. This difference between square footage in public universities and private universities may be explained in part by public universities typically offering more majors and programs, and some of these majors and programs requiring lab space which significantly increases square footage per student.

Carnegie Classification

The variable indicating Carnegie classification was used to specify whether or not the institution was a research institution. In the core square footage regression models two, three, five, and six, Carnegie classification was positive and highly significant indicating the amount of core educational square footage was correlated to whether or not the college or university was a "research" institution as defined by Carnegie classification. Interestingly, the same cannot be said for total square footage of the entire campus. In the total square footage regression the research variable was only significant

in two out of the six models, indicating a lack of correlation with the research variable in those models. This was predictable considering that research universities would likely need additional square footage for laboratories and other research related activities. The entire square footage of the university would thus be less impacted by whether or not the institution was a research university.

Relationship to Prior Research

Research to date on the expansion and square footage of college and university physical campuses is sparse. The data collected by SCUP and utilized in this study represent the most recent effort to document the square footages of college and university campuses, an effort that ended in 2007. Data collection of construction activity though is currently collected annually by American School & University, documenting the amount of money spent by colleges and university on construction projects. Neither organization, however, analyzed the data for rationale of the actors.

Because low R^2 values in the study indicate that the variables used in this study do not entirely explain the square footage decisions of college and university campus facilities, other motivations should be considered. For example, the findings documented by Frank (2008), positing that colleges and universities are locked in a positional arms race forcing administrators to expand campus facilities to compete, should be considered. The results also leave plenty of room for a more cynical elucidation explained by Buchanan and Tullock (1962) as public choice theory. Public choice theory postulates that the bureaucrat personally maximizes power and utility by increasing budgets and over-expanding campus facilities. Any research in the area of square footage expansion

would be remiss without acknowledging these plausible alternative theories, however, they are beyond the scope of this dissertation.

Implications for Theory

This study discovered significant relationships between empirical data, such as endowments and tuition, to changes in college and university campus facility square footage. Higher education administrators acting within the framework of teleological theory would only expand college or university campuses when required to meet the goals or achieve the missions of the institution. In the teleological construct, administrators should expand campus facilities only when relying on empirical data from research based on enrollment, endowments, and tuition. Teleological theory ignores or downplays the possibility that individuals within the organization might act from alternative motives conflicting with those of the organization. The results of this study show that empirical data, such as enrollment, endowment and tuition are being considered; however, increases in campus square footage that cannot be attributed to this empirical data, also appear to take place. This is exemplified by the lower than expected R^2 results.

This study adds to the body of knowledge of college and university campus facility expansion by revealing that although a significant amount of the increase in square footage can be accounted for by careful evaluation of empirical data, other motivations may exist as well. These include the concept of the positional arms race and public choice theory. The low R^2 numbers in several models indicate that at least some of the changes in square footage is unexplained by the variables regressed. Coase (1960) demonstrated effectively that in the absence of any distorting influences, such as

imperfect information or perverse incentives, a rational actor will choose the efficient outcome such as that seen in this study and in teleological theory.

Economists develop theories to explain and predict how changes in situations affect economic behavior. There are obvious risks in applying these theories to elucidate the change in square footage of campus facilities. De Alessi (1983) posits that the relationship asserted by neoclassical economic theory predicts behavior, considering idealized variables under theoretical conditions. This theoretical construct highlights the importance of considering applicable theories and alternative hypotheses that affect relationships to real world phenomena (Milgrom & Roberts, 1992; Nagel, 1963). In the vernacular of economic theory, consideration must be given for friction, distorting influences, or externalities that might cause otherwise rational actors to make choices that deviate from theoretical expectations. Some economists refer to the actions taken that are counterproductive or inefficient as market failures (Viscusi, Vernon, & Harrington, 2000). Although not considered a formal theory, the concept known as a positional arms race may account for the distorting influences attributed to market failures.

Frank (1999) documents recent competition for students among higher education institutions, forcing these institutions into what he refers to as an "arms race" (p. 9) for the biggest and best facilities. A classic example of an arms race is the race for naval supremacy between the United Kingdom and the German empire prior to the First World War. In explaining this arms race, Massie (1991) details how both Germany and the United Kingdom expended significant amounts of their national treasure over a 20 year period to build two fleets that never met in the decisive battle naval theorists had predicted. The result of the First World War would have probably been the same if both

nations refrained from engaging in the arms race. Similarly, the competition between universities appears to have characteristics of an arms race, whereby too many of the scarce educational resources available to higher education institutions are consumed in a pointless competition for status contributing to unnecessarily increased costs (Hirsch, 1976; Winston, 2000; Zimsky, Wegner, & Massy, 2005).

This competition is partially fueled by the growing importance of academic ranking. Students are increasingly concerned with the rankings published in the *U.S. News & World Report's* annual college ranking issue (Ehrenberg, 2001). A testament to this fact is that this issue is the magazine's leading seller, and university applicant pools swing sharply in response to changes and fluctuations in the rankings. Investments in facility square footage and renovation, made by America's colleges and universities to compete for the best and brightest students, may be mutually offsetting just as the arms races of competing nations to obtain the most powerful weaponry (Frank, 1999; Hirsch, 1976). In the end, gains are minimized and expenditures are substantial in paying for the added facility square footage and upgrades. Given the propensity of actors in organizations to operate contrary to the principles described in neoclassical theory and their tendency to be drawn into unproductive positional arms race in higher education, public choice theory is subsequently considered to elucidate decision-makers' motivation and pursuit of facility campus expansion.

The public choice theoretical perspective argues that many of the expenditures made to expand campus facilities are wasteful. In their seminal work, Buchanan and Tullock (1962) posited that economic theory could be used to understand government institutions, political actors, and non-profit organizations. They contend that the principle

of rational maximization could be applied to governmental and bureaucratic behaviors, however, one should not expect bureaucrats to take actions that would further the mission of the organization over their own personal well-being. Analysis of self-serving behavior by administrators was further expanded by Jensen (2000), who argued that to view an organization as a rationally maximizing entity is erroneous. Organizational entities are typically composed of self-satisfying rent-seeking actors. This composition of individuals leads to a further issue, as expounded by Milgrom and Roberts (1992), who illustrate how information asymmetries make the costs of monitoring so expensive that it is economically impractical for any board or other supervisors to ever truly eliminate self-regarding behavior in organizational management.

Organizational theorists note that physical expansion and growth give the appearance of competence to those administering the growth of the organization (Kaufman, 1973; Marris, 1964; Penrose, 1959; Perrow, 1979; Whetten, 1980). Expansion also gives university administrators the opportunity to dispense favors and expend significant resources in the local community, thereby enhancing their own status. These conditions would potentially influence a self-interested administrator to be biased toward expansion, even if it were not economically preferable (Cyert & March, 1963). The result is an inefficient production of a bureau's services compounded by potentially perverse motivations in bureaucrat compensation (Downs, 1967; Mueller, 2003). Warren (1975) found that leadership in private industry is normally able to claim a share of savings and profits generated by an increase in efficiency, however, public bureaucrats' salaries are either unrelated or indirectly and perhaps inversely related to improved efficiency. Without financial incentives in place for the higher education administrator, a

host of self-serving behaviors may manifest, including salary inflation, power seeking, public reputation seeking, patronage, and favor dispensation in the community (Niskanen, 1971). Public choice theory paints a clear path and incentive for the bureaucrat to maximize power and utility by increasing budgets and over expanding the campus facilities.

With their seminal work Buchanan and Tullock (1962) revolutionized political economy doctrine theory by demonstrating that economic analysis could be used to explain the behavior of government institutions, political actors, and bureaucracies. Just as Jensen (2000) opened the black box called the firm and found individual self-regarding rational actors behaving in their own self-interest, the public choice economist opens the black box called the bureaucracy and finds it filled with rational self-regarding maximizing actors. Applying this concept to higher education, Massey (2001) referred to a situation he calls resource diversion where people follow their own interests at the expense of the organization at every opportunity. Thus, in lieu of using the type of marginal-cost, marginal-benefit analysis or empirical data such as enrollment, endowment, and tuition described in teleological theory, the individual bureaucrat may act so as to maximize their personal utility rather than the public's benefit. In a worst case scenario, a self-maximizing administrator in a university system could seek to gain control of a program simply to maximize the budget and incentivize over-expansion of campus facilities.

Implications for Practice

Historically, space planning on college and university campuses focused on ensuring that enough usable space existed to serve the needs of the campus and even

society in general. Expansion projects on higher education campuses were thus generally looked at in a positive light, and the economic impact of these improvements to the local community was well documented (Aschauer, 1989; Ehrenberg, 2004; Gottlieb & Fogarty, 2003; Hoenick, 1994; Howe, 1994; Jorgensen & Stiroh, 2000; King & Smith, 1988; Moretti, 2004; Pencavel, 1991; Perry & Wiewel, 2005; Wang, 2004). The enthusiasm for such expansion projects possibly contributed to reduced pressure to justify increases in campus square footages. The continuing need for college-trained citizens in the United States also aided administrators in their decisions to expand campus facilities. According to Ehrenburg (2006), however, the infinite appetite for funding facility expansions may be ending and the ramifications of expanding facilities without justification are worth consideration.

One implication of this study is the introduction of a predictor model illustrated in figure 4.10. A college or university administrator could simply enter the college or university data—such as enrollment, tuition, and endowment—and compare the institutions' square footage to the mean of the college and universities used in the study. This would allow college and university administrators to compare square footage measurements with peers and measure against goals, thus addressing the concerns raised by Ehrenburg.

This study provides practitioners with empirical data showing the relationship between the independent variables of enrollment, endowments, and tuitions and the dependent variable of facility campus square footages. The study also analyzes results revealing that factors are involved other than the variables initially considered. Minimal training or planning, in terms of shrinking college and university campuses in the United

States (Daigneau, 1994), exists. The literature reflects a concern that the future may look very different than the past in terms of the square footage needed on higher education campuses. This study takes an initial first step toward clarifying the reasoning behind rapid campus expansions and investigates a few of the possible variables considered in the planning process. Through the lens provided by teleological theory, the results of the study show a correlation between the variables of endowments, tuition, institution control, and Carnegie classification and college and university campus square footages.

Stakeholders in American higher education may look at the results of this research and conclude that administrators are expanding college and university campuses with ample justification of increasing endowments and tuition to support adding square footage. However, the low R^2 values in the regressions might indicate that there are other reasons to consider. This result would leave stakeholders to consider alternate theories for the motivations to continue increasing college and university campus square footage. With the predictions that fewer students will populate American campuses in the near future, stakeholders in these college and universities should challenge and evaluate changes in campus square footage.

Recommendations for Future Research

This study potentially provides a baseline research platform for much-needed future research in the area of college and university campus facility square footage. Although the study documents a correlation between enrollment, endowments, and tuition to the institution's campus facility square footage, it also documents other factors that exist in the campus facility square footage decision. Although several theoretical explanations are identified as possibilities in this study, they are not the focus of the study

itself. The identified theoretical possibilities would be better researched utilizing qualitative techniques. In the discussion section of the study the concept of the positional arms race is explored as a possible consideration by higher education administrators in making campus facility square footage decisions. Also explored in the contemplation of expanding campus facilities is public choice theory. While the empirical data indicators explained some of the increased square footage during the time frame studied, interviews with higher education administrators in a qualitative study format might find evidence to enhance the empirical data found in this study.

Additional campus inventory data should be collected documenting the square footage increases over time so time-series studies could be added to these research results. Time-series analysis was not possible in this study due to the limited number of years for which campus square footage data were available. Because this study documented a correlation between the variables of enrollment, endowments, and tuitions, additional research documenting the effects of societal trends and events on those variables might be useful in predicting square footage needed on American colleges and universities. Such trends as on-line course enrollment, unemployment, birth rates, and high school enrollments might be examples of interesting variables to compare.

Summary

Enrollments at American colleges and universities are projected to decrease significantly beginning in 2014. The enrollment decline is calculated based on the end of the echo boom generational surge (Bare, 1997; Kennedy, 2011; Roach, 2008). This situation, coupled with growing online enrollment, exacerbates waning facility usage on campuses nationwide. Surplus college and university facilities may become liabilities if

administrators miscalculate square footage requirements (Daigneau, 1994). Consequently, to minimize risk, administrators who make decisions regarding campus square footage should do so based on empirical data and strategic planning models.

This dissertation explored the relationships between facilities square footage and the variables of enrollment, endowment, and tuition. The results indicated a strong correlation between endowments, tuitions, whether a university is classified as a research institution, whether the institution is public or private, and square footage of the campus facilities. The results may accordingly be useful for efforts to minimize risk.

A counterintuitive finding was the lack of correlation between enrollment and campus square footage. Although the results demonstrated correlation between the other variables and campus square footage, the results left ample space for alternative theories. Teleological theory as an explanation—based on empirical data such as enrollment, endowment, and tuition—did not fully explain square footage decisions. Therefore, alternative theories such as the arms race concept and Public Choice Theory should be considered. Although the empirical data did not fully explain decisions regarding college and university campus facility square footage, the research revealed the existence of key relationships. This dissertation developed a predictor model that higher education administrators may use to compare campus square footage requirement numbers to those of the sample used in this study. Predictor models such as this may help to reduce the risk of square footage miscalculation.

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APPPENDICES

APPENDIX A
CARNEGIE CLASSIFICATION DEFINITIONS

Doctoral/granting Institutions

Doctoral/Research Universities – Extensive: These institutions typically offer a wide range of baccalaureate programs, and are committed to graduate education through the doctorate. During the period studied, they awarded 50 or more doctoral degrees per year across at least 15 disciplines.

Doctoral/Research Universities – Intensive: These intuitions typically offer a wide range of baccalaureate programs, and they are committed to graduate education through the doctorate. During the period studied, they awarded at least ten doctoral degrees per year across three or more disciplines, or at least 20 doctoral degrees per year overall.

Master's Colleges and Universities

Master's Colleges and Universities I: These institutions typically offer a wide range of baccalaureate programs, and they are committed to graduate education through the master's degree. During the period studied, they awarded 40 or more master's degree's per year across three or more disciplines.

Master's Colleges and Universities II: These institutions typically offer a wide range of baccalaureate programs, and they are committed to graduate education through the master's degree. During the period studied, they awarded 20 or more master's degree's per year.

Baccalaureate Colleges

Baccalaureate Colleges – Liberal Arts: These institutions are primarily undergraduate colleges with major emphasis on baccalaureate programs. During the period studied, they awarded at least half of their baccalaureate degrees in liberal arts fields.

Baccalaureate Colleges – General: These institutions are primarily undergraduate colleges with major emphasis on baccalaureate programs. During the period studied, they awarded less than half of their baccalaureate degrees in liberal arts fields.

Baccalaureate/Associate's Colleges: These institutions are undergraduate colleges where the majority of conferrals are below the baccalaureate level (associate's degrees and certificates). During the period studied, bachelor's degrees accounted for at least 10% of undergraduate awards.

Associate's Colleges

These institutions offer associate's degree and certificate programs but, with few exceptions, award no baccalaureate degrees. This group includes institutions where, during the period studied, bachelor's degrees represented less than 10% of all undergraduate awards.

Specialized Institutions

These institutions offer degree programs ranging from the bachelor's level to the doctorate, and typically award a majority of degrees in a single field. The list includes only institutions that are listed as separate campuses in the 2000 Higher Education Directory.

Specialized institutions include:

Theological seminaries and other specialized faith-related institutions: These institutions primarily offer religious instruction or train members of the clergy.

Medical schools and medical centers: These institutions award most of their professional degrees in medicine. In some instances, they include other health professions programs, such as dentistry, pharmacy, or nursing.

Other separate health profession schools: These institutions award most of their degrees in such fields as chiropractic, nursing, pharmacy, or podiatry.

Schools of engineering and technology: These institutions award most of their bachelor's or graduate degrees in technical fields of study.

Schools of business and management: These institutions award most of their bachelor's or graduate degrees in business or business-related programs.

Schools of art, music, and design: These institutions award most of their bachelor's or graduate degrees in art, music, design, architecture, or some combination of such fields.

Schools of law: These institutions award most of their degrees in law.

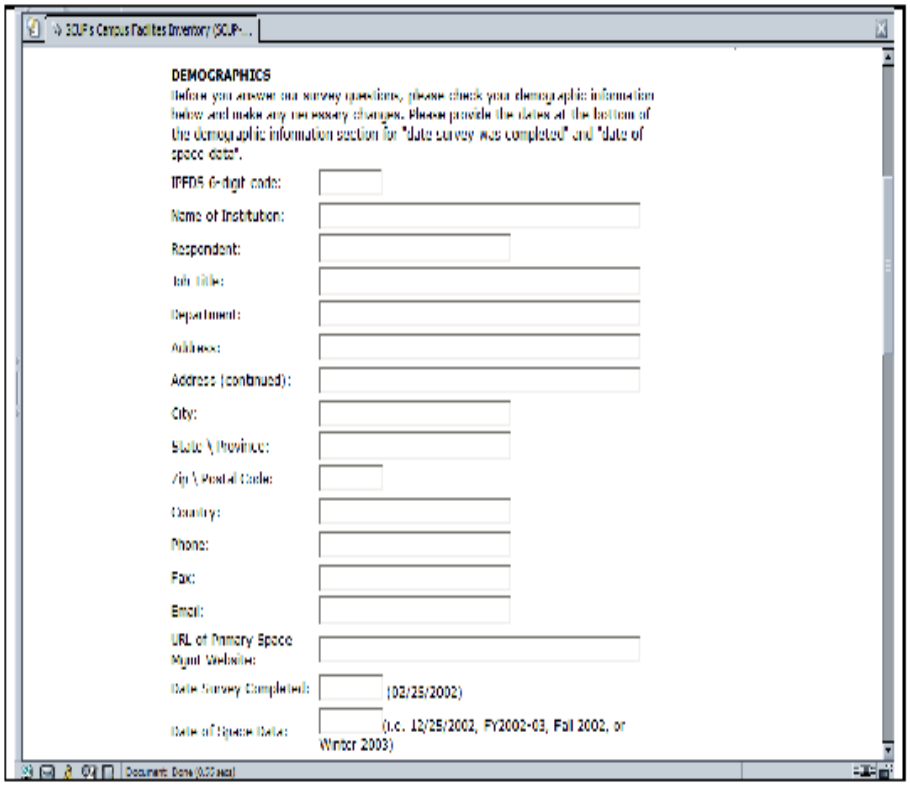
Teachers colleges: These institutions award most of their bachelor's or graduate degrees in education or education-related fields.

Other specialized institutions: Institutions in this category include graduate centers, maritime academies, military institutions, and institutions that do not fit any other classification category.

APPENDIX B

CFI INSTRUMENT

Figure 1 **CFI Demographic Data Collection Screen**



SCUP's Campus Facilities Inventory Survey (SCUP-CFI)

Please assist us by answering the following questions. Your response will help us to gather higher educ
data. **Names of institutions participating in the survey, along with their data, are shared ONLY
institutions that complete the survey for 2005.**

Important notes as you complete the survey:

1. Room Use codes are consistent with the NCES *Postsecondary Education Facilities Inventory and C
   Manual, 1992.
2. All room use-categories include support space for that category.
3. Please use whole numbers - no fractions or decimals.

INSTITUTION IPEDS NUMBER AND NAME
You are about to submit data for the following institution:

IPEDS code:
[?]

Institution:

YOUR PERSONAL DEMOGRAPHICS
Before you answer our survey questions, please check **your** demographic information below and make any n
changes. Please provide the date information for "date of space data" at the bottom of the your demographi

Respondent:

Your Institution:

Job Title:

Department:

Address:

Address (continued):

City:

State \ Province:

Zip \ Postal Code:

Country:

Phone:

Fax:

Email:

URL of Primary Space Mgmt

SCUP's Campus Facilities Inventory Survey (SCUP-CFI)

Please assist us by answering the following questions. Your response will help us to gather higher education space data. **Names of institutions participating in the survey, along with their data, are shared ONLY with other institutions that complete the survey for 2006.**

Important notes as you complete the survey:

1. Room Use codes are consistent with the NCES *Postsecondary Education Facilities Inventory and Classification Manual,* 1992. Definitions and examples are available throughout the survey.
2. All room use-categories include support space for that category.
3. Please use whole numbers - no fractions or decimals.

INSTITUTION IPEDS NUMBER AND NAME
You are about to submit data for the following institution:

IPEDS code: [?]

Institution:

YOUR PERSONAL DEMOGRAPHICS
Before you answer our survey questions, please check **your** demographic information below and make any necessary changes. Please provide the date information for "date of space data" at the bottom of the your demographics.

Respondent:

Your Institution:

Job Title:

Department:

Address:

Address (continued):

City:

State \ Province:

Zip \ Postal Code:

Country:

Phone:

Fax:

Email:

URL of Primary Space Mgmt Website: [?]

Date of Space Data: [?] 2005) (i.e. 12/25/2005, FY2005-06, Fall 2005, or Winter

SCUP's Campus Facilities Inventory Survey (SCUP-CFI)

Please assist us by answering the following questions. Your response will help us to gather higher education sp
data. **Names of institutions participating in the survey, along with their data, are shared ONLY with o
institutions that complete the survey for 2007.**

Important notes as you complete the survey:

1. Room Use codes are consistent with the NCES *Postsecondary Education Facilities Inventory and Classific
   Manual, 1992. Definitions and examples are available throughout the survey.
2. All room use-categories include support space for that category.
3. Please use whole numbers - no fractions or decimals.

INSTITUTION IPEDS NUMBER AND NAME
You are about to submit data for the following institution:

IPEDS code:
[?]

Institution:

YOUR PERSONAL DEMOGRAPHICS
Before you answer our survey questions, please check **your** demographic information below and make any necessar
changes. Please provide the date information for "date of space data" at the bottom of the your demographics.

Respondent:

Your
Institution:

Job Title:

Department:

Address:

Address (continued):

City:

State \ Province:

Zip \ Postal Code:

Country:

Phone:

Fax:

Email:

URL of Primary Space Mgmt Website: [?]

Date of Space Data: [?] (i.e. 12/25/2006, FY2006-07, Fall 2006, or Winter 2006)

VITA

James David Chapman

Candidate for the Degree of

Doctor of Philosophy

Thesis: AN INVESTIGATION INTO THE RELATIONSHIPS BETWEEN HIGHER EDUCATION FACILITY SQUARE FOOTAGE AND STUDENT ENROLLMENTS, UNIVERSITY ENDOWMENTS, AND STUDENT TUITION

Major Field: Higher Education/ Educational Leadership and Policy Studies

Biographical:

Education:

Completed the requirements for the Doctor of Philosophy/Education in Leadership and Policy Studies major at Oklahoma State University, Stillwater, Oklahoma in May, 2012.

Completed the requirements for the Master of Business Administration at Embry Riddle Aeronautical University, Daytona Beach, Florida in 1991.

Completed the requirements for the Bachelor of Science in Engineering Technology at Oklahoma State University. Stillwater, Oklahoma in 1987.

Experience:

Instructor, University of Central Oklahoma. (August 1, 2006 - Present).
Adjunct Instructor, University of Central Oklahoma. (August 1, 2004 - August 1, 2006).

CEO, Realty 1, LLC, Real Estate Brokerage. (September 1, 2003 - Present).
Chairman, Vistage International, CEO Mentorship. (January 1, 1998 - February 1, 2008).

President/CEO, ExecuTrain of Oklahoma. (June, 1992 – June 2001).
Mechanical Engineer, General Dynamics Corporation. (June 1987 – June 1992).

Professional Memberships:

Education Chairman, Realtor Commercial Alliance
Oklahoma City Metro Area Realtor Association

Name: James David Chapman Date of Degree: May, 2012

Institution: Oklahoma State University Location: Stillwater, Oklahoma

Title of Study: AN INVESTIGATION INTO THE RELATIONSHIPS BETWEEN HIGHER EDUCATION FACILITY SQUARE FOOTAGE AND STUDENT ENROLLMENTS, UNIVERSITY ENDOWMENTS, AND STUDENT TUITION

Pages in Study: 130 Candidate for the Degree of Doctor of Philosophy

Major Field: Higher Education

Scope and Method of Study: The purpose for this non-experimental quantitative research study was to investigate the relationships between student enrollment, institutional endowments, and tuition (independent variables) on campus facility square footage (dependent variable), controlling for Carnegie classification and whether the institution is private or public (control variables).

Findings and Conclusions: The different models employed in this study provided differing results in statistical significance of the variables. The institutional support variable, indicating whether a college or university was private or public, showed positive, statistical significance across all six models. The enrollment variable showed inconsistent results depending upon which model was regressed. Tuition and fees showed significant consistency across models, especially once the weighting technique was employed. Endowment proved to be another variable with consistency across all six models. The Carnegie variable, indicating whether or not an institution was a research university, did not show significant consistency across models.

ADVISER'S APPROVAL: Dr. Stephen Wanger