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The Comparative Efficiency of Public and Private Provision of Postsecondary Education in U.S. National Universities

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The Comparative Efficiency of Public and Private Provision of Postsecondary Education in U.S. National Universities

by

David L. Talley

A Dissertation Submitted in Partial Fulfillment of the Requirements for the Degree

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ACCEPTANCE

This dissertation was prepared under the direction of the *DAVID TALLEY* Dissertation Committee. It has been approved and accepted by all members of that committee, and it has been accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Business Administration in the J. Mack Robinson College of Business of Georgia State University.

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ABSTRACT

The Comparative Efficiency of Public and Private Provision of Postsecondary Education in U.S. National Universities

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The research uses postsecondary education in the United States as a test case for broader claims of superior efficiency of production from private sector producers as compared to public sector producers. Using linear regression and structural equation modeling on secondary data from 230 national universities, I provide evidence that private universities are more efficient in production of postsecondary education than public universities, and that the relationship is not mediated by competition. Using qualitative analysis of semi-structured depth interviews with both private and public university administrators, I provide evidence that personal motivation is also not a mediator of the relationship, but bureaucratic motivation for inefficiency likely is.

The research contributes to knowledge by examining and clarifying the explanatory power and boundary conditions of x-inefficiency, expectancy theory, and budget-maximizing theory in the context of higher education. The research contributes to practice by offering guidance to both public and private university administrators on improving efficiency. Policy recommendations are provided with regard to higher education generally, as are recommendations for future research.

INDEX WORDS: Efficiency, Education, Public, Private, University

I INTRODUCTION

In non-academic discourse, especially in discussions of politics or government, one often encounters the claim that the private sector is more efficient in terms of producing goods and services than the public sector. The assertion is frequently made with little or no supporting evidence, which is unfortunate, because the academic literature provides mixed support for such claims at best (Goodman and Loveman 1991) (Pier Vernon and Wicks 1974) (Sav 2012). Many public policy debates proceed based on this untested assertion, and potentially reach conclusions which may be inaccurate if the underlying assumption is incorrect, or which may only hold under certain conditions. It is worth pausing to examine this foundational assertion before proceeding to larger policy debates about the appropriate role of government in production, or the wisdom of privatization as a tool of economic policy.

Understanding if, and under what conditions, the private sector may be more efficient in production than the public sector has economic, policy, and management implications in the United States. Although the U.S. is generally regarded as a model free market economy, the government still plays a significant role in the economy at the federal, state, and local levels. This is true not just in terms of providing regulatory oversight, but also in terms of production of both goods and services in direct competition with the private sector. Examples of such competition include providing hospital care to the sick and injured; provision of incarceration and rehabilitation services for prisoners; production and distribution of electricity and water; provision of primary, secondary, and postsecondary education; road construction, maintenance, and operation; golf course operation; swimming pool operation; trash collection and disposal; letter and package delivery; and many others.

President Trump's administration has strongly signaled a desire for the federal government to privatize portions of the economy and to adopt behaviors of the private sector to operate more efficiently. The administration has recommended the use of public-private partnerships to encourage private investment in public infrastructure to stimulate economic growth and help repair the country's deteriorating roads and bridges (Levitt and Mulholland 2017). The president has suggested privatizing the nation's air traffic control system, claiming this could lead to more efficient outcomes for travelers (Shaper 2017). For government operations which cannot be privatized, the administration has created an Office of American Innovation to improve operations by closely consulting with the private sector (Furan 2017).

Detecting the presence of a relative efficiency gap between public and private provision of goods and services and providing evidence of the underlying reasons for that gap could prove useful in improving the efficiency of the overall U.S. economy. Armed with that information, public managers would know that efficiency gains are possible, either by having the public sector emulate the behavior of the private sector, or through privatization if the underlying causes implied that the private sector behavior could not be effectively emulated.

In the arena of higher education, efficiency has received an increasing amount of both popular and academic attention. As increases in tuition continue to consistently outpace normal inflationary growth, policy makers and prospective students are increasingly worried about college affordability and access. This has accelerated pressure on universities to reign in the rate of tuition growth, and to do so without sacrificing quality. Student debt is quickly becoming a financial burden for young graduates that threatens to overwhelm their ability to repay their financial obligations.

Understanding how to make a class of inefficient universities operate more like efficient universities would have benefits beyond just the immediate financial implications of saving tuition dollars for current students. To the extent the trend in runaway tuition increases can be checked by increases in university efficiency, society benefits by preserving the concept that "college is worth it." A university education has long been considered a gateway to the middle class, and to the extent that view can be maintained, society will continue to enjoy the benefits of a well-educated population such as a more highly skilled work force, higher disposable incomes, additional income tax revenues, and reductions in social ills associated with lack of education such as poor health outcomes and higher rates of crime (Ross and Van Willigen 1997).

Attempting to identify and explain the underlying causes for a hypothesized efficiency gap between public and private producers of goods and services is a very broad task given the large areas of competition between the two sectors. This paper focuses on production of a single service as a test case for the broader assertion that the private sector is more efficient in production. Specifically, the current research examines the provision of postsecondary education from national universities as a specific case of private organizational efficiency versus public organizational efficiency. The current research is a two-stage study designed to address two research questions. Stage one focuses on answering the primary research question; are private organizations more efficient than public sector organizations? Stage two focuses on a secondary research question; why are private sector organizations more efficient organizations?

This research contributes to scientific knowledge by providing evidence to support and clarify theoretical explanations of why private producers may be more efficient than government producers. The research contributes to practice by illuminating aspects under a government producer's control which can help increase efficiency.

II LITERATURE REVIEW

I.1 Definition and Measurement of Efficiency

A useful first step in addressing issues of efficiency is to define the term. Economists have historically dedicated effort toward the study of allocative efficiency, and deviations therefrom. Briefly, allocative efficiency refers to a situation in which prices are truly reflective of the actual costs of producing a good or service, and therefore all the resources in an economy are utilized in the production of the good or service that is most valued by society. Smith first articulated this concept in the metaphor of the "invisible hand," (Smith 1776).

In contrast, the concept of productive efficiency encapsulates producing the maximum amount of output with the smallest amount of inputs possible. This concept is normally what people mean when they discuss efficiency in terms of public versus private production. A competitive market achieves economic productive efficiency when firms are producing at the minimum average total cost. Productive efficiency is closely related to technical efficiency. Technical efficiency refers to maximizing output with a given set of inputs, whereas productive efficiency allows the producer to vary their inputs to minimize costs. Farrell authored the foundational work on defining and measuring productive efficiency (Farrell 1957), and he advocates that productive efficiency, which he terms "price efficiency," is a superior construct to technical efficiency precisely because it accounts for management decisions regarding the appropriate mix of inputs to use in production.

The proper definition (Massy 2011) and measurement (Kosor 2013) of efficiency in higher education have been the subjects of much debate. Massy provides a comprehensive discussion of the conceptual advantages and disadvantages to several measures for both productivity and efficiency in higher education. The ideal conceptualization of efficiency, he argues, should recognize that universities produce multiple outcomes. The learning that takes

place in individual classes is an outcome unto itself, beyond the more easily quantifiable outcome of awarded degrees. Kosor concurs that the multiple outcomes produced by universities complicate the measurement of higher education outcomes but extends the argument by differentiating between the teaching and research outputs of the university.

Massy also points to the issue of controlling for educational quality as a complicating factor in defining efficiency. Traditionally, researchers have either used the cost of education as a proxy for quality or have controlled for quality with more direct quality measurements such as performance on a standardized post-university test like the Collegiate Learning Assessment.

Kosor summarizes the two main methods used for evaluating efficiency in higher education. Stochastic frontier analysis is a statistical tool developed in the late 1970s (Aigner Lovell and Schmidt 1977). Stochastic frontier analysis is an econometric estimation technique that attempts to model inefficiency as systematic error in the approach of optimizing producers to maximizing their input. The method relies on the concept of benchmarking or comparing a producer's performance to a theoretically possible efficiency frontier. Data envelopment analysis is a non-parametric tool developed around the same time (Charnes et al 1978). The technique is similar in approach to stochastic frontier analysis, although the benchmark used is not a theoretically possible efficiency frontier, but a "best in class" producer. A third method uses regression based on the education production function literature. Here, the analysis takes into consideration individual student characteristics to help explain their knowledge outcomes. This provides a richer analysis but focuses the individual student level of analysis.

Despite calls for clarity and proposed national benchmark models (Powell et al 2012), the United States still does not rely on a single, authoritative source for data and measures of efficiency in higher education. This lack of precise definitions and clear consensus on

measurement for efficiency creates difficulty in understanding exactly what factors influence efficiency.

The current research adopts a broad definition of efficiency. Spending per degree is the conceptual basis, but more specifically the measure of efficiency proposed here is core expenses per degree awarded. This definition captures the broadest concept of economic productive efficiency for which data is readily available.

Core expenses include university spending on instruction, research, public service, academic support, institutional support, student services, and other core expenses not otherwise classified. Students select universities for a variety of reasons beyond instruction, so the measure includes other expenditure categories because universities must expend funds on research and in other areas to attract and maintain the faculty required to attract quality students and maintain high educational standards.

Degrees awarded is used as the denominator in this operationalization of efficiency. The advantage of using degrees awarded is that it is a broad measure of the output of universities. Conceptually, the largest drawback to using this denominator is that it excludes learning outcomes that do not result in an awarded degree.

II.1 Factors of Production Influence Efficiency

Broadly, efficiency is a measure of the relationship between inputs and outputs. In classical economic thought, the only factors of production available to generate consumable outputs are land, labor, and capital. The production of lasers, submarines, toothpicks, and all other goods and services result from the combination of different types of land, labor, and capital. Therefore, the factors which influence efficiency within an industry will be context-

specific to that industry, because different industries are interested in using different inputs to create different outputs.

As an example, the efficiency of agricultural production is typically represented in terms of crop yield divided by land, farm equipment, fertilizer, and the labor of the farmers involved in production. Efficiency in the production of tobacco involves pounds of tobacco produced from inputs of land, tractors and wagons, fertilizer and pesticides, and the labor of farmers (Abay Miran and Gunden 2004). Efficiency in the production of rice is measured in much the same way; the only difference being the measures for crop yields and the specific types of land and machinery involved in production (Anang Backman and Sipilainen 2016).

The production of cruise ship vacations is considerably different than the production of agricultural products. The inputs for the production function of cruise ship vacations do not focus on land, but here capital plays a much more important role in terms of the design and features of the cruise ship, and labor in terms of the quality and number of crewmembers available to assist passengers (Gregoriou Gultek and Demirer 2017). Beyond different cost inputs, though, there is no standardization for the output of services such as cruise ship vacations as there is for agricultural products. It is possible to simply count the number of vacations provided as a measure of output but doing so would assume that all cruise ship vacation experiences are equal, and that the level of satisfaction enjoyed by all guests was similar. This additional complication of defining and measuring output to capture differences in quality will be addressed later in the Methodology section.

It follows that the factors which influence efficiency in higher education are related to the inputs and outputs of institutes of higher education. With respect to inputs, compensation to faculty and staff drive most of the costs incurred by universities, especially for teaching-oriented

universities (Davis 2012). Technology also contributes to the educational production function, although the promise of online education has not yet materialized in terms of "bending down the cost curve," (Deming Goldin and Katz 2015). Interestingly, large, private, for-profit institutions of higher education appear to have been the most aggressive in adopting online education, whereas public and private non-profit universities appear to have been more cautious in adoption, perhaps because of a perceived lack of quality in the education received through online delivery.

The academic literature on the higher education production function focuses primarily on the effort and quality of students and the effort and quality of faculty and staff (Dolan and Schmidt 1994). There is some theoretical and empirical evidence that the physical capital plant at universities is also an important part of the production function of higher education (Dolan and Schmidt 1994) (Hopkins 1990).

II.2 Previous Research on Efficiency in Higher Education

Powell and colleagues conducted an interesting study on the relationship between efficiency and effectiveness in higher education (Powell et al 2012), which serves as a partial model for the present study. Their research points to a perception, especially amongst university presidents, of a trade-off between efficiency, effectiveness, and access in higher education. Only reductions in quality or restrictions in access to students without financial wherewithal can increase efficiency.

Building on previous research (Bowen 1980), Powell examined the hypothesis that universities follow the revenue theory of cost. This theory holds that costs will expand to consume available revenues, in part because society has viewed education as a public good, and price signals in the market are comparatively weak. One implication of this is that one should

expect to find radically different costs and levels of efficiency for different universities, because costs, and subsequently levels of efficiency, are simply a function of available revenues. Another important implication is that there is little or no incentive to reduce costs and improve efficiency under this model; the incentive would be to maximize available revenues and then decide how to allocate those revenues among cost categories.

Research has generally supported Bowen's revenue theory of cost in a variety of academic settings. Leslie and colleagues found support for the theory amongst research-focused universities, especially among public institutions, which implies there are some differences between public and private universities (Leslie et al 2011). Archibald and Feldman (2011) provide a counterpoint, arguing that the revenue theory of cost focuses too narrowly on higher education, and more general theories such as cost disease provide a better explanation for tuition increases over time. Cost disease refers to the phenomenon of prices rising more quickly than inflation in industries where capital cannot easily replace labor. Economist Robert Frank explained cost disease by noting,

> "*While productivity gains have made it possible to assemble cars with only a tiny fraction of the labor that was once required, it still takes four musicians nine minutes to perform Beethoven's String Quartet in C minor, just as it did in the 19th century*." (quoted from Bowen 2012).

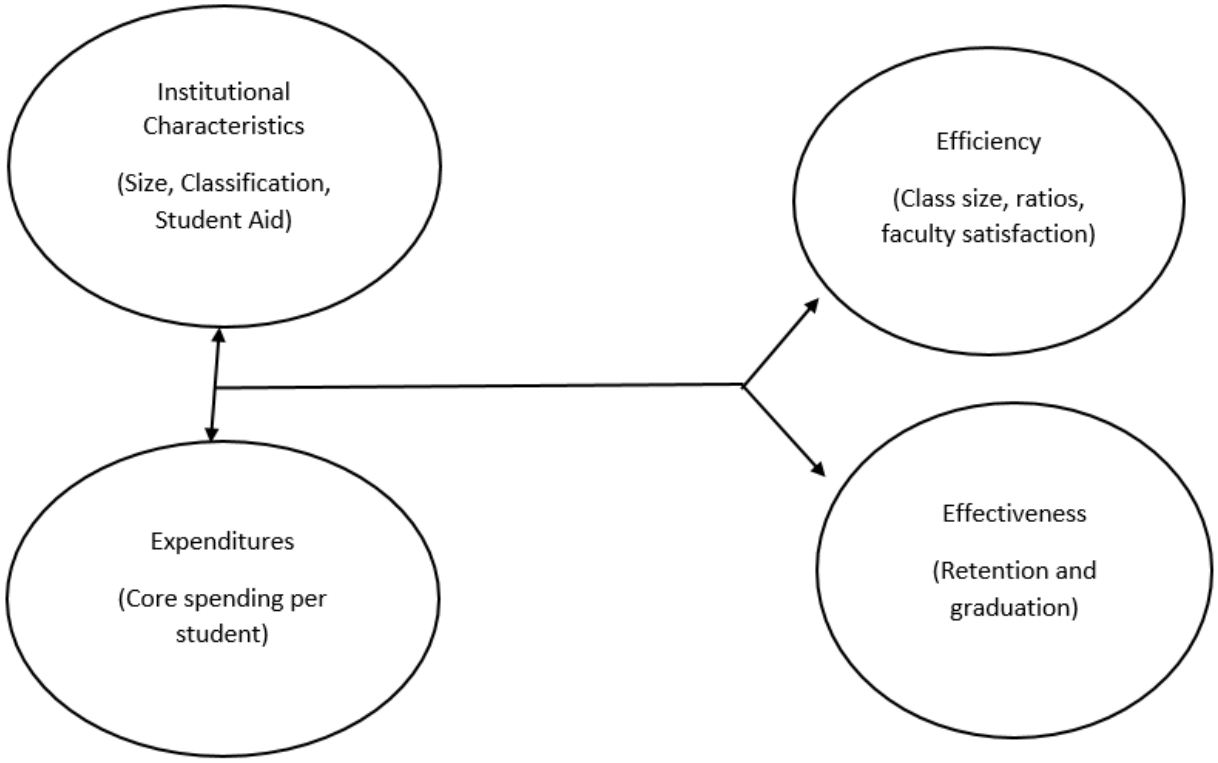
This is likely true, at least to a certain degree, in higher education. While this is a convincing argument, the focus of the current research is not the drivers of tuition increases over time, but with the relationship between the publicness of a university and the efficiency with which the university provides educational services.

Powell's team developed a model of higher educational efficiency and effectiveness that depicted these concepts as functions of institutional characteristics and expenditures. Institutional characteristics included size as measured by enrollment, Carnegie classification,

which measures the highest degree available for student pursuit, and the percentage of students receiving federal aid. The team measured expenditures as federally reported core expenditures on research and instruction. Class size, student to faculty ratio, administration to faculty ratio, teaching load, and faculty satisfaction were the measures for efficiency. Effectiveness measures included first year retention rates and four and six-year graduation rates. Powell's model, depicted in Figure 1, will serve as a basis for modification to answer the present research questions.

Powell found that, as expected, there was an inverse relationship between efficiency and effectiveness for universities. More meaningfully though, the research indicated that institutional characteristics were predictors of both efficiency and effectiveness. Recall that Powell tested institutional characteristics such as size and classification, but not the publicness of the universities.

Figure 1: Powell's Model of Efficiency and Effectiveness



This model requires some modification to address the present research questions. First, there are two dependent variables in Powell's model. As I am primarily interested in efficiency, a control variable for quality will subsume the construct of effectiveness. Secondly, Powell modeled expenditures as a driver of efficiency using several measures for expenditures based on aggregate spending reported by universities.

I argue that expenditures per award are a broader, more appropriate measure of efficiency than are class size, and professor or administrator to student ratios. Expenditures per award encapsulate all aspects of the educational experience that class size and ratios might ignore. Furthermore, it is better to use class size and student ratios as controls to help explain variations in expenditures per award than the reverse.

With these modifications, we turn to understanding some mediating variables through which inefficiency may be transmitted from the institutional characteristic of being a public university through to an outcome such as being less efficient in terms of spending per award. The academic literature contains three compelling theoretical explanations for why public universities may be less efficient than their private counterparts.

II.3 Causes of Inefficiency for Hypothesized Model

The production function for higher education, and for all other goods and services, begins with the factors of production. For higher education, the labor of faculty and staff, and to a lesser extent the capital stock of the university in terms of buildings, equipment, and technology are all important inputs to producing higher education. If the markets for all these inputs are approximately competitive, then universities should be able to acquire them for the same price. If that is true, then why would anyone expect public universities to be any less efficient than private universities?

The answer is that while the production function begins with land, labor, and capital; it certainly does not end there. Economists have long recognized that the way in which managers combine the factors of production has a significant impact on efficiency. Smith recounts a story of remarkable gains in the yield of pins produced by workers simply by dividing labor and specializing in certain areas of production (Smith 1776), a concept which Ford later refined and exploited on a much larger scale with the advent of the automated production assembly line in the early 1900s.

Just as managers can improve efficiency through new and innovative ways of combining the factors of production, so too can they introduce and encourage inefficiency by acting, or failing to act, in certain ways. There are three strong theoretical explanations that could help

explain why managers of government producers might behave in ways which lead to less efficient production than do managers of private enterprises.

Leibenstein was the first to formalize the concept that governments involved in production would not maximize efficiency (Leibenstein 1966) by coining the term "X-Inefficiency." The fundamental argument was that it was the degree of competition that producers felt which motivated them to behave in ways that were efficient. Government producers could rely on taxpayer subsidies to prevent them from having to cease operations, whereas private producers were subject to extreme competition which would result in their eventual destruction if they did not maximize efficiency. The need to strive and compete, he argued, disciplined private managers to make the tough choices that governmental managers would simply not have to make.

This argument is simple, elegant, and convincing. However, contained within it are some assumptions and boundary conditions which may not make it an entirely satisfactory explanation for differences in efficiency between public and private universities. First, because disparities in levels of competition drive X-Inefficiencies, the explanation only makes sense if public university managers perceive taxpayers will bail them out of inefficient decisions, and that private university managers feel that the market will punish them for inefficient decisions. Secondly, the argument presupposes that universities compete for students to a large degree based on efficiency, and not on some other characteristic such as perceived quality or reputation.

The second possible theoretical explanation for a potential efficiency differential between public and private production comes from the field of psychology. Expectancy theory holds that rational self-interest motivates (Vroom 1964). Three elements precede motivation to act. There must first be expectancy, which means that a person must believe that by increasing their

individual level of effort, they will be able to improve their performance. The second element is instrumentality, meaning that a person must believe that by improving their performance they will be able to achieve a specified outcome. The third element is valence, meaning that the person must value achieving the outcome, and perceive some reward after having obtained it.

Expectancy theory can be a useful prism through which to view human motivation. With respect to managerial behavior at public and private universities, the theory could help provide an explanation for an efficiency gap, but only under the conditions presented in the theory. To the extent that public university managers are less likely than their private university counterparts to believe they can improve their performance in attempting to increase efficiency, to believe that their increased performance will lead to improved efficiency, or to believe that they will in some way be rewarded for their efforts if they are able to improve efficiency, then expectancy theory can help explain differences in efficiency. This is only true to the extent to which there are differences between public university managers and private university managers. If neither group believes they can influence efficiency, or both groups are equally convinced that they can improve efficiency, then the theory does not provide much insight into efficiency differences.

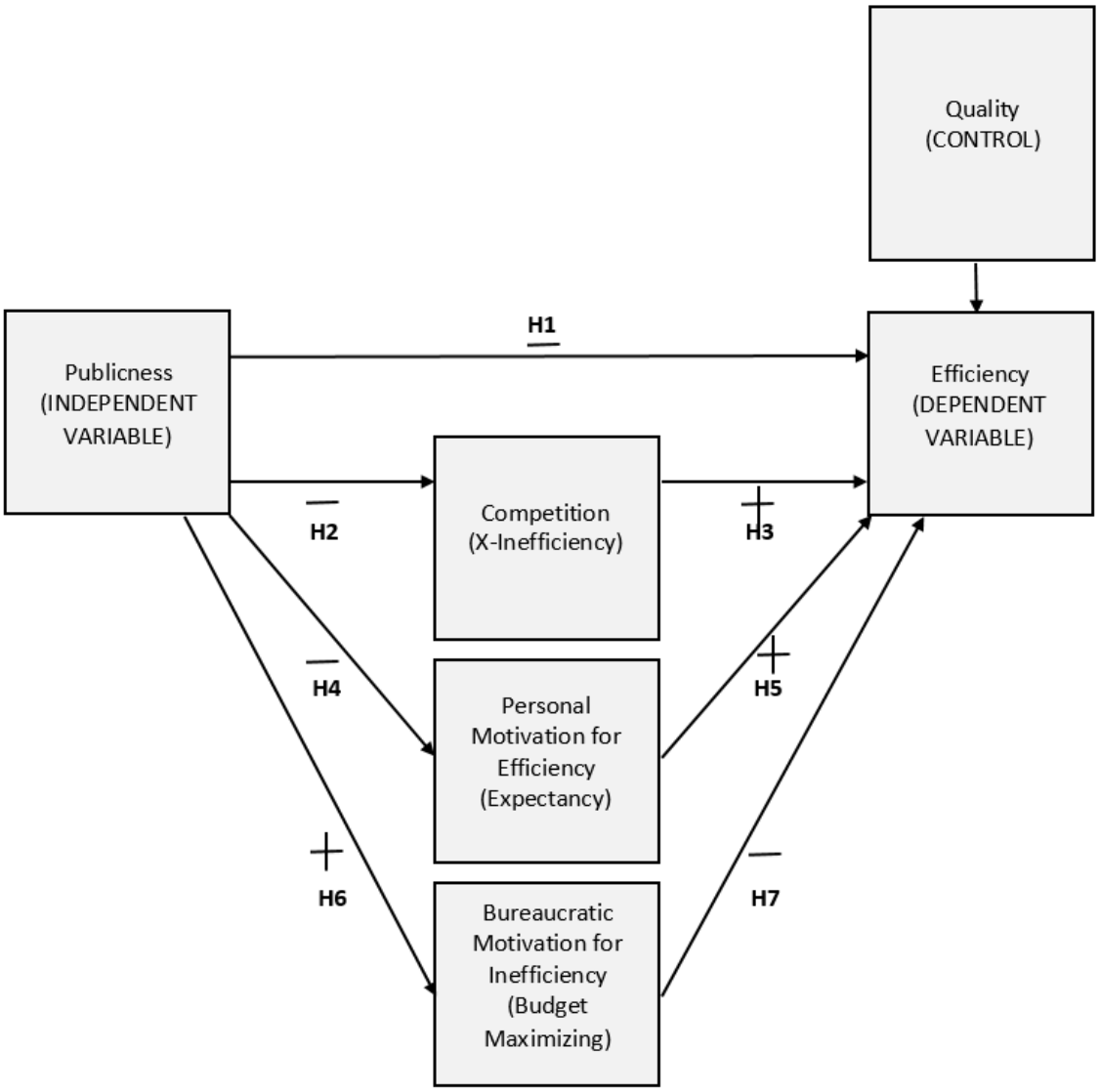
A final potential theoretical framework to help explain differences in efficiency between public and private producers is budget maximizing theory. Like X-Inefficiency, budget maximizing theory comes from economics. Specifically, this theory developed in the sub-field of public choice economics. Budget maximizing theory holds that public sector managers do not simply lack an incentive to be efficient, they are in fact incented to be *inefficient* in production. This incentive occurs because the budgeting model for governments is often based on consumption of the previous year's budget (Niskanen 1971). This creates an incentive for public

sector managers to utilize all their budgeted resources in any given year to increase their likelihood of receiving additional resources in future years, regardless of whether using those budgetary resources in the current year results in additional output.

If public university managers are attempting to maximize their current resource usage to maximize available resource in future years, one would expect that they will behave in ways that are less efficient than private university managers. This would only be true in the instance that public university managers do, in fact, have their budgets set based on previous budgets, and that private university managers do not, or at least the influence of the previous year's budget on the current year's budget for private university managers is less than that of the public university managers.

Figure 2 displays a general, combined model of the impacts of publicness on efficiency drawing from X-Inefficiency, expectancy theory, and budget-maximizing theory.

Figure 2: Model of Publicness and Efficiency



The present research will subject the hypotheses contained in the model to testing. Stage one will test hypotheses one, two, and three and stage two will examine hypotheses four through seven.

H1: The more publicness a university exhibits, the less efficient the university will be with respect to producing postsecondary education.

H2: The relationship between publicness and efficiency will be mediated through competition for students. Managers at public universities will perceive less competition for students than will managers at private universities.

H3: The relationship between publicness and efficiency will be mediated through competition for students. The more competition a university faces for students, the more efficient the university will be.

H4: The relationship between publicness and efficiency will be mediated through personal motivation for efficiency. Managers at public universities will be less motivated to make the university operate more efficiently than will be managers at private universities.

H5: The relationship between publicness and efficiency will be mediated through personal motivation for efficiency. The more managers are motivated to increase efficiency, the more efficient the university will be.

H6: The relationship between publicness and efficiency will be mediated through bureaucratic motivation for inefficiency. Managers at public universities will perceive more bureaucratic motivation for inefficiency than will managers at private universities.

H7: The relationship between publicness and efficiency will be mediated through bureaucratic motivation for inefficiency. The more managers perceive bureaucratic motivation for inefficiency, the less efficient the university will be.

III METHODOLOGY

III.1 Overview

This is a two-part study designed to answer two related research questions embedded in the model depicted in Figure 2. The first research question is, are private national universities in the United States more efficient than public national universities at producing postsecondary education? The second research question is, which, if any, theories help explain differences in efficiency? The answers to these questions will help researchers better understand the dynamics and boundary conditions of efficiency theories in the higher education setting, with implications for the broader economy. Answering these questions will also help managers in public universities understand how they may be able to increase efficiency in practice.

III.2 Stage One

III.2.1 *Definition of Measures*

The dependent variable under consideration is efficiency. Recall that efficiency measures input per output. The measure for efficiency in this research is Total Core Expenses per Award. As constructed, this measure is actually an indicator of inefficiency. As core expenses per award increase, the university is expending more per degree, and therefor can be thought of as operating in a less efficient (or more inefficient) manner.

Information was gathered from the National Center for Educational Statistics within the U.S. Department of Education. This agency maintains the Integrated Postsecondary Education Data System (IPEDS), which houses a wide range of cost and performance data for colleges and universities in the United States populated from self-reported information provided by postsecondary educational institutions in response to surveys (IPEDS 2017).

Total Core Expenses are the input portion of the efficiency measure. Guidance from the Financial Accounting Standards Board (FASB) and Governmental Accounting Standards Board (GASB) governs the calculation and presentation of total core expenses. Core expenses include, and are reported individually for, instruction, research, public service, academic support, student services, institutional support, and other. Core expenses specifically exclude expenses for auxiliary services such as bookstores, dormitories, hospitals, and other independent operations.

Awards represent one form of postsecondary education output. Awards are degrees conferred upon students for completion of academic courses of study. The measure used for awards in this research is the total number of awards issued by schools as reported to IPEDS from July 1, 2015 through July 30, 2016. The total awards data are aggregated from several smaller, discrete categories of awards including certificates, associates degrees, bachelor's degrees, master's degrees, and various types of doctoral degrees awarded.

The independent variable under consideration is the publicness of national universities. The definition of national universities comes from U.S. News and World Report, an organization that routinely provides information to the public on a variety of university performance and cost metrics. National universities in this context "offer a full range of undergraduate majors, plus masters and doctoral programs, and emphasize faculty research" (Morse et al 2016). National universities are distinct from other types of universities, such as national liberal arts colleges, which focus on undergraduate education and award significant numbers of arts and science degrees. U.S. News and World Report also provides information on regional universities, which offer few or no doctoral programs, and on regional colleges, which focus on undergraduate education or associate degrees.

There are different ways to define the publicness of national universities. U.S. News and World Report, the federal government, and the public use a binary distinction between public and private. Typically, the distinction is based upon whether publicly elected or appointed individuals control and operate the university, as well as the source for most of the national university's funding. There is a further subdivision of private national universities into private non-profit and private for profit, but private for profit national universities represent less than 3% of all national universities, and they do not report meaningful performance and cost metrics, so the study excludes them. The binary nature of the distinction between public national universities and private national universities oversimplifies the concept of publicness. This research uses the binary distinction of publicness as an independent variable, but also employs an alternate construction.

Additional information from the federal IPEDS database related to federal, state, and local appropriations and operating grants as a percentage of overall national university operating revenue creates a more robust measure for publicness. This creates a continuous index that serves as a proxy for the degree of publicness of a university. The greater the proportion of governmental revenues to overall operating revenues, the larger is the value for the publicness index. A similar measure for publicness was used by Sav (2012).

Stage one also tested the mediating variable of competition. Competition is the rate at which the university rejects applications for admission as measured by the number of applications and the number of admissions for the fall 2016 semester reported by universities to the IPEDS database. This measure of competition was selected as it is the most readily available data on competition between universities. Conceptually, other measures for competition could include geographic characteristics such as the number of competing national universities within

the state, or within a given area. The measure used here is broader in the sense that it accounts for the fact that students can be mobile, and may apply to, be accepted to, and attend a university that is geographically distant from their home.

Differences in efficiency between public national universities and private national universities may appear for reasons other than the publicness of the university. For this reason, the analysis must implement some statistical controls to limit the impacts of confounding factors which may also be influencing efficiency. The confounding factor most likely to influence measures of efficiency is quality. The production of high quality goods and services typically requires higher quality, costlier inputs. It is difficult to measure the quality of educational output, unlike other economic output such as iron or tobacco. Therefore, measuring and controlling for the influence of quality on educational outputs is both important and difficult.

Measuring perceived quality from the viewpoint of the students for which universities compete provides a logical point from which to begin. If prospective college students and their families perceive that a university is of higher quality, they may be willing to tolerate a lower level of efficiency from that university in exchange for receiving what they perceive as higher quality output. Higher quality output could mean that the educational experience leads to more certainty in terms of job placement after graduation, to a higher starting salary, to a greater or deeper understanding of their area of study, or any other subjective or objective criteria which the student values.

Adopting this definition of quality, one broad measure that is available as a proxy comes from U.S. News and World Report. This organization has, since 1983, annually published several lists and rankings that are available for use by prospective college students and their families. The rankings contain summary and detailed information about several institutional

characteristics of both public and private universities in a format that is readily assessable, searchable, and understandable to the public. Criticisms of such rankings appear from several sources, including from students, academia, and the government. Critics point out that such comparisons are subjective and downplay important distinctions between universities that can be predictors of success in postsecondary education. Despite these criticisms, many of which are valid, there is evidence that some students consider these rankings "very important," when making decisions about which university to attend. This is especially true for students from higher income families and those attending highly selective universities (Espinosa et al 2014).

U.S. News and World Report scores national universities on a ranking system from zero to 100. The score consists of a combination of metrics around graduation and retention rates as reported by universities (22.5%), undergraduate academic reputation as judged by peer universities and high school guidance counselors (22.5%), faculty resources as measured by class size and faculty salary (20%), student selectivity as measured by acceptance rates and ACT scores of entering students (12.5%), financial resources as measured by per student spending (10%), graduation rate performance which measures graduation rates experienced in excess of graduation rates predicted by spending (7.5%), and alumni giving rate as reported by the universities (5%) (Morse et al 2016).

As previously mentioned, the U.S. News and World Report rankings are not without critics. Some of the constituent components of the U.S. News and World Report scores are available individually from the IPEDS database. Additionally, there are other data available in IPEDS which serve as proxies for either the quality of incoming students or the quality of the university itself. These measures can be used individually, or collectively, as an alternative quality control in lieu of the U.S. News and World Report scores. This alternative quality

control measure does not have the subjective undergraduate reputation component, which provides additional assurance in the objective, unbiased robustness of the quality control.

Table 1 summarizes the measures used in stage one of the research.

Table 1: Stage One Measures

Measures	Type	Construction	Values	Source Data
Inefficiency	Dependent Variable	Total Core Expenditures divided by Total Awards	Positive values	Data for 2016 from IPEDS federal database.
Publicness	Independent Variable	Governmental appropriations and operating grants divided by total operating revenues	0% to 100%	Data for 2016 from IPEDS federal database.
Competition	Mediating Variable	Fall 2016 rejection rate of applications for admission to the university	0% to 100%	Data for 2016 from IPEDS federal database.
Quality (Index)	Primary Control	Graduation retention rate, Undergraduate Academic Reputation, Faculty Resources, Student Selectivity, Financial Resources, Graduation rate performance, Alumni giving rate	0 to 100	Data for 2018 from U.S. News and World Report.
Quality (Enrollment)	Alternate Control	Total enrollment reported for the Fall 2016 semester	Positive values	Data for 2016 from IPEDS federal database.
Quality (ACT)	Alternate Control	Average ACT score for the incoming freshman Fall 2016 admitted class	0 to 36	Data for 2016 from IPEDS federal database.
Quality (Indebtedness)	Alternate Control	Average cumulative student debt load of students graduating in 2016	Positive values	Data for 2016 from IPEDS federal database.
Quality (Scholarship)	Alternate Control	Average undergraduate needs-based scholarship	Positive values	Data for 2016 from IPEDS federal database.
Quality (Faculty Ratio)	Alternate Control	Inverse of student to faculty ratio for 2016	0 to 1	Data for 2016 from IPEDS federal database.
Quality (Graduation Rate)	Alternate Control	Four-year graduation rate	0% to 100%	Data for 2016 from IPEDS federal database.

Quality (Freshman Retention)	Alternate Control	Percentage of returning freshman enrolled at the beginning of their sophomore year	0% to 100%	Data for 2016 from IPEDS federal database.
Quality (Tuition)	Alternate Control	Weighted average for in-state and out-of-state tuition for all students	Positive values	Data for 2016 from IPEDS federal database.

Publicness is the percentage of university operating revenues in 2015 derived from federal, state, and local government contracts or appropriations. The source of data for the measure is the IPEDS federal database.

Inefficiency is total core expenditures per award. The source of data for the measure is the IPEDS federal database.

Competition is the total number of rejected applications in the fall of 2016 divided by the total number of applications.

Quality is a subjective score from zero to 100, based upon graduation rates, undergraduate academic reputation, faculty resources, student selectivity, financial resources, graduation rates, and alumni giving rates. The source of data for the measure is the 2018 U.S. News and World Report College and University rankings.

Constituent parts of the overall quality score provided by U.S. News and World Report, and other factors, may serve as additional controls.

Appendix A contains a full list of all 230 public and private national universities, as well as their measures for efficiency, publicness, and quality.

III.2.2 *Data Analysis*

III.2.2.1 Descriptive Statistics

The first step in analyzing the secondary data is to understand the descriptive statistics that summarize the variables under consideration. Table 2 shows descriptive statistics for the secondary data collected as segregated by the binary definition of public and private universities.

With respect to efficiency, it is apparent that private universities expend more dollars per award granted. Private universities expend an average of $197,097 per award, whereas public universities expend an average of $146,977 per award. That means that on average, private universities are spending roughly one third more per degree awarded than are public universities.

The variation in efficiency, however, is much greater within private universities as compared to public universities. The range of efficiency for private universities is over $1,000,000 per degree awarded, whereas the range for public universities is closer to $350,000 per degree. The standard deviation of efficiency for private universities is over $186,000, whereas it is only $61,000 for public universities. Even accounting for the higher mean of private university efficiency, the coefficient of variation for private universities is nearly 95%, but only 42% for public universities.

With respect to the publicness of universities, public universities on average receive a considerably larger share of their operating revenues from government sources than do private universities. For public universities, the average is almost 44% of revenues coming from state sources, whereas private universities operate on roughly only 11% of state funds. However, there are some private universities that receive more than half of their revenues from government sources whereas some public universities receive as little as 14% of revenues from governments. This illustrates the blurring of the traditional definitions of public universities, especially as

public universities have recently experienced reductions to their state appropriations in the face of austere fiscal conditions.

With respect to competition, there is a good deal of overlap in the range over which private and public universities reject candidates for admission. Private universities reject just over 54% of applications for admission. Public universities only turn away 35% of their applicants. The respective standard deviations of 25% for private universities and 17% for public universities indicate that the variation of competition among the two types of universities are similar. However, the most selective private universities reject 95% of applicants and the most selective public universities turn away 84% of applicants. This is an indication that there may be some divergence between the two types of universities at the more selective end of the spectrum.

With respect to the U.S. News and World Report quality index, private universities on average score more than 13 points higher on a 100-point scale than do public universities. The average score for private universities was 58, and the average score for public universities was almost 45. This means that private universities, on average, scored almost 30% better on the quality index than did their public counterparts. This closely mirrors the 34% better that public universities did with respect to efficiency.

Returning to the quality index, the maximum score for private universities matched the maximum possible score of 100 points. The maximum score for public universities was 78, a full 22 points lower. When ranking all 230 universities by this quality index, the first 21 universities are private in the binary sense of that term. As with the competition measure, the wide disparity in the maximum score for the quality index indicates divergence of public and private universities at the high end of the quality index scale.

That is borne out by the alternate indicators of quality. Private universities enroll students with higher average ACT scores, place those students in classes with more faculty members per student, retain a greater percentage of those students from their freshman into their sophomore year, and ultimately graduate a much higher percentage of those students in the traditional four-year time frame.

Table 2: Descriptive Statistics

Private Universities

Public_Binary		N	Minimum	Maximum	Mean	Std. Deviation
0	Efficiency	98	$38,492	$1,090,404	$197,097.26	$186,655.444
	Public_Continuous	97	0.00%	54.00%	11.0309%	10.86322%
	Competition	98	7.00	95.00	54.3776	24.95295
	Quality_Index	98	27	100	58.07	20.902
	Enrollment	98	2240	50550	12116.33	8447.525
	ACT	98	21	35	28.08	3.757
	Indebtedness	88	8908	46779	29261.18	6914.503
	Scholarship	94	3975	50744	27152.69	12735.261
	Faculty_Ratio	98	.05	.33	.1038	.04837
	Graduation_Rate	98	29%	90%	64.72%	17.654%
	Fresh_Retention	98	70%	99%	89.04%	7.238%
	Tuition	98	$5,460	$57,208	$43,907.11	$9,360.031

Public Universities

1	Efficiency	132	$64,571	$415,352	$146,977.66	$61,002.344
	Public_Continuous	132	14.00%	73.00%	43.7045%	12.44391%
	Competition	132	5.00	84.00	35.3712	17.36207
	Quality_Index	132	27	78	44.82	13.144
	Enrollment	132	2202	65302	27964.33	13040.626
	ACT	129	19	32	25.72	2.595
	Indebtedness	125	18221	40967	27196.66	4841.783
	Scholarship	127	3897	20980	9300.10	3962.042
	Faculty_Ratio	132	.03	.10	.0582	.01127
	Graduation_Rate	132	12%	88%	43.20%	17.535%
	Fresh_Retention	132	66%	97%	85.50%	6.767%
	Tuition	132	$6,696	$34,271	$15,843.29	$5,259.553

III.2.2.2 Pearson Correlations

The next step of the analysis is to examine the relationships between different variables. Bivariate correlation analysis was performed using Pearson's correlation coefficient (Wilcox 2009). This measures the strength of relationships between variables one at a time, without

controlling for the influence of other variables in the analysis. The formula for obtaining a Pearson correlation coefficient is given below:

$$r = \frac{\sum (x - \bar{x})(y - \bar{y})}{\sqrt{\sum (x - \bar{x})^2 \sum (y - \bar{y})^2}}$$

where

x and y are individual observations of the variables within a sample
$\bar{x}$ and $\bar{y}$ are the sample means of the variables

Correlation coefficients measure the strength of relationships between two variables on a scale from negative one to one. A score of zero indicates that the values for the two variables do not move together in any meaningful way, therefore knowing the value of one does not help predict the value for the other. A score of one indicates a perfectly correlated or predictive relationship, where 100% of the variation in one variable is associated with variation in the other variable. Conversely, a score of negative one indicates a perfectly inverse correlation or predictive relationship, where 100% of the variation in one variable is associated with variation in the opposite direction of the other variable.

Correlation coefficients, like other inferential statistics, attempt to infer some characteristic about the population under examination based on the analysis of one or more samples of that population. When using a sample to make inferences about a population, there is always the possibility that the result produced by the analysis of the sample will not truly reflect the actual relationship in the population. To measure this likelihood, the result is subjected to a test of statistical significance. Statistical significance in this context means that the chance that the correlation coefficient from the sample would appear because of random chance, and not because of a true relationship in the population, is less than 1%. Stated differently, if one

continually drew samples of U.S. national universities and performed these analyses on them, only in one out of every 100 instances would you calculate a correlation coefficient of the given magnitude without such a relationship existing in the underlying population (Wilcox 2009).

Table 3 presents the Pearson correlation coefficients for several key variables. Focusing first on the dependent variable of efficiency, there are three statistically significant individual correlations with other variables.

Efficiency has a correlation coefficient of 0.586 with respect to competition. Using Cohen's (1988) thresholds for effect sizes, as modified by Rosenthal (1996), the individual relationship between efficiency and competition is considered large. A large positive correlation indicates that efficiency and competition largely move together in the same direction. Recall that efficiency is measured as dollars per degree awarded, so larger values actually indicate less efficient universities. It makes intuitive sense that highly competitive universities would be less efficient, but as with all correlations we must be cautious not to interpret causality. There is nothing in the data that indicates that *because* a university is competitive that it is less efficient, or that *because* a university is less efficient it is competitive. The large correlation coefficient only means that these measures move together.

Efficiency is also correlated individually with the U.S. News and World Report quality score index. The correlation coefficient of 0.680 is even stronger than the relationship between efficiency and competition. The magnitude here is just shy of the "very strong," category. Again, this makes intuitive sense. High quality universities are likely to experience larger expenditures to attract and retain high quality faculty, which would be associated with higher costs per degree awarded.

Efficiency is negatively correlated with the binary measure for publicness with a small magnitude coefficient of -0.188. This means that lower costs per degree awarded are associated with higher levels of publicness. The coding for the binary definition of publicness is a value of zero for private universities, and a value of one for public universities. The negative correlation indicates that public universities are associated with lower core expenditures per award than are private universities. Recall, however, that this is a bivariate correlation analysis, and so the relationship between the two is not taking into consideration other variables. That analysis will come later.

With respect to the continuous variable for publicness, there are statistically significant correlations with competition, and quality. Publicness has a small negative correlation of -0.171 with competition when measured continuously, and a medium negative correlation of -0.411 when measured in the binary sense. This is an indication that public universities are associated with fewer rejections of applications for admission than are private universities. Anecdotally, many are familiar with stories of elite private universities where admission is very competitive, but these correlation coefficients take into account the relationship between publicness and competition for all universities studied. The data include some highly selective public institutions like the Universities of Virginia and Michigan, as well as less selective private universities.

Publicness also has a small negative correlation of -0.199 with quality as measured by the U.S. News and World Report score index when publicness is measured continuously, and a medium negative correlation with quality of -0.363 when publicness is measured in the binary sense. This is an indication that public universities are associated with lower levels of quality scores on this index than are private universities.

Finally, the strongest correlation is between quality and competition. The correlation coefficient there of 0.813 falls comfortably within the "very large," range. This is even larger than correlation between the two definitions of publicness (0.809), which we would expect to be the largest in the set because both definitions purport to measure the same underlying concept. Part of the strength of this correlation is explained by the fact that the quality index contains a component which measures competition. Even with this partial explanation, the relationship is still very strong. This is evidence that much of the variation in the competitiveness of admission to a university is associated with variations in the quality of the university. When this correlation is combined with the correlations between publicness and quality and between publicness and competition discussed above, there is some indication that public and private universities may be competing for different students. If public universities are associated with lower quality scores, and public universities are associated with lower competition for admission, and lower quality scores are very strongly associated with less competition for admission, it may be the case that public and private universities are competing for different sets of students.

Again, all of the correlation coefficients discussed only suggest that variables move together, and further only suggest that one variable moves with one other variable. The "chain-logic," used in the preceding paragraph to introduce the notion that public and private universities are competing for different students cannot be fully supported with correlation analysis because each relationship described at each step of the analysis pertains only to the relationship between two variables. To simultaneously account for changes in multiple variables, we need to move from correlation analysis to regression and structural equation modeling.

Table 3: Bivariate Pearson Correlations

Correlations

		Efficiency	Public_Continuous	Competition	Quality_Index	Public_Binary
Efficiency	Pearson Correlation	1	.086	.586**	.680**	-.188**
	Sig. (2-tailed)		.193	.000	.000	.004
	N	230	229	230	230	230
Public_Continuous	Pearson Correlation	.086	1	-.171**	-.199**	.809**
	Sig. (2-tailed)	.193		.009	.003	.000
	N	229	229	229	229	229
Competition	Pearson Correlation	.586**	-.171**	1	.813**	-.411**
	Sig. (2-tailed)	.000	.009		.000	.000
	N	230	229	230	230	230
Quality_Index	Pearson Correlation	.680**	-.199**	.813**	1	-.363**
	Sig. (2-tailed)	.000	.003	.000		.000
	N	230	229	230	230	230
Public_Binary	Pearson Correlation	-.188**	.809**	-.411**	-.363**	1
	Sig. (2-tailed)	.004	.000	.000	.000	
	N	230	229	230	230	230

**. Correlation is significant at the 0.01 level (2-tailed).

III.2.2.3 Structural Equation Modeling and Regression

The final analysis for stage one involves structural equation modeling. Structural equation modeling is a form of statistical analysis designed to perform regression analysis on several latent variables simultaneously (Hair 2014) (Hair Ringle & Sarstedt 2011) (Hancock & Mueller 2013). Linear regression is a statistical method of analysis by which the impact of one variable, the independent or explanatory variable, is measured on another, the dependent or explained variable. The advantage of linear regression over correlation analysis is that linear regression allows for the analysis of the impact of the explanatory variable on the explained variable, while holding constant the values of other variables which may also influence the explained variable. Unlike correlation analysis, linear regression allows the influences of

multiple explanatory variables to be tested on a single explained variable simultaneously such that the effect of each explanatory variable can be ascertained individually.

Linear regression simultaneously estimates the relationships between one or more explanatory variables and a single explained variable by minimizing the sum of the squared variances between the individual observations of each variable and the estimated line that best fits the data. The most general form of the regression equation is given as:

$$y = \alpha + \boldsymbol{\beta}x + \varepsilon$$

where

y is the dependent variable
α is the intercept
β is the slope
x is the independent variable
ε is the error term

In the regression equation, beta estimates the impact that each independent variable has on the dependent variable. Unstandardized betas are presented in the units of measure for the original variables and indicate how much change a one unit increase in the independent variable changes the dependent variable. When the betas are standardized such that they are presented in terms of standard deviations, they can be interpreted much like correlation coefficients. Standardized betas estimate the relative explanatory strength of each independent variable on the dependent variable (Freedman 2009).

Structural equation modeling takes the advantage of linear regression over correlation one step further. In linear regression, the influence of multiple explanatory variables can be tested on a single explained variable. In structural equation modeling, multiple explanatory variables can be tested on multiple explained variables. Variables in structural equation modeling can act as both explanatory as well as explained latent variables.

Four structural equation models were performed. Two models used the binary definition of public as the independent variable, and two used the continuous definition. Two models used the U.S. News and World Report quality score as a control for quality, and two models used several constituent indicators of quality as controls. Model 3, which uses the continuous measure of publicness and the U.S. News and World Report score as the quality control, is the preferred model. Model 3 is preferred because it has a continuous rather than binary independent variable, and because there is no multicollinearity amongst multiple indicators for quality. The other models are presented to demonstrate that the results hold under alternate definitions of publicness with alternate controls for quality. The estimated standardized betas are summarized in Table 4. The results of all four models are contained in **APPENDICES C-F**.

The results of these models support several conclusions about the comparative efficiency of public and private sector provision of postsecondary education in U.S national universities.

III.2.2.3.1 Hypothesis 1

With respect to hypothesis one, that public universities are less efficient than private universities, the model shows a positive relationship between the publicness of a university and the university's core expenses per award. That is, as a university becomes more public, it expends more dollars per award granted than its private counterparts (becomes less efficient), even after controlling for differences in quality. Again, using Cohen's (1988) thresholds for effect sizes, as modified by Rosenthal (1996), the estimated standardized beta of .232 in the primary model is considered a small effect. The effect is statistically significant in all models, although the magnitude of the effect size varies across models.

Standardized betas represent strengths of relationships, but there is also meaning attached to unstandardized betas. Unstandardized betas are the estimated slopes in the regression

equation presented in Section III.1.2.2.3. Since unstandardized betas are presented in the original units for the variables they pertain to, they can be used to predict values for the dependent variable given values for the independent variables.

As an example, running a standard ordinary least squares regression analysis on the secondary data with efficiency as the dependent variable and with the continuous measure of publicness, competition, and quality as the explanatory variables yields the following regression equation:

y = -$140,129 + ($1,535)*(Publicness) + ($629)*(Competition) + ($4,688)*(Quality)

Before proceeding, it is important to note that the unstandardized beta estimate for competition of $629 is not statistically significant at 95%. For a full report of the regression analysis, please see **APPENDIX G**.

One method for interpreting and testing estimates produced by a regression analysis is to use the estimated regression equation to estimate a data point that is already in the sample used to construct the regression. If I substitute the average values for public universities in the estimated regression equation, I find:

y = -$140,129 + ($1,535)*(43.7) + ($629)*(35.4) + ($4,668)*(44.8)

or

y = $158,374 per degree awarded

The actual average efficiency of the public universities in the sample was $146,977. The regression equation over-estimated the parameter by $8,788, or roughly 7.75%.

Similarly, if I substitute the average values for a private university from the descriptive statistics, I find:

$$y = -\$140,129 + (\$1,535)*(11) + (\$629)*(54.4) + (\$4,668)*(58.1)$$

or

$$y = \$182,218 \text{ per degree awarded}$$

The actual average efficiency of the private universities in the sample was $197,097. The regression equation under-estimated the parameter by $14,879, or roughly 7.55%.

The estimated regression equation can be used to predict values for the dependent variable given any set of values for the independent variables. With respect to hypothesis one, the correct interpretation for the unstandardized beta is, "For each additional percentage point of operating revenues that a university receives from government sources, their operating cost per degree awarded will increase by $1,535, controlling for the influence of competition and quality."

III.2.2.3.2 Hypothesis 2

With respect to hypothesis two, which predicts that public universities will experience less competition for students than private universities, there is mixed support for the mediating influence of competition between publicness and efficiency. The primary model shows a very weak negative effect of -0.10, but the estimated effect is not statistically significant. The first model also shows a weak negative effect, and the effect there is statistically significant. However, models 2 and 4, which use the constituent controls for quality, both show a weak positive effect, one of which is significant and the other of which is not. There is not sufficient evidence in the data to conclude that public universities face less competition for students than private universities.

To evaluate the unstandardized beta, I estimate a new regression equation where competition is the dependent variable rather than efficiency, and the independent variables are the continuous measure for publicness and quality. This yields the estimated regression equation:

$$y = -8.04\% - (.01\%)*(\text{Publicness}) + (1.03\%)*(\text{Quality})$$

Again, it is worth noting before continuing that the estimated unstandardized beta for publicness is not statistically significant at 95%. This is evidence to conclude that the data do not support the hypothesis that publicness contributes to competition. Full results of the regression analysis are found in **APPENDIX H**.

Notwithstanding the fact that the regression equation yields a non-statistically significant coefficient for publicness, we continue the interpretation by substituting the average values for public universities, and find:

$$y = -8.04\% - (.01\%)*(43.7) + (1.03\%)*(44.8)$$

or

$$y = 37.4\% \text{ rejection rate}$$

The actual average level of competition for public universities in the sample, as measured by the application rejection rate, was 35.4%. The regression equation over-estimated the parameter by 2%, or roughly 5.6% of the actual value.

Similarly, if I substitute the average values for a private university from the descriptive statistics, I find:

$$y = -8.04\% - (.01\%)*(11) + (1.03\%)*(58.1)$$

or

$$y = 51.5\% \text{ rejection rate}$$

The actual average level of competition for private universities in the sample, as measured by the application rejection rate, was 54.4%. The regression equation over-estimated the parameter by 3%, or roughly 5% of the actual value.

III.2.2.3.3 Hypothesis 3

With respect to H3, which predicts that universities which experience more competition for students will be more efficient, there is again mixed support for the mediating influence of competition between publicness and efficiency. The primary model shows a small effect of .106, and the estimated effect is statistically significant. The first model also shows a small, statistically significant effect (.128), but the second (-.067) and fourth (.136) models indicate small negative effects, one of which is statistically significant. There is not sufficient evidence in the data to conclude that public universities face less competition for students than private universities.

Regarding the unstandardized betas, we can use the same regression equation used for hypothesis one and interpret those results. Recall that the coefficient for competition in that estimated regression equation was not statistically significant at 95%. This is evidence that the data do not support the hypothesis that competition affects efficiency.

III.2.2.3.4 Other Findings

There are also several other interesting findings that result from stage one which were not part of the original set of hypotheses. For example, the primary model shows a small negative effect of publicness on quality (-.199). The other models provide similar support with different

effect sizes, and all are statistically significant. This is an indication that public schools are of lower "quality," and that holds true for both measures of quality and both measures of publicness. Coupled with the finding that there is little evidence to support the hypothesis that public schools face less competition for students, this evidence suggests that public and private universities are perhaps competing in two different spheres for two different populations of students.

This notion is further supported by an additional finding, which is that the quality of the university has a very large effect on the level of competition. The primary model shows an effect size of .813 between quality and competition. That effect, and the large effect size, are reproduced in the other three models, and the effect size is even larger than the control in place between quality and efficiency (.640). Quality goes a long way in explaining how much competition there is to attend a university, and the publicness of the university affects quality.

The evidence thus far indicates that there is an inverse relationship between the publicness of a U.S. national university and the efficiency with which the university delivers postsecondary education. The relationship does not appear to be mediated through competition. The model does indicate that there may be other mediating variables between publicness and efficiency. To explore the mediating influence of personal motivation of efficiency and bureaucratic motivation for inefficiency, we turn our attention to stage two and the collection and analysis of qualitative data.

Table 4: Structural Equation Modeling Results

			Test H1	Test H2			Test H3
#	Independent/Control	Publicness to Quality	Publicness to Efficiency	Publicness to Competition	Quality to Competition	Quality to Efficiency	Competition to Efficiency
1	Binary/Index	-0.363**	0.085*	-0.133**	0.765**	0.607**	0.128**
2	Binary/Constituent	-0.652**	0.527**	0.172**	0.907**	1.139**	-0.067
3	Continuous/Index	-0.199**	0.232**	-0.010	0.811**	0.640**	0.106*
4	Continuous/Constituent	-0.224*	0.282**	0.011	0.813**	0.977**	-0.136*

* Significant at 95%
**Significant at 99%

III.3 Stage Two

Having performed statistical analysis on secondary data to provide evidence of a relationship between the publicness of a university and the efficiency of the university, I now turn to the question of why that might be the case. The analysis in stage one did not support the hypothesis that competition played a mediating role between the publicness of a university and the efficiency with which the university conferred degrees. The model proposed in Figure 2 contemplates two other possible sources of mediation for the relationship in accordance with expectancy theory and budget-maximizing theory.

The data required to test the mediating influence of personal motivations and budgeting models are not currently collected and reported in any meaningful way. There is some scattered information available on university websites and in financial statements related to the budgeting process, but the data is very spotty and not useable for any statistical analysis. Data on the personal motivations of university administrators are even scarcer, as by definition the

motivation for individual administrators is unique to the administrator and does not exist in any meaningful way at the university level.

III.3.1 *Primary Data Collection*

To collect the data necessary to better understand the mediating impacts of personal motivation and budgeting processes, a series of semi-structured depth interviews was performed with administrators and faculty at both public and private universities. Semi-structured depth interviews allow the investigator to guide an information gathering discussion with the subject, while allowing the subject freedom to give rich, meaningful insights into the matter under investigation (Strauss 1987).

A total of ten interviews were conducted in February and March of 2018, both face-to-face and over the telephone. Audio of the interviews was recorded, and the audio file was used to create a written transcript of the interview. The written interview transcripts then became the artifacts which were the basis of qualitative analysis.

Universities were chosen at random from the list of 230 universities examined in stage one. Contact was made via e-mail and by telephone with a point of contact listed on publicly available websites for offices of institutional research. After briefly explaining the research to the instructional research point of contact, the investigator asked for the name of a potential interview subject. The only conditions imposed for participation were that subject had to be willing to be interviewed, and that they had familiarity with the university budgeting process.

The ten subjects that agreed to participate were subjected to a semi-structured interview consisting of six questions, with appropriate follow-up questions or re-directions as needed. Before the interviews began, the investigator gave a brief introduction to the research, including the definition for the term "efficiency." The questions encouraged subjects to discuss the relative

importance of efficiency at their university, the incentives in place and personal motivations to be efficient, the influence of the budgeting process on efficiency, and the views of the administrator on non-traditional academic calendars and non-traditional methods of course delivery, such as online learning, in terms of both their impacts on efficiency and the quality of education provided. The complete interview guide used can be found in **Appendix B.**

III.3.2 *Data Analysis*

III.3.2.1 Data Description

To encourage honest and forthright discussions during the interviews, subjects were assured that personally identifiable information would not be included in the research. However, it is possible to provide some general overview of the interview data collected to provide context for its analysis. Ideally, interviews would be conducted with university presidents or provosts to provide the broadest possible view of university budgeting, and to ascertain the personal motivations of individuals at the highest levels of the university administration with ostensibly the most ability to influence such a broad measure as university efficiency. Practically, these individuals have enormous demands on their time, and are therefore difficult to gain access to. To partially overcome this inability to collect data from the highest levels of university administrators, the investigator interviewed a broad sample of university personnel to gain perspectives from different areas of university life.

The interview subjects had experience in several different areas of the university including research, student aid, registration, institutional effectiveness, and academic program management. Their experiences covered a broad range of university activities, including assisting students, interacting with the federal government, general university administration, academic program creation and management. None of the subjects listed their primary

responsibility as teaching, although three of the public university subjects and four of the private university subjects were either actively teaching courses or had taught courses within the past two academic years.

Three interview subjects had worked at both public and private universities and were able to provide comparative and contrasting points of view for each type of institution. Most subjects had been in academia their entire professional career, and the average time at the current institution was 12 years. Only one subject described himself as being in the early stage of his career, most considered themselves in mid-career, and two subjects mentioned decisions or impending decisions to retire within the next five years.

III.3.2.2 Word Cloud Analysis

Using online tools to perform world cloud analysis has been recognized as a useful supplement to more traditional methods of qualitative analysis (McNaught and Lam 2010). Word cloud analysis involves transforming textual interview data into graphic form. The size of words and phrases that appear in the graphic represent the relative frequency with which the words or phrases occurred in the interview transcript. This provides a visual overview of the words spoken most frequently by the interview subjects, which may be thought of as a proxy for the relative importance they place on the concepts.

Creating meaningful word clouds requires some data cleansing. The author removed common verbal ticks such as “um,” “uh,” “like,” “so,” and “you know” from the analysis. Also, some basic transformations were made to combine like words and phrases such as “student” and “students” and “efficiency” and “efficient.”

Figures 3 shows the word cloud resulting from the combination of all private university subject interview transcripts, and Figure 4 shows the world cloud from all public university subject interviews.

The most striking similarity between the two clouds is that the largest, and therefore most frequently occurring word in both, is “students.” Subjects from both private and public universities discussed the concept of efficiency from a student-centric perspective. The subjects were not familiar with speaking of efficiency in terms of how the university was using its resources; instead they were thinking in terms of the time and effort students were expending to obtain their degrees. Four-year and six-year graduation rates, which are outcome measures, were discussed as measures of efficiency for moving students through the university system. This was especially true at public universities, where the degree to which “students” was the most frequent word was even greater than its relative frequency in private university interviews.

Perhaps more interesting than the similarities are the differences in the word clouds. For example, the word “state” appears with some regularity in the public university interviews, but not at all in the private university interviews. The words “research,” "budget," and “tuition” appear more frequently in public university interviews. For the private university interviews, terms related to the structure of the universities like “model” and “mission" are more prevalent. Importantly, the relative importance of terms that indicate size were very different between the two types of universities. Subjects at private universities were more likely to use terms like “small,” and “little,” when discussing size, whereas the most prevalent size term in the public university interviews was “big.”

The similarities and differences in word clouds are brought into even sharper relief by comparing the ten most frequently used terms from each cloud. For private university subjects,

the ten most frequently used words were “students,” “faculty,” “efficiency,” “years,” “college,” “going,” “really,” “money,” “mission,” and “model.” For public university subjects, the ten most frequently used words were, “students,” “university,” “going,” “get,” “efficiency,” “money,” “budget,” “research,” “state,” and “really.”

The fact that private university subjects used the word “faculty” more frequently than "efficiency," even though the questions coming from the interviewer used the term “efficiency,” but not “faculty,” implies that the concept of faculty is very important to private university subjects. Based on interviewer observation of content and tone, private university subjects most often spoke of faculty in terms of resources that improved the experience for students, but acted as a drain on, and were often openly hostile to, the concept of “efficiency.” That is why the term “efficiency,” appeared next most frequently, and toward the end of the list the terms “mission,” and “model," as in subjects describing that the mission of the university and model it used were, by nature, not efficient.

Public university interview subjects spoke about efficiency as well, but even though the term was included in their questions just as with private university subjects, the public subjects only used it enough for the term to be the fifth most popular, as opposed to the third most popular with private university subjects. This implies that the concept of efficiency, even during an interview about efficiency, was just not as much on the forefront of the minds of public university subjects.

Word cloud analysis can help with beginning to identify trends in qualitative data. Some early patterns begin to emerge with respect to the views of university administrators in general, but also some differences between the concepts that public and private university administrators emphasize. All interview subjects were familiar with the concept of efficiency from the point of

view of students, but not from the point of view of the university. Private university administrators were more likely to talk about the mission of the university and the model of education they used to achieve that mission, whereas public university administrators focused on words indicating diverse missions like “research,” but also on terms related to revenue and efficiency such as “tuition,” and “budget.”

To confirm these trends, and find further patterns in the data, I turn to a more established and systematic tool for analyzing qualitative data.

Figure 3: Private University Word Cloud

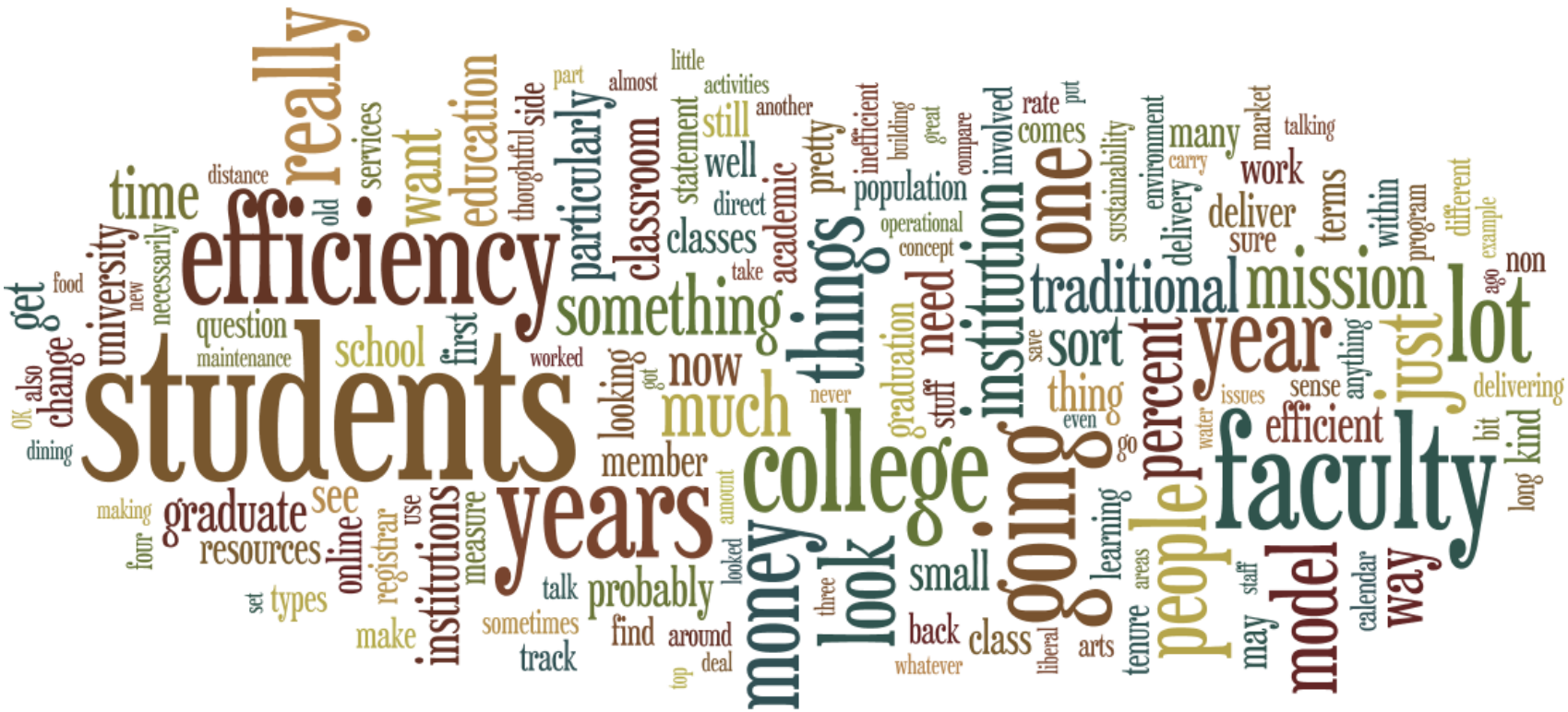


Figure 4: Public University Word Cloud

III.3.2.3 Matrix Analysis

Matrix analysis is another tool of qualitative analysis, which is useful for both coding and analysis, but can be especially useful with respect to identifying themes and comparing themes across subgroups (Ryan and Bernard 2003). Figures 5 and 6 contain matrices that extract themes from the responses for private university subjects and public university subjects. The first column corresponds to the topics introduced through the semi-structured interview questions. The second column contains representative quotes from interview subjects about the topic, and the third column indicates an overall pattern of the responses.

Comparing the responses for the importance of efficiency at the university between the matrices gives insight into how administrators at each type of university view the topic at their institution. Overall, subjects at private universities did not consider efficiency to be a topic that their administrations discussed frequently or emphasized. There was some indication that the concept of efficiency had been gaining popularity and interest over the recent past, while some private university subjects expressed a clear opinion that efficiency in delivery of education was almost antithetical to their business model.

On the other hand, public university administrators indicated that they heard the concept of efficiency discussed relatively frequently. Public interview subjects were not able to articulate precisely what the university goals were with respect to efficiency, but the topic did come up in regular conversation. The views of efficiency were context specific, generally with faculty members discussing the concept less frequently and with more disdain, but with higher level administrators focusing more on the topic and seeming more interested in understanding the metrics around efficiency.

Regarding the use of efficiency metrics and measures of efficiency, both private and public university interview subjects indicated that their universities collected or tracked at least some information about efficiency. Neither type of university was interested in using their efficiency metrics to attract potential students, in fact some of the private university subjects again stated that marketing based on efficiency would be counter-productive from the standpoint of their efforts to brand themselves as a "high touch" university. Public university administrators did mention, without prompting or direct questioning by the interviewer, that efficiency metrics can and were used for other purposes. Two public university subjects discussed in detail how efficiency measures were used during discussions with the state legislature, and one mentioned that the university president and members of the board of trustees were interested in efficiency metrics.

Regarding the influence of budgeting on efficiency, the private university subjects did not indicate that the budgeting process had a great deal of impact on efficiency. For the most part, budgeting did seem to be based on previous year budgets, but several subjects indicated that other factors played a role and the relationship between budgeting and efficiency was weak.

Public university administrators, on the hand, were clear that the budgeting process was a disincentive to behaving efficiently. The term "use it or lose it," was brought up more than once, and one subject indicated employees would go on a "spending spree" as they approached the end of a budget year. This problem was exacerbated by a lot of cross-subsidizing between budgetary units in the form of indirect cost allocations to and from a central budgeting unit, to the point that it was not clear what units were operating efficiently and which were not.

Public administrators did indicate that there had been a shift over the past ten years toward a more de-centralized budgeting process, but in one instance the subject indicated that

this was more of a cyclical change than a linear movement toward decentralization. At least one public administrator also indicated that the university was moving toward a more "student outcome-based budgeting model," although the administrator was not clear on how student outcomes were to be measured or how the budgeting shift would be implemented.

To understand the use of one possible tool to increase efficiency, the interviewer asked private and public university subjects about their university's adoption of non-traditional academic calendars and/or non-traditional methods of course delivery such as online or distance learning programs. The questioning centered around not only their use of non-traditional instruction methods, but also their thoughts on whether the use of non-traditional course delivery would constitute a degradation in the quality of the educational experience.

Private university subjects indicated, for the most part, that they had begun to adopt some forms of non-traditional academic calendars such as more instruction during the summer, but by and large they were resistant to online and distance learning. The private university subjects expressed that online and distance learning did represent a lower level of educational quality than in-person instruction, but more broadly they perceived resistance to online instruction at their university as more "not a fit" for their model of instruction. Words like "tradition," "model," and "our way of doing business," were prevalent during these portions of the interviews.

Public university subjects expressed a much greater willingness to adopt both non-traditional academic calendars and especially non-traditional methods of course delivery. Two public university subjects spoke of non-traditional course delivery almost as points of pride. One subject indicated "We are really progressive," in terms of delivering online and distance learning, and another stated that "We have really leaned into that." Public university subjects also exhibited the sentiment that online course delivery could result in a loss of educational

quality, but they were more nuanced in their reservations. Three public university subjects indicated that the type of instruction was the key to whether the course could be delivered online without a loss in quality. Subjects such as mathematics and chemistry which lend themselves to a more lecture-style learning environment were thought to be good candidates for online learning, whereas seminar or participation-based learning were thought to be poor candidates.

III.3.2.4 Other Qualitative Insights

Aside from the trends identified by the word cloud analysis and refined in the matrix analysis, some additional patterns emerged from the interviews overall which were not directly related to questions in the interview or to the concepts contained in the hypothesized model of efficiency. Three main patterns emerged spontaneously throughout the interview process and were common across both types of interview subjects.

First, as partially discussed earlier, interview subjects were not particularly familiar with thinking of efficiency in terms of the university, as opposed to in terms of the student as they moved through the university. When subjects began to think more deeply about efficiency from the standpoint of the university, they began to make distinctions between the efficiency of the university in terms of day-to-day operations, and the efficiency of the university with respect to delivering education. Subjects agreed that concepts such as dining operations, building maintenance, landscaping, and other operational aspects of the university were subject to pressures for efficiency. The way in which the university was organized academically and the way in which the university delivered education were thought to be outside the realm of efficiency considerations. The subjects' responses implied that attempting to apply efficiency to the academic aspects of the university would be thought of as crude or counterproductive,

whereas focusing on efficiency in daily operations was accepted and encouraged as part of being good stewards of students' tuition dollars.

Related to the first point, when discussing the efficiency of daily operations, two private university subjects and three public university subjects used the term "sustainability" in lieu of efficiency. All these subjects interpreted efforts at sustainability to be euphemisms for operational efficiency but packaged in such a way as to be more attractive to outside stakeholders. Subject eight told an entire story that lasted nearly four minutes about how the university had saved several million dollars in landscaping and watering costs by changing to hardscaping, but specifically did not emphasize the cost savings when discussing their "green initiatives." The same was true from subject three, who told a story about eliminating trays in the cafeteria, forcing students to make multiple trips to carry all their food. The university highlighted the fact that less soap and water were used since there was no longer a need to wash trays but did not advertise the fact that students were now eating less because of the change, and so food costs had gone down while the price of a meal plan had not. Again, the undercurrent of the stories was that it was somehow distasteful to discuss efficiency for its own sake.

Finally, a stray pattern emerged concerning confusing the size of the university with the publicness of a university. The beginning of this pattern was identified in the word cloud analysis but was clearly touched upon by multiple subjects in their interviews even beyond the extent of the relative size of the words in the word clouds. The subjects routinely used "small" to mean "private," and "large," to mean "public." This is best illustrated by an interaction with subject three, who currently works at a large public university, but had previously worked at a small, private liberal arts university. Proper nouns are redacted for privacy, and italics is added for emphasis. Also, like most other subjects, subject three here assumes that my findings in

stage one, which were discussed generally before the interview, had found public universities to be more efficient than private ones.

Interviewer: "You mentioned previously that you worked for a private university before your current position. Can you tell me a little about how *private* universities view efficiency differently than *public* universities?"

Subject 3: "So, prior to (current university), I was at (previous university). I think the *smaller* liberal arts schools tend not to do nearly as good a job as the *bigger* state schools in terms of efficiency. They just do not measure or care about it as much. It is not a concern of theirs."

III.3.2.4.1 Hypothesis 1

Recall that there was evidence from stage one to support the hypothesis that private universities are more efficient than public universities, but there was not sufficient evidence to support hypotheses that this relationship was mediated through competition. The matrix analysis in stage two provides some additional insight into why private universities may be more efficient.

As discussed below under hypothesis six, the budgeting model of the university may be playing a role. Beyond budgeting though, the concept of efficiency just did not seem to be at the forefront of public university subjects' minds. This was also true of private university interview subjects, but the concept was even more remote from the forefront for public university subjects than for private university subjects.

When public university managers did begin to speak about efficiency, they often spoke very narrowly about areas with which they were familiar. That was true even of the more senior level public university subjects interviewed. Recall also that some interview subjects used the terms "public" and "large" interchangeably, and "private" and "small" interchangeably. Finally,

recall that public university subjects discussed centralized budgeting and cross-subsidization of units across campus.

Together, these points may help explain why private universities are more efficient than public universities. It may be the case that public universities are so large, and unfocused on efficiency, and so narrowly focused on budget units which are cross-subsidizing one another, that they may be experiencing some diseconomies of scale. Rather than enjoying the benefits of spreading fixed costs over a larger number of students, it may be the case that these universities become so large and difficult to manage from an overall point of view, that individual units make decisions that ultimately lead to less efficiency at the university level.

III.3.2.4.2 Hypothesis 4

There is not sufficient evidence to support the hypothesis that managers at public universities are less motivated to act in efficient ways than are managers in private universities. Neither public nor private university administrators could readily think of incentives that their universities had put in place to increase efficiency. This question tended to bring the interviews almost to a standstill. It took a good deal of mental effort for the subjects to understand what was being asked, and even after providing examples of possible incentives that could be put in place, almost no subject was able to come with an example at their university. Only one of the ten subjects was finally able to offer that he had received an extra $100 in return for attending a health screening, and that example took him nearly one minute to recall. Either universities are not implementing incentives for efficient behavior, or if they are, they are doing an ineffective job of communicating those efforts to employees.

III.3.2.4.3 Hypothesis 5

The data do not provide evidence that managers who are more motivated to behave in efficient ways increase the efficiency of their universities. There was little to no variation in the level of motivation for personal efficiency, either as measured by university incentives in place, or in terms of other general topics raised by interview subjects during the interviews. More variation is needed in the level of personal motivation before meaningful conclusions may be drawn concerning the impact of motivation on efficiency.

III.3.2.4.4 Hypothesis 6

There is evidence to support hypothesis six, which indicated that public university managers would perceive more bureaucratic motivation for inefficiency. While private university managers were somewhat ambiguous in their responses, public university managers clearly signaled that centralized budgeting and a "use it or lose it," mentality encouraged officials to act in inefficient ways.

Perhaps more importantly though, the budgeting process was also revealed as a source of masking which units were efficient and which were not based. Heavy use of indirect cost allocations and centralized budgeting processes in public universities mean that it is difficult for managers to grasp an overall view of efficiency, and to easily identify which units are efficient and which are not.

While this same pattern may be true to a certain extent in private universities, it was not mentioned by any private university interview subjects. This indicates that the pattern is either not present, or possibly present but not as prevalent at private universities.

III.3.2.4.5 Hypothesis 7

While there is no direct evidence to support the hypothesis that employees with less bureaucratic motivation for inefficiency will cause their universities to operate in a more efficient manner, there is indirect evidence that indicates this is a likely mediator for the relationship between publicness and efficiency. The evidence from hypothesis one indicates that public universities are less efficient than private universities, and the evidence from hypothesis six indicates that public university managers experience more bureaucratic motivation for inefficiency. The combination of these sets of evidence suggest that bureaucratic motivation for inefficiency is a prime candidate to help explain the relationship between publicness and efficiency.

Figure 5: Private University Matrix Analysis

Topic	Representative Private University Quotes	Private University Theme
Importance of Efficiency	"I was the only one that really gave much thought to that sort of concept." "I think it's something we talk about a lot." "I'd say it depends on the situation…on the operational side it is very important…but on the academic side, not at all." "We are thoughtful of how we use resources now, but ten years ago not at all." "I would phrase it as, we don't worry about inefficiency, because it's part of our business model."	Little to no emphasis on efficiency, although there has been increased focus there over the past ten years.
Use of Efficiency Metrics	"We measure a lot." "We do not directly market to students on efficiency, although we do so indirectly." "It does not help attract students." "This is a high touch country club type of school, efficiency would not be something we would promote to students. Their parents are driving the equivalent of two Lexus' off a cliff each year to send them here."	Not used in marketing material to attract potential students.
Impact of Budget Process	"The budget matters, and it matters a great deal, but only on the operational side." "Budgets are largely based on what we spent last year." "I have never worried about the budget process, because we have the luxury of being able to fundraise almost at will."	The budget process does not incentivize efficiency and may work as a disincentive to efficiency.
Incentives / Motivation	"There wasn't anything direct." "I know what you're talking about, but that is not something we have done that I'm aware of." "We do not have an incentive structure like what you are talking about."	There are no formal or informal incentives in place to reward efficient behavior.
Non-Traditional Instruction	"We are a very traditional school." "That is not what we do. We will not even accept transfer credits from an online university." "There is active resistance to that." "We have started to move ever so slightly toward more classes in the summer, but as to online or distance learning, there has been no movement in that direction and I can't see it happening in the foreseeable future."	Very little support for non-traditional academic calendars, and no support for non-traditional methods of course delivery.

Figure 6: Public University Matrix Analysis

Topic	Representative Public University Quotes	Public University Theme
Importance of Efficiency	"I think it's something we talk about more. It has been more of a focus in recent years with budget cuts from the state." "I think people do pay attention to it, but more at a student level and it depends on who you are talking to." "Faculty do not really pay attention, but for those in other roles it varies." "I hear it discussed from time to time."	The topic is discussed in general terms, but it is very context dependent.
Use of Efficiency Metrics	"You talk about efficiency, but that is also part of sustainability…that is good public relations, so they are going to market that." "Efficiency, no, I've never seen that in the marketing materials…we market on student experience and football." "We don't market it to students…but it would be something we would discuss with the legislature." "It would not be included in marketing…but would be used by administration."	Not used in marketing material to attract potential students, but useful for other purposes.
Impact of Budget Process	"This is how much we spent last year, and we need to spend it because if we don't, we'll get less next year." "The budget model is changing to more of a focus on student success." "If the facilities people had money in the month of May, they would go on a spending spree." "It's use it or lose it." "More of the money, instead of being centralized, is kind of doled out so there is a little bit more discretion among units." "I don't know of any incentives to come in under budget."	There are some strong disincentives to efficiency, although that is changing or somewhat mitigated through shifts toward de-centralization or outcome-based budgeting.
Incentives / Motivation	"If you participate in a health screening, they give you $100." "I can't think of any specific examples." I've worked at a few places that do that, not here, I can't think of one." "I don't know of anything off the top of my head…there are resources like lean six sigma for them to use, but no incentives." "The answer is no, and the problem is the accounting system makes it hard to tell how efficient you are." "No, not that I'm aware of."	There are few or no incentives in place to reward efficient behavior.
Non-Traditional Instruction	"We offer a lot of instruction at non-traditional times, and some online and distance learning." "I think we're pretty progressive…we have an online college." "Yes, we're very interested in that." "We offer distance learning, although there is some debate as to the quality of the educational experience." "We have several online and distance learning courses and programs."	Wide support for non-traditional calendars and non-traditional instruction, but not at the expense of quality.

IV DISCUSSION

IV.1 Conclusions

The model set forth in Figure 2 contained seven hypotheses. Using the combined quantitative and qualitative analyses, I am now able to draw some conclusions regarding some of those hypotheses.

H1: The more publicness a university exhibits, the less efficient the university will be with respect to producing postsecondary education.

Four structural equation models using both a binary and continuous measure for publicness as well as an index and component-based controls for quality provide support at a 99% level of statistical significance that there is a relationship between publicness and efficiency. Examining 230 national universities in the United States, the primary model indicated a small effect size of 0.232 between publicness and efficiency. The direction of the relationship was consistent with the hypothesis, meaning that as a university became more public, it expended more dollars per degree awarded, even after accounting for the effects of quality.

H2: The relationship between publicness and efficiency will be mediated through competition for students. Managers at public universities will perceive less competition for students than will managers at private universities.

The quantitative data analyzed do not provide sufficient evidence to support this hypothesis. Two of the structural equation models indicated a very weak positive relationship and two indicated a very weak negative relationship. Two models indicated a statistically significant relationship, but two others indicated the effect size was not statistically significant.

H3: The relationship between publicness and efficiency will be mediated through competition for students. The more competition a university faces for students, the more efficient the university will be.

The quantitative data analyzed do not provide sufficient evidence to support this hypothesis. Two of the structural equation models indicated a very weak positive relationship and two indicated a very weak negative relationship. Two models indicated a statistically significant relationship at 95% confidence, but one indicated the effect size was not statistically significant.

H4: The relationship between publicness and efficiency will be mediated through personal motivation for efficiency. Managers at public universities will be less motivated to make the university operate more efficiently than will be managers at private universities.

After performing ten semi-structured in depth interviews with five private university administrators and five public university administrators, no evidence was found to support this hypothesis. Neither private nor public university administrators were aware of any incentives offered by their universities to behave in efficient ways.

H5: The relationship between publicness and efficiency will be mediated through personal motivation for efficiency. The more managers are motivated to increase efficiency, the more efficient the university will be.

There is not sufficient data to provide evidence for this hypothesis. More variability is needed in terms of the incentive structure facing managers before meaningful comparisons may be made.

H6: The relationship between publicness and efficiency will be mediated through bureaucratic motivation for inefficiency. Managers at public universities will perceive more bureaucratic motivation for inefficiency than will managers at private universities.

The qualitative interviews do provide some evidence that managers at public universities are more aware of the perverse budgetary influences on university efficiency. A clear pattern

emerged among public university interview subjects concerning the "use it or lose it," nature of budgeted funds, where no such pattern emerged for private university interview subjects.

H7: The relationship between publicness and efficiency will be mediated through bureaucratic motivation for inefficiency. The more managers perceive bureaucratic motivation for inefficiency, the less efficient the university will be.

The combination of the qualitative interviews and the quantitative analysis provides some evidence that this might be the case. The combination of evidence from H1 and H6 implies that budgetary incentives may be the mechanism through which publicness impacts inefficiency.

IV.2 Limitations

Like all research, the current study makes deliberate choices about what research questions to answer, and what methods to use to answer those questions. In making these choices, limitations on the research are introduced.

With regard to the quantitative analysis, some data points are missing or appear to be reported in an inconsistent manner in the IPEDS database. The overall number of missing data points was less than 1%. Unfortunately, IPEDS represents the best available source of secondary comparative data available to researchers interested in examining postsecondary education in the United States.

Also with respect to the quantitative analysis, not every national university in the United States was analyzed. This is, again, partly due to data limitations, but was also partially a conscious choice based on marginal returns to collecting additional data. Some of the smaller national universities do not report data consistently to IPEDS, and/or do not contain a score on the U.S. News and World Report index, and therefore would not have a quality control value for two of the structural models.

Because the measure for efficiency is constructed so broadly, and also because the national universities examined are geographically and structurally diverse, the research may not uncover meaningful data trends at a regional or other sub-national levels, or for specific subsets of efficiency.

With respect to the qualitative interviews, time and resource constraints, primarily time constraints of the interview subjects, prevented detailed follow-up conversations to further explore emerging trends. Also, data was collected, transcribed, and coded by a single researcher, so it is subject to bias or error introduction. To guard against these errors, voice recognition software was used to assist with transcription, and a standardized script was used for all interview subjects.

IV.3 Contributions to Knowledge

The current research provides evidence to support the popular notion that private producers are more efficient in production than are public producers. The quantitative analysis is strong evidence in terms of internal validity within the context of national universities, and the results are likely generalizable to other types of universities in the United States.

Importantly, the research also clarifies that competition is not always the mediating mechanism for differences in efficiency between the public and private sector. This highlights a boundary condition of the X-Inefficiency theory, which is that its explanatory power only holds if there is direct competition in the market between producers.

The research indicates that private and public national universities in the United States are likely competing for different pools of students based on quality. It may also be the case that universities are competing for students on the basis of qualities other than efficiency. In either case, because the universities are not directly competing for the same students, the level of

competition they face is not a good explanation The research also provides some evidence to support that Niskanen's budget-maximizing theory has validity in the context of postsecondary education in U.S. national universities.

IV.4 Contributions to Practice

As with all engaged scholarship research, the aim of this study is not only to contribute to academic knowledge, but also to make meaningful contributions to practice as well (Van de Ven 2007). In terms of practical advice to public university administrators, the research highlights three important areas.

Firstly, there is room for public university administrators to improve the efficiency of their universities without sacrificing quality. The experience of private universities provides evidence that this is possible. Improving efficiency, while perhaps not a primary goal for the university, should be considered as part of an overall strategic mission. Increasing efficiency can translate into keeping tuition costs as low as possible, and maintaining access to higher education for a broader segment of society. This will become increasingly important for public universities as state appropriations are reduced in the face of tight fiscal constraints.

Both public and private universities would benefit from a focus on defining, measuring, and understanding efficiency from the point of view of the university. Administrators are not at all familiar with thinking in these terms. Before any improvement can be made, efficiency must be measured in a meaningful way and administrators must think in terms of how their actions impact efficiency.

Public universities in particular should re-examine the ways in which they allocate budget across the university. De-centralized budgeting with little or no cross-subsidization through

indirect cost allocation can act as a moderating influence on administrators' budget-maximizing actions. This, in turn, may lead to greater efficiency for the university.

IV.5 Public Policy Recommendations

Policy makers might consider some recommendations based in part on the findings of this research. Firstly, there is a need for more consistent and reliable reporting from universities in the United States. While the IPEDS database and mandatory federal reporting tied to receipt of federal dollars has helped, there is great room for improvement. The data collection and reporting mechanisms in place in the United Kingdom are perhaps considered burdensome by universities, but they provide a much richer base of data from which to conduct meaningful research.

More generally, policy makers must consider larger questions such as, what is the appropriate role of postsecondary educational institutions in the United States. Clearly, increases in tuition are unsustainable at current rates, and act as a threat to affordability and accessibility for large segments of the population. The need for efficiency must not dominate public policy so as to become the primary reason for education at the expense of quality, but its importance must be recognized in terms of preserving accessibility. Instituting standardized measures and reporting requirements for efficiency may aid in bringing attention to efficiency as a component of overall success in delivering postsecondary education.

Finally, to stimulate measurement and achievement of efficiency in institutions of higher education, policy makers should consider incentivizing efficiency at the university level to encourage universities to focus on efficiency at sub-university levels. Beyond requiring measurement of efficiency, tying financial incentives such as faster access to Pell Grant award funds or other federal money to success on well thought out efficiency measures may provide

impetus to universities to perform well on those measures. This should be balanced against maximizing other objects such as quality and accessibility.

IV.6 Future Research

Future research is needed to further explore these findings. Time series data should be examined to understand the impacts to efficiency over time as universities become more or less public to confirm whether the findings hold over time as opposed to a point in time. More focused, comparative research should be conducted with respect to differences between drivers of efficiency for public universities and driver of efficiency for private universities. Researchers should also focus on differing analyses between undergraduate and graduate education. Finally, future researchers might consider using alternative outcome and efficiency measures such as numbers of patents to determine if different universities are perhaps trying to maximize different outcomes.

Additional data is needed to explore the incentive and budget-maximizing findings. Specifically, researchers should focus on collecting survey data from a wider sample of national universities, and administer those surveys to the highest levels of university governance. By collecting a larger sample, it will become possible to test hypotheses related to incentives and budget-maximizing by means of quantitative analysis as opposed to qualitative analysis only.

Finally, analysis should be done on alternative types of universities such as regional universities to test the external validity of these results. More analysis can be done in terms of sub-sets of universities from different areas, or with different missions. Future researchers may also choose to focus on the distinction between size and publicness of a university by examining cross-sectional data on large private institutions and small public institutions.

APPENDICES

Appendix A: National Universities Analyzed

RECORD NUMBER	UNIVERSITY NAME	TYPE	INEFFICIENCY	PUBLIC NESS	QUALITY
001	Princeton University	Private	$588,555	7%	100
002	Harvard University	Private	$409,061	10%	98
003	University of Chicago	Private	$389,780	19%	96
004	Yale University	Private	$619,381	11%	96
005	Columbia University	Private	$249,770	18%	95
006	Massachusetts Institute of Technology	Private	$862,917	30%	95
007	Stanford University	Private	$799,678	24%	95
008	University of Pennsylvania	Private	$358,767	22%	93
009	Duke University	Private	$463,776	22%	92
010	California Institute of Technology	Private	$1,090,404	54%	91
011	Dartmouth College	Private	$435,269	13%	90
012	Johns Hopkins University	Private	$493,811	30%	90
013	Northwestern University	Private	$282,943	20%	90
014	Brown University	Private	$302,899	16%	86
015	Cornell University	Private	$242,690	18%	86
016	Rice University	Private	$276,233	14%	86
017	Vanderbilt University	Private	$507,507	40%	86
018	University of Notre Dame	Private	$225,109	6%	85
019	Washington University in St. Louis	Private	$574,746	17%	85
020	Georgetown University	Private	$203,162	10%	80
021	Emory University	Private	$369,231	32%	78

022	University of California-Berkeley	Public	$218,706	40%	78
023	University of California-Los Angeles	Public	$331,697	34%	78
024	University of Southern California	Private	$221,562	16%	78
025	Carnegie Mellon University	Private	$225,071	19%	76
026	University of Virginia	Public	$183,959	22%	76
027	Wake Forest University	Private	$473,702	16%	75
028	University of Michigan-Ann Arbor	Public	$213,603	36%	74
029	Tufts University	Private	$216,881	16%	72
030	New York University	Private	$273,271	11%	71
031	University of North Carolina-Chapel Hill	Public	$283,658	57%	71
032	Boston College	Private	$150,805	5%	70
033	College of William and Mary	Public	$126,407	30%	70
034	Brandeis University	Private	$128,916	14%	68
035	Georgia Institute of Technology	Public	$243,287	53%	68
036	University of Rochester	Private	$266,049	31%	68
037	Boston University	Private	$146,467	15%	67
038	Case Western Reserve University	Private	$294,497	38%	67
039	University of California-Santa Barbara	Public	$138,396	45%	67
040	Northeastern University	Private	$112,713	10%	66
041	Tulane University	Private	$142,229	21%	66
042	Rensselaer Polytechnic Institute	Private	$210,657	20%	65
043	University of California-Irvine	Public	$165,147	40%	65
044	University of California-San Diego	Public	$324,224	46%	65
045	University of Florida	Public	$192,393	43%	65

046	Lehigh University	Private	$170,959	11%	64
047	Pepperdine University	Private	$117,491	1%	64
048	University of California-Davis	Public	$236,949	48%	64
049	University of Miami	Private	$367,678	25%	64
050	University of Wisconsin-Madison	Public	$246,469	39%	64
051	Villanova University	Private	$107,497	2%	64
052	Pennsylvania State University-University Park	Public	$174,909	17%	63
053	University of Illinois-Urbana Champaign	Public	$171,505	33%	63
054	Ohio State University-Columbus	Public	$163,510	37%	62
055	University of Georgia	Public	$102,368	46%	62
056	George Washington University	Private	$157,765	14%	61
057	Purdue University-West Lafayette	Public	$135,384	36%	61
058	University of Connecticut	Public	$178,901	49%	61
059	University of Texas-Austin	Public	$145,795	34%	61
060	University of Washington	Public	$221,973	42%	61
061	Brigham Young University-Provo	Private	$108,408	2%	60
062	Fordham University	Private	$99,579	3%	60
063	Southern Methodist University	Private	$130,889	5%	60
064	Syracuse University	Private	$107,912	9%	60
065	University of Maryland-College Park	Public	$156,090	57%	60
066	Worcester Polytechnic Institute	Private	$198,405	14%	60
067	Clemson University	Public	$134,110	36%	59
068	University of Pittsburgh	Public	$183,807	38%	58
069	American University	Private	$120,643	4%	57

070	Rutgers University-New Brunswick	Public	$169,983	54%	57
071	Stevens Institute of Technology	Private	$81,877	16%	57
072	Texas A&M University-College Station	Public	$200,246	38%	57
073	University of Minnesota-Twin Cities	Public	$193,238	45%	57
074	Virginia Tech	Public	$133,166	46%	57
075	Baylor University	Private	$129,902		56
076	Colorado School of Mines	Public	$143,144	25%	56
077	University of Massachusetts-Amherst	Public	$112,425	47%	56
078	Miami University-Oxford	Public	$84,627	17%	55
079	Texas Christian University	Private	$110,668	2%	55
080	University of Iowa	Public	$187,092	40%	55
081	Clark University	Private	$78,804	4%	54
082	Florida State University	Public	$81,277	64%	54
083	Michigan State University	Public	$156,047	31%	54
084	North Carolina State University-Raleigh	Public	$144,473	55%	54
085	University of California-Santa Cruz	Public	$121,909	61%	54
086	University of Delaware	Public	$139,748	16%	54
087	Binghamton University-SUNY	Public	$86,085	57%	53
088	University of Denver	Private	$93,479	5%	53
089	University of Tulsa	Private	$160,324	3%	53
090	Indiana University-Bloomington	Public	$124,287	29%	52
091	Marquette University	Private	$111,616	4%	52
092	University of Colorado-Boulder	Public	$167,202	36%	52
093	University of San Diego	Private	$106,141	4%	52

094	Drexel University	Private	$109,480	9%	51
095	Saint Louis University	Private	$123,934	8%	51
096	Yeshiva University	Private	$213,134	48%	51
097	Rochester Institute of Technology	Private	$125,091	7%	50
098	Stony Brook University-SUNY	Public	$159,792	65%	50
099	SUNY College of Environmental Science and Forestry	Public	$151,484	73%	50
100	University at Buffalo-SUNY	Public	$415,352	63%	50
101	University of Oklahoma	Public	$147,079	41%	50
102	University of Vermont	Public	$210,980	31%	50
103	Auburn University	Public	$129,369	38%	49
104	Illinois Institute of Technology	Private	$99,237	20%	49
105	Loyola University Chicago	Private	$111,469	9%	49
106	University of New Hampshire	Public	$109,434	34%	49
107	University of Oregon	Public	$104,050	27%	49
108	University of South Carolina	Public	$102,699	37%	49
109	University of Tennessee	Public	$151,568	54%	49
110	Howard University	Private	$217,726	15%	48
111	University of Alabama	Public	$96,692	30%	48
112	University of San Francisco	Private	$100,723	1%	48
113	University of the Pacific	Private	$139,421	4%	48
114	University of Utah	Public	$235,688	39%	48
115	Arizona State University-Tempe	Public	$86,983	37%	47
116	Iowa State University	Public	$131,758	44%	47
117	Temple University	Public	$134,638	14%	47

118	University of Kansas	Public	$164,324	42%	47
119	University of St. Thomas	Private	$82,041	1%	47
120	The Catholic University of America	Private	$116,023	11%	46
121	DePaul University	Private	$78,965	4%	46
122	Duquesne University	Private	$86,921	4%	46
123	University of Missouri	Public	$107,145	41%	46
124	Clarkson University	Private	$110,482	12%	45
125	Colorado State University	Public	$145,122	37%	45
126	Michigan Technological University	Public	$135,165	39%	45
127	Seton Hall University	Private	$100,810	4%	45
128	University of Arizona	Public	$173,917	37%	45
129	University of California-Riverside	Public	$138,961	46%	45
130	University of Dayton	Private	$119,818	25%	45
131	University of Nebraska-Lincoln	Public	$187,543	47%	45
132	Hofstra University	Private	$119,513	7%	44
133	Louisiana State University-Baton Rouge	Public	$162,598	41%	43
134	Mercer University	Private	$85,085	13%	43
135	The New School	Private	$108,531	1%	43
136	Rutgers University-Newark	Public	$122,208	41%	43
137	University of Arkansas	Public	$116,078	48%	43
138	University of Cincinnati	Public	$102,131	33%	43
139	University of Kentucky	Public	$205,501	47%	43
140	George Mason University	Public	$91,128	38%	42
141	New Jersey Institute of Technology	Public	$141,770	51%	42

142	San Diego State University	Public	$65,500	47%	42
143	University of South Florida	Public	$97,872	57%	42
144	Washington State University	Public	$130,276	49%	42
145	Kansas State University	Public	$148,085	39%	41
146	Oregon State University	Public	$136,107	35%	41
147	St. John Fisher College	Private	$68,347	2%	41
148	University of Illinois-Chicago	Public	$237,494	28%	41
149	University of Mississippi	Public	$142,781	49%	41
150	University of Texas-Dallas	Public	$98,110	29%	41
151	Adelphi University	Private	$77,383	2%	40
152	Florida Institute of Technology	Private	$91,798	7%	40
153	Ohio University	Public	$67,958	34%	40
154	Seattle Pacific University	Private	$57,835	2%	40
155	University at Albany-SUNY	Public	$113,724	70%	40
156	Oklahoma State University	Public	$115,956	49%	39
157	University of Massachusetts-Lowell	Public	$114,401	40%	39
158	University of Rhode Island	Public	$103,515	37%	39
159	Biola University	Private	$98,935	1%	38
160	Illinois State University	Public	$99,066	23%	38
161	University of Alabama-Birmingham	Public	$286,291	65%	38
162	University of Hawaii-Manoa	Public	$185,990	71%	38
163	University of La Verne	Private	$38,492	1%	38
164	University of Maryland-Baltimore County	Public	$109,039	55%	38
165	Immaculata University	Private	$54,846	2%	37

166	Maryville University of St. Louis	Private	$46,123	1%	37
167	Missouri University of Science & Technology	Public	$89,169	40%	37
168	St. John's University	Private	$126,580	2%	37
169	University of California-Merced	Public	$220,828	54%	37
170	University of Louisville	Public	$208,256	38%	37
171	Mississippi State University	Public	$151,217	55%	36
172	Rowan University	Public	$169,448	44%	36
173	University of Central Florida	Public	$64,571	61%	36
174	University of Idaho	Public	$148,723	60%	36
175	Virginia Commonwealth University	Public	$118,900	55%	36
176	Kent State University	Public	$66,925	36%	35
177	Robert Morris University	Private	$70,736	3%	35
178	Texas Tech University	Public	$104,217	17%	35
179	Union University	Private	$41,776	0%	35
180	University of Hartford	Private	$74,773	4%	35
181	Edgewood College	Private	$70,550	2%	34
182	Lesley University	Private	$74,692	3%	34
183	Lipscomb University	Private	$76,506	1%	34
184	Suffolk University	Private	$82,750	2%	34
185	University of Maine	Public	$169,365	49%	34
186	University of Wyoming	Public	$166,651	65%	34
187	Azusa Pacific University	Private	$72,324	0%	33
188	Ball State University	Public	$82,178	43%	33
189	Montclair State University	Public	$76,688	36%	33

190	Pace University	Private	$91,240	3%	33
191	West Virginia University	Public	$125,773	37%	33
192	Andrews University	Private	$96,002	4%	32
193	Indiana University-Purdue University-Indianapolis	Public	$146,680	39%	32
194	University of Houston	Public	$113,176	26%	32
195	University of New Mexico	Public	$203,417	51%	32
196	University of North Dakota	Public	$135,330	38%	32
197	Widener University	Private	$93,255	3%	32
198	New Mexico State University	Public	$129,051	52%	31
199	North Dakota State University	Public	$134,187	44%	31
200	Nova Southeastern University	Private	$83,305	5%	31
201	University of North Carolina-Charlotte	Public	$69,271	58%	31
202	Bowling Green State University	Public	$72,925	37%	30
203	California State University-Fullerton	Public	$65,890	58%	30
204	Dallas Baptist University	Private	$73,770	1%	30
205	University of Massachusetts-Boston	Public	$121,396	42%	30
206	University of Nevada-Reno	Public	$148,574	53%	30
207	Central Michigan University	Public	$67,073	31%	29
208	East Carolina University	Public	$98,193	62%	29
209	Florida A&M University	Public	$104,689	71%	29
210	Montana State University	Public	$141,154	44%	29
211	University of Alaska-Fairbanks	Public	$343,343	67%	29
212	University of Colorado-Denver	Public	$283,016	40%	29
213	University of Massachusetts-Dartmouth	Public	$104,244	48%	29

214	University of Montana	Public	$92,193	46%	29
215	Western Michigan University	Public	$100,474	32%	29
216	Florida International University	Public	$78,818	53%	28
217	Louisiana Tech University	Public	$87,622	35%	28
218	South Dakota State University	Public	$113,788	42%	28
219	Southern Illinois University-Carbondale	Public	$146,210	34%	28
220	University of Alabama-Huntsville	Public	$169,964	67%	28
221	University of Missouri-Kansas City	Public	$115,902	38%	28
222	Utah State University	Public	$114,120	63%	28
223	Ashland University	Private	$76,642	0%	27
224	Benedictine University	Private	$43,301	17%	27
225	California State University-Fresno	Public	$76,247	65%	27
226	Gardner-Webb University	Private	$47,892	3%	27
227	Georgia State University	Public	$84,282	46%	27
228	Shenandoah University	Private	$68,730	3%	27
229	University of South Dakota	Public	$97,503	43%	27
230	Wayne State University	Public	$147,894	43%	27

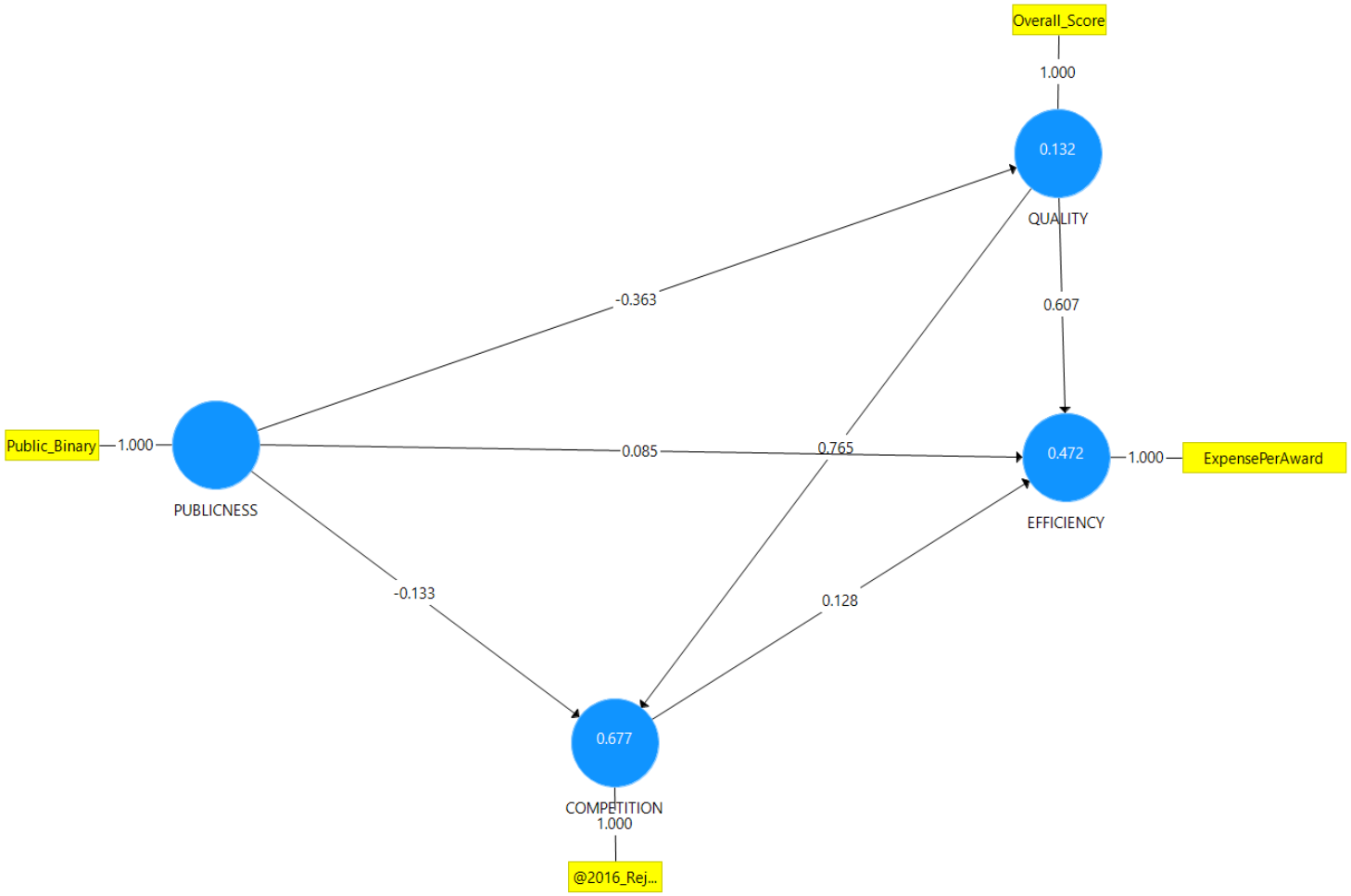
Appendix B: Interview Guide

This guide is for semi-structured interviews, administered either in person or over the telephone and lasting between 30 and 60 minutes. The role of the interviewer is to put the respondent at ease, and to gently re-direct the conversation if it drifts into unproductive areas. Aside from these restrictions, the respondent may speak freely about the concepts they feel are most important.

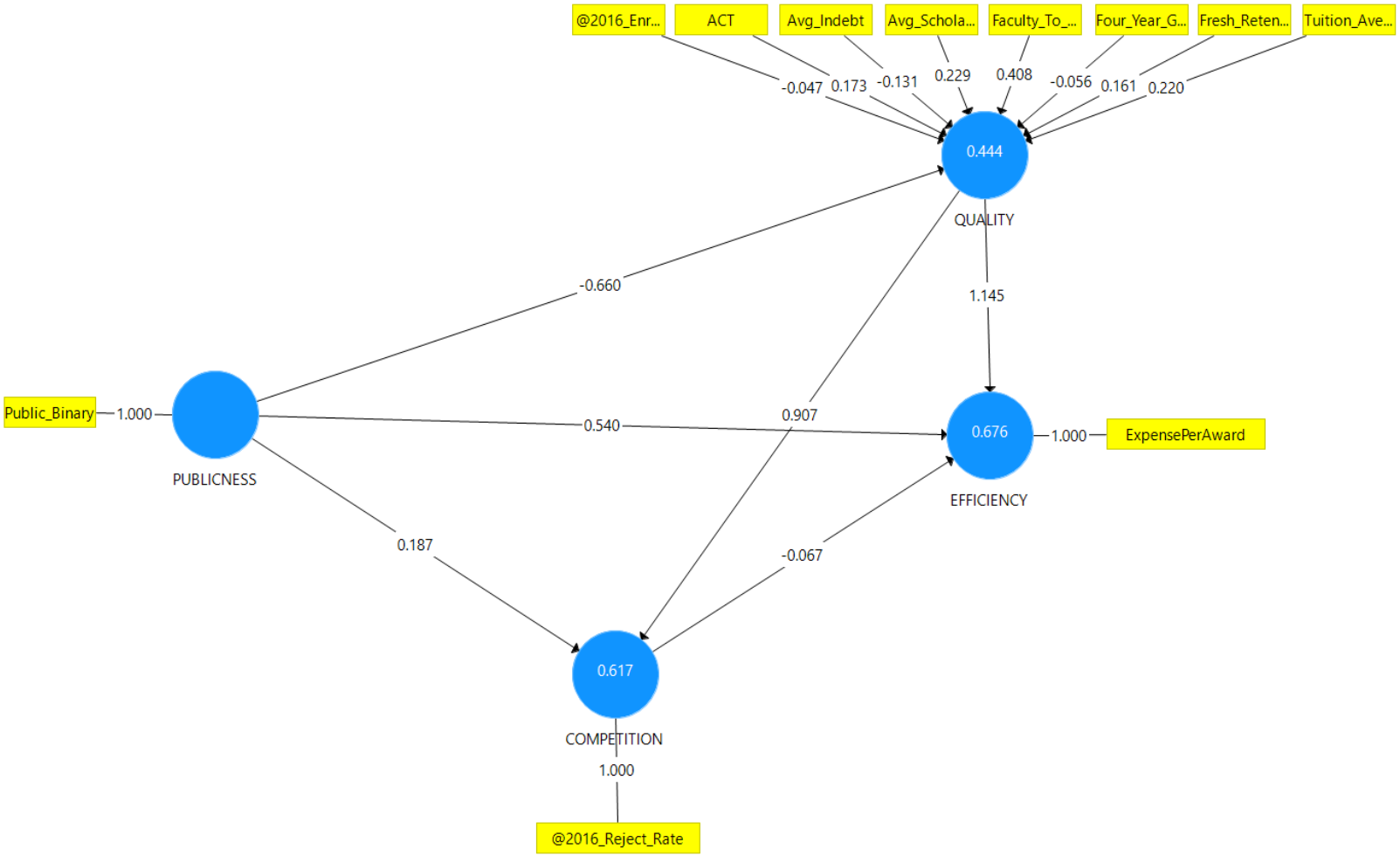
1. Tell me a little about yourself and your role at the university.
2. I am interested in the efficiency of universities. By efficiency, I mean the cost the university incurs per degree awarded. Can you talk a little bit about the relative importance of efficiency at your university? Is it a major focus, an interesting metric, or something that is mostly ignored?
3. Tell me a little bit about your own personal motivation to increase efficiency. If the university were to become more efficient, would that translate into personal gain for you? If the university were to reward you personally for increases in efficiency, what types of rewards would you consider motivating?
4. Tell me a little bit about the way in which the university allocates budgetary resources. Are there aspects of the budgeting process which either encourage or discourage people from acting in an efficient way? Specifically, what happens to a budgetary unit if they spend less or more than their allocated budget in each year?
5. Tell me a little bit about alternative academic calendars, or alternative methods of course delivery such as online learning. Are those practiced at your university? Do you feel that non-traditional course delivery may translate to reduced quality of the educational experience?

6. Is there anything else you would like to tell me about efficiency at your university?

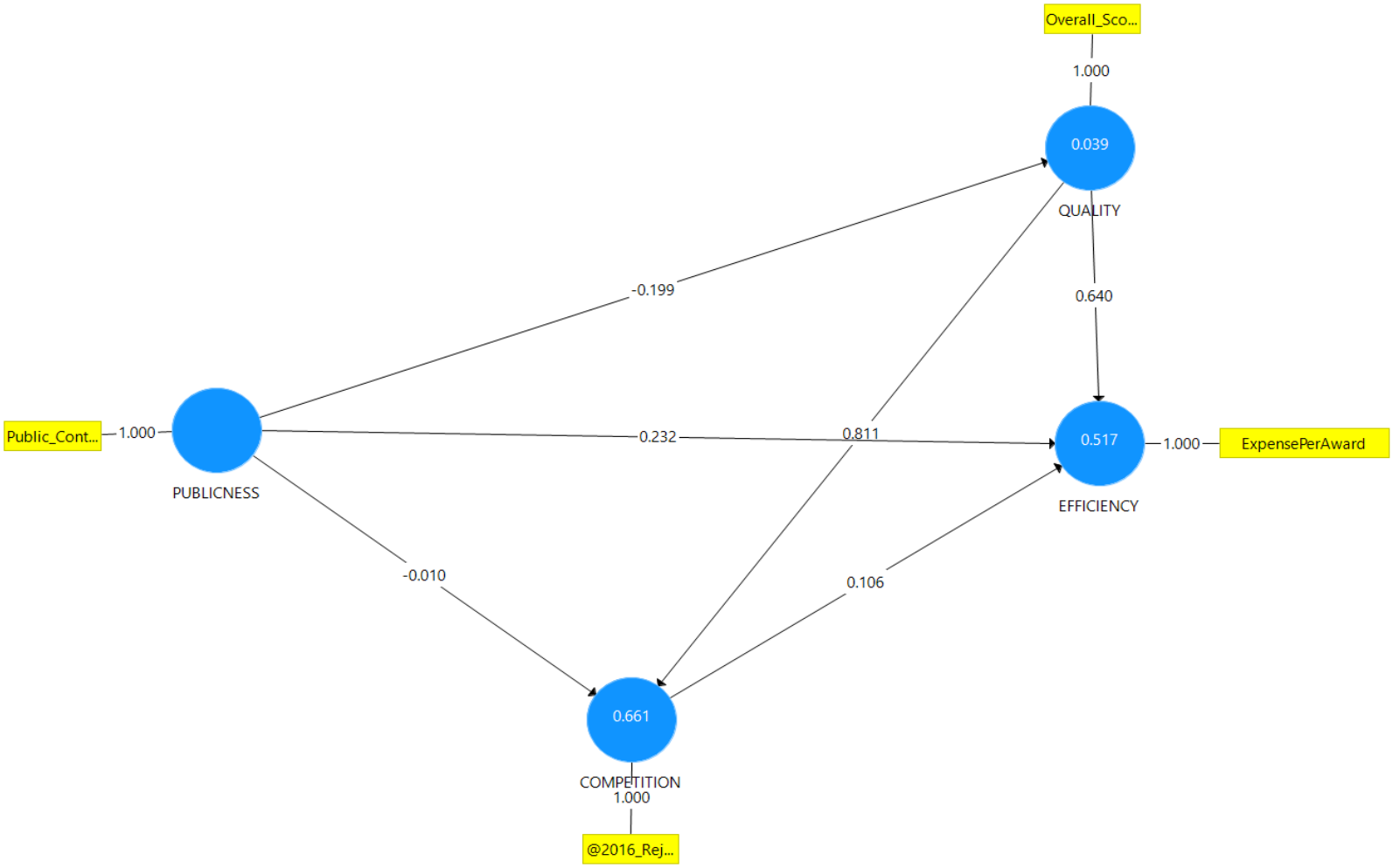
Appendix C: PLS-SEM Model 1



Appendix D: PLS-SEM Model 2



Appendix E: PLS-SEM Model 3



Appendix F: PLS-SEM Model 4

Appendix G: Regression for H1 and H3

Regression Statistics	
Multiple R	0.719924301
R Square	0.518291
Adjusted R Square	0.511868213
Standard Error	92618.87834
Observations	229

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	2.07668E+12	6.92228E+11	80.69565853	1.78572E-35
Residual	225	1.93011E+12	8578256625		
Total	228	4.00679E+12			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-140,129	22507.3459	-6.225920664	2.31971E-09	-184481.1018	-95776.7981	-184481.1018	-95776.7981
Publicness	1,535	312.7990976	4.908045822	1.76588E-06	918.8418537	2151.622754	918.8418537	2151.622754
Competition	629	459.6059085	-1.369562664	0.172188791	-276.2234848	1535.14167	-276.2234848	1535.14167
Quality	4,668	584.7879652	7.982546743	7.30564E-14	3515.735512	5820.459022	3515.735512	5820.459022

Appendix H: Regression for H2

Regression Statistics	
Multiple R	0.813256757
R Square	0.661386553
Adjusted R Square	0.658389974
Standard Error	13.40478012
Observations	229

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	79319.32106	39659.66053	220.7138587	7.18745E-54
Residual	226	40609.51737	179.68813		
Total	228	119928.8384			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-8.043484398	3.213259307	-2.503216713	0.01301425	-14.37526405	-1.711704743	-14.37526405	-1.711704743
Publicness	-0.011646793	0.045264952	-0.257302665	0.797179249	-0.100842116	0.077548531	-0.100842116	0.077548531
Quality	1.026717197	0.049989944	20.5384746	1.36706E-53	0.9282112	1.125223194	0.9282112	1.125223194

Appendix I: IRB

INSTITUTIONAL REVIEW BOARD

Mail: P.O. Box 3999
Atlanta, Georgia 30302-3999
Phone: 404/413-3500
Fax: 404/413-3504

In Person: Dahlberg Hall
30 Courtland St, Suite 217

March 08, 2018

Principal Investigator: Danny Bellenger

Key Personnel: Bellenger, Danny; Mathiassen, Lars; Talley, David

Study Department: Executive Doctorate in Busines

Study Title: The Comparative Efficiency of Public and Private Provision of Postsecondary Education in U.S. National Universities

Submission Type: Exempt Protocol Category 2

IRB Number: H18384

Reference Number: 348221

Approval Date: 02/27/2018

Expiration Date: 02/26/2021

The above referenced study has been determined by the Institutional Review Board (IRB) to be exempt from federal regulations as defined in 45 CFR 46 and has been evaluated for the following:

1. determination that it falls within one of more of the six exempt categories allowed by the institution; and
2. determination that the research meets the organization's ethical standards

If there is a change to your study, you should notify the IRB through an Amendment Application before the change is implemented. The IRB will determine whether your research protocol continues to qualify for exemption or if a new submission of an expedited or full board application is required.

Exempt protocols must be renewed at the end of three years if the study is ongoing. When the study is complete, a Study Closure Form must be submitted to the IRB.

Any unanticipated/adverse events or problems resulting from this investigation must be reported immediately to the University Institutional Review Board. For more information, please visit our website at www.gsu.edu/irb.

Sincerely,

Shelia L. White, IRB Member

Federal Wide Assurance Number: 00000129

WORKS CITED

Abay, C., Miran, B., and Gunden, C. (2004). An Analysis of Input Use Efficiency in Tobacco Production with Respect to Sustainability: The Case Study of Turkey. Journal of Sustainable Agriculture. Vol 204, Issue 3.

Aigner, D., Lovell, K., and Schmidt, P. (1977). Formulation and estimation of stochastic frontier production function models. *Journal of Econometrics*, 6, 21-37.

Anang, B., Backman, S., Sipilainen, T. (2016). Technical Efficiency and Its Determinants In Smallholder Rice Production in Northern Ghana. The Journal of Developing Areas. Volume 50, No 2.

Archibald, R. B., & Feldman, D. H. (2011). Why does college cost so much? New York: Oxford University Press, 2011.

Bowen, H.R. (1980). *The costs of higher education: How much do colleges and universities spend per student and how much should they spend?* New York: McGraw-Hill.

Bowen, W. (2012). The 'Cost Disease' in Higher Education: Is Technology the Answer? The Tanner Lectures. Stanford University, October 2012.

Cohen J. (1988). Statistical Power Analysis for the Behavioral Sciences. New York, NY: Routledge Academic

Charnes, A., Cooper, W. and Rohes, E. (1978). Measuring the efficiency of decision making units. *European Journal of Operational Research*, 2, 429-444

Davis (2012). An Inquiry into the Rising Cost of Education. Davis Educational Foundation. November, 2102.

Deming, D., Goldin, C., Katz, L., Yuchtman, N. (2015). Can Online Learning Bend the Higher Education Cost Curve? Issues in Higher Education. May 1, 2015.

Dolan, R., and Schmidt, R. (1994). Modeling Institutional Production of Higher Education. Economics of Education Review, v13 n3 p197-213.

Espinosa, L., Crandall, J., and Tukibayeva, M. (2014). Rankings, Institutional Behavior, and College and University Choice. American Council on Education Center for Policy Research and Strategy.

Farrell, M. (1957). The Measurement of Productive Efficiency. Journal of the Royal Statistical Society.

Foran, C. (2017). Can Trump Fix Government by Running It Like a Business? The Atlantic, March 29, 2017. Accessed online August 15, 2017.

Freedman, D. (2009) Statistical models: Theory and practice, revised ed, Cambridge U Press, p 86.

Goodman, J. B., & Loveman, G. W. (1991). Does Privatization Serve the Public Interest? *Harvard Business Review*, 69(6), 26-38

Gregoriou, G., Gultek, M., and Demirer, I. (2017). Efficiency of Cruise Ships: A Data Envelopment Analysis Approach. International Journal of Global Business. 10(1) 8-25, June 2017.

Hair, J. F. (2014). *A primer on partial least squares structural equations modeling (PLS-SEM)*. Los Angeles : SAGE, ©2014.

Hair, J. F., Ringle, C. M., & Sarstedt, M. (2011). PLS-SEM: Indeed a Silver Bullet. *Journal Of Marketing Theory & Practice*, *19*(2), 139-152.

Hancock, G. R., & Mueller, R. O. (2013). *Structural Equation Modeling : A Second Course*. Charlotte, NC: Information Age Publishing.

Hillman, N., Tandberg, D., & Gross, J. (2014). Market-Based Higher Education: Does Colorado's Voucher Model Improve Higher Education Access and Efficiency? *Research In Higher Education*, *55*(6), 601

Hopkins, D. (1990). The Higher Education Production Function: Theoretical Foundations and Empirical Findings. The Economics of the American Universities.

IPEDS (2017). Integrated Postsecondary Education Data System. National Center for Education Statistics. United States Department of Education. Accessed online August 30, 2017. https://nces.ed.gov/ipeds/

Kosor, M. (2013). Efficiency Measurement in Higher Education: Concepts, Methods, and Perspective. Procedia Social and Behavioral Sciences 106(2013) 1031-1038.

Leibenstein, H. (1966). ALLOCATIVE EFFICIENCY VS. "X-EFFICIENCY". *American Economic Review*, *56*(3), 392.

Leslie, L., Slaughter, S., Taylor, B., and Zhang, L. (2012). How do Revenue Variations Affect Expenditures Within U.S. Research Universities. *Research In Higher Education*. September 2012, Vol. 53 Issue 6, p614-639

Levitt, David and Sarah Mulholland "Trump Looks to Australia for Infrastructure, Roth Says" *Bloomberg* April 24, 2017

Massy, W. (2011). Metrics for Efficiency and Effectiveness in Higher Education: Completing the Completion Agenda. State Higher Education Executive Officers Association, May 1, 2011.

McNaught, C., & Lam, P. (2010). Using Wordle as a Supplementary Research Tool. Qualitative Report, 15(3), 630-643.

Morse, R., Brooks, E., and Mason, M. (2016). How U.S. News Calculated the 2017 Best Colleges Ranking. September 12, 2016. Accessed online August 30, 2017. https://www.usnews.com/education/best-colleges/articles/rankings-methodologies

Niskanen, W. A. (1971). *Bureaucracy and public economics*. Aldershot, Hants, England; Brookfield, Vt., USA: E. Elgar, c1994

Pier, W. J., Vernon, R. B., & Wicks, J. H. (1974). AN EMPIRICAL COMPARISON OF GOVERNMENT AND PRIVATE PRODUCTION EFFICIENCY. *National Tax Journal*, 27(4), 653-656

Powell, B., Gilleland, D., & Pearson L. (2012). Expenditures, Efficiency, and Effectiveness in U.S. Undergraduate Higher Education: A National Benchmark Model. Journal of Higher Education.

Ross, C., and Van Willigen, M. (1997). Education and the Subjective Quality of Life. *Journal of Health and Social Behavior*. Vol. 38, No.3, pp. 275-297.

Rosenthal, J.A. (1996). "Qualitative descriptors of strength of association and effect size," Journal of Social Service Research, 21(4): 37-59.

Ryan, G., and Bernard, H.R. (2003). Techniques to Identify Themes. *Field Methods*. Vol. 15, No. 1, February 2003 p 85-109

Sav, G. T. (2012). Stochastic cost frontier and inefficiency estimates of public and private universities: Does government matter? *International Advances in Economic Research, 18*(2), 187-198.

Schaper, D. (2017). Trump Announces Plan to Privatize Air Traffic Control. NPR, June 5, 2017. Accessed online August 15, 2017.

Smith, A. (1776). *An Inquiry into the nature and causes of the wealth of nations. [electronic resource]*. London: Electric Book Co., c2001.

Strauss, A. (1987). Qualitative Analysis for Social Scientists. Cambridge: Cambridge University Press.

Van de Ven, A. H. (2007). Engaged scholarship : a guide for organizational and social research. Oxford ; New York : Oxford University Press, 2007.

Vroom, V. H. (1964). *Work and motivation*. New York, Wiley [1964].

Webber, D., and Ehrenberg, R. (2010). Do expenditures other than instructional expenditures affect graduation and persistence rates in American higher education. *Economics of Education Review*. Volume 29, Issue 6, December 2010, Pages 947-958.

Wilcox, R. R. (2009). Basic Statistics : Understanding Conventional Methods and Modern Insights. Oxford: Oxford University Press.

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PROFESSIONAL SUMMARY

- Over fifteen years of professional work history including ten years of management experience
- Strong private and public sector experience in transportation, tolling, budgeting, and finance
- Proven ability to analyze complex information and make calculated risk decisions facing uncertainty
- Demonstrated leadership abilities under extreme stress including live combat situations

EMPLOYMENT HISTORY

LEGISLATIVE FISCAL ANALYST | **KY LEGISTLATIVE RESEARCH COMMISSION** | 3/2016 TO PRESENT | *Frankfort, KY*

- Provide expert nonpartisan advice to lawmakers on various aspects of the Commonwealth's budget
- Conduct professional research project and white papers for policy issues related to the budget
- Draft statutory and budgetary language for consideration and passage by the General Assembly
- Lead and participate in cooperative training sessions with legislative staff from other states

ASSOCIATE VICE PRESIDENT FINANCIAL CONSULTANT | **HNTB** | 3/2016 TO PRESENT | *Frankfort, KY*

- Provide financial and tolling advice to new and existing public sector clients across the country
- Clients include DOTs and toll agencies in Texas, Wisconsin, Louisiana, Kentucky, and Virginia
- Activities include cost benefit analysis, tolling feasibility studies, strategic plans, and lane audits
- Member of the Smart Columbus team awarded a $40M grant from USDOT

INNOVATIVE FINANCE MANAGER | **KY TRANSPORTATION CABINET** | 4/2014 TO 3/2016 | *Frankfort, KY*

- Hired as the Cabinet’s first ever Innovative Finance Manager to oversee mega projects
- Work simultaneously on the Louisville Bridges and Brent Spence Bridge Projects
- Assisted in financing the largest infrastructure project in the Commonwealth’s history
- Oversee construction and implementation of the state’s first ever all electronic tolling system
- Act as staff for the Kentucky Public Transportation Infrastructure Authority
- Represent projects to the Governor, legislative leadership, outside groups, and the public
- Awarded Government Finance Officers Association award for excellence in financial reporting

DEPUTY BUDGET DIRECTOR | **KY TRANSPORTATION CABINET** | 4/2009 TO 4/2014 | *Frankfort, KY*

- Responsible for managing a staff of forty accountants, purchasing agents, and budget analysts in administering the day-to-day fiscal operations of the Cabinet and developing, monitoring, and executing the Cabinet’s approximately $2 billion capital and operating budget.
- Perform a monthly cash model analysis to forecast the liquidity position of the Road Fund.

SECTION LEADER **UNITED STATES ARMY** 8/2004 TO 11/2008 *Fort Sill, OK*

- Non-Commissioned Officer responsible for managing eight subordinates in the safe, accurate, and timely firing of a 155 mm howitzer cannon.
- Leadership experience includes one year of duty in Iraq leading security teams for logistics patrols.
- Awarded the Good Conduct Medal, two Army Commendation Medals, and National Defense Medal.

PERSONAL BANKER **FIFTH THIRD BANK** 5/2003 TO 8/2004 *Lexington, KY*

- Responsible for dispute resolution, customer account management, and consumer lending including personal loans, automobile loans, and home equity lines of credit.
- Recognized for implementing innovative sales campaigns which contributed to my branch earning the highest ever recorded annual profit and becoming the sales leader in the Central Kentucky region.

EDUCATION

DOCTORATE BUSINESS ADMIN	**GEORGIA STATE UNIVERSITY**	8/2015 - 5/2018	*Atlanta, GA*
MASTERS PUBLIC ADMIN	**UNIVERSITY OF KENTUCKY**	8/2012 – 5/2014	*Lexington, KY*
MASTERS ECONOMICS	**UNIVERSITY OF OKLAHOMA**	12/2006-5/2009	*Norman, OK*
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BS FINANCE AND ECONOMICS	**UNIVERSITY OF KENTUCKY**	8/1999 – 5/2003	*Lexington, KY*

INDUSTRY INVOLVEMENT

- Member of the Government Finance Officers Association (GFOA)
- Member of the International Bridge Tunnel and Turnpike Association (IBTTA)
- Member of the American Association of State Highway and Transportation Officials (AASHTO) Subcommittee on Fiscal Management and Accounting
- Panel member for a National Academies of Sciences Engineering and Medicine study on Value Capture Toolkits for State Transportation Agencies (NCHRP Project 19-13)

COMMUNITY INVOLVEMENT

- Board Member and Treasurer of the Sunshine Center
- Member of the Hearn Elementary Parent Teacher Association
- Frankfort Youth Instructional Baseball League Coach