8-1-2015

# Revenue Structure, Revenue Diversification, and Severe Economic Downturns: Using Ordered Response Models to Predict Public Research University Credit Ratings

Joshua Michael Cohen
*University of Northern Colorado*

UNIVERSITY OF NORTHERN COLORADO

Greeley, Colorado

The Graduate School

# REVENUE STRUCTURE, REVENUE DIVERSFICATION, AND SEVERE ECONOMIC DOWNTURNS: USING ORDERED RESPONSE MODELS TO PREDICT PUBLIC RESEARCH UNIVERSITY CREDIT RATINGS

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

Joshua Michael Cohen

College of Education and Behavioral Sciences
Department of Leadership, Policy and Development:
Higher Education and P-12 Education
Higher Education and Student Affairs Leadership

August, 2015

This Dissertation by: Joshua Michael Cohen

Entitled: *Revenue Structure, Revenue Diversification, and Severe Economic Downturns: Using Ordered Response Models to Predict Public Research University Credit Ratings*

has been approved as meeting the requirement for the Degree of Doctor of Philosophy in College of Education and Behavioral Sciences in Department of Leadership, Policy and Development: Higher Education and P-12 Education, Program of Higher Education and Student Affairs Leadership

Accepted by the Doctoral Committee

_____
Gabriel R. Serna, Ph.D., Research Advisor

_____
Florence M. Guido, Ph.D., Committee Member

_____
Spencer Weiler Ph.D., Committee Member

_____
Trent Lalonde, Ph.D., Faculty Representative

Date of Dissertation Defense _June 23rd, 2015_____

Accepted by the Graduate School

_____
Linda L. Black, Ed.D.
Associate Provost and Dean
Graduate School and International Admissions

## ABSTRACT

Cohen, Joshua Michael. *Revenue Structure, Revenue Diversification, and Severe Economic Downturns: Using Ordered Response Models to Predict Public Research University Credit Ratings*. Published Doctor of Philosophy dissertation, University of Northern Colorado, 2015.

In a progressively more competitive market, postsecondary institutions across the country have undertaken large capital projects to remain viable and attract prospective students, faculty, and staff. In order to finance the construction of these plants, institutions of higher education have been turning to debt markets, specifically through the sale of long-term tax-exempt municipal bonds, at an increasing rate. When issuing debt via bonds, an institution's credit rating becomes especially important given that it directly determines the interest rate and debt costs associated with borrowing, and the ability to find buyers.

While the impact of credit ratings is broad, from fiscal sustainability to budgetary policies affecting access and affordability for students, the topic of institutional credit ratings, particularly public research university credit ratings, is largely unexamined in the higher education scholarly literature. Because there is a dearth of research on this topic, relatively little is known about how changes in institutional, state, and national factors impact changes in public research university credit ratings. Additionally, little analysis has been undertaken that can guide decision-makers around the incentives and difficulties that arise when credit rating optimization is a broad organizational and policy goal.

This study explores how changes in known credit rating determinants impact public research university credit ratings–employing a data set of 75 public research universities, spanning 12 consecutive years, and using two types of ordered response estimators. The results show that factors associated with increased market position, demand, and wealth are positively associated with higher credit ratings. However, association with an academic medical center is shown to negatively impact university credit ratings. Credit ratings are shown to be highly revenue dependent, although as revenue bases become less broad and more focused on state interests the impact becomes negative. On a related note, improved revenue diversification is also positively associated with higher credit ratings. High state credit ratings are positively associated with improved university credit ratings, as the former suggests increased ability to fund public institutions. Increased total debt burden is positively associated with higher credit ratings, while decreased debt servicing ability appears to work in the opposite direction.

Furthermore, the impact of severe economic downturns, measured by The Great Recession, is positively associated with higher credit ratings. The spillover effects from this economic variable indicate increased emphasis being placed upon an institution's ability to distinguish itself nationally, as well as generate revenues. Moreover, while large amounts of debt are still positively associated with higher credit ratings, the magnitude of the impact is lessened when accounting for the recession. This suggests increased caution around large debt loads during times of economic uncertainty.

Finally, the results of the analysis suggest that while certain policies may improve an institution's credit rating, it is important that decision makers and other senior

administrators do not lose sight of the impacts that these capital planning policies have on student access and affordability, as well as public service and the public good.

*To my daughter Taelor, my greatest inspiration*

## ACKNOWLEDGEMENTS

Throughout this process, I have been fortunate enough to receive much care, attention, and guidance. First, I would like to thank the members of my dissertation committee. To my research advisor, mentor, and friend Gabriel Serna, who recognized my interests in higher education finance and quantitative methods during my first semester of graduate school. With his encouragement, support, and attention, I have been able to develop and mature as a scholar and thinker. I am grateful for his continued guidance and friendship. To Florence Guido, who actively engaged me in critical debates, guided me in learning qualitative research, and further opened my mind to a multitude of perspectives. To Spencer Weiler, whose patience and attention to detail aided me in refining this study. And finally, to Trent Lalonde, who provided me with invaluable support and education in categorical data analysis, supported my interests in ordered response models, and patiently helped me understand complex modeling issues on both technical and intuitive levels.

I would not be where I am today without the constant love and support of my family. Throughout my long and somewhat non-traditional journey through education and life, my mother and father, Rita and Morris Cohen, have continued to provide unconditional support and faith in my abilities. To my sister Ricki Laviano, who allowed me to confide in her during this research. She has provided me with a voice of reason and a source of solace during this difficult process.

I would like to say a special thank you to my daughter Taelor Cohen, who has shown an incredible amount of maturity and patience while I devoted much time and energy to this project. She has provided me with perspective and grounding during times of frustration, and empowered me with drive and passion. Her love, encouragement, and excitement truly make me the luckiest father alive.

Finally, I would like to thank the University of Northern Colorado Graduate School and the Higher Education and Student Affairs Leadership department for their continued financial support. Such aid has not only allowed me to finish this research, but has also fostered my development as a scholar. While the Ph.D., and especially dissertation, process has at times felt like a marathon of insurmountable challenges, it has ultimately proven to be a journey of great personal development and genuine accomplishment!

## TABLE OF CONTENTS

## LIST OF TABLES

## LIST OF FIGURES

FIGURE

## LIST OF ABBREVIATIONS

- AAHC- Association of Academic Health Centers
- AMC- Academic Medical Center
- AME- Average Marginal Effects
- CDF- Cumulative Distribution Function
- CPIAUSCL- Consumer Price Index for All Urban Consumers
- ECS- Education Commission of the States
- FTE- Full-Time Equivalent
- GO Bonds- General Obligation Bonds
- HHI- Hirschman-Herfindahl Index
- IPEDS- Integrated Postsecondary Education Data System
- IRB- Institutional Review Board
- MEM- Marginal Effects at the Mean
- NACUBO- National Association of College and University Business Officers
- NASBO- National Association of State Budget Officers
- NCES- National Center for Educational Statistics
- NIH- National Institutes of Health
- PDF- Probability Density Function
- UMIFA- Uniform Management of Institutional Funds Act
- UPMIFA- Uniform Prudent Management of Institutional Funds Act

## LIST OF SYMBOLS

- α- alpha
- β- beta
- ε- epsilon
- Λ- Lambda
- μ- mu
- Φ- Phi
- Pr- Probability
- Σ- Sigma
- σ- sigma

Covariates:

- $x_{sel}$- Freshman Selectivity
- $x_{res}$- Research Intensity
- $x_{lnufte}$- Log Undergraduate FTEs
- $x_{lntfpfte}$- Log Tuition and Fees per FTE
- $x_{lnsappfte}$- Log State Appropriations per FTE
- $x_{lnfgpfte}$- Log Federal Operating Grants and Contracts per FTE
- $x_{lnstatefte}$- Log State and Local Operating Grants and Contracts per FTE
- $x_{amc}$- Academic Medical Center
- $x_{lnendpfte}$- Log Endowment Value per FTE

- $x_{highreg}$- High Governing Board Regulation
- $x_{dl}$- Debt Limit
- $x_{highstate}$- High State Credit Rating
- $x_{lndbs}$- Log Debt Burden per Student
- $x_{lev}$- Leverage
- $x_{hhi}$- Hirschman-Herfindahl Index
- $x_{recession}$- Recession

# CHAPTER I

## INTRODUCTION AND OVERVIEW

In a progressively more competitive market, postsecondary institutions across the country have undertaken large capital projects to remain viable and attract prospective students, faculty, and staff.[1] To finance these projects, colleges and universities have turned to debt markets at an increasing rate (Blustain, Cobine et al., 2009; Carlson, 2013a; Jacob, McCall, & Stange, 2013; Jaschik, 2013; Pollack, 2000). Evidence of this trend is found in a 2006 article published in *The Economist*, which states that between 2000 and 2006 the higher education debt market grew to $33 billion (The Economist, 2006). By 2011, debt levels among the public higher education sector surpassed $60 billion (Kiley, 2012).[2]

One recent example of a public institution issuing large amounts of debt is The Ohio State University, which in 2011 "became the first public university to issue a 100-year bond, which totaled $500 million" (Kiley, 2012, Rethinking Funding section, para. 4). With the issuance of this century bond, the debt level at Ohio's flagship university surpassed $2.4 billion. Another example is the University of California System, which in February of the following year issued its own century bonds. While the University of California's sale was initially planned at $500 million, it was ultimately expanded to

[1] Definitions of relevant terms are located in Appendix H.

[2] The 2006 debt number of $33 billion is equal to about $36.82 billion in 2011 constant dollars.

$860 million. This was the largest university issued 100-year bond, both public and private, since 1995 (Nolan & McGee, 2012).

These two examples highlight the importance of understanding how debt, and in particular debt costs which are based primarily upon a university's credit rating, matter for public higher education. Since these ratings affect borrowing costs and debt service by determining interest rates (Moody, 2008; O'Hara, 2012; Rabson, 2008; Serna, 2013a; Thau, 2011), it would be prudent for institutional decision-makers and fiscal managers to educate themselves regarding the factors impacting college and university credit ratings. Specifically, by understanding how various internal and external factors influence an institution's creditworthiness, these senior administrators can most effectively implement short- and long-term university planning. However, this topic still remains largely unexamined in the research literature. This study examines this topic, focusing specifically on the determinants of public research university credit ratings and highlights many of the implications related to both their determination and larger impacts.

In this study public research universities are defined as public four-year universities that have a high or very high level of research activity.[3] These categories follow those established by the Carnegie Foundation for the Advancement of Teaching (2010).[4] This study is not concerned with private, nonprofit or for profit colleges and universities, doctorate granting institutions with a low level of research activity (i.e., Carnegie Classification Doctoral/Research universities), or institutions that primarily award masters, baccalaureate, or associates degrees. Lack of focus on these types of

[3] Following Serna (2012) and Trautman (1995), public four-year universities are defined as a type of public authority, which during establishment are considered subordinate agencies of the state government.

[4] Definitions of the Carnegie Classifications and their corresponding methodology can be found at http://carnegieclassifications.iu.edu/methodology/basic.php

institutions is not intended to downplay their importance, especially since they are beginning to actively utilize debt markets for capital project funding (Kiley, 2012; Supiano, 2008). Instead, decisions regarding this study's chosen population are motivated by issues such as data availability, research literature focus, and increased validity from analyzing institutions that are more-similar to one another.

In examining public research university credit ratings, this study asks three related research questions:

Q1 How are the factors involved in public research university revenue structure associated with institutional credit ratings?

Q2 How is the level of revenue diversification in public research university revenue structure associated with institutional credit ratings?

Q3 How do severe economic downturns impact public research university credit ratings?

By answering these questions, this study significantly contributes to the knowledge surrounding public research university credit ratings and their effects on the operation and decision-making structure of public institutions. In doing so, it fills a gap in the extant literature by thoroughly examining a topic that has recently gained attention in higher education circles, but has been left largely unexamined in the peer-reviewed literature.

## Scope of the Study

The focus of this research is at the institutional level and emphasis is placed upon examining how factors involved in public research university revenue structure impact institutional credit ratings. Therefore, it does not draw upon the literature on private postsecondary institution credit ratings (e.g., Morgan, 2002; Tuby, 2009). Recently, a handful of higher education scholars have examined issues pertaining to

state capital appropriations (e.g., Delaney & Doyle, 2014; Harris, 2011; Ness & Tandberg, 2013; Tandberg & Ness, 2011) and the rising costs of deferred maintenance (e.g., Harris, Manns, & Katsinas, 2012; Manns, 2003/2004; Manns & Katsinas, 2006). While this literature is important for higher education finance, particularly the area of capital budgeting, it is beyond the scope of this study.

With regard to the first, although state appropriations are a factor in public research university credit ratings, the focus of this study is on how changes in individual determinants impact institutional creditworthiness, not on the determinants of individual revenue streams (i.e., determinants of determinants). As for the second, there is a connection between deferred maintenance and credit ratings, since building renewal projects will likely require institutions to issue large amounts of debt. However, while the level of an institution's creditworthiness may influence decisions around deferred maintenance, ultimately credit ratings are just one of many factors involved in such decisions.

In addition to individual revenue streams, this study looks at the relationship between revenue diversification and credit ratings. There is a fair amount of literature in the field of public finance that examines the relationship between public governments' level of revenue diversification and the stability of their revenue base (e.g., Carroll, 2009; Carroll & Stater, 2009; Chernick, Langley, & Reschovsky, 2011; Tuckman & Chang, 1991). However, while the above literature examines the positive role of revenue diversification in general, this study is specifically focused on the relationship between revenue diversification and credit ratings. Finally, this study examines the role played by severe economic downturns, particularly The Great Recession, on public research

university credit ratings. Its primary hypothesis with regard to this question is that severe economic downturns, measured by The Great Recession, negatively impact public research university credit ratings, due to the reverberations from poor macroeconomic conditions on federal and state budgets.

## Warrant for the Study

Historically, the use of debt instruments to finance capital projects at universities was relatively minor. In fact, prior to the mid-20th century, university operations (including capital projects) were largely funded with public monies (Thelin, 2004). While public postsecondary institutions occasionally borrowed money to finance physical facilities, this type of financing was confined to buildings with the ability to generate revenue from service charges (e.g., auxiliary plants). This self-generated revenue could then be used to service the debt (Millet, 1952). In fact, financing educational plants without sufficient cash-on-hand to finish projects was traditionally viewed as a threat to an institution's stability (Russell, 1954).

During the 1960s and 1970s, increased student demand for higher education resulted in a "college building boom" (Jenny, Hughes, & Devine, 1983, p. 41), requiring increased capital funding. Still, during this time, debt market utilization remained the domain of larger institutions with sizeable endowments and complex fiscal structures. But, in the 1980s, changes in "federal tax laws, bank lending programs, institutional management capacity, and mounting fiscal pressures" resulted in a sizeable increase in the number of colleges and universities utilizing bond markets (Blustain, Cobine et al., 2009, p. 8).

Although the number of institutions using debt markets, along with the different types of available debt instruments, increased during the 1980's, the bonds sold by colleges and universities were still primarily secured by narrow revenue streams. As a result, creditworthiness for the institution as a whole was of secondary importance in the rating process (King, Anderson, Cyganowski, & Hennigan, 1994). However, beginning in the 1990s many institutions began utilizing long-term debt obligations that were secured by the full-faith and credit of the institution (Fitzgerald, 2005; King et al., 1994). Thus, the entirety of an institution's revenue base gained importance in the rating process.

Since bond pledges broadened and credit ratings were soon based on the entirety of an institution's revenue structure, universities were able to secure lower interest rates based on their higher credit ratings (King et al., 1994). As a result, bond market utilization once again increased. Rapid growth in capital projects financed primarily with debt flourished, as colleges and universities undertook rapid construction of ever larger and more luxurious plants intended to help attract prospective students and staff (Carlson, 2013a; Jacob, McCall, & Stange, 2013; Pollack, 2000). In a sense, the beginning of the 21st century can be understood as the beginning of another college building boom.

Colleges and universities also continued to defer maintenance on existing facilities (Manns, 2003/2004; Carlson, 2013b; Harris, Manns, & Katsinas, 2012; Manns & Katsinas, 2006). In fact, it is estimated that with many of the buildings constructed in the 1960s and 1970s nearing the end of their initial 50-year life-span, large building renewal projects are going to require additional debt financing in the near future

(Blustain, Bruszewski, Daigneau, Roloff, & Ledbetter, 2009). Such demands further warrant the need for a better understanding of factors impacting university credit ratings.

Furthermore, in the wake of the recent economic crisis, there has been a high degree of volatility in state funding for capital projects, decreased access to tax-exempt bonds, and higher interest rates on debt instruments (Gephardt & Nelson, 2010; Kiley, 2012; Weisbrod & Asch, 2010). In addition, as assets began to shrink in value during the recession, many feared institutions had over-leveraged themselves and now lacked sufficient liquidity to service their outstanding debt (Blumenstyk & Field, 2008; Goodman & Nelson, 2009; Wilson, 2008; Wolverton, 2008). While liquidity concerns have since lessened (Gephardt, 2011; Serna, 2013b), these events suggest a debt market where increased uncertainty is occurring within an environment of greater variability. It also suggests that in order to navigate the current economic environment, a thorough knowledge of credit rating determinants and the credit rating process are essential of capital planning.

Thus, as postsecondary institutions seek out increased debt financing, a more nuanced understanding of how resource allocation and policy decisions impact credit ratings will allow institutional decision makers to best lead the planning process. While credit ratings and their determinants can play an important role in the decision-making process, it is important that these processes are ultimately made with education at the forefront. That is, when trying to maximize creditworthiness and lower the costs of debt, it is vital that access and affordability are not jeopardized in the process. Since price-sensitive students are more susceptible to the negative effects of tuition and enrollment decisions (Heller, 1999; Martin & Gillen, 2011a, b; Shin & Milton, 2006), capital

planning that is not made with education and public service as the primary motivators can inadvertently harms this population. Therefore, by adding to the understanding of how changes in credit rating determinants impact public research university credit ratings, capital planning decisions that benefit institutional finances and all of their student populations can be made.

## Study Foundations

The topic for this study stems from recent discussions in trade publications around issues of university debt and capital project financing (e.g., Carlson, 2013a; Jaschik, 2013; Kiley, 2012; Supiano, 2008; The Economist, 2006). While some of this debt issuance is used for expansion and renovation of academic facilities, as means to attract faculty and researchers (Pollack, 2000), the majority of recent bond issuance has aided in funding consumption amenities (e.g., luxury dorm rooms, expansive student recreation and leisure facilities) aimed at attracting new students. This trend has led researchers with the National Bureau of Economic Research to brand these *new* postsecondary universities as country club campuses (Jacob, McCall, & Stange, 2013).

With the recent economic recession, and the rapid growth in these country club-type campuses that are fuelled by large amounts of debt financing, those in higher education circles have begun worrying about institutions overleveraging themselves (i.e., borrowing beyond the ability to repay debt) and lacking sufficient liquidity to service their growing debt (Blumenstyk, 2009; Blumenstyk & Field, 2008; Field, 2008; Gephardt & Nelson, 2010). That is, as assets decrease in value, resources that can be used to service debt decrease as well. This lack of resources may lead to resource allocation decisions that ultimately work to the detriment of students, especially those who are more

price-sensitive. In other words, insufficient resources may force institutions to adopt revenue generating policies, such as increased tuition and fees, that decrease access and affordability for some students. Furthering this concern are the consistently negative forecasts issued by the credit rating agencies since 2009, which have been motivated by the macroeconomic conditions emanating from the recession and increased uncertainty around university revenue streams (Bogaty, 2013; Gephardt & Nelson, 2010; Goodman & Nelson, 2009; Tuby, 2014; Tuby & Nelson, 2012). Exacerbating these concerns is the continued growth in deferred maintenance among colleges and universities (Manns, 2004/2004; Carlson, 2013b; Harris, Manns, & Katsinas, 2012; Manns & Katsinas, 2006), which will inevitably require attendance in the near future. Therefore, as debt financing becomes more commonplace in capital financing policy, a thorough understanding of the factors impacting ratings is important not just for the fiscal longevity of an institution, but also for the betterment of its students. With regard to the latter, since the primary mission of public universities is public service and education, it is important that debt service and credit rating obligations do not lead institutions to rely on resource management policies that disconnect them from their public mission.

Although the significance of this topic is evidenced by its impact on many facets of higher education (e.g., finance, budgeting, planning, access), it is still largely ignored in the empirical research literature. In fact, prior to this study, Michael Moody's (2008) analysis of public university credit ratings was the only published study to employ econometric methods to analyze higher education bond rating determinants.[5] Although it plays an influential role in motivating this current study, Michael Moody's analysis

[5] Serna (2013a, b) is also worth mentioning in this regard, since these two articles on higher education credit ratings provide a theoretical foundation for this topic.

employed a relatively small data set (142 observations) and few university specific variables. In other words, while taking a large step forward by utilizing rigorous analytical methods to examine this area of research, Moody's work ultimately revealed that there are many questions still unanswered. The purpose of this study is to fill the gap revealed by Moody's article and to bring attention to an important, but neglected, topic in higher education finance.

## Dissertation Synopsis

This section provides a brief overview of the remaining four chapters in this study. Chapter II provides a review of the extant literature, as it applies to public research universities and helps set a foundation for the subsequent analysis and implications. Since few studies have yet to examine university credit ratings, the chapter draws on a number of different sources. These include literature on higher education budgeting and planning, higher education economics and finance, published reports and methodologies by credit rating agencies, and public finance research focusing on municipal debt and credit ratings. After providing an overview of long-term municipal bonds and their relationship to credit ratings, Chapter II discusses the major factors involved in the ratings process. The chapter culminates with a functional form equation for public research university credit ratings. It is arguably the case that Chapter II advances one of the most in-depth theoretical discussions of public research university credit ratings to date.

Chapter III begins by discussing the study's paradigm, population, and data. The data set includes 75 public research universities, classified as having either a high or very high level of research activity, observed between 2001-2002 and 2012-2013 (900

observations). Additionally, it provides a rationale for the chosen research design, including decisions regarding the inclusion and exclusion of particular universities, as well as each variable. The chapter also discusses the methodological approach used in the study, including the econometric methods employed. For each of the research questions, ordered response models (i.e., ordered probit and ordered logit) are estimated. Marginal effects are calculated for the probability of receiving specific credit ratings based on changes in individual predictor variables. In addition, since data separation, resulting in convergence issues and unreliable parameter estimates, is a particularly problematic issue in categorical data analysis, the data for each variable is examined, using either contingency tables or scatterplots. Chapter III concludes by specifying the models for each of the three research questions, along with a list of 14 corresponding hypotheses that are developed from the literature review. Providing the hypotheses in this manner connects them, along with their corresponding research questions, back to the literature. In doing so, it establishes the study's theory-driven analysis.

Chapter IV provides the estimation results and findings from the econometric specifications. The findings provide evidence that increased market presence and demand for an institution's enrollment spaces positively impacts creditworthiness. Increases in selectivity and enrollment are shown to increase the likelihood of receiving a higher credit rating. As institutions increase their selectivity and enrollment, they signal to credit rating agencies increased demand, as well as the ability to generate additional revenues.

Turning to revenue factors and other financial variables, evidence is provided that increases in federal operating grants and contracts, tuition and fees, and endowment value

positively impact credit ratings. Increases in state and local operating grants and contracts and affiliation with an academic medical center (AMC) increase the likelihood of receiving a lower credit rating. Although these facilities provide options for further diversification in an instituion's revenue base, through patient care fees and research funding, uncertainty surrounding medical education and healthcare has resulted in these facilities being viewed as a credit liability. Finally, changes in state appropriations do not show statistically significant effects in the models related to the first research question. These findings support the argument that credit ratings favor both a broader fiscal base and factors more akin to a private model of higher education.

Of the governance variables included in the models, high state credit ratings, as measured by a state general obligation (GO) bond rating of Aa2 or higher, is shown to positively impact institutional credit ratings. This is not surprising, since strong state GO ratings may signal a state's increased ability to finance its public institutions (Moody, 2008; Serna, 2013a). Additionally, high state ratings may also suggest a lack of binding fiscal restraints, such as debt limits.

Both debt factors, total debt burden per student and leverage (percentage of debt to revenue) follow their hypothesized relationships. Increased total debt positively impacts credit ratings, while increased leverage has a negative impact. Taken together these findings suggest that while active debt market usage and experience managing debt is rewarded by credit rating agencies, the ability to service outstanding debt is just as important.

The primary variable related to the second research question, revenue diversification, is positively associated with higher credit ratings. This finding follows

the hypothesized relationship as well as findings from previous state-level credit rating studies (e.g., Grizzle, 2012; Yan, 2011). Revenue diversification is viewed as a credit benefit, due to its ability to limit the effects of variance in revenue streams. That is, by drawing revenue from a variety of sources, institutions are better able to compensate for fluctuations in specific sources.

In the third research question, the variable for recession is positively associated with higher credit ratings. This is surprising, considering the large body of literature showing the negative impacts on funding from the Great Recession, as well as the numerous negative outlooks issued by the rating agencies. However, since this study examines research universities, which tend to be larger and wealthier than other types of colleges and universities, the noted macroeconomic effects of the recession may have not impacted those in the data set as strongly. Chapter IV also compares the estimates from the models without the recession variable with those from the models including recession. Doing so allows for a more nuanced interpretation of the spillover effects from economic downturns.

Chapter V returns to the estimation results presented in Chapter IV, focusing specifically on the implications for policy, research, and practice. Furthermore, this chapter frames the study's findings in the context of the concerns over access and affordability presented in the warrant. The results for market position and demand suggest that the credit ratings process favors larger, wealthy institutions, because of their ability to generate revenues through student demand and greater philanthropic support. This also suggests that private models of higher education, which tend to be characterized

by greater emphasis on tuition and fee revenue and research, are preferred by credit rating agencies.

The positive estimates for federal operating grants and contracts, as well as tuition and fees, supports the privatization hypothesis. By incentivizing wealth, size, and research, the credit rating process may lead institutions to focus more on research, high tuition, and increased selectivity and less on public service, access, and affordability. Such an outcome would be detrimental to both the mission of public higher education, as well as to the larger population.

The debt measures demonstrate the importance of adequate debt service coverage. However, they also imply that if institutions are able to afford larger debt burdens they will be positively rewarded with higher credit ratings. Chapter V discusses how in order to service larger debt loads, institutions may institute policies such as increased tuition and fees or reduced tuition subsidies. Returning to the study's larger theme of access and affordability, such policies may prove hazardous for price-sensitive students, since these individuals are disproportionately impacted by such practices.

## Chapter Conclusion

This chapter has provided a general introduction to the study. It introduced the study's topic and the three primary research questions. The scope, warrant, and foundations were provided and connections were made to issues such as institutional longevity, access, and affordability. Finally, a synopsis of the studyas a whole was provided, including summaries for chapters two through five. In introducing the research in such a manner, this chapter has provided a solid foundation for the remainder of the study.

# CHAPTER II

## REVIEW OF LITERATURE

In order to develop the theory to begin addressing the three research questions posed in Chapter I– *How are the factors involved in public research university revenue structure associated with institutional credit ratings? How is the level of revenue diversification in public research university revenue structure associated with institutional credit ratings? How do severe economic downturns impact public research university credit ratings?*–this chapter builds a conceptual foundation by reviewing the extant literature related to university debt and credit ratings. Since few studies have yet to examine credit ratings in higher education, this chapter draws on a number of different literatures, including literature on higher education budgeting and planning, literature on higher education economics and finance, published reports and methodologies by credit rating agencies, and public finance literature on state and municipal debt and credit ratings. The decision to examine research from the field of public finance is motivated by a historical lack of attention in higher education journals towards the topic of institutional debt and credit ratings.

Traditionally, higher education finance scholars have focused largely on the topic of state funding (e.g., Archibald & Feldman, 2006, 2008a, 2008b, 2011; Callan, 2002; Cheslock & Gianneschi, 2008; Dar, 2012; Hossler, Lund, Ramin, & Irish, 1997; Longanecker, 2006; McLendon, Hearn, & Mokher, 2009; Serna, 2013c; Serna & Harris,

2014; Tandberg, 2008, 2010; Weerts & Ronca, 2006). There are many possible explanations for this, some of which include: trends in decreased state funding for higher education, especially during and following recessionary periods (State Higher Education Executive Officers, 2013; Zumeta, 2013; Zumeta, Breneman, Callan, & Finney, 2012); the spillover effects of reduced state funding on tuition and fees– i.e., many states try to mitigate funding reductions by shifting costs onto students and parents (Johnstone, 2004; Johnstone & Marcucci, 2010; Zumeta, 2010, 2012; Zumeta & Kinne, 2011); and state appropriations' traditional role as the primary source of funding for public college and university operating budgets (Barr & McClellan, 2011; Goldstein, 2012; Zumeta, 2009). However, as postsecondary institutions continue to utilize municipal debt markets more readily (Kiley, 2012; Supiano, 2008), further research into areas associated with capital funding is necessary. Additionally, since capital projects also affect operating budgets (e.g., need for increased staff, cost of operation and utilities, regular maintenance), this is an area of research that exceeds the boundaries of capital budgeting and directly relates to the day-to-day fiscal activities of institutions (Goldstein, 2012).

This is not to say that research on postsecondary capital funding has been completely absent from the research literature. In fact, recently a handful of higher education researchers have begun directing their attention toward exploring state capital appropriations (e.g., Delaney & Doyle, 2014; Harris, 2011; Ness & Tandberg, 2013; Tandberg & Ness, 2011), the rising costs of deferred maintenance (e.g., Harris, Manns, & Katsinas, 2012; Manns, 2003/2004; Manns & Katsinas, 2006), and describing the factors involved in rating college and university long-term tax-exempt bonds (e.g., Serna 2013a, b). Since the first body of research is primarily concerned with state funding, albeit

funding that is dedicated to capital budgets, and the second focuses primarily on maintenance costs and capital budget master plans, they are not directly applicable to this study's examination of credit ratings. These two literatures focus on trends in and factors associated with changes to single variables (e.g., federal capital appropriations, deferred maintenance); that is, capital appropriations, or deferred maintenance, can be understood as the dependent variable in these studies. With this study, the emphasis is placed not on what impacts individual variables, but how each variable works to predict changes in institutional credit ratings. Credit ratings become the dependent variable and the various individual factors the predictors. Stated differently, this study can be understood as moving up one level in unit of analysis to examine how these factors help predict public university credit ratings.

As for the latter, these two studies will be discussed in more depth later in this chapter, as they provide a foundation for developing a functional framework for understanding university credit ratings. Thus, the sparseness of research on credit ratings in the higher education literature specifically requires that this study be interdisciplinary. This requires spanning the fields of higher education, public finance, public policy, and economics to focus on the research literature that examines tax-exempt municipal bonds and the financial and economic behaviors of public sector entities

The motivation to borrow from these fields is further supported by the assumption that research pertaining to governments and nonprofits are transferable to higher education. As nonprofit organizations, public colleges and universities are similar to governments in that they are both mission-oriented, focus on sustainability rather than profit, and both participate in tax-exempt borrowing (Yan, Denison, & Butler, 2009).

Additionally, public colleges and universities can be understood as a type of public authority. Public authorities are public benefit corporations, with appointed boards that are "wholly owned by units of regular government," but enjoy separation of legal liability from their parent government (Leigland, 1993, p. 376). Both public authorities and public institutions of higher education are creations of the state, operate within political jurisdictions, and rely on similar sources of revenues, such as user charges and fees (Denison, Fowles, & Moody, 2014; Trautman, 1995). In fact, King et al., (1994) directly classify public colleges and universities as "government entities or public benefit corporations" (p. 33).

By drawing on the literatures listed in the beginning of this chapter, this review will form a theoretical foundation for modeling public research university credit ratings– a foundation which arguably has yet to be assembled. The remainder of this chapter is divided into five sections: 1) an overview of the fundamentals of tax-exempt municipal bonds, including credit ratings basics; 2) a discussion of the main factors that contribute to bond ratings; 3) a review of the literature on revenue diversification; 4) an examination of the impact of severe economic downturns on credit ratings; and 5) a conclusion that provides a theory-driven functional model of credit ratings.

## Fundamentals of Long-Term Municipal Bonds and Credit Ratings

Today, public colleges and universities have access to a diverse array of financial instruments for financing debt (King et al., 1994); however, their primary long-term debt instrument for funding capital projects remains tax-exempt municipal bonds (Blustain, Cobine et al., 2009). There is a large body of literature examining municipalities' decisions to issue long-term debt (e.g., Bahl & Duncombe, 1993; Bowman, 2002; Bunch,

1991; Calabrese, 2011; Clingermayer & Wood, 1995; Denison, 2009; Denison, Fowles, & Moody, 2014; Denison, Hackbart, & Moody, 2006; Ellis & Schansberg, 1999; Farnham, 1985; Hackbart & Leigland, 1990; Kiewiet & Szakaly, 1996; Moody, 2007; Trautman, 1995; Yan, Denison, & Butler, 2009). But, since this study is concerned with the determinants of credit ratings, rather than the influences surrounding debt issuance decisions, that literature will not be discussed in-depth.

Still, in order to understand the rationale behind tax-exempt municipal bond usage, it is important to briefly discuss some of the conventional logic used when issuing public debt. Capital projects are essentially "long-term investment programs with benefits spread over the years to come" (Oates, 1972, p. 153); therefore, it is presumed that future residents, or students, should share in the project costs. This is known as the benefit principle of taxation. Since future students are going to be the ones realizing many of the project's benefits, these individuals share the financial burden. In other words, debt financing of capital projects allows numerous project costs to be shifted to the primary beneficiaries- future users. Additionally, since many capital projects are extremely expensive, issuing municipal bonds, as opposed to a PAYGO approach, allows institutions to be more ambitious than would be possible if only using resources on-hand (Blustain, Cobine et al., 2009).[6] In fact, many of these projects are too expensive to finance with existing resources. Furthermore, debt financing can often times be more cost-effective for an institution, since internal funds, which would be used in a PAYGO approach, can be invested at a greater rate of return than the cost of financing debt (Blustain, Cobine et al., 2009).

[6] PAYGO, which stands for "pay-as-you-go", is a policy requiring capital needs to be financed directly from current revenues (Forsythe, 1993).

But, there are some potential downsides to utilizing debt as a means of financing capital projects. Since debt service is a fixed cost, it requires a constant allocation of future streams of resources, which may have to be shifted from other areas, such as additional faculty lines and student financial assistance (Blustain, Cobine et al., 2009). Another risk is that as public research universities continue to utilize debt markets at a greater rate, they become more susceptible to market fluctuations. For example, following the mortgage crisis in 2008, many institutions experienced declines in their asset values, resulting in liquidity risks and potential violations of debt ratio covenants (Gephardt, 2011; Weisbrod & Asch, 2010).[7] These changing ratios have only proved problematic for a small segment of the industry, but have the potential to become significant for a larger share (Blumenstyk, 2009). Even as median expenses continually surpass median revenues (Tuby. 2014), postsecondary institutions have increasingly taken on larger amounts of debt (Gephardt, 2011). If these trends continue, it is reasonable to infer that larger institutions may begin experiencing problems servicing outstanding debt, especially if both their asset values and liquidity decrease. Additionally, while institutions of higher education have traditionally received fairly high credit ratings (Johnson & Kriz, 2005; Serna, 2013b; Standard & Poor's Ratings Services, 2014a), recent reports from two of the three major credit rating agencies have forecasted negative outlooks and increased volatility for the sector (Bogaty, 2013; Standard & Poor's Ratings Services, 2013).

[7] Bond covenants are legal provisions placed on specific issues with the intent of maintaining the "credit strength of the obligor" (King et al., 1994, p. 82). Debt ratio covenants require institutions to maintain a specified debt service coverage ratio, such as debt to revenue or liabilities to assets (King et al., 1994; Rubinoff & Marion, 2007).

## Characteristics of Tax-Exempt Municipal Bonds

One of the key characteristics of municipal securities is their exemption from federal taxes on interest paid.[8] Since public postsecondary institutions function as state government agencies (i.e., public authorities), they qualify under Internal Revenue Code § 103's public benefit corporation provision (Blustain, Cobine et al., 2009). In addition to exemption from federal taxation, many states also provide state resident investors exemption from state taxes when municipal bonds are issued within their own borders. However, although tax exemption applies to interest, capital gains from selling tax-exempt bonds at a higher price than purchased or from redeeming bonds bought at a discount are subject to federal income taxes (O'Hara, 2012).

For investors, the benefits of tax exemption are reflected in the security's interest rate and yield.[9] Because investors receive tax benefits (i.e., they do not have to pay federal and in some cases state and local income taxes on the bonds), they are willing to accept lower interest rates than would be required with a similar taxable security (Blustain, Cobine et al., 2009; O'Hara, 2012). Therefore, issuers are afforded lower debt service payments.

## Credit Ratings Fundamentals

There are many factors that can affect a municipal bond's yield. Of particular interest to this study are credit ratings. A credit rating is a measure of the likelihood–usually expressed with a letter with some sort of qualifier–that an issuer will make timely

---

[8] Internal Revenue Code § 103(b) states, "interest paid on state and local obligations will not be taxable to the recipient" (Internal Revenue Service, n.d., p. B-3).

[9] Bond yields express rate of return on an investment. See O'Hara (2012, pp. 26-27) for an explanation of the types and of bond yields and their respective calculations.

principal and interest payments (Blustain, Cobine et al., 2009; Johnson, 1993; O'Hara, 2012; Rabson, 2008; Serna, 2013a). From a risk prevention perspective, credit ratings can be understood as a measure of "the likelihood of default on contractually promised payments and the expected financial loss suffered in the event of default" (Moody's Investors Service, 2014, p. 7). It should be noted that failure to redeem principal at maturity, as well as failure to make interest payments on time, both constitute default (Thau, 2011).

Ratings for long-term obligations for the three major credit bureaus are listed in Table 1. These ratings refer to debt issues with a maturity of more than one year (Moody's Investors Service, 2014; Rabson, 2008). Since this study is concerned with the rise in research universities' use of municipal bond markets to finance long-term capital projects, long-term ratings are the focus. While municipal bonds are often rated by more than one credit rating agency, there are times when they are rated by only one (Rabson, 2008). This is evidenced in the differences in numbers of U.S. public four-year higher education institutions and systems rated by each agency (see Table 1). Otherwise, the rating scales used by the three agencies are fairly similar. However, Moody's ratings have traditionally been given more "weight" by the marketplace (Lamb, 1993, p. 32).

Table 1

*Credit Ratings for Nonprofit Long-term Obligations*

| | **Moody's** | **S&P** | **Fitch** |
|---|---|---|---|
| **Investment Grade** | Aaa | AAA | AAA |
| | Aa | AA | AA |
| | A | A | A |
| | Baa | BBB | BBB |
| **Speculative** | Ba | BB | BB |
| | B | B | B |
| **Speculative:** | Caa | CCC | CCC |
| **Nearing Default** | Ca | CC | CC |
| | | C | C |
| **Default*** | C | SD | RD |
| | | D | D |
| Qualifiers | 1 through 3, where 1 > 2 > 3 | Plus and minus used to indicate stronger/weaker position | Plus and minus used to indicate stronger/weaker position |
| Number of U.S. Public Four-Year Higher Education Institutions and Higher Education Systems Rated | 226 (2011) | 163 (2014) | <119 (2015) |

*Note*: Standard & Poor's and Fitch have two default ratings. SD (selective default) or RD (restricted default) are assigned if an obligor has defaulted on an issue but is believed to able to continue meeting obligations on other issues; D (default) is assigned if the default is believed to affect payment on all obligations.
*Sources*: Fitch Ratings (2015); Moody's Investor's Service (2014, 2015a); Standard & Poor's Ratings Services (2014b).

Credit ratings can affect an institution's debt financing in a number of ways. In general, the higher an issuer's credit rating (i.e., its creditworthiness), the lower the interest rate (i.e., its coupon) on the bond sold (Moody, 2008; O'Hara, 2012; Rabson, 2008; Serna, 2013a; Thau, 2011). The reasons for this are fairly straightforward. As a measure of the probability of default, lower credit ratings signal to investors increased investment risk. Therefore, in order to attract buyers, less creditworthy issuers must sell

bonds at a higher coupon, providing greater investment income for potential buyers based on the increased credit-risk associated with lending to the entity.

Additionally, movement within and between different rating categories (e.g., investment grade, speculative, speculative: nearing default, default) can impact a bond's coupon differently. Traditionally, movement within the *investment grade* category impacts interest rates much less than movement within or into other categories (Thau, 2011). But, with the rise in rating downgrades (Bogaty, 2013; Kiley, 2013) and increasing amounts of debt being issued by institutions of higher education, even differences in rating qualifiers are beginning to result in considerable differences in bond prices (Serna, 2013a).

**Long-Term Municipal Bonds**

The type of long-term municipal bond issued by a university also has a bearing on that institution's assigned credit rating. Tax-exempt municipal bonds are traditionally classified into two different categories, general obligation bonds (GOs) and revenue bonds. These refer to the type of security pledged by the issuer. GOs are backed by the "full faith and credit of the issuer" (Blustain, Cobine et al., 2009, p. 38). These bonds can be serviced from any of the issuer's revenue sources. Revenue bonds, on the other hand, are issued to fund specific projects and are secured by and paid for with a specific revenue pledge.

Due to their narrower pledge, and thus increased obligation volatility, revenue bonds tend to have lower credit ratings than GOs (Ambler, Burr, McManus, Mischel, & Roswick, 1993). However, such a generalization is somewhat simplistic and can be deceiving, since ratings can be influenced by the industry in which the issuer operates

(Thau, 2011). For example, revenue bonds issued by a major state university or university system may receive higher credit ratings than GOs issued by a small liberal arts college, due to the former's significantly larger revenue base. Related to this is that when rating revenue bonds ratings agencies do not solely examine the pledged security in isolation. Instead the institution as a whole is examined, and then afterwards the specific pledge is analyzed and its financial standing is weighted accordingly (Fitzgerald, 2005). Therefore, it is important to understand the industry or sector of a specific issue.

Additionally, generalizing bond types into two distinct categories can lead to a misunderstanding of the subtleties embedded in the many variations found in these securities. In 1994, King et al., identified at least seven different types of higher education municipal bond security pledges, ranging from general obligation and state appropriation pledges on the high creditworthiness end to auxiliary revenue bonds (secured by facilities such as housing and dining) on the low creditworthiness end. Perhaps it is more appropriate to refer to tax exempt municipal bonds issued by public postsecondary institutions as being secured by consolidated revenue pledges versus individual revenue streams, with various bonds (GO and revenue) existing on a spectrum of high to low creditworthiness. Such a model is illustrated in Figure 1.


*Figure 1.* Revenue Pledge and Associated Creditworthiness, by Author

King et al., (1994) first noted the movement among institutions of higher education towards issuing bonds secured by all unrestricted resources. Over a decade later Moody's Investors Service echoed this observation, by writing that "[o]ver the past

several years, public higher education institutions have increasingly been moving to consolidated revenue pledges, rather than issuing debt supported only by individual revenue streams" (Fitzgerald, 2005, p. 1). The use of these "consolidated" bonds lends itself to increased validity in analysis, as models can focus on factors that are universal to revenue structure, rather than trying to account for the multiplicity of factors that are unique to a specific, individual revenue stream.

## Factors Involved in Determining Credit Ratings

Since the models used to predict credit ratings in this study are rooted in the theory developed from extant literature, this section provides a review of literature related to credit rating determinants. While a more detailed discussion of specific variables, including measurement and expected impact, is provided in Chapter III, this section's purpose is to provide a theoretical foundation for analysis. This *framework* is applicable to all three of the study's research questions, but it is especially germane to the first, because of the question's focus on individual revenue and institutional components.

The credit rating process has been accurately described with adjectives such as "complex, opaque [and] murky" (Serna, 2013a, pp. 4-5). Although rating agencies publish methodologies related to the process of rating postsecondary institutions (e.g., Kedem, 2011; Moody's Investors Service, 2014, 2015a; Standard & Poor's Ratings Services, 2014b; Viacava, 2010), these primarily consist of descriptive overviews of specific factors analyzed in the ratings process and do not provide a cohesive summary of the data generating process in full. In other words, what is missing from these publications is the actual mechanics (e.g., statistical calculations) used to estimate higher education credit ratings.

In the public finance literature there exist succinct overviews of the categories of factors involved in rating tax-exempt municipal bonds (e.g., Denison, Yan, & Zhao, 2007; Feldstein, 2008; Feldstein & Goode, 2008; Hildreth & Miller, 2002; Johnson,1993). These include economic, financial, debt, and issuer management. While these four categories are useful for understanding the general aspects involved in the ratings process, a more thorough overview is needed, specifically one that accounts for the unique aspects of public postsecondary education revenue structure. A starting place is Serna's (2013a, 2013b) five-category typology, which is reproduced in Figure 2. It provides a succinct overview of the criteria used in rating public postsecondary institutions.

| Criteria | Measured via |
|---|---|
| **Market Position and Demand** | Enrollments, number of students accepted, student quality, student yield, retention and graduation rates, percent of tenured faculty, and competition |
| **Finances and Operating Performance** | Revenues (including tuition and state appropriations), expenses, risk management, operating budgets and balance sheets, endowment and long-term investment pools, liquidity provisions, and total debt burden |
| **Governance and Management** | Overall institutional strategies and policies implemented by university administration, track record of dealing with unforeseen difficulties, tenure of management, composition and structure of the university governing board, and reporting mechanisms and monitoring procedures |
| **Debt Profile** | Security pledges, debt covenants, as well as other liabilities and debt instruments |
| **State Policies and Government Relationship** | Mandated tuition caps, declines in budgetary resources provided by the state, requirement to remit surpluses or unspent dollars back to the state, bonding limits, and relationship with the state board |

*Figure* 2. Public Higher Education General Credit Rating Criteria. Reproduced with permission from "Employing College and University Credit Ratings as Indicators of Institutional Planning and Effectiveness, 2013, *Planning for Higher Education Journal, 41*(4), p. 4. Copyright 2013 by Gabriel Ramón Serna, Ph.D.

**Market Position and Demand**

As the public higher education sector remains one in which institutions face continued fiscal constraints, an institution's market position, essentially its marketability, has become an increasingly important factor for ratings analysts (Serna, 2013a). Since greater market position and increased demand for services can be understood as reflecting the odds that an institution will fair better during changing economic conditions, rating agencies employ a number of demand related variables to measure an institution's vulnerability to market changes (Serna, 2013a, 2013b). Essentially, stronger market position is viewed as better enabling universities to "compete effectively for tuition revenue, private gifts, research grants, and government support" (Kedem, 2011, p. 3). The criteria that Moody's Investors Service uses to evaluate market position and demand are listed below:[10]

1. Scope of operations- Greater diversity in operations provides insulation against economic and demographic changes by allowing an institution to better leverage its influence and consolidate resources during difficult economic periods; affiliation with an academic medical center (AMC) [11] can provide a level of stability, or instability, due to its financial relationship with the university (Kedem, 2011); when operations are diversified it is likely that the same can be said for revenue structure.

[10] For brevity, Moody's Investors Service and Standard and Poor's Rating Services will be referred to as Moody's and S&P from here forward, except when the full name is needed to avoid confusion.

[11] An academic medical center is a university affiliated teaching hospital that functions as a major health provider for the state and conducts a broad array of biomedical and health services research. This definition is developed from the Association of Academic Health Centers Annual Report (2014).

2. Student demand and pricing power- Greater demand provides increased flexibility in shaping offerings and student body characteristics; it also decreases an institution's price elasticity, allowing for greater flexibility in setting tuition and fees (Kedem, 2011); increased selectivity, which may result from greater demand, may reflect an institution's competitive position (Standard & Poor's, 2007).
3. Philanthropic support- Donor funds are a form of public endorsement and can provide greater media exposure and national recognition (Kedem, 2011). Typically, endowments are a good measure of philanthropic support and the ability to accrue donative resources (Winston, 1999).

Market position and demand is one of the more understudied aspects of ratings criteria. Since these factors are somewhat unique to higher education (e.g., enrollments and selectivity), it is difficult to locate related findings from analyses of governments or other nonprofits. Michael Moody's (2008) analysis of public university credit ratings is the only empirical study to examine the relationship between university demand factors and creditworthiness.[12] The presence of a university hospital, which did not return statistically significant results, can be understood as reflecting the scope of an instituion's operations. Next, freshman selectivity–a measure of student demand and/or selectivity–returned a small positive coefficient, which suggests that an increase in the ratio of acceptances to applicants (decreased selectivity) *probably* positively impacts credit ratings. This is surprising, since the literature suggests that rating agencies favorably view increased selectivity (Kedem, 2011; Standard & Poor's, 2007). However, since

[12] Michael Moody is a public policy researcher who is not affiliated with Moody's Investors Service.

none of the marginal effects are statistically significant, this variable provides little in the way of evidence. [13]

This one study shows that there is much work to be done in this area. For example, it would be interesting to see if a larger dataset returns different results for Moody's (2008) two demand variables. Also, other measures of demand and selectivity might be analyzed. For example, S&P (2007) states that the most selective institutions predominantly have retention rates of "90% or more"; in addition, they claim that "[g]raduation rates tend to correlate with selectivity–the more selective an institution, the higher the four-and five-year graduation rates" (p. 178). Therefore, these two measures could be included to help capture selectivity. Additionally, enrollment growth rates could be used to help capture student demand (Kedem, 2011).

**Finances and Operating Performance**

Financial strength is one of the more important criteria in the ratings process (Serna, 2013b). It serves as an indicator of an institution's ability to service its debt, especially when confronted with "financial stress, tight budgets, diminished demand, and lower revenues or increased expenses" (Serna, 2013b, p. 55). In addition to servicing debt, strong operating performance allows universities to continue supporting their institutional missions (Kedem, 2011). Analysis of finances and operating performance is further illustrated with the two subcategories below:

1. Cash flow- The concern is whether institutions are generating sufficient cash flow to cover operational costs while still being able to invest in programs and

[13] One of the limitations in Michael Moody's analysis is his use of the ordered probit estimator, which requires the calculation of marginal effects for interpreting the specific impact of covariates. Although Moody does not enter into any explanation about this, his analysis's failure to return statistically significant marginal effects for freshman selectivity may be due to the small sample size of 142 observations.

facilities; in addition to traditional revenue sources that provide much of the operating revenue for a single year (e.g., tuition and fees, state appropriations, grants), Moody's also evaluates investment pools, including endowments, since such revenue sources may aid an institution's operations (Kedem, 2011).

2. Budgetary flexibility and operating freedom- Well-run universities have the ability to adjust their operations in order to generate needed revenue in response to market changes; revenue generation is decidedly a primary focus when evaluating an instituion's creditworthiness, since expense reduction could result in program reduction/elimination, negatively impacting market position; increased flexibility can be measured through an instituion's level of revenue diversity, which measures both the number and distribution of funds (Kedem, 2011).

Although there are few statistical analyses of the relationship between specific revenue streams and credit ratings, especially at the institutional level, prior literature provides us with a starting point from which to begin understanding these associations. Returning to Moody's (2008) study of state debt policies and public university credit ratings, expendable financial resources per student, measured in thousands of dollars, is both statistically significant and positively associated with a higher credit rating. An additional $10,000 per student in total financial resources increases the probability of receiving a Aa2 rating (from Moody's Investors Service) by 31%. Conversely, the same addition decreases the probability of being rated A1 by 33%. While informative (i.e., increased revenues is positively associated with higher credit ratings), it tells us little about the associations for individual revenue streams or how the distribution among streams might matter.

Looking at county and city government credit ratings, Palumbo and Zaporowski (2012) find that per capita general revenues are positively associated with higher credit ratings. Since this variable measures "the fiscal capacity of the issuing government to meet its expenditure needs as well as debt service requirements," it is applicable to higher education (Palumbo & Zaporowski, 2012, p. 93). That is, it is similar to Michael Moody's (2008) expendable financial resources per student variable, in that both provide an overall understanding that increased revenue is associated with increased creditworthiness. Unfortunately, neither of these studies tells us anything about individual revenue streams, which are important for this study's examination of revenue structure. However, by looking at some of the descriptive literature, inferences can begin to be made regarding the individual revenue streams and university credit ratings.

**Tuition and fees.** Tuition and fees have long been viewed as "a primary revenue source for both public and private higher education institutions" (McKeown-Moak & Mullin, 2014, p. 70). But changes in economic conditions have increased price sensitivity among certain students (Serna, 2013a). Following the economic crash in 2007-2008, a combination of fewer high school graduates, decreased household net worth, "depressed family income," and increased government scrutiny over tuition costs have led to slowed enrollment and net tuition revenue growth (Bogaty, 2013, p. 4). In fact, in FY 2008 only 9% of public higher education institutions failed to grow their tuition revenue by the Federal Reserve's target inflation rate of 2%. Yet, in FY2011, 21% of public universities failed to grow their tuition revenue by this number (Bogaty, 2013). Days of retarded tuition growth do not appear to be ending any time soon. In their *2015 Outlook*, Moody's forecasts aggregate revenue growth below 3%, with

"[c]onstrained net tuition revenue growth as the key driver" (Tuby, 2014, p. 2). This volatility suggests that ratings analysts may cautiously view heavy dependence on this funding source. This inference is supported by Grizzle's (2012) empirical findings that among state GO debt, increased revenue volatility is negatively associated with a stronger credit rating.

**State and local appropriations.** As discussed toward the beginning of this chapter, there is a large body of literature documenting variations in state appropriations. Even as early as 2012, rating agencies began forecasting negative outlooks for state funding to higher education, noting the weak economic recovery and competition with other state priorities (Bogaty, 2013). For comparison, public university reliance on state appropriations accounted for over 30% of operating revenues in FY2009, but by FY2013 that number dropped below 25% (Tuby, 2014). Public institutions have seen slight increases in state funding during FY2013 and FY2014; yet, in many cases these monies are attached to performance requirements (Tuby, 2014), which can impede a school's ability to access such support (Dougherty et al., 2014; Dougherty & Reddy, 2011). Because state appropriations are becoming an increasingly unstable funding option, dependence on this source introduces a greater amount of variation and unpredictability into a university's revenue base. This may lead analysts to regard these institutions as more susceptible to revenue shortfalls and as a result have difficulty meeting debt obligations. Supporting this assumption is that in FY2013 S&P (2014a) reported that for institutions rated AAA state funds represented 8.2% (median) of their total revenues, while those rated A relied on state funds for 26.5% of their revenues. While this data is

not to be understood as demonstrating a causal relationship between state monies and credit ratings, it does suggest an inverse correlation between the two.

**Federal grants and contracts.** Federal grants and contracts represent the third primary source of public higher education funding (McKeown-Moak & Mullin, 2014). For the past 150 years, the federal government has played an integral role in funding public and private postsecondary institutions. These monies not only include student financial aid, but also competitive grants for research and other public activities (McKeown-Moak & Mullin, 2014). Grants include funding for both direct (e.g., salary and benefits for investigators, graduate assistants, technicians, supplies, travel) and indirect (e.g., utilities, accounting, payroll, costs associated with maintaining space) costs (Goldstein, 2012).

As with other areas of funding, federal grants and contracts have also suffered in recent years. While there has always been competition around this source of funding, the difficulty in obtaining these monies has intensified in recent years (Bogaty, 2013). For example, the success rate for university grant proposals submitted and approved by the National Institutes of Health (NIH) dropped from 30% in 2003 to 18% in FY2011 (Bogaty, 2013). Whether this drop reflects a decrease in grant money or increased competition is unclear. What is known is that large research universities have fared better in securing federal grants in recent years. This may be due to their large brand recognition, the broad scope of activities, and that many are affiliated with research hospitals, where biomedical research remains one of the largest areas of this type of support. However, affiliation with an academic medical center (i.e., a university-affiliated teaching hospital), or AMC, may be a double-edged sword. With healthcare

reforms, patient-care revenues have experienced slowed growth (Bogaty, 2013; Tuby, 2014). Still, federal grant and contract revenues are likely to be positively associated with higher credit ratings, as they may reflect factors such as institution size and stability, brand recognition, and national reputation.

**Endowment funds.** Although endowment funds are technically not a revenue source on their own, they generate investment returns that are used by many high creditworthy universities to help fund operations (Bogaty, 2013). Traditionally, under the rules of the Uniform Management of Institutional Funds Act (UMIFA), a portion of an endowment's cash income (e.g., dividends, interest, etc.) was distributed to the university for either specified purposes or general uses. This payout rate was usually based upon the endowment's historical market value and payouts from previous years. The remaining cash and investment income was then reinvested into the endowment so that the fund could grow into perpetuity (Goldstein, 2012).

However, with the market crash of 2008, endowment funds lost value and as a result payouts were not available, or were insufficient to fund many of the activities normally supported by these monies. Therefore, the Uniform Prudent Management of Institutional Funds Act (UPMIFA) was passed, which allows "prudent use of a portion of principal to meet current spending needs" (Goldstein, 2012, p. 50). Stated otherwise, endowments now function as large reserve funds. Both S&P and Moody's consider endowments to be "indicator[s] of strength" (Serna, 2013b, p. 61). In fact, in FY 2013, S&P AAA rated institutions had a median endowment market value of $6 billion, $585 million for AA institutions, and $9 million for those in the BBB category (Standard &

Poor's Rating Services, 2014a). Thus, it is likely that statistical analysis will find a positive relationship between endowment value and credit rating.

**Governance and Management**

When evaluating an institution's governance and management, rating agencies look at factors such as leadership, management policies and strategies, and track record, especially during fiscal hardships (Serna, 2013a). One of the primary concerns in such an analysis is whether "management and governance of the institution might lead to default or even closure of the institution" (Serna, 2013b, p. 56.). Three sub-factors that further illustrate governance and management are listed below:

1) The board and senior management's composition- A balance between tenured and new members, possessing a variety of skills such as knowledge of institutional history, leadership in a variety of sectors, and fiscal and risk management are valued; also accounted for is the board's role in strategic planning and decision making (Kedem, 2011).
2) Oversight and disclosure practices- The institution's policies should be clearly articulated, and controls put in place to allow for transparency, accountability, and oversight (Kedem, 2011); since these allow for efficient debt management, larger amounts of debt may suggest that clearly articulated policies are in place.
3) Short- and long-term planning- Clear definition of an institution's long-term strategic plan, long-term financial plan, and prudent short-term budgeting, as well as the alignment of all three allow for efficient use of debt (Kedem, 2011); as with oversight, larger amounts of debt may suggest the implementation of clearly defined short- and long-term planning.

Since effective management can help ensure prudent decisions regarding debt issuance and financing, a well-established leadership team can often mean the difference between being viewed as more or less creditworthy. While Moody's argues "[t]here are no purely quantitative ratios that can be used to ascertain the strength of an institution's management and governance" (Rubinoff & Marion, 2007), board centralization and its relationship to institutional autonomy has been quantified and studied in the research literature. Lowry (2001) finds that reduced institutional autonomy can negatively impact a school's net tuition and fee revenues. State legislators make funding decisions based on the political costs and benefits to their states (i.e., they are motivated by the desire to maximize political support). Hence, they may wish to increase voter support by keeping tuition and fees low. Since governing board members are appointed through political processes or directly by a state's governor (Lowry, 2001; National Association of College and University Business Officers, 2012; Purcell, Harrington, & King, 2012), a highly centralized board (e.g., a consolidated governing board)[14] can essentially link universities to the state by as little as one-degree of separation.

Two studies confirm and further illustrate this relationship between centralization/regulation, institutional alignment, and revenues. Analyzing tuition policies at land-grant universities, Burgess (2011) finds that institutions in states with low levels of centralization tend to have lower tuition and fees. Knott and Payne (2004) find similar results while looking at comprehensive and Ph.D.-granting public universities. Additionally, their analysis shows that increased centralization negatively impacts

[14] Consolidated governing boards exercise control over their institutions' operating and capital budgets and hold authority over revenue allocation (McGuinness, 2001).

endowment value and total research funding. The explanation is that while centralized boards more strongly align public universities with the state's interests, decentralized boards align institutions with a "private university model that relies more on tuition revenue and research dollars rather than state appropriations" (Knott & Payne, 2004, p. 28).

In the context of credit ratings, since reliance on state appropriations have been shown to negatively impact creditworthiness, while grants and contracts have an opposite relationship, it can be hypothesized that high levels of centralization may too strongly dictate a university's activities. This can result in limited managerial freedom and hampered revenue generation. This conclusion is bolstered by Michael Moody's (2007) findings that highly centralized governing boards lead to lower overall debt levels, which may negatively impact an institution's creditworthiness. While governing board restrictions may protect institutions from over-leveraging their assets, such austerity may also "inhibit the ability of universities to leverage their full debt-capacity" (Serna, 2013b, p. 62). Additionally, it may signal to the debt markets potential problems accessing debt for refinancing and other needs. That is to say, when a governing board intervenes too often or too directly in institutional matters this can send a negative signal to debt markets.

**Debt Profile**

The inclusion of total debt burden as a measurement under finances and operating performance is meant to contextualize revenue with regard to budgetary surpluses or deficits. Analysis of a university's debt profile, on the other hand, focuses on the institution's ability and willingness to meet debt obligations; in other words, whether or

not an institution is able to make timely debt payments (Serna, 2013b). Moody's does not prescribe an ideal debt profile for universities. Instead, they state "[t]he appropriate debt structure for a university depends on its unique credit characteristics and management's risk tolerance" (Kedem, 2011, p. 17). Factors such as the breadth and stability of revenue pledges, security pledges, ability to adjust to interest rate spikes in the case of variable rate securities, staggered obligation expiration dates, access to various types of debt products, and restrictions placed on universities by debt covenants are all accounted for when evaluating debt profile (Kedem, 2011).

Unfortunately, the empirical literature has yet to fully explore most of these factors through statistical analysis. Instead, debt profile is usually modeled as a general measure of total outstanding debt (Grizzle, 2010, 2012; Johnson & Kriz, 2005; Moody, 2008; Palumbo & Zaporowski, 2012; Yan, 2011). In all of these studies, higher levels of debt are associated with weaker credit ratings.[15] But, some of the more nuanced factors analyzed in debt profile are not explored. One explanation for this analytical gap may be due to feasibility. University credit characteristics are "unique," (Kedem, 2011, p. 17). When building a statistical model, one seeks an acceptable level of generalizability. This requires finding variables that are applicable in some fashion to the entire population. It may be the case that institutional debt profiles are so unique that many of their characteristics are difficult to adequately reduce. This suggests that analysis of debt profile may benefit from qualitative studies. However, to date no qualitative research on credit ratings or university debt profile exists. This is a deficiency in the research

[15] Johnson and Kriz (2005) also include a variable for per capita state short-term debt outstanding, as well as indicator variables for bonds with maturities of less than 10 years and bonds with maturities of greater than 10 years. All of these variables return negative coefficients (i.e., negatively associated with credit ratings).

literature that could benefit from such attention. In the meantime, the use of total outstanding debt in econometric models likely tells something about the debt-behaviors of public universities.

**State Policies and Government Relationship**

The connection between university credit ratings and state-level factors is one based on an interesting relationship. On the one hand, many states have statutes and constitutional provisions that provide legal protection from public university obligations becoming their own (Moody, 2008). Yet, state debt officers often report feeling morally obligated for the borrowing activity of their public entities, as well as concerned that they will still be affected by their public institutions' debt (Hackbart & Leigland, 1990). As a result, states may institute constraints, such as debt-limits, as means to control what may be viewed as universities lacking the "resolve to limit their own borrowing" (Moody, 2008). Ultimately, the decision to institute debt-limits is based on a lack of confidence in public institution competence or willingness to take on risk by executive leadership.

Although there is a wide variety in the characteristics of a debt-limit's restrictions, they usually impose limitations in the form of total dollar amount of debt or percentage of debt institutions are allowed to incur (Serna, 2013c). Also, the term "debt capacity" is often alluded to with regard to these restrictions. This term is most commonly used in the context of optimality. Debt capacity is the optimal amount of debt that can be incurred before additional borrowing results in increased borrowing costs due to credit ratings being adversely affected (Denison, Hackbart, & Moody, 2006; Moody, 2008). If debt-limits are properly aligned with debt capacity, they can work to assist universities in maintaining favorable debt service ratios and demonstrating prudent financial

management with the rating agencies (Moody, 2008). Unfortunately, there is no evidence that states link debt limits to debt capacity; rather, these fiscal restrictions are more commonly implemented as means to minimize debt by states with strong, politically motivated, aversions to borrowing (Denison, Hackbart, & Moody, 2006).

The potential risk to postsecondary institutions of such an austere policy approach is that they may be unable to efficiently finance their capital projects. For example, if a university wishes to undertake the construction of a facility that they project will produce ample revenue after completion (e.g., revenue that can be used to service the obligation), a debt limit may not allow the needed borrowing based on the future revenue not yet having been realized. Thus, as with state oversight, debt limits may signal to the debt markets potential problems accessing debt.

Still, universities are never completely independent from the states in which they reside. This is why a state's own GO credit rating is accounted for, as a measure of its fiscal health and ability to support its public postsecondary institutions (Serna 2013a). Michael Moody's (2008) findings support this assumption. A state credit rating of Aaa, as opposed to A, increases the probability of a university receiving an Aa2 rating by 30.5%; conversely, a state rating of Aa, as opposed to A, increases the probability of a university receiving an Aa2 rating by only 24.8%.[16]

**Revenue Diversification**

As discussed earlier, revenue diversification can improve budget flexibility. It provides "greater revenue stability," which allows institutions to lessen the negative effects of adverse economic conditions and better ensure their prosperity through

[16] Although the marginal effects for an institution receiving Aa1 and Aaa were not statistically significant, they show a similar trend where Aaa state rating is associated with a higher probability of increased university creditworthiness than is Aa.

consistent revenue generation (Kedem, 2011, p. 8). Since this area of fiscal structure is the focus of the second research question–*How is the level of revenue diversification associated with public research university credit ratings?*–this section will review how such a factor has been observed and measured in the extant literature. In doing so, it contributes to a hypothesis about the expected association with university credit ratings.

The concept of revenue diversification is rooted in Modern Portfolio Theory, specifically literature on selecting a combination of investment securities that most efficiently reduces portfolio variation or risk (Markowitz, 1952). If investors make decisions based entirely on maximizing expected returns, they may end up situating all of their resources into a single investment that is expected to provide the greatest profit. Since the future is uncertain, such a resource allocation decision introduces a large amount of variance (i.e., risk), exposing investors to all of the market impacts that are incurred on that one investment. Markowitz goes on to state that diversification is something that is observable. By employing such an approach, investors can minimize correlation between a portfolio and random fluctuations in individual investments. Additionally, because securities are likely to be correlated with one another, especially within the same sector, it is also advisable to invest in firms representing different industries (e.g., railroads, mining, public utility, manufacturing, etc.) in order to reduce covariance. This reduction in covariance between investments enables investors to minimize the variance/risk due to market volatility, so that the risk they face is random (Markowitz, 1952; Sharpe, 1963). The implications of this are important, in that by diversifying one's portfolio (both in number and type of investments), investors are able to effectively minimize risk (Markowitz, 1952).

At the state level, scholars also provide empirical evidence supporting revenue diversification as a policy decision for fiscal stability. Suyderhoud (1994) finds that diversification is correlated with strong fiscal performance, including support for higher tax effort, increased tax equity via less regressive income taxes, and lower property taxes when controlling for the overall state-local tax rates.

As might be expected, the public finance and nonprofit literature suggests that a more diversified revenue base is positively associated with increased revenue stability (Chang & Tuckman, 1994; Chernick, Langley, & Reschovsky, 2011; Carroll, 2005, 2009; Carroll & Stater, 2009; Tuckman & Chang, 1991). For example, Carroll and Stater (2009) find that increased revenue diversification among nonprofit 501c3 organizations, including educational organizations, is associated with decreased revenue volatility over time. This makes sense, because for well-diversified public universities declines in one funding source (e.g., state appropriations) have the potential to be offset by increases in another (Tuckman & Chang, 1991).

Other research focusing on nonprofits finds that increases in fund-raising expenditures and accumulation of revenue surpluses are positively associated with greater revenue diversification (Chang & Tuckman, 1994). This can be illuminated by referring back to public higher education governing boards. As discussed in the last section, increased centralization/regulation among university governance can negatively impact managerial adaptation (Volkwein and Malik, 1997), which can limit an institution's ability to grow its endowment (Knott & Payne, 2004) and can restrict its tuition and fee revenue (Burgess, 2011; Knott & Payne, 2004; Lowry, 2001). Thus, it can be inferred that institutions operating under centralized governing boards are more limited in their

ability to generate funds from alternate sources and are less likely to have diverse revenue bases and surpluses.

The research discussed thus far provides a fairly strong case for the role played by revenue diversification in fiscal stability at all levels of public finance. It can be inferred that increased diversification is positively associated with higher education credit ratings, since rating agencies value consistent cash flow and financial stability (Kedem, 2011; Standard & Poor's Ratings Services, 2014a). In fact, in the context of the U.S. higher education sector, S&P explicitly states that they view "revenue diversity as a credit strength and revenue concentration as a credit weakness" (S&P Capital IQ, 2014, Revenue diversity section, para. 1). Furthermore, Suyderhoud (1994) notes greater diversification is positively correlated with higher rated state GO bonds.

While this literature allows us to form some fairly strong assumptions about the impact of revenue diversification on credit ratings, empirical analysis primarily focusing on the relationship between these two variables is lacking. To date, only two studies have undertaken such analysis, and both are at the state level (Grizzle, 2012; Yan, 2011). Using similar ordered response estimators, both of these studies find increased diversification is positively associated with improved credit ratings. For example, for a one standard deviation (0.09) increase in the Hirschman-Herfindahl Index (HHI),[17] the probability of a state receiving a Aaa credit rating increases by nearly 25% (Grizzle, 2012, p. 45). These two studies further bolster the assumption that increased diversity in postsecondary institution funding increases the likelihood of being deemed more creditworthy.

[17] The HHI is a commonly used index to measure revenue diversification. A zero is equal to no diversification and a one is equal to perfect revenue diversification among all streams. This index is discussed in more detail in Chapter III.

## Severe Economic Downturns

Goldstein (2012) notes that "[t]he economies of all institutions are linked with the national economy" (p. 25). This statement is illustrated by looking at the 2008-2009 economic downturn, referred to as The Great Recession,[18] the worst economic crises since the Great Depression (Zumeta, 2010; Zumeta, Breneman, Callan, & Finney, 2012). Consumer spending, high rates of unemployment, and declines in property values impacted the three major sources of state and local taxes (Peng, Kriz, & Wang, 2014). Macroeconomic conditions also weakened postsecondary budgets by creating uncertainty around "the prospect for growth of household income and wealth, philanthropic support, investment returns, state appropriations, and federal funding" (Bogaty, 2013, p. 1). These sustained problems have driven Moody's to issue negative outlooks for the sector since 2009 (Bogaty, 2013; Goodman & Nelson, 2009; Tuby, 2014; Tuby & Nelson, 2012). This section explores some of the post-recession issues facing higher education. In doing so, it contributes to the study's theoretical framework, especially concerning the third research question– *How do severe economic downturns impact public research university credit ratings?*

When The Great Recession hit, Wachovia bank froze the accounts of 1,000 postsecondary institutions (Blumenstyk & Field, 2008). The combined $9.3 billion was invested in the Commonfund for Short Term Investments, which was often used by many colleges and universities to fund operating expenses. Wachovia eventually resigned its role as trustee of the fund and institutions were said to be able to access assets once securities matured. However, the tight credit markets worried many that difficulty selling

[18] The terms Great Recession and severe economic downturns will be used interchangeably throughout this study, since the former will function as a treatment variable for the latter. This will be discussed more in Chapter III.

securities would leave institutions without adequate liquidity to make payroll (Field, 2008).

In 2008, the concern over higher education liquidity was also expressed by the credit rating agencies. For instance, in March of 2008, Moody's downgraded Colorado School of Mines' debt rating, due in part to the school holding $54 million in variable-rate bonds and only $24.9 million in operating cash. Moody's downgrade was motivated by fears that the university was not operating with enough flexibility (i.e., it was leveraging itself too highly) to weather market fluctuations (Wolverton, 2008). In other words, if interest rates were to rise, Colorado School of Mines may not have had enough cash to service its debt. These liquidity concerns prompted Moody's to introduce two new ratios in FY 2009–one to assess the portion of cash and investments that is unrestricted and the other to assess the portion that is liquid within one month or one year (Gephardt, 2011). Although concerns have since lessened, Moody's admits that they are still unsure about liquidity risks for some universities (Gephardt & Nelson, 2011). Since there does not exist empirical research examining the role played by liquidity in public university credit ratings, both pre- and post-recession, this is an area that still remains largely uncertain.

The effects of the Great Recession can also be seen with individual revenue streams. In 2013, Moody's reported that all non-tuition revenue sources (e.g., government appropriations, investment earnings, gifts, research grants, patient care reimbursements) had either slowed or declined since FY 2008 (Bogaty, 2013). One especially notable area is state appropriations. As discussed earlier, state appropriations have become an increasingly unstable revenue source, especially with the recent trend in

attaching performance requirements (Tuby, 2014). Furthermore, with state budget cutbacks, higher education has had to compete with K-12 and health care (including Medicaid) for a piece of an even smaller pie (Zumeta & Kinne, 2011). In fact, between FY 2008 and FY 2013, state support to higher education declined by a total of $8.8 billion, or 10.8% (Zumeta, 2013, p. 31). These declines may be further explained by the fact that states do not have "constitutional funding mandates nor linkages to federal matching dollars," as they do with K-12 and health care, to protect higher education funding (Zumeta & Kinne, 2011, p. 32). Public colleges and universities are assumed to be able to simply make up the difference by charging their clients more. Thus, the earlier hypothesized negative relationship between state appropriations and university credit ratings is likely to be accentuated in recent years.

In response to declining state support, public universities have shifted more of the cost burden onto students by raising tuition and fees, as well as increasing out-of-state enrollments (Bogaty, 2013; Serna, 2013a). As noted earlier, high unemployment, flat earnings, and uncertain job prospects for many recent graduates have motivated public scrutiny over tuition and fee increases (Bogaty, 2013; Zumeta, 2013). This has increased price-sensitivity, resulting in greater importance being placed on universities' ability to distinguish themselves from one another (Tuby & Nelson, 2012). Thus, measures that reflect demand (e.g., selectivity, endowment) are likely to play a more significant role in improving creditworthiness. At the same time, because growth in tuition and fee revenue has slowed in recent years as a response to what are arguably recessionary pressures (Bogaty, 2013; Zumeta, 2013), the already hypothesized negative relationship between this factor and improved creditworthiness is likely to be magnified in the post-recession

years; that is, since tuition and fees have become even more uncertain following the recession, increased dependence on this revenue stream is likely to be viewed by ratings agencies in an increasingly negative light. This inference is supported by claims from Moody's regarding its prominent role in generating negative outlooks for the sector (Bogaty, 2013; Tuby, 2014).

Also mentioned earlier, endowment value and grant revenues can signify the scope and market position of an institution, as well as increase its fiscal base. Thus, endowments are expected to positively impact credit ratings. With the endowment losses experienced by many institutions following the recession (Bogaty, 2013; Goldstein, 2012), and the increased competition for grant funding in recent years (Bogaty, 2013), these factors are likely to continue their role in strengthening university credit ratings. That is, institutions that are able to grow endowments and obtain grant funding are likely to be viewed favorably by rating agencies. On a related note, AMCs are also able to bring in biomedical grants and philanthropic support. But, challenges such as reductions in funding to graduate medical education, cuts to Medicare and Medicaid, and uncertainty over the effects of healthcare reform pose potential problems for universities affiliated with AMCs. So, amidst a lack of empirical research, it is difficult to infer how the presence of hospitals impact university credit ratings post-recession.

The literature reviewed thus far may suggest that revenue diversification should positively impact public research university credit ratings, especially in the post-recession years. Such a view is supported in part by Carroll's (2005) findings that states with higher levels of diversification generally experienced smaller revenue declines during and after the 2001 recession, than did states with less diversification. However, in light of the

immense strain placed on all tuition and non-tuition revenue by the most recent economic downturn, placing such high importance on revenue diversification may be overzealous. In fact, in their 2013 negative outlook, Moody's specifically noted that "diversity no longer offers a safe haven," due to the strain on all non-tuition revenue sources (Bogaty, 2013, p. 7). Ultimately, since the impact of the Great Recession, and its associated spillover effects, on public research university credit ratings have yet to be empirically tested, answering this study's third research question will significantly add to an under examined area of higher education finance.

## Chapter Conclusion

This chapter has reviewed the literature pertaining to public research university credit ratings. Surveying literature on higher education budgeting and planning, higher education economics and finance, credit report methodologies published by credit rating agencies, and research on state and municipal debt and credit ratings, it has sought to establish a theoretical framework from which the study's analysis may proceed. In doing so, it has laid the groundwork for a functional framework and the selection of variables to be included in the next chapter. The review's order was intended to follow the progression of research questions and illustrate their development: beginning with an overview of municipal securities and credit ratings, followed by a discussion of characteristics involved in the ratings process, proceeded by an overview of the literature on revenue diversification, and finally a discussion of the impact of severe economic downturns on credit ratings. In structuring this chapter in the above manner, the goal was not only to cover literature pertaining to all three research questions, but also to show

how each question, while distinct, builds on the previous one(s). To help illustrate this point, the study's research questions are reiterated once again:

Q1 How are the factors involved in public research university revenue structure associated with institutional credit ratings?

Q2 How is the level of revenue diversification in public research university revenue structure associated with institutional credit ratings?

Q3 How do severe economic downturns impact public research university credit ratings?

Michael Moody's (2008) study of debt policies and public university credit ratings is the only analysis to date that empirically examines credit ratings on the level of higher education. Due to this limitation in the empirical literature, along with Moody's small dataset and limited number of variables, this literature review had to draw on empirical work at the municipal and state levels to cover the study's scope. Such a decision was based on public universities' similarities to state governments, nonprofits, and public authorities. Still, even the empirical research on credit ratings at these other levels is fairly small. Thus, many inferences were made based on descriptive studies and research that is only tangentially related to the study's topic. As a result, this chapter uncovered a large gap in the subject of public higher education bond ratings.

Still, by covering a broad expanse of literature it is possible to formulate a functional form equation for public research university credit ratings to guide the analysis:

$$CR = f(Dem, R, Gov, Debt, End, State, Econ) \quad (2.1)$$

Where credit ratings are a function of demand related factors (e.g., enrollment and selectivity), revenue factors (e.g., tuition & fees, state appropriations, grants, revenue diversification), governance and management factors (e.g., governing board

centralization, total debt capacity), debt related factors (e.g., debt per student, debt service ratios), the value of the university endowment fund, state relationship factors (e.g., debt limits, state credit ratings), and the condition of the national economy (e.g., recession). As will be discussed more thoroughly in Chapter III, various revenue and economic variables (e.g., revenue stream variables, revenue diversification, recession) will be interchanged in the study's models, as deemed necessary for specific research questions.

# CHAPTER III

## DATA SOURCES AND METHODOLOGY

This chapter provides an overview of the study population, data collection, and proposed methodology to answer the study's three research questions. As posed in Chapter I and reiterated in Chapter II, these questions are as follows:

Q1 How are the factors involved in public research university revenue structure associated with institutional credit ratings?

Q2 How is the level of revenue diversification in public research university revenue structure associated with institutional credit ratings?

Q3 How do severe economic downturns impact public research university credit ratings?

More specifically, it carefully presents how this study will begin testing these three questions and the related hypotheses stated in this chapter's conclusion.

The outline of Chapter III is as follows. Part one describes the paradigmatic worldview in which study is situated. Part two describes the population and characteristics of the dataset. Additionally, it explains the study's time-span and rationale for these choices. Part three covers the method of data collection, including the data sources, the manner in which the data was measured, and descriptions of the included variables. In addition, it provides the rationale behind these choices, including how the variables best utilize the theory developed in Chapter II to answer the three research questions. Part four provides an overview of the ordered probit and ordered logit

estimators used to analyze the data, along with the rationale for their choice. Finally, part five provides a discussion of some of the problems that occurred during data collection and analysis. This chapter concludes with a list of 12 hypotheses used to answer the three research questions in Chapter IV. All analyses, except when stated otherwise, are conducted with Stata/IC 13.1.

## Paradigm

This study is situated in an objectivist, post-positivist worldview. As with most econometric analyses, this project assumes a "deterministic philosophy," in which associations between factors (e.g., financial variables) are empirically tested to determine their relationship to a specific outcome (i.e., credit ratings) (Creswell, 2009, p. 7). In other words, claims are tested on observations, using objectivity and rationality as criteria (Benton & Craib, 2011). Post-positivism aligns with the ontological position of philosophical realism, the notion that reality exists independent of human perception (Maxwell, 2012). But, unlike traditional positivism, which presumes that reality can be known with certainty (Crotty, 2013), post-positivism argues that such certainty can never be fully attained (Trochim & Donnelly, 2008). There is an inherent level of uncertainty in observations. Thus, knowledge is developed through falsifying theories, and reality is only ever known probabilistically (i.e., imperfectly) (Crotty, 2013; Guba & Lincoln, 2005). Since this study uses statistical analysis to predict how university credit ratings are impacted by changes in institutional and state factors, it aligns well with the post-positivist view of knowledge and approach towards falsifiability. Additionally, while credit ratings are acknowledged as the product of individual analysts who impose a

certain degree of subjectivity, university bond ratings are nevertheless formulated according to a predetermined set of criteria, such as those listed in Figure 2.

## Population

The population for this study includes public four-year research universities with either a high or very high level of research activity as defined by the Carnegie Foundation for the Advancement of Teaching (2010).[19] Decisions regarding this population are motivated by both theoretical and practical considerations. To begin with, private institutions were excluded because of the differences in revenue structure between them and their public counterparts; namely, that they do not receive direct state appropriations and rely heavily on tuition and fees (Goldstein, 2012; McKeown-Moak & Mullin, 2014 ). For example, state support to private institutions represented a mere 1.4 percent in 2010 for the four-year sector as compared to 14.4 percent of public four-year total revenues; and, private four-year institutions generated 40.2 percent of their revenues from tuition and fees, whereas their public counterparts only generated 19.2 percent from this source (Goldstein, 2012). As discussed in Chapter II, and suggested above, due to differences in sectors it is important to compare bond ratings from the same, or similar, industry (Thau, 2011). Therefore, the differences in revenue structure between public and private postsecondary institutions motivate the decision not to include both in the study's population. The cost shifting that is occurring in the form of decreased state appropriations (due to decreased budgets and greater calls for accountability) and increased tuition and fees raises important implications for public university revenue dependence–implications that do not necessarily affect private universities that are far

[19] Descriptions of these categories are located in the List of Definitions. A more thorough discussion of the methodology used by the Carnegie Foundation and a description of their classifications can be found at http://carnegieclassifications.iu.edu/methodology/basic.php.

less dependent on state funding. Additionally, governance and management, as well as the relationship to the parent state are far more important factors when examining public institutions. Board centralization has been shown to impact the managerial behavior and decision-making at public institutions (Knott & Payne, 2004; Lowry, 2001). Furthermore, a state's credit rating is more likely to influence public university credit ratings, since such a measure reflects the state's fiscal health and ability to consistently fund its public institutions (Moody, 2008), which as noted in chapter two are often impacted by severe economic downturns.

While decreases in state appropriations and increased dependence on tuition and fees revenue, which were discussed in Chapter II (Bogaty, 2013; Standard & Poor's Ratings Services, 2014a; Serna, 2013a; Tuby, 2014; Zumeta, 2013), may blur the distinction between public and private based solely on revenue streams, the established role of public higher education institutions clearly distinguishes them from their private counterparts. As a type of public authority, public universities function as creations of the state, operating within political jurisdictions, and relying on similar sources of revenues, such as user charges and fees (Denison, Fowles, & Moody, 2014; Trautman, 1995). That is, public authorities (i.e., public postsecondary institutions) are subordinate agencies of the state (Serna, 2012; Trautman, 1995). Thus, through the legal nature of their establishment, they are aligned with the parent state, sharing a similar revenue structure and mission. This role as government entity distinguishes the public and private higher education sectors.

Turning to the specific population for this study, theory also plays a role in choosing a suitable population from among all public postsecondary institutions. As with

the comparison to private institutions, public universities should be compared to those that are similar, so as to avoid comparing bonds that differ too much in the factors in which they are based (Thau, 2011). This means that it would make little sense to compare a state flagship research university to a regional school, as the former would have a much broader market position and revenue base such as larger research grants, generally larger endowments, increased grant funding, and a focus on research as opposed to teaching (Bogaty, 2013). This is probably not universal across the sector, but it is likely that by focusing exclusively on research universities much of the variation in institutional structure can be minimized. Additionally, as of 2011 Moody's Investor Services rates 226 public four-year U.S. colleges and universities (see Table 1). While regional institutions are beginning to utilize more debt financing, research universities still comprise the majority of higher education debt market activity (Bogaty, 2013; Kiley, 2012; Supiano, 2008). Thus, examining the research questions from the perspective of these institutions provides significant information regarding the ways in which credit markets react to different revenue structures, diversification, and severe economic variability.

## Data

The data set in this study spans the 2001-2002 through 2012-2013 academic years. The starting year was chosen because it marks a change in how financial data was reported by the National Center for Education Statistics' Integrated Postsecondary Education Data System (IPEDS). Beginning with this year better ensures that data on selected variables are observed in a consistent manner. The final year, 2012-2013, coincides with the most recent year in which data is available. In total, 75 public research

universities, defined by the Carnegie Foundation for the Advancement of Teaching (2010) as having a high or very high level of research activity, are included in the data set. These institutions are listed in Table A1 of Appendix A. Originally, there were a total of 151 public research universities that fell into the chosen Carnegie classifications. However, institutions that lacked published data were excluded. Also, institutions that are rated at the system level, or whose debt is issued at the state level, were excluded in order to avoid unit of analysis problems. But, if a university is rated at the system level and there is one campus that generates an average of 85% or more of the system's total revenue, then that one campus was included with its associated system rating.[20] The list of omitted universities, and the reason for their removal from the data set can be found in Table A2 (Appendix A).

The list of variables and corresponding data sources are provided in Table 2. While there are many more variables that can be included, these predictors were chosen because of their prominence in the literature, evidence that they are best able to measure the major factors in public research university credit ratings, and their ability to answer the research questions.

[20] Unfortunately, because of the limited research on higher education credit ratings there is no theory to drive this decision. However, if a campus represents 85% of a system's total revenue it can be inferred that it occupies a significant position in the system's revenue base, and by extension plays a significant role in the rating process.

Table 2

*Variables and Data Sources for Years 2001-2002 through 2012-2013*

| Variable | Source |
|---|---|
| Institutional Credit Rating | Moody's Investor's Service |
| Freshman Selectivity | IPEDS; Individual University IR Officers |
| Research Intensity | IPEDS (Graduate FTEs/Total FTEs) |
| Undergraduate Full-Time Equivalents (FTEs) | IPEDS (Self Calculated for Missing Years) |
| Tuition and Fees per FTE | IPEDS |
| State and Appropriations per FTE | IPEDS |
| Federal Operating Grants and Contracts per FTE | IPEDS |
| State and Local Operating Grants and Contracts per FTE | IPEDS |
| Academic Medical Center | Association of Academic Health Centers |
| Endowment Value per FTE | National Association of College and University Business Officers (NACUBO) |
| High Regulation | Knott & Payne (2004); Education Commission of the States (ECS) |
| Debt Limit | National Association of State Budget Officers (NASBO) |
| High State Credit Rating | Moody's Investors Service |
| Debt Burden per Student | IPEDS |
| Financial Leverage | IPEDS |
| Revenue Diversification | Calculated with Hirschman-Herfindahl Index (HHI) |
| Recessionary Impact | ≥ FY 2009 |

*Note.* IPEDS = Integrated Postsecondary Education Data System.

Another factor involved in choosing variables is model parsimony. In addition to its noted desirability in writings spanning philosophy, probability theory, and statistics (Grünwald, 2000), parsimony plays an important role in constructing discrete

response models. Small numbers of events per covariate have been shown to bias parameter estimates in logistic regression models (Hosmer, Lemeshow, & Sturdivant, 2013; Nemes, Jonasson, Genell, & Steineck, 2009; Peduzzi, Concato, Kemper, Holford, & Feinstein, 1996; Vittinghoff & McCulloch, 2007). That is, as the number of outcomes for a specific regressor decreases, the size of the parameter bias and the probability of overstating its statistical significance increase.[21] For example, in the case of two outcomes (binary response), parameter estimates for independent variables with only 2 "yes" outcomes are more likely to show inflated values and overstated statistical significance than variables with 10 "yes" outcomes. Such an issue is significantly more important with multinomial ordered response models, where small sample sizes can lead not only to biased estimates but also problems with model convergence (Long & Freese, 2006).[22] Therefore, model parsimony helps ensure that parameter estimates are not biased in addition to achieving model convergence.

Parsimony is also achieved through the measurement of specific variables. For example, Serna (2012) codes state governance as simply "high regulation," rather than "minimal, moderate, and high regulation," since his goal is to determine whether states maintained such level (p. 64). Hence, based on the literature reviewed in chapter two, the this study examines how "high regulation" is associated with changes in credit ratings, since such a variable has been shown to influence school priorities and revenue dependence (Burgess, 2011; Knott & Payne, 2004; Lowry, 2001).

---

[21] Parameter bias refers to the difference between the mean, or expected value, of the estimated parameter and the true population parameter value: $(E\hat{\beta} - \beta)$. For a discussion of unbiasdness, see Kennedy (2008).

[22] The estimation procedure follows an iterative process that first estimates regression coefficients and then continues to repeat the process until it reaches a fixed value. Nonconvergence occurs if the process is unable to maximize the likelihood function; that is, if the estimated values grow infinitely.

**Institutional Review Board**

Since this study examines factors impacting public university credit ratings, all data and analysis is at the institution and state levels (e.g., tuition and fees, institutional credit rating, state credit rating, state debt policies). Hence, no data are directly related to an individual and is there no personally identifying information. All data are drawn from publically available data sets (e.g., IPEDS, Moody's Investors Service) and require no permission to access and use the data. Therefore, Institutional Review Board (IRB) approval is not required.

**Variables and Data Sources**

Since this study makes use of a large amount of data, multiple sources are utilized in order to supply the needed variables. These include Moody's Investors Service (2015b); the National Center for Education Statistics' Integrated Postsecondary Education Data System (U.S. Department of Education, 2015), specifically the Institutional Characteristics component, the Enrollment component, and the Finance component; the National Association of College and University Business Officers' (NACUBO) Commonfund Study of Endowments, for fiscal years 2002 through 2013; and the National Association of State Budget Officers (2002, 2008). Data on university governance is obtained from ECS data and the framework set forth in Knott & Payne (2004) and McGuinness (2001, 2003). Finally, data on whether a university is affiliated with an academic medical center (AMC) is gathered from the Association of Academic Health Centers' (AAHC) 2014 annual report. All continuous non-ratio independent variables are transformed into natural logarithms, which allow for interpretation of coefficients as percent changes. The natural logarithm transformation standardizes the

continuous independent variables, so that comparison and analysis can be conducted on the same scale (i.e., in percent changes). This practice is common in higher education finance studies (e.g., Baldwin & McCraken, 2013; Dar & Lee, 2014; Delaney & Kearney, 2015; Doyle, 2010 2012; Hearn, Griswold, & Marine, 1996; Lacy & Tandberg, 2014; Morphew & Baker, 2004; Ness & Tandberg, 2013; Serna, 2012; Serna & Harris, 2014; Tandberg, 2010; Tandberg & Ness, 2011; Zhang, 2007, 2011).

**Dependent variable.** The dependent variable in this study is the underlying credit rating assigned to public research universities by Moody's Investors Service. Moody's was chosen because of the relatively large number of public four-year institutions rated (see Table 1) and the increased weight allotted to it, over S&P and Fitch, by the marketplace (Lamb, 1993). It is important to note that on some issues, alternative ratings such as enhanced and insured, are also provided.[23] But since these ratings introduce additional factors, which may not be consistent across the entire sector, the underlying rating was chosen; in other words, underlying credit ratings solely measure the specific risk posed by the institution, rather than a hedge introduced by state enhancement or credit insurance programs. Additionally, because the criteria evaluated in the rating process can vary depending on the narrowness of the pledge (Fitzgeralid, 2005), this study focuses on consolidated pledges (see Figure 1), which tend to primarily emphasize the entirety of a university's operations.

Since bonds are rated throughout the year, deciding what to consider as the beginning and end of a given observation year was necessary. Because academic years, and by extension their funding, tend to run from the July 1st through June 30th of the

[23] Enhanced ratings factor in the added support provided by state credit enhancement programs, while insured ratings do the same thing with the added benefit of financial guarantees (Moody's Investors Service, 2015a).

following year, a rating issued on June 1st, 2005 is included as part of the 2004-2005 time period. Conversely, a rating issued on August 1st, 2005 is included as part of the 2005-2006 time period. This relates to the time lag between university factors and assigned credit ratings. Since credit ratings are assumed to temporally follow institutional factors (e.g., credit ratings are a response to previous financial conditions), all of the independent variables are lagged one year. So, a rating issued in 2006-2007 is paired with data from 2005-2006. This way, for example, a rating issued in March 2007 is not modeled as dependent upon the market value of an endowment fund measured at the end of June 2007.

By placing public research university credit ratings on the left side of the regression equation, as the dependent variable, the study is best be able to estimate how different factors are associated with changes in creditworthiness. That is, temporally, the independent variables on the right hand side occur prior to the assignment of credit ratings. Furthermore, credit ratings take on a natural ordering that reflect increasing creditworthiness (e.g., A3<A2<A1<Aa3<…<Aaa). In order to account for this ordering, identifiers are assigned on an increasing scale, in relation to the improved creditworthiness represented by their credit rating. In total, there were nine different observed credit ratings. The frequency distribution of responses is displayed in Table 3.

Table 3

*Original Response Variable Frequency Distribution*

| Institutional Credit Rating | Counts | Percent | Cumulative Percent |
|---|---|---|---|
| Baa2 | 1 | .11 | 0.11 |
| Baa1 | 9 | 1.00 | 1.11 |
| A3 | 11 | 1.22 | 2.33 |
| A2 | 115 | 12.78 | 15.11 |
| A1 | 272 | 30.22 | 45.33 |
| Aa3 | 253 | 28.11 | 73.44 |
| Aa2 | 144 | 16.00 | 89.44 |
| Aa1 | 55 | 6.11 | 95.56 |
| Aaa | 40 | 4.44 | 100.00 |
| Total | 900 | 100.00 | |

Due to the small number of observations in Baa2, Baa1, and Aaa, these ratings were collapsed with their adjacent categories. The six-category frequency distribution is shown in Table 4. Although the majority of observed responses still fall in the A1 and Aa3 categories, this re-ordering improves upon the sparseness in the tails of the original response distribution, where 1 indicates the lowest credit rating and 6 the highest rating, while still retaining much of this variable's ordinality.

Table 4

*Six-Category Response Variable Distribution*

| Institutional Credit Rating | Ordering | Counts | Percent | Cumulative Percent |
|---|---|---|---|---|
| ≤ A3 | 1 | 21 | 2.33 | 2.33 |
| A2 | 2 | 115 | 12.78 | 15.11 |
| A1 | 3 | 272 | 30.22 | 45.33 |
| Aa3 | 4 | 253 | 28.11 | 73.44 |
| Aa2 | 5 | 144 | 16.00 | 89.44 |
| ≥ Aa1 | 6 | 95 | 10.56 | 100.00 |
| Total | ------- | 900 | 100.00 | -------- |

**Market position factors.** This study includes a number of independent variables to capture the impact of market position and demand on institutional credit ratings. The first is freshman selectivity. This is measured by taking the total number of first-time, degree/certificate-seeking undergraduate students who were accepted and dividing it by the total number of first-time, degree/certificate-seeking undergraduate students who applied; the lower the ratio, the more selective the university (Moody, 2008). Increased selectivity (small freshman selectivity ratio) may result from greater demand and reflect improved competitive position (Standard & Poor's, 2007). A second market position related predictor is the degree of research intensity, measured by the ratio of graduate full-time equivalents to total full-time equivalents (FTEs). This measure functions as a "proxy for the level of research intensity and desirability of programs for highly sought after graduate students" (Rubinoff & Marion, 2007, p. 5). A third variable is total undergraduate FTEs. Moody's considers enrollment numbers as an indicator of demand (Kedem, 2011). Changes in an institution's enrollment can be understood as reflecting changes in student demand for a specific institution (Heller, 1999; Koshal & Koshal, 2000 McLendon, Hearn, & Mokher, 2009; Serna, 2012). Additionally, past studies (e.g., Moody, 2007, 2008; Ness & Tandberg, 2013; Serna 2013a, b, c; Serna & Harris, 2014; Tandberg, 2013; Tandberg & Ness, 2011), indicate that the use of undergraduate FTEs as a proxy for enrollment demand is appropriate.

For years in which undergraduate or graduate FTEs are not provided, these data are calculated using the National Center for Education Statistics' (NCES) methodology (U.S. Department of Education, n.d.), which is "based upon an institution's 12-month instructional activity … and calendar system" (McKeown-Moak & Mullin, 2014, p. 28).

If a school operates on a quarter system, the total number of undergraduate and graduate credit hours are divided by 45 and 36, respectively, to arrive at the corresponding FTE numbers. For schools operating on a semester/trimester system, the undergraduate and graduate divisors are 30 and 24 (McKeown-Moak & Mullin, 2014). These formulas are derived from the NCES definition of full-time undergraduate/graduate enrollment under a quarter system as 45/36 credit hours and under a semester/trimester system as 30/24 credit hours (U.S. Department of Education, n.d.). Other selectivity variables discussed in chapter two, specifically retention and graduation rates, are not included because of the unavailability of data before fall 2003 and a lack of methods for calculating earlier years.

**Revenue variables.** This study includes four revenue specific independent variables: tuition and fee revenue per FTE, state appropriations per FTE, federal operating grants and contracts per FTE, and state and local operating grants and contracts per FTE. To answer the first research question, interest lies in determining the association between each of these variables and public research university credit ratings. Drawing on the literature, these four variables are judged to best represent revenue categories that determine credit ratings (Bogaty, 2013; Kedem, 2011; Moody, 2008; Serna, 2013a, b; Tuby, 2014). In order to account for differences in university size, each of these variables are divided by undergraduate FTEs. Studies in public finance and higher education also use this approach (i.e., controlling for population), in order to mitigate concerns around scale effects (e.g., Grizzle, 2012; Moody, 2008; Palumbo & Zaporowski, 2012; Yan, Denison, & Butler, 2009; Serna & Harris, 2014; Tandberg, 2010). Also, in order to account for inflationary effects, all revenue variables are

adjusted to constant 2012-2013 dollars, using the Consumer Price Index for All Urban Consumers (Federal Reserve Bank of St. Louis, 2015).

The first three of these variables represent the three largest sources of revenues for public postsecondary institutions (McKeown-Moak & Mullin, 2014). Incidentally, they also represent three levels of funding–student, state, and federal. By including tuition and fee revenue as a variable, this study evaluates how dependence on student funding influences credit ratings. With the increased variability and slowed growth in tuition revenue in recent years (Bogaty, 2013; Tuby, 2014), estimates from this predictor provide insight into how ratings agencies view the uncertainty associated with this source.

As another major revenue source that has suffered reductions in recent years (Bogaty, 2013; Tuby, 2014), state appropriations also provide insight into how ratings agencies view potential instability in public university funding. This variable provides a measure of a school's dependence on state funding. In addition to providing information about a school's dependence on the state, it also informs about how states view their role in funding public higher education.

The third major source of funding is federal operating grants and contracts. By including this factor and scaling it by FTEs, total federal operating grants and contracts allows the study to examine the level of financial support received beyond the student and state levels. As a supplement to student and state support, federal operating grants and contracts may also indicate a broader revenue base and improved market position. This argument is possibly supported by the fact that competition for federal grants has increased in recent years (Bogaty, 2013; Tuby, 2014); thus, increases in grant funding

serve as a strong signal of an institution's dependence upon external funding, and possibly as an indicator of research standing.

The final revenue variable that is included is state and local operating grants and contracts. This variable is composed of state and local funds for research projects and programs deemed part of an institution's operations. It is included as a contrast to federal operating grants. Whereas increased federal grant dollars may represent a broader revenue base and improved market position, the state and local grant category focuses on a narrower geographic revenue scope. In part, it is a compliment to state appropriations and adds further nuance to the measurement of breadth in an institution's revenue base.

**Other fiscal variables.** Although not "pure" sources of revenue, academic medical centers (AMCs) and the size of a university's endowment are related to an institution's market position and fiscal sustainability. AMCs can be a significant source of revenue for universities, due to their steady funding from patient care, but at the same time these facilities can incur significant expenses as a result of demands for new buildings and physical plant maintenance (Moody, 2008). The size of these operations is illustrated with the University of Mississippi. Recently, its medical center budget was reported at $1.7 billion, while its flagship campus budget was $600 million (Basken, 2015). With large medical centers comes the ability to generate revenues from biomedical research grants. But recently, slowed growth in patient-care revenues, reductions in funding to graduate medical education, cuts to Medicare and Medicaid, and uncertainty over the effects of healthcare reform means AMCs face a number of revenue generating challenges (Kedem, 2011; Tuby, 2014). Finally, as discussed in Chapter II, AMCs may also function as a proxy for increased operational scope. In order to measure

the presence of an AMC, a binary variable, where one is equal to university affiliation with an AMC and zero is equal to no affiliation, is included.

University endowment size can signify an institution's fiscal health, by reflecting its ability to accumulate wealth and increase reserves (Serna, 2013a, b; Winston, 1999). Related to this, endowment size provides evidence that universities will be able to meet their debt obligations in a timely manner, since as an endowment increases so too does the value of an institution's assets (Moody, 2008). Supporting this argument are the recent changes in endowment management regulations, which now allow schools to access a portion of their endowment principle (Goldstein, 2012). As with the revenue variables, endowment values are divided by undergraduate FTEs in order to mitigate scale effects. University endowment is also adjusted to constant 2012-2013 dollars, using the Consumer Price Index for All Urban Consumers (CIPAUCSL).

**Oversight and governance.** Since public university finances are influenced by the level of regulation imposed by state oversight (Burgess, 2011; Knott & Payne, 2004; Lowry, 2001; Moody, 2007, 2008; Serna 2013a, b, c; Serna & Harris, 2014), three variables are included to control for these relationships: board centralization, constitutional debt limits, and state credit rating. Board centralization is incorporated as a binary variable, where one is equal to high centralization and zero is equal to moderate or minimal centralization. Using the framework set forth by McGuinness (2003) and Knott and Payne (2004), and utilized in past research studies (e.g., Moody, 2007; Tandberg, 2013), the existence of a consolidated governing board constitutes high centralization. These governance structures exercise decision-making authority over an institution's salaries, governance, policies, and resource allocation, whereas less centralized boards

are often limited to an advisory role. This variable provides insight into how the impact of centralization on university funding (Burgess, 2011; Knott & Payne, 2004; Lowry, 2001) transfers to credit ratings.

As noted in the literature, whether a state has policies limiting the amount of debt issued can impact an institution's borrowing activity and their credit ratings (Moody, 2007, 2008). In light of this evidence, the presence of a debt limit is coded with a binary variable, where one indicates an umbrella debt limit and zero indicates no debt limit. Finally, state credit ratings are also be accounted for in the models. As discussed in Chapter II, a state's GO rating reflects its fiscal health and ability to support its public institutions (Serna, 2013a). Following the research literature (Moody, 2008), state credit ratings are included as a binary variable, where one equals high state credit rating (≥ Aa2) and zero equals not high state credit rating (< Aa2). While Michael Moody (2008) incorporates three state credit rating variables in his analysis of university credit ratings (A, Aa, and AAA), a single measure is included in this analysis to improve model parsimony and capture the influence of strong state creditworthiness.[24]

**Debt variables.** Two independent variables are included to account for a university's debt portfolio. The first, debt burden per student (DBS) is intended to measure an institution's total debt burden (Moody, 2008, Serna, 2013a), scaled by undergraduate FTE students. This variable is likely to provide insight into how credit rating agencies view a university's "prior and current reliance on debt financing in its financial planning" (Moody, 2008, p. 295). Additionally, it may provide insight into the scope of a university's debt portfolio, since larger amounts of debt could be interpreted as

[24] Greater than or equal to Aa2 was chosen as the cut-off for high state credit rating based on the distribution of the data. While Aaa and Aa1 were considered as cut-offs, these specifications resulted in separation issues with the data. Separation is discussed in more depth later in this chapter.

greater and more diverse debt market usage and experience with debt management policies. As with the other variables expressed in dollars, debt burden per student (DBS) is adjusted to constant 2012-2013 dollars using the CPIAUSCL.

While DBS tells us about the amount of debt being held by an institution, it provides little insight into an institution's ability to service said liabilities. In order to capture this factor, an independent variable for financial leverage is included. This variable consists of a ratio equaling the portion of total debt divided by total revenue. Since institutions with high levels of research activity tend to exhibit higher levels of debt (Kedem, 2011; Rubinoff & Marion, 2007), this variable helps explain the level at which institutions are leveraging themselves and their potential risk of default.

**Revenue diversification.** In order to capture the level of diversification in a university's revenue structure, and answer the second research question, a Hirschman-Herfindahl Index (HHI), such as the one used by Suyderhoud (1994) is employed. This index measures the level of diversification by summing the squared relative shares of each revenue source, subtracting the sum from one, and dividing the difference by the maximum level of diversification. Suyderhoud's (1994) HHI index is shown in equation 3.1 below:

$$RD = \frac{1 - \sum_{i=1}^{4} \left( \frac{r_i}{R} \right)^2}{0.75} \tag{3.1}$$

Where, $r_i$ = the revenue from source $i$, and $R$ = total revenue. Since there are four revenue sources used in this study–tuition and fees, state appropriations, federal operating grants and contracts, and stat and local operating grants and contracts–maximum diversification (0.75) is calculated by dividing 1 by 4 and subtracting the quotent from 1.

This version of the HHI is common in recent empirical literature on both revenue diversification and credit ratings (Carroll, 2005; Carroll & Stater, 2009; Grizzle, 2012; Yan, 2011). The index score approaches one as the shares of revenue derived from each source become more even; conversely, the score approaches zero as a larger portion of the total revenue comes from one or few sources. All revenue sources are weighted equally and the index score is not dependent on instituion size (Chang & Tuckman, 1994). Thus, the HHI gives a fairly objective interpretation of revenue distribution, allowing for an analysis of how the level of revenue diversification is associated with university credit ratings.

**Recessionary impact.** In order to measure the impact of severe economic downturns, The Great Recession of 2008-2009 is used as a treatment variable. By including a binary variable equal to one for years greater than or equal to 2009, the recession is treated as an exogenous macroeconomic shock, impacting ratings across the entire sector. This is supported by Moody's negative outlooks for the entire higher education sector, beginning in 2009 (Bogaty, 2013; Goodman & Nelson, 2009; Tuby, 2014; Tuby & Nelson, 2012). Because 2009 marks the first year of these sector-wide negative outlooks, this year serves as an ideal cut-point for this variable. Additionally, estimates for the covariates in the models with recession are compared to the models without this predictor. While this will not demonstrate a direct, or causal, effect for recession, comparison allows for observations around possible spillover effects.

## Methodology

As with population, data, and variable selection, theory drives the decisions regarding the most appropriate methodology to answer this study's research questions.

By referring back to recent studies on municipal credit ratings (Grizzle, 2012; Johnson & Kriz, 2005; Moody, 2008; Palumbo & Zaporowski, 2012; Yan, 2011) it is clear that ordered response models are the dominant statistical approach. Recent studies were consulted because of advances in statistical methods. Modern estimators capable of capturing credit ratings' nonlinear ordinal nature were not introduced until McElvey and Zavoina (1975) proposed the ordered probit and McCullagh (1980) derived the proportional odds model.[25] Since credit ratings are reported as discrete categories (e.g., A3, A2, A1, Aa3 … AAA), they are not continuous nor are they unbounded. Additionally, with discrete responses, the relationship between the dependent outcome and the covariates is likely to be nonlinear (Hosmer, Lemeshow, & Sturdivant, 2013). Therefore, linear regression may not be the most appropriate method for modeling credit ratings. Conversely, the ordered response approach accounts for this nonlinearity in the data.[26]

**Alternative Models**

Next, the decision regarding which ordered response model to choose was undertaken. One of the difficulties in working with this type of regression is the many options regarding estimators. Decisions were motivated in part by the past literature and also by the study's research questions. All of the municipal credit rating studies mentioned in the beginning of this section default to the ordered probit and assume

[25] Older studies of bond ratings, particularly in the corporate sector, tended to rely primarily on techniques such as multiple linear regression (e.g., Horrigan, 1966; Pogue & Soldofsky, 1969; West, 1970). The linear probability model focuses on a small interval of independent variable values. Those that fall outside this interval can return negative probabilities, which are meaningless.

[26] Ordinal response models also account for ordinality in data; however, it could be argued that a linear regression model that uses an integer scale for the dependent variable may be able to account ordinality.

parallel lines (i.e., equivalent slopes throughout all categories).[27] Use of the probit link function is predicated on the assumption that the residuals are normally distributed (Cameron & Trivedi, 2005; Wooldridge, 2010). However, one of the limitations with the probit link is that the parameter estimates are not directly interpretable, due to the normal cumulative distribution function's (cdf) complexity. As a result, the coefficients are not directly interpretable and marginal effects (i.e., partial derivatives of the probability of falling into a specific category) must be calculated (Wooldridge, 2010).

Alternatively, due the simpler logistic cdf, the ordered logit, which to the best of my knowledge has not been used in public finance studies, provides coefficients that can be directly interpreted as either odds ratios or probabilities. Whereas the ordered probit assumes that the residuals are normally distributed, the ordered logit assumes that they are logistically distributed.[28] The probability density functions (pdf) for both of these distributions are shown in Figure 3. These two distributions are fairly similar, where both are symmetric around the mean, and the logistic pdf has slightly thicker tails (Agresti, 2013). Additionally, as sample sizes increase, the logistic distribution "converges to a normal distribution" (Nemes, Jonasson, Genell, & Steineck, 2009, Background section para. 4). What this means is that both provide similar results, with ordered logit providing slightly larger coefficients and standard errors (Agresti, 2013). Since the ordered probit is the default choice in public finance, but the ordered logit lends itself to easier interpretation, models with both link functions are estimated.

---

[27] Parallel lines assumes that each independent variable's coefficient is the same for each response category. That is, a specific variable's impact on the probability of moving to a higher/lower category is the same, regardless of which rating category a university currently occupies.

[28] The standard normal distribution has a mean ($\mu$) of zero, a variance ($\sigma^2$) of one, and a standard deviation ($\sigma$) of one. For the standard logistic distribution, $\mu$ equals 0, $\sigma^2$ equals $\pi^2/3$, and $\sigma$ equals 1.81.

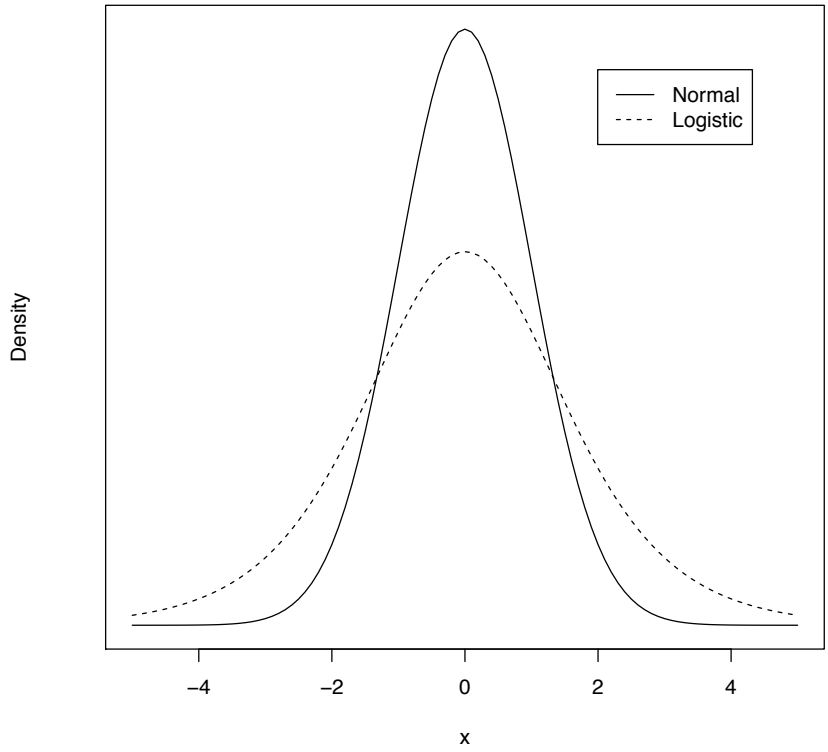


*Figure 3*. Normal and Logistic Probability Density Functions

The ordered probit models found in the public finance literature can be understood as cumulative models. That is, they estimates of the probability of falling into either a lower or higher category. But with the logit link there are also other options, such as the continuation ratio logit, adjacent category logit, baseline category logit, and stereotype logit.[29] However, since all three of this study's research questions are concerned with the probability of an institution either increasing or decreasing its creditworthiness, and not with comparing specific categories or focusing on movement between specific adjacent ratings, cumulative models are deemed best to answer the research questions.

[29] For a discussion of these models, see Agresti, 2013; Ananth & Kleinbaum, 1997; Anderson, 1984; Hosmer, Lemeshow, & Sturdivant, 2013; and Lall Campbell, Walters, & Morgan, 2002).

**Proportional Odds, Random Effects and Data Separation**

Two modeling issues that were considered were whether to assume proportional odds and how to treat the longitudinal nature of the data set. With regard to the first, the assumption is that regressor slopes remain the same in each rating category; that is, the probability, or odds of moving into a higher or lower rating is only affected by a category's intercept, or threshold parameter. This is referred to as the proportional odds, parallel lines, or parallel slopes assumption (e.g., Brant, 1990; Hosmer, Lemeshow, & Sturdivant, 2013; Long & Freese, 2006; Rabe-Hesketh & Skorondal, 2012; Williams, 2006). For example, suppose the coefficient on endowment is 2.5. This would mean that for a one-unit increase in endowment a university is two and a half times more likely to be in a higher credit rating, regardless of whether it is currently rated A3 or Aa2. While this is a fairly strong assumption, relaxing the covariate slopes introduces a number of potential complications. For one, relaxing the proportionality constraint on all of the regressors often results in estimating more parameters than necessary (Williams, 2006). Additionally, it has been argued that a completely unconstrained model loses ordinality, as categories can be rearranged in any manner (Clogg & Shihadeh, 2004). While it is possible to relax proportionality on select covariates, a partial proportional odds model (Peterson & Harrell, 1990), such an approach can lead to negative fitted values (McCullaph & Nelder, 1989). Because the slopes are allowed to vary between categories, the logits (i.e., logistic cdfs) can cross each other and return negative probabilities.

With regard to the longitudinal nature of the data, panel data methods were considered. Because there are repeated observations on universities over multiple time-

periods, there is clustering within universities and there is likely to be serial correlation and dependence between measures. There are two sources of residual variance–that which is between institutions and that which is within institutions (Kennedy, 2008; Wooldridge, 2010). In the higher education finance literature, the common approach in such situations is to use a fixed effects estimator (e.g., Archibald & Feldman, 2006, 2008a; Dar & Lee, 2014; Delaney & Doyle, 2014; Doyle, 2012; Hillman, Tandberg, & Gross, 2014; Jaquette & Curs, 2015; Leslie, Slaughter, Taylor, & Zhang, 2012; McLendon, Hearn, & Mokher, 2009; Ness & Tandberg, 2013; Tandberg, 2013; Toutkoushian & Hillman, 2012). The fixed effects procedure essentially uses each unit as its own control (Allison, 2009). By including dummy variables or transforming the data with a differencing procedure, the estimator "wipes out all explanatory variables that do not vary within an individual" (Kennedy, 2008, p. 284). All that remains is the within unit variance, which can be controlled for with the inclusion of additional time-varying covariates.

Attempting to apply a fixed effects approach to ordered response models is impeded by two major obstacles. First, unlike linear regression, a method for differencing out the fixed effects has not yet been developed for these types of estimators (Greene & Hensher, 2009, p. 207). Second, if dummy variables are included for each unit (e.g., university) this results in what is known in the statistics and econometrics literature as the incidental parameters problem. What happens is that with a finite number of time periods, the number of fixed effects dummy parameters grows with the sample size. This violates the maximum likelihood properties and results in biased

estimates (Allison, 2009; Greene & Hensher, 2009; Lancaster, 2000; Neyman & Scott, 1948; Wooldridge, 2010).[30]

This leaves two remaining options. The data can be pooled, assuming that there is only one level of residual variance, and robust standard errors employed to account for the serial correlation; or, a random effects estimator can be used (Wooldridge, 2010). The traditional random effects model makes a strict Orthogonality assumption, where the residuals are assumed to be statistically independent of the covariates: $Cov(x_{ij}, u_{ij})=0$ and $Cov(x_{ij}, \varepsilon_{ij})=0$ (Cameron & Trivedi, 2005; Wooldridge, 2010). A solution to this problem, originally proposed by Mundlak (1978), is the correlated random effects model, which involves including group means for each time-varying covariate in order to control for correlation.

Unfortunately, the data set in this study does not allow for either relaxing the proportional odds assumption or estimation via correlated random effects. This is likely due to separation in the data. This issue, which is particularly problematic in categorical outcomes, occurs when there is a single predictor or set of values that are allocated to one outcome (Albert & Anderson, 1984). For example, suppose that for a specific variable, values 1-100 always result in response 1, while 101 and up always result in response 2. This variable is said to perfectly predict the outcome, since observations above or below 100 always result in a specific response. As a result, the maximum likelihood estimator is unable to maximize the likelihood function, and the parameter coefficients will continue to increase, while failing to converge on a fixed value (Allison, 2008). This can also occur when an independent variable *almost* perfectly predicts an outcome (i.e.,

[30] It is documented that with binary data and as few as two periods, the parameter coefficients are biased by as much as two times: $\hat{\beta} = 2\beta$ (Greene & Hensher, 2009; Lancaster, 2000).

quasi-complete separation); that is, there is some overlap in the data, but there are still values that only result in one response. While statistical packages usually detect separation in data and report the problem, improvements in estimation algorithms sometimes result in models appearing to converge, though with incorrect parameter estimates (i.e., false convergence). Although these false estimates can usually be detected by large parameter coefficients coupled with "enormous" standard errors (Agresti, 2010, p. 65), plotting the responses provides a much clearer of picture of whether there is separation and where it may be occurring.

Contingency tables showing counts for each of the binary independent variables are located in Appendix B. Since there are no response categories with zero counts for any of these covariates, it can be assumed that separation is not an issue with these variables. Variable fit can be further assessed by examining the yes responses for pairwise combinations of these regressors. This is shown in the contingency tables located in Appendix C. Except for category A3 and below, where there are no counts for both Academic Medical Center and High State Rating reporting yes, each pairwise combination of categorical covariates have at least one count. This further demonstrates the desired variability in the data, as well as the relationship between these variables.

Assessing separation in continuous variables is not as straight forward as with categorical variables, whose counts can be neatly assigned to cells in contingency tables. However, using the method described by Agresti (2010), the data can be plotted, collapsed, and examined between responses. In other words, category one is compared to categories two through six, categories one and two are then compared to three through six, categories one through three are compared to four through six, etc. The scatterplots

in Appendix D indicate the occurrence of separation in several of the independent variables.[31] One such example is endowment fund value per full-time equivalent (FTE), where the values increase with the response category. In fact, in the raw data, endowment values greater than $1 billion were largely associated with Aa1 and Aaa rated institutions (response category six). Two other examples include tuition and fees per FTE and federal operating grants and contracts per FTE. In the former the separation appears to occur most clearly in response category six. With the latter, this can be seen with categories four through six versus one through three.

While the log transformations, which are also plotted in Appendix D, seem to help with some of these problems, there are still outliers in these data. One important observation that can be made from these "messy" data is that revenue is a strong predictor of credit ratings. That is, increases in certain revenue (e.g., endowment) overwhelmingly predict stronger credit ratings agencies. This aligns with the literature that was discussed in Chapter II (e.g., Bogaty, 2013; Kedem, 2011; Tuby 2014).

Estimating the models with correlated random effects resulted in the warning messages, "model is nearly unidentifiable," and "Variance-covariance matrix of he parameters is not defined." As a result, some of the coefficients were extremely large (e.g., leverage group mean = 216.54), and standard errors, z values, and p-values could not be calculated. This is likely due to the data separation just discussed. Convergence issues also arose while trying to relax the proportional odds assumption. Since estimation methods designed to address data separation in logistic regression, such as exact methods

[31] All scatterplots were created with the R package 'ggplot2' (Wickham, 2009).

(see Cox & Snell, 1989) and penalized maximum likelihood (see Firth, 1993),[32] have not been adequately extended to ordered response models, the data were estimated with the pooling approach involving standard errors clustered for institution (75 clusters). That is to say, this study employs both ordered probit and ordered logit models with the proportional odds assumption as its estimation technique.

**Estimation**

Ordered response models, particularly cumulative models, are most commonly derived as either generalized linear models (GLM) (e.g., Agresti, 1996, 2013; McCullagh, 1980; McCullagh & Nelder, 1989) or as latent variable models (e.g., Cameron & Trivedi, 2005; Greene, Hensher, 2009; Wooldridge, 2010). The former approach has traditionally been favored in the fields of statistics and biostatistics, while the latter is largely used in econometrics and psychometrics (Rabe-Hesketh & Skrondal, 2012). What is important to remember is that these two approaches are largely conceptual, and that they lead to equivalent models (Rabe-Hesketh & Skorondal, 2012). Interestingly, statisticians and biostatisticians working under the GLM framework have noted the usefulness of imagining these models as motivated by an underlying continuous random variable (e.g., Anderson, 1984; Anderson and Philips, 1981; Hosmer, Lemeshow, & Sturdivant, 2013; McCullagh, 1980).

The finance literature largely takes the latent variable approach, viewing creditworthiness as an underlying continuous random variable measuring an institution's credit strength (e.g., Afonso, Gomes, & Rother, 2009, 2011; Grizzle, 2012; Moody, 2008; Palumbo & Zaporowski, 2012; Yan, 2011). Although methodologies published by the

[32] Bias correction has been extended to the proportional odds model in a select number of theoretical articles (e.g., Kosmidis, 2014; Lipsitz et al., 2013), but software implementing these methods is not yet available.

ratings agencies are extremely vague as to whether they view credit ratings as predicated on a latent variable, since this study is deeply ingrained in the field of public finance it will follow this disciplinary approach.

To begin with, it can be assumed that creditworthiness is a continuous, albeit unobservable, random variable, which takes the form found in equation 3.2.

$$Y_{it}^{*} = \beta X_{it} + \varepsilon_{it} \tag{3.2}$$

Where $Y^*$ equals creditworthiness, $X$ is a vector of time-variant and time-invariant regressors associated with institution and state characteristics, $\beta$ is a corresponding vector of variable effects, and $\varepsilon$ is the idiosyncratic random error term associated with each institution $i$ at each time period $t$. As discussed earlier, in the ordered probit and ordered logit models, the individual level error terms are either normally or logistically distributed:

$$\textit{Probit: } \varepsilon_{it} \sim N(0,1) \tag{3.3}$$

$$\textit{Logit: } \varepsilon_{it} \sim \textit{Logistic}\ (0, \pi^2/3)$$

Because the latent variable $Y_{it}^*$ is unobservable, creditworthiness must be partitioned into discrete categories separated by $J\text{-}1$ thresholds, or cut points ($J$ = the number of credit rating categories/the highest category). The threshold parameters ($\alpha$) are ordered integers, where $\alpha_1 < \alpha_2 < \alpha_3 < \ldots < \alpha_{J-1}$. They can be understood as marking points in the distribution of $Y_{it}^*$ where a university's creditworthiness moves to a higher/lower credit rating. In the context of the model, they can also be understood as the intercepts for each category. This censoring of $Y_{it}^*$ is illustrated below:

$$\mathrm{Y}_{it} = \begin{cases} 1\ (\leq \mathrm{A1}) \text{ if } Y_{it}^{*} \leq \alpha_1 \\ 2\ (\mathrm{A2}) \text{if } \alpha_1 < Y_{it}^{*} \leq \alpha_2 \\ \quad\quad . \\ \quad\quad . \\ \quad\quad . \\ 6\ (\geq \mathrm{Aa1}) \text{ if } Y_{it}^{*} > \alpha_5 \end{cases} \tag{3.4}$$

If a university's creditworthiness crosses cut point $\alpha_1$, the university is upgraded to the next highest credit rating. This is further illustrated with a three-category example in the density plot in Figure 4.

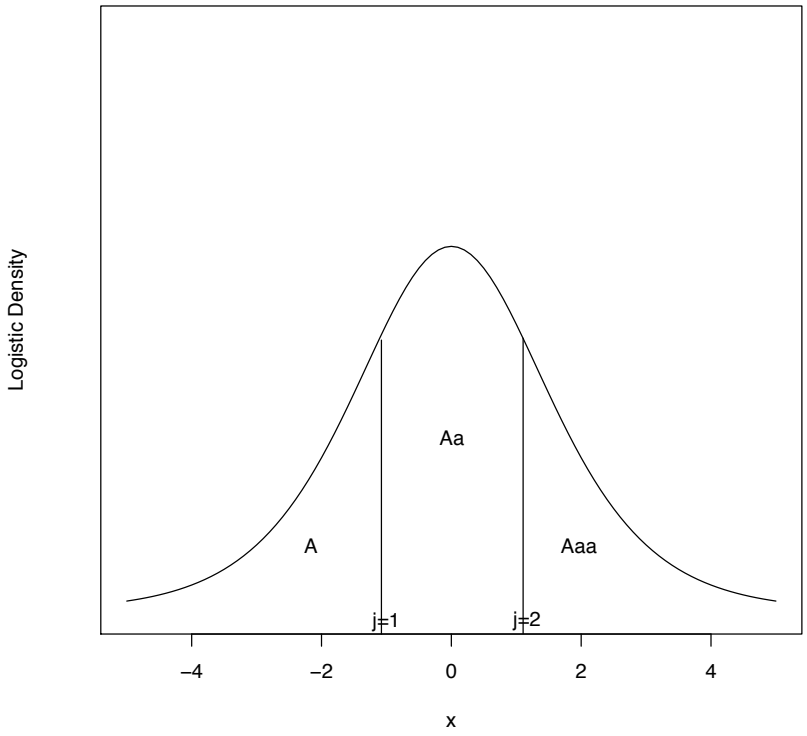


*Figure 4*. Three Category Density Plot with Cut Points

In the above figure, as creditworthiness surpasses cut point 1 ($j$ = 1) credit rating is upgraded from A to Aa.

Whereas in linear regression the mean of the outcome is modeled, ordered response models estimate the probability of creditworthiness falling into one of the

specified intervals, defined by the *J*-1 cut points. This produces the ordinal logistic and probit regression equations.

$$\Pr(Y_{it} \leq j \mid X_{it}) = \Pr(Y_{it}^{*} \leq \alpha_j \mid X_{it}) = F(\alpha_j - \beta X_{it}) \tag{3.5}$$

Where *F* equals the cdf of the standard normal distribution (Φ) with the ordered probit and the cdf of the standard logistic distribution (Λ) with the ordered logit.[33] Cumulative models predict the probability, or odds, of falling into a lower category based on a one-unit change in a regressor, *ceteris paribus*. Using $F(\alpha_j - \beta X)$, each response probability is computed as follows:

$$\begin{aligned}
&\Pr(Y_{it} = 1 \mid X_{it}) = \Pr(Y_{it}^{*} \leq \alpha_1 \mid X_{it}) = F(\alpha_1 - \beta X_{it}) \\
&\Pr(Y_{it} = j \mid X_{it}) = \Pr(\alpha_{j-1} < Y_{it}^{*} \leq \alpha_j \mid X_{it}) = F(\alpha_j - \beta X_{it}) - F(\alpha_{j-1} - \beta X_{it}) \\
&\Pr(Y_{it} = 6 \mid X_{it}) = \Pr(Y_{it}^{*} > \alpha_5 \mid X_{it}) = 1 - F(\alpha_5 - \beta X_{it})
\end{aligned} \tag{3.6}$$

In the above equation, one equals the lowest credit rating category (≤ A3), five equals the highest credit rating category (≥ Aa1), and *j* equals any of the middle rating categories.

Parameters are estimated by maximizing the log likelihood equation shown below:

$$\begin{aligned}
&LL(\alpha, \beta, X) = 1[Y_{it} = 1]\log[F(\alpha_1 - \beta X)] + 1[Y_{it} = 2]\log[F(\alpha_2 - \beta X) - F(\alpha_1 - \beta X)] \\
&+ \ldots + 1[Y_{it} = 6]\log[1 - F(\alpha_5 - \beta X)]
\end{aligned} \tag{3.7}$$

As discussed earlier, *F* equals Φ in the ordered probit and Λ in the ordered logit. Since the ordered probit does not provide estimates that are directly interpretable, marginal effects, for both functions, for the continuous covariates are calculated with the following equations:

[33] Due to the standard logistic distribution having a variance of $\pi^2/3$, as opposed to the standard normal's variance of one, the ordered logit coefficients and threshold parameters are scaled by this value.

$$\begin{aligned}
\frac{\partial \Pr(y=1)}{\partial x} &= -F'(\alpha_1 - \beta X) \\
\frac{\partial \Pr(y=j)}{\partial x} &= F'(\alpha_{j-1} - \beta X) - F'(\alpha_j - \beta X) \\
\frac{\partial \Pr(y=6)}{\partial x} &= F'(\alpha_5 - \beta X)
\end{aligned} \tag{3.8}$$

Where $F'$ is the derivative of $F$, and $1 < j < 6$. The parameter coefficients from these equations can be interpreted as measuring the change in response probability for a one-unit increase in a particular covariate, *ceteris paribus*.[34] For discrete variables, marginal effects are calculated using the finite difference method, which is equal to the difference in response probability for changing a specified binary predictor from zero to one (Cameron & Trivedi, 2010; Wooldridge, 2009). Additionally, in this study average marginal effects (AME), as opposed to marginal effects at the mean (MEM), are calculated. The former averages the marginal effects for each covariate value in the data, and the latter calculates the marginal effects at the average $x$ value. AMEs are recommended in policy work, since they account for all of the data (Cameron & Trivedi, 2010). Also, AMEs are recommended when there are discrete variables, since the mean values of such covariates (i.e., they fall somewhere between zero and one) are unrealistic (Wooldridge, 2009).

**Models and Hypotheses**

To answer all three research questions, this study employs six different models. In addition, based on the literature reviewed in Chapter II, this study also tests 14

[34] Since derivatives calculate a very small, or infinitesimal, change, marginal effects for a "one unit-increase" for continuous predictors is more ambiguous than with binary covariates. Regardless, they can be interpreted as the change in probability of receiving a different credit rating for a small change in a specific x-value.

hypotheses. These hypotheses are listed below, under their corresponding research question number and model(s).[35]

Quesion1 (Revenue Structure):

$$\text{Model: } \Pr(Y_{it} \le j \mid X_{it}) = F[\alpha_j - (\beta_1 x_{sel} + \beta_2 x_{res} + \beta_3 x_{\ln ufte} + \beta_4 x_{\ln tfpfte} + \beta_5 x_{\ln sappfte} + \beta_6 x_{\ln fgpfte} + \beta_7 x_{\ln statefte} + \beta_8 x_{amc} + \beta_9 x_{\ln endowpfte} + \beta_{10} x_{highreg} + \beta_{11} x_{dl} + \beta_{12} x_{highstate} + \beta_{13} x_{\ln dbs} + \beta_{14} x_{lev})] \quad (3.9)$$

H1: All variables representing market position and demand should be positively associated with improved creditworthiness.

H2: Due to increased volatility and constraint, tuition and fee revenues should be negatively associated with improved creditworthiness.

H3: Due to instability and declines in state funding for higher education, state appropriations should be negatively associated with improved creditworthiness.

H4: Federal operating grants and contracts should be positively associated with improved creditworthiness, since these funds signify improved market position and provide a greater financial base.

H5: Increases in an institution's state and local operating grants and contracts should be negatively associated with increased creditworthiness, since it may represent narrower geographic scope.

H6: Increases in an instituion's endowment fund should be positively associated with improved creditworthiness, since it improves fiscal base and is correlated with market position.

H7: Affiliation with an AMC should be positively associated with improved creditworthiness, since university hospitals bring in revenue from service charges and research grants.

H8: Centralized governing boards should be associated with decreased creditworthiness and decentralized boards with improved creditworthiness, since the former tends to align universities with state interests and the latter provides more operational freedom.

H9: Debt limits should be associated with decreased creditworthiness, since these policies restrict a university's ability to access debt.

[35] Each of the listed models is estimated as an ordered probit and an ordered logit (two different models). Explanation of each symbol in the equations can be found in the "List of Symbols."

H10: Improved state credit ratings should be associated with improved university creditworthiness, since state ratings reflect fiscal health and the ability to aid public institutions.

H11: Total outstanding debt should be positively associated with improved creditworthiness, since it reflects effective implementation of oversight practices and short- and long-term planning.

H12: Financial leverage, as measured by the ratio of total debt to total revenue should be negatively associated with improved creditworthiness, since a larger number represents decreased debt servicing capacity.

Question 2: (Revenue Diversification):

Model:
$$\begin{aligned}\Pr(Y_{it} \le j \mid X_{it}) = F[\alpha_j - (&\beta_1 x_{hhi} + \beta_2 x_{sel} + \beta_3 x_{res} + \beta_4 x_{\ln ufte} + \beta_5 x_{amc} \\ &+\beta_6 x_{\ln endowpfte} + \beta_7 x_{highreg} + \beta_8 x_{dl} + \beta_9 x_{highstate} + \beta_{10} x_{\ln dbs} + \beta_{11} x_{lev})]\end{aligned} \tag{3.10}$$

H13: Increased revenue diversification should be positively associated with improved creditworthiness, since it provides greater fiscal stability.

The above model substitutes revenue diversification, measured with HHI, for the four revenue components (log tuition and fees per FTE, log state appropriations per FTE, log federal operating grants and contracts per FTE, and log state and local grants and contracts per FTE) that make up its composition. Since revenue diversification is a measure composed of each of these four revenue variables (see equation 3.1), it is likely to be highly collinear with each one; thus, they were not included together. Additionally, using the diversification index as compared to revenue structure means that it is possible to determine if increased flexibility, rather than simply levels of revenue components, is associated with a higher rating.

Question 3: (Severe Economic Downturns):

Model:
$$\begin{aligned}\Pr(Y_{it} \le j \mid X_{it}) = F[\alpha_j - (&\beta_1 x_{recession} + \beta_2 x_{sel} + \beta_3 x_{res} + \beta_4 x_{\ln ufte} + \beta_5 x_{\ln tfpfte} \\ &+\beta_6 x_{\ln sappfte} + \beta_7 x_{\ln fgpfte} + \beta_8 x_{\ln statefte} + \beta_9 x_{amc} + \beta_{10} x_{\ln endowpfte} + \beta_{11} x_{highreg} \\ &+\beta_{12} x_{dl} + \beta_{13} x_{highstate} + \beta_{14} x_{\ln dbs} + \beta_{15} x_{lev})]\end{aligned} \tag{3.11}$$

H14: Severe Economic Downturns, as measured by The Great Recession, should negatively impact credit ratings.

Although recession is not being modeled as directly impacting the independent variables, there are likely to be spillover effects from its inclusion. Therefore, it is modeled with the individual revenue streams in order to isolate its effects on ratings while also including other control variables cited previously.

## Chapter Conclusion

This chapter discussed the study's data collection and methodology procedures. It outlined the worldview in which the study is situated, the proposed population and sample characteristics, the variables that are measured, the planned statistical procedures, the data-reporting format, and the hypotheses and models associated with each research question. In doing so, it has aimed at providing a clear rationale for conducting this analysis. As outlined throughout this study, empirical research on public research university credit ratings is limited. Also, ordered response models have only been moderately used in this context. As a result, information on the impact of various factors on university credit ratings is still largely unknown. The analysis that follows answers these questions and adds to the understanding of this area of higher education finance.

# CHAPTER IV

# RESULTS AND FINDINGS

This chapter presents the results of the econometric models specified in Chapter III. It begins with an overview of the data's features, including measures of central tendency and dispersion. Following these descriptive statistics, the estimation results from the ordered probit and ordered logit models are provided for each research question. Findings and discussion are grouped by research question and appropriate hypotheses. This allows for a more nuanced comparison and discussion.

## Descriptive Statistics

The data's main features are displayed in Table 5. For all of the variables, the raw mean, standard deviation, minimum value, and maximum value are provided. For Institutional Credit Ratings both the within and between standard deviations are shown as well. Table 5 shows quite a bit of variability in the independent variables. This is especially true with the financial covariates, which show relatively large standard deviations and ranges. For example, endowment values in the data set range from $44.80 per FTE to $334,131 per FTE. Thus, it can be inferred that although the universities chosen for the data set share similar Carnegie Classifications, there is still quite a bit of heterogeneity in their fiscal structures. This is further evidenced by the within and between standard deviations for the dependent variable institutional credit ratings. Most

of the variation in this response occurs between institutions (1.13), rather than within institutions (.534).

Table 5

*Descriptive Statistics (n = 900)*

| Variable | Mean | Std. Dev. (between/within) | Min | Max |
|---|---|---|---|---|
| Institutional Credit Rating | 3.74 | 1.24 (1.13/.534) | 1 | 6 |
| Freshman Selectivity | .714 | .146 | .283 | .992 |
| Research Intensity | .186 | .064 | .065 | .414 |
| Undergraduate Full-Time Equivalents | 18276 | 8410.49 | 2783 | 55016 |
| Tuition and Fees per FTE | 10714.19 | 4639.56 | 2932 | 33152 |
| State Appropriations per FTE | 12158.88 | 5606.51 | 1530.41 | 40714.73 |
| Federal Operating Grants and Contracts per FTE | 8257.51 | 7854.46 | 302.85 | 44937.69 |
| State and Local Operating Grants and Contracts per FTE | 3453.81 | 3016.73 | 105.23 | 21754.31 |
| Endowment Value per FTE | 32117.26 | 45289.55 | 44.28 | 334131.4 |
| Academic Medical Center (AMC) | .38 | .486 | 0 | 1 |
| High Regulation | .786 | .411 | 0 | 1 |
| Debt Limit | .859 | .348 | 0 | 1 |
| High State Credit Rating | .786 | .411 | 0 | 1 |
| Debt Burden per Student (DBS) | 20539.78 | 16135.7 | 746.91 | 92698.06 |
| Leverage | .376 | .215 | .015 | 1.52 |
| Hirschman-Herfindahl Index (HHI) | .878 | .074 | .472 | .993 |
| Recession | .417 | .493 | 0 | 1 |

In addition to the above descriptive statistics, a correlation matrix, showing the dependence for each of the independent variables, is located in Appendix G.[36] For each pairwise combination, the Pearson product-moment correlation coefficient is provided. Several variables share relatively strong positive correlations. Notable examples include those between tuition and fees per FTE and both endowment per FTE and DBS (.530 and .548, respectively), federal operating grants and contracts and state/local operating grants and contracts (.681), and DBS and leverage (.638). These values suggest relatively strong positive relationships between tuition and fees and both endowment value and total debt burden, grant funding at the federal and state level, and debt load and debt servicing capability. These relationships will be examined in more depth later in the study's analysis; however it is worth mentioning at this point that these positive relationships suggest a degree of covariance between the features of university credit ratings captured by the variables in the models. Additionally, there are strong positive correlations between HHI and both grant categories (.689 and .715). This relationship is likely due to HHI being a more aggregate measure of these two revenue sources.

## Results

As outlined in Chapter III, the general model for the study is as follows:

$$\Pr(Y_{it} \leq j \mid X_{it}) = \Pr(Y_{it}^{*} \leq \alpha_j \mid X_{it}) = F(\alpha_j - \beta X_{it})$$

Where, $F = \Phi$ in the ordered probit and $\Lambda$ in the ordered logit; $\alpha_j$ are the cut-points in the distribution, or intercepts in the equations, $X$ is a vector of time-variant and time-invariant regressors associated with institution and state characteristics, and $\beta$ is a corresponding vector of estimated variable effects. The models estimate how changes in individual

[36] The Pearson product-moment correlation coefficients were calculated with R version 3.2.0.

covariates, *ceteris paribus*, are associated with the probability of falling into a lower or higher credit rating category (*j*). Although the pooled models converged and did not report overly large standard errors and parameter estimates, the separation shown in the continuous variable scatterplots (Appendix D) suggests that the estimation results in this chapter should be interpreted with some caution.

Model formulation was based on theoretical and practical reasons. The former has already been explicated in detail throughout Chapters II and III. As for the practical reasons, convergence issues hindered estimation of subject-specific models (i.e., correlated random effects) as well as relaxing the proportional odds assumption. With subject-specific models, each time-varying covariate was originally mean-differenced (the within effect) and also group means for each of these variables were included (the between effect), to account for correlation with the error terms. The variables employed in the pooled models are not mean-differenced, nor are group-level means (i.e., Mundlak devices) included. In addition to changes in estimation, this also changes coefficient interpretation. Whereas interpretation of parameter estimates in subject-specific models correspond to changes within a single unit, or university, estimates in this study's pooled models refer to differences between two populations of institutions. That is, the estimates discussed in the remainder of this study refer to the difference between two populations of public research universities.

**Revenue Structure**

The first research question is focused primarily on the role played by revenue structure in determining public research university credit ratings. This question asks, *How are the factors involved in public research university revenue structure associated*

*with institutional credit ratings?* Estimation results for the ordered probit and ordered logit models pertaining to this question are shown in Table 6.[37] Odds ratios, and exponentiated 95% confidence intervals, which measure the estimated precision of the odds ratio, for the ordered logit are also provided. Marginal effects, estimated for each observation and averaged across the entire sample, for both estimators, are displayed in Appendix E. While there is a relationship between odds ratios and probabilities, the marginal effects are not a conversion of the odds ratios. Whereas odds ratios are related to a change in the odds of receiving a different credit rating, marginal effects report the increase or decrease in probability of receiving a different credit rating, for a change in a specific regressor. Table 7 compares the hypothesized to actual relationships between the covariates and the dependent variable.

[37] For all of the estimation results in this chapter, the threshold parameters are reported in Appendix F.

Table 6

*Ordered Probit and Ordered Logit Results for Revenue Structure*

| Variable | Ordered Probit Coefficient (Std. Error) | Ordered Logit Coefficient (Std. Error) | Odds Ratios (Exp. 95% C.I.) |
|---|---|---|---|
| Freshman Selectivity | -1.42*** (.545) | -2.65*** (1.03) | .071*** (.009 \| .535) |
| Research Intensity | -2.07 (1.71) | -3.27 (3.38) | .038 (.00005\| 28.58) |
| Undergraduate Full-Time Equivalents (ln) | 1.67*** (.225) | 3.00*** (.428) | 20.04*** (8.66 \| 46.35) |
| Tuition and Fees per FTE (ln) | .917*** (.326) | 1.46** (.617) | 4.30** (1.28 \| 14.39) |
| State Appropriations per FTE (ln) | .228 (.244) | .346 (.467) | 1.41 (.566 \| 3.53) |
| Federal Operating Grants and Contracts per FTE (ln) | .648*** (.163) | 1.14*** (.300) | 3.12*** (1.73 \| 5.62) |
| State and Local Operating Grants and Contracts per FTE (ln) | -.239** (.106) | -.436** (.196) | .647** (.440 \| .949) |
| Endowment Value per FTE (ln) | .424** (.211) | .907* (.499) | 2.48* (.932 \| 6.58) |
| Academic Medical Center (AMC) | -.392 (.249) | -.770* (.471) | .463* (.184 \| 1.16) |
| High Regulation | .088 (.265) | .168 (.490) | 1.18 (.452 \| 3.09) |
| Debt Limit | .188 (.288) | .382 (.539) | 1.47 (.510 \| 4.21) |
| High State Credit Rating | .883*** (.198) | 1.50*** (.381) | 4.50*** (2.13 \| 9.50) |
| Debt Burden per Student (ln) | .821*** (.244) | 1.41*** (.464) | 4.09*** (1.65 \| 10.16) |
| Leverage | -2.44*** (.804) | -3.98*** (1.58) | .019*** (.001 \| .412) |

***denotes statistical significance at the .01 level; **denotes statistical significance at the .05 level; *denotes statistical significance at the .10 level

Table 7

*Hypothesized Versus Actual Relationships for Revenue Structure*

| Variable | Hypothesized Relationship | Actual Relationship |
|---|---|---|
| Freshman Selectivity | − | − |
| Research Intensity | + | No statistical significance |
| Undergraduate Full-Time Equivalents (ln) | + | + |
| Tuition and Fees per FTE (ln) | − | + |
| State Appropriations per FTE (ln) | − | No statistical significance |
| Federal Operating Grants and Contracts per FTE (ln) | + | + |
| State and Local Operating Grants and Contracts per FTE (ln) | − | − |
| Endowment Value per FTE (ln) | + | + |
| Academic Medical Center (AMC) | + | − |
| High Regulation | − | No statistical significance |
| Debt Limit | − | No statistical significance |
| High State Credit Rating | + | + |
| Debt Burden per Student (ln) | + | + |
| Leverage | − | − |

**Hypothesis one.** All variables representing market position and demand were hypothesized to be positively associated with improved creditworthiness. The findings show that while this is true for some of these factors, others are negatively associated. Freshman selectivity reports coefficients of -1.42 and -2.65 for the ordered probit and ordered logit (respectively), both at the .01 significance level.[38] For a one-unit increase in the selectivity index, a population of institutions is 14.1 (1/.071) times as likely as a

[38] Positive coefficients indicate an increase or positive relationship between estimate value and higher credit rating.

population of institutions whose selectivity did not change to receive a lower credit rating.[39] Because selectivity is composed of a ratio of acceptances to applicants (i.e., percent accepted), an increase in this number signifies decreased selectivity. Therefore, increased selectivity is shown to be positively associated with increased creditworthiness.

The value of 14.1 appears to be quite a large number for the change in odds associated with a 1% increase in acceptances. Statistically, this may be due to selectivity not being log transformed. Although the natural log transformation places less weight on outliers and reduces positive skewness, ratio variables, such as selectivity, were not log transformed. These variables do not show signs of skewness and the scatterplots in Appendix D do not show the log transformation having much effect on the distribution of the data. Substantively, since these variables are already expressed in percentages, the log transformation would change their interpretation to a percentage change of a percentage (semi-elasticity of a percentage).

Theoretically, the research literature notes that increased market position decreases an institution's price elasticity, allowing for greater flexibility in setting tuition and fees (Kedem, 2011). Additionally, increased competitive position is often accompanied by increased philanthropic support (e.g., endowment value), as well as a greater share of federal operating grant monies (Bogaty, 2013; Kedem, 2011). All three of these variables (tuition and fees, federal operating grants, endowment value) are positively associated with improved creditworthiness. If freshman selectivity is a strong

[39] For odds ratios that are less than one, the effect on moving in the opposite direction can be calculated by taking the inverse of the odds ratio. Due to its easier interpretation, odds ratios greater than one are interpreted as increases in credit rating, while those less than one are interpreted as decreases in credit rating from here forward.

measure of market position and demand, then its impact may also reflect the combined impact of these other variables.

Regardless of the bias that may exist in selectivity's large odds ratio, it can be concluded that decreased selectivity is viewed negatively by credit rating agencies. This is further illustrated with the average marginal effects, which show the greatest impact occurring between categories A1 and Aa3. While these numbers, as with other estimates should be interpreted with caution, due to the data separation discussed in Chapter III, movement between these two categories demonstrates a clear shift in the sign of the effect. When selectivity decreases, as measured by an increase in the percentage of applicants whom are accepted, the probability of receiving an A1 rating increases by 9.9% to 10.1%, depending on the distributional assumptions. The probability increases for A2, a less-creditworthy category, by between 12.5% and 13.5%. At the same time, the probability of receiving an Aa3 rating (improved creditworthiness), decreases by between 4.1% and 4.9%, and for Aa2 the probability decreases by between 12.4% and 14.1%.

The results for selectivity follow the research literature (Standard & Poor's, 2007; Kedem, 2011), which claims that increased selectivity positively impacts creditworthiness. This makes sense, especially if increased selectivity is viewed as a reflection of increased market demand. However, the results do not match those in Michael Moody's (2008) analysis. His findings show a positive relationship between decreased selectivity and increased creditworthiness. But, as discussed in Chapter II, none of the marginal effects in Michael Moody's (2008) study are statistically significant,

and the direction of his coefficient may be biased by his data set's small sample size (146 institutions).

Similar effects are found for undergraduate full-time equivalents (FTEs). For a one-percent increase in the number of undergraduate FTEs, a population of institutions is 20 times as likely to receive a higher credit rating than a population whose undergraduate FTE's do not increase. The average marginal effects show increases in this variable as having the greatest impact between A1 and Aa3, where a one percent increase changes the probability from negative to positive, respectively. The large odds ratio for this variable may be due to it capturing multiple determinants. As discussed in the literature, increased enrollment (i.e., undergraduate FTEs) likely reflects increased student demand for a specific institution (Heller, 1999; Kedem, 2011; Koshal & Koshal, 2000; McLendon, Hearn, & Mokher, 2009; Serna, 2012, 2013a, 2013b). As a result, increases in enrollment enable greater pricing power. Thus, populations of institutions with larger enrollment numbers are likely able to generate greater revenues. If credit ratings are revenue dependent, which is suggested by Michael Moody's (2008) findings, increases in FTEs can be understood as enabling institutions to generate additional revenues and improve their creditworthiness.

The third market position variable is research intensity, as measured by the ratio of graduate FTEs to total FTEs. While the literature suggests that this variable is positively associated with improved creditworthiness (Rubinoff & Marion, 2007), the estimations failed to return statistically significant results. This may be due to data separation in this variable, most clearly seen by collapsing categories one through three

and 4 through six (see Figure 2D), because of the small observation values (mean=.186), or from the reflection of research standing in federal operating grants and contracts.

**Hypothesis two.** Hypothesis two predicts that tuition and fee revenues are negatively associated with improved creditworthiness. This is supported by the literature highlighting the slowed growth in tuition revenue, especially in recent years because of factors such as fewer high school graduates, decreased household net worth and income, increased government scrutiny over tuition costs, and increased price discrimination (Bogaty, 2013; Serna, 2013a; Tuby, 2014). Surprisingly, tuition and fees per FTE returned positive and statistically significant coefficients for both the ordered probit and ordered logit models. For a one percent increase in this variable, the odds of receiving a higher credit rating are 4.3 times that of a population of institutions without an increase. As with the other variables, the average marginal effects show the greatest change occurring between A1 and Aa3, where a one percent gain decreases the probability of receiving the former rating by between 11.5% and 11.8%, and increases the probability of receiving the latter rating by 4.6% to 5.8%. This suggests that while tuition growth may have slowed in recent years, revenue from this source is still viewed as a strength.

Also, as noted in the last section, enrollment growth is strongly associated with increased creditworthiness. Between FY 2002 and FY 2013, undergraduate FTEs for the universities in the data set grew at an average rate of 1.6%. So, even though tuition growth rates may have slowed, increased enrollments have consistently generated revenue for institutions. Finally, increased tuition and fees may also represent decreased reliance on state appropriations, where the former represents increased autonomy and control over revenue generation decisions.

**Hypothesis three.** Turning to the other side of the tuition and fees/state appropriations duality, hypothesis three predicts that state appropriations are negatively associated with improved credit ratings, due to continued reductions in this source (Bogaty, 2013; Tuby, 2014) and recent attachments of state monies to performance requirements (Dougherty et al., 2014; Dougherty & Reddy, 2011). Both models failed to return statistically significant estimates for this variable. This may be because state appropriations represent an ever-shrinking piece of university revenue structure, as a result of decreased state budgets and transitions to high tuition models of postsecondary education. In other words, the reliance upon state funds for operating revenue at public research institutions may have decreased sufficiently so as to make this variable a less important revenue component when rating these types of institutions.

**Hypothesis four.** Federal operating grants and contracts show positive and statistically significant parameter estimates for both the ordered probit and ordered logit. For a one percent increase in this variable, *ceteris paribus*, a population of institutions is 3.12 times as likely as one with no increase to receive a higher credit rating. Movement is most pronounced between A1 and Aa3, where the probability for the receiving the former rating declines by a factor of 4.4% to 4.6%% and increases for the latter by 1.7% to 2.2%. The probability magnitude continues decreasing and increasing for A2 and Aa2, respectively.

These findings confirm hypothesis four and align with the literature showing that because competition for federal grant monies has steadily increased, funding from this source signifies increased competitive standing and greater brand recognition (Bogaty, 2013). This also translates into a larger and more diversified revenue base, which is also

viewed positively by ratings agencies (Kedem, 2011). Additionally, as discussed in hypothesis one, this variable may be absorbing some of the effects of research intensity, since increased competition for federal operating grants means that securing said funding reflects an institution's research standing. In other words, research intensity may be positively associated with improved creditworthiness, but the impact may be better captured by this variable.

**Hypothesis five.** The parameter estimates for state and local operating grants and contracts are statistically significant and negative, indicating a negative association with improved creditworthiness. For a one percent increase in this variable, *ceteris paribus*, a population of institutions is 1.55 (1/.647) times as likely as a population with no increase to receive a lower credit rating. This equals an increase in the probability of receiving an A2 rating by 1.7%, versus a decrease in the probability of receiving an Aa3 rating by just less than 1%. These findings confirm the hypothesized relationship. Whereas increases in federal operating grants and contracts reflect increased geographic scope and presence, increases in state and local grants may reflect the opposite.

**Hypothesis six.** Hypothesis six predicts that the market value of an institution's endowment fund is positively associated with improved creditworthiness. Based on the literature, university endowment size reflects its ability to accumulate wealth, largely through philanthropic support, which can in turn increase reserves and debt service capacity (Serna, 2013a, b; Winston, 1999). Findings from both estimations support this assumption. For a one percent increase in endowment value per FTE, a population of institutions is 2.48 times as likely as a population that did not increase its endowment to receive a higher credit rating. More specifically, the probability of receiving an Aa3

rating increases by an average of 1.4% to 1.5%, while the probability of receiving an A1 rating decreases by 3% to 3.5%. Thus, as with most of the other variables, the shift in impact direction for endowment gains occurs between the A and Aa categories. Additionally, this variable can also be understood as reflecting an institution's market position, since increased philanthropic support implies broader recognition and demand for its services.

**Hypothesis seven.** Hypothesis seven predicts that affiliation with an academic medical center (AMC) is positively associated with improved creditworthiness. Due to its ability to provide greater revenue diversification and increased operational scope, credit rating agencies are presumed to positively view affiliation with an AMC (Kedem, 2011). Michael Moody (2008) includes this variable in his analysis of university credit ratings, but his findings for this variable are not statistically significant. Results from this study are statistically significant at the .10 level, only for the ordered logit estimator.[40] But, instead of the hypothesized positive relationship, the parameter estimates for this variable are negative. Institutions affiliated with an AMC are 2.16 (1/.463) times as likely as those not affiliated with an AMC to receive a lower credit rating. The probability of receiving an A1 rating increases by 2.5%, and the probability of receiving an Aa2 rating decreases by 3.9%. Although these findings run counter to the hypothesized impact, they are supported by the literature suggesting that slowed growth in patient-care revenues, reductions in funding to graduate medical education, cuts to Medicare and Medicaid, and uncertainty over the effects of healthcare reform have made AMCs a liability for public universities (Bogaty, 2013; Tuby, 2014).

[40] The p-value for AMC in the ordered probit model is .116.

**Hypothesis eight.** Although hypothesized to negatively impact university credit ratings, the parameter estimates for the presence of a highly centralized governing board are not statistically significant in either model. This is surprising since the research literature largely suggests that high levels of centralization inhibit operational freedom (Burgess, 2011; Knott & Payne, 2004; Lowry, 2001), which can lead to restrictions on debt issuance (Moody, 2007) and hinder an institution's ability to fully leverage its assets (Serna, 2013b). One explanation for this failure to find statistical significance is the buffering effect played by governing boards. That is, highly centralized boards have been shown to magnify the budgetary powers of the state governor (Tandberg, 2013). Since state credit ratings can be viewed as reflections of how rating agencies view a state's fiscal governance, the inclusion of state credit rating in the models may be absorbing some of the affects of the high regulation variable. Also, since highly centralized boards have been shown to restrict the level of university debt issuance (Moody, 2007), debt burden per student (DBS) may also be absorbing some of the parameter's effects. Finally, increased governing board centralization has been shown to align universities' interests with those of the state and a public model that is less tuition-heavy, while universities operating under less centralized boards align more with a private model that is strongly supported by tuition revenue and research dollars (Knott & Payne, 2004; Lowry, 2001). Therefore, the positive parameter estimates for tuition and fees may also reflect credit rating agencies' positive views toward decreased governing board centralization.

**Hypothesis nine.** The binary variable for the presence of an umbrella debt limit also failed to return statistically significant parameter estimates. Similar to the above

findings this is surprising, since the research literature suggests that these fiscal restraints can negatively impact a public university's borrowing activity and credit ratings (Moody, 2007, 2008). However, as with governing boards, the inclusion of a variable for state credit rating may be absorbing the debt limit variable's effects. This is supported by research showing the negative impact of debt limits on state credit ratings (Johnson & Kriz, 2005). Additionally, since debt limits restrict the amount of debt issuance, debt burden per student (DBS) may again be responsible for absorbing some of the effect.

**Hypothesis 10.** Unlike the previous two variables, high state credit rating shows statistically significant estimates (at .01 level in both models). For universities in states with high credit ratings (≥Aa2), the odds of a higher institutional credit rating are 4.5 times those of institutions in states with lower General Obligation credit ratings. The impact shifts from negative to positive between A1 (-5.4% to -5.8%) and Aa3 (5% to 5.6%), and remains positive for the two higher categories. These findings confirm the hypothesized relationship, as well as findings from the research literature (Moody, 2008; Serna, 2013a).

**Hypothesis 11.** Debt burden per student (DBS), a measure of total long-term debt scaled by undergraduate FTEs, is positively associated with increased credit ratings. For a one percent increase in DBS, the odds of a higher credit rating increase 4.09 times. The probability of receiving an A1 credit rating decreases by 5.4% to 5.8%, while the probability of receiving an Aa3 credit rating increases by 2.2% to 2.8% and 7.2% to 7.5% for an Aa2 rating. These findings support the hypothesized relationship, and the past literature's suggestion that larger amounts of debt reflect diverse debt market usage and effective realization of oversight and planning (Kedem, 2011; Moody, 2008).

**Hypothesis 12.** As hypothesized, the level of financial leverage, measured by the ratio of total debt to total revenue, negatively impacts public research university credit ratings. For a one-unit increase in the leverage ratio (.001), indicating decreased debt service capability, the odds of receiving a lower credit rating increase by almost 53 times (1/.019 = 52.63).[41] With decreased debt service capability (increase in ratio), the probability of receiving an A1 rating increases by 15.2% to 17.1%, while the probability of receiving an Aa3 rating decreases by 8.4%. The signs remain consistent below A1 and above Aa3. As discussed in Chapter III, this variable helps separate the effects of debt service capability from high levels of debt and debt market usage (i.e., DBS), the latter of which is often associated with high levels of research (Kedem, 2011; Rubinoff & Marion, 2007). Therefore, in addition to being focused on a specific aspect of debt, the effects of variables associated with research (e.g., federal operating grants and contracts, research intensity) may be influencing the parameter estimate.

**Revenue Diversification**

The second research question focuses on the role played by revenue diversification in determining public research university credit ratings. It asks, *How is the level of revenue diversification in public research university revenue structure associated with institutional credit ratings?* The estimation results for the ordered probit and ordered logit models pertaining to this question are shown in Table 8. Odds ratios, and exponentiated 95% confidence intervals for the ordered logit are also provided. Again, AMEs for the continuous variables, for the ordered probit and ordered logit estimators, are displayed Appendix E.

[41] As with selectivity, this variable is also expressed as a proportion (debt as a percentage of revenue) and it is not log transformed. Therefore, its high odds ratio may also be due to it not being transformed.

Table 8

*Ordered Probit and Ordered Logit Results for Revenue Diversification*

| Variable | Ordered Probit Coefficient (Std. Error) | Ordered Logit Coefficient (Std. Error) | Odds Ratios (Exp. 95% C.I.) |
|---|---|---|---|
| Revenue Diversification (HHI) | 2.43** (1.16) | 4.08** (2.08) | 59.29** (1.00 \| 3510.98) |
| Freshman Selectivity | -1.55*** (.545) | -2.97*** (1.04) | .051*** (.007 \| .392) |
| Research Intensity | -.891 (1.36) | -1.59 (2.63) | .204 (.001\| 35.10) |
| Undergraduate Full-Time Equivalents (ln) | 1.61*** (.237) | 2.90*** (.436) | 18.15*** (7.72 \| 42.67) |
| Endowment Value per FTE (ln) | .510** (.232) | 1.11** (.455) | 3.02** (1.24 \| 7.37) |
| Academic Medical Center (AMC) | -.541** (.242) | -.1.07** (.433) | .342* (.146 \| .798) |
| High Regulation | .076 (.264) | .156 (.495) | 1.17 (.443 \| 3.08) |
| Debt Limit | .082 (.276) | .260 (.512) | 1.30 (.475 \| 3.54) |
| High State Credit Rating | .802*** (.178) | 1.32*** (.328) | 3.73*** (1.93 \| 7.23) |
| Debt Burden per Student (ln) | 1.38*** (.225) | 2.35*** (.441) | 10.49*** (4.42 \| 24.89) |
| Leverage | -3.16*** (.651) | -5.24*** (1.27) | .005*** (.0004\| .064) |

***denotes statistical significance at the .01 level; **denotes statistical significance at the .05 level; *denotes statistical significance at the .10 level

**Hypothesis 13.** As hypothesized, both the ordered probit and ordered logit parameter estimates for revenue diversification are positive, indicating a positive association between this variable and university credit ratings, at the .05 level. For a one-unit increase in the HHI index (.001), the odds of receiving a higher credit rating are

59.29 times those for no increase. The average marginal effects show that the probability of receiving an A1 credit rating decreases by 19.1% to 21.1%. At the same time, the probability of receiving an Aa3 rating increases by 8.7% to 10.6%. The relationship between revenue diversification and university credit ratings follow past studies modeling revenue diversification and state GO ratings (Grizzle, 2012; Yan, 2011).

The parameter estimates for revenue diversification do seem a bit large for this variable. This is most apparent in the magnitude of the odds ratio (59.29), as well as the exponentiated 95% confidence interval range (1.001 to 3510.98). It is suggested in the literature that large confidence intervals imply sample sizes that are too small (Long & Freese, 2006). However, with 900 observations, and no similar magnitude ranges for the other covariates, problems due to sample size are unlikely. What is more probable is that the parameter estimates are biased because of separation in the data. Examination of figure D6 in Appendix D shows clear separation around x-values of 0.5, occurring in rating category four. Since these are outliers at the lower extreme of the x-range, collapsing categories would not correct for this problem. However, it is important to note that the parameter estimates for this variable are actually smaller than those found in past studies (e.g., Grizzle, 2012 = 10.071; Yan, 2011 = 23.953).[42] Thus, although it is wise to interpret this variable with caution, as with other large estimates, the magnitude and direction follow results in the research literature and confirm the related hypothesis.

**Comparison with first question estimates.** Since this research question is closely related to, though distinct from, the first, parameter estimates from the variables included in both models speaks to the accuracy of the above results. They also allow for reflection on reasons behind any major changes. Table 9 shows the odds ratios from the

[42] Both Grizzle (2012) and Yan (2011) use only an ordered probit estimator.

ordered logit estimation for the first research question alongside the odds ratios for the ordered logit estimation used in this research question. Additionally, the change between the two estimations is noted.

All of the covariates from the revenue structure models that are included in the revenue diversification models retain their statistical significance, or in the case of high regulation and debt limit remain statistically insignificant. Just as important, the direction of their signs remains constant. While the odds ratios change between these two models, most of these changes are relatively minor and can be attributed to differences in model specification. This is illustrated with freshman selectivity, which changed from an odds ratio of 14.1 in the earlier model to 19.4 in the latter. Since selectivity is negatively correlated with the four primary revenue sources (tuition and fees, state appropriations, federal operating grants and contracts, and state and local operating grants and contracts), and revenue diversification is an aggregate of these variables, the magnitude changes are likely due to HHI being a more blunt measure of revenue in terms of its diversification rather than its specific structure.

Table 9

*Comparison of Odds Ratios from Ordered Logit Estimations with and without HHI*

| Variable | No Recession Odds Ratio (Exp. 95% C.I.) | Recession Odds Ratio (Exp. 95% C.I.) | Change |
|---|---|---|---|
| Freshman Selectivity | .071*** (.009 \| .535) | .051*** (.007 \| .392) | − (.02) |
| Research Intensity | .038 (.00005\| 28.58) | .204 (.001\| 35.10) | + (.166) |
| Undergraduate Full-Time Equivalents (ln) | 20.04*** (8.66 \| 46.35) | 18.15*** (7.72 \| 42.67) | − (1.89) |
| Endowment Value per FTE (ln) | 2.48* (.932 \| 6.58) | 3.02** (1.24 \| 7.37) | + (.54) |
| Academic Medical Center (AMC) | .463* (.184 \| 1.16) | .341* (.146 \| .798) | − (.122) |
| High Regulation | 1.18 (.452 \| 3.09) | 1.17 (.443 \| 3.08) | − (.01) |
| Debt Limit | 1.47 (.510 \| 4.21) | 1.30 (.475 \| 3.54) | − (.17) |
| High State Credit Rating | 4.50*** (2.13 \| 9.50) | 3.73*** (1.93 \| 7.23) | − (.77) |
| Debt Burden per Student (ln) | 4.09*** (1.65 \| 10.16) | 10.49*** (4.42 \| 24.89) | + (6.4) |
| Leverage | .019*** (.001 \| .412) | .005*** (.0004\| .064) | − (.014) |

***denotes statistical significance at the .01 level; **denotes statistical significance at the .05 level; *denotes statistical significance at the .10 level

Two notably larger changes between the models occur with log debt burden per student (DBS) and leverage. In the revenue structure model, a one percent increase in DBS is associated with a population of institutions being 4.09 times as likely to receive a higher credit rating. In the revenue diversification model, a one percent increase in DBS

is associated with a population being 10.49 times as likely to receive a higher credit rating. The average marginal effects show a similar increase, with the probability of receiving an A1 rating changing from a decrease of 5.4% to a decrease of 11% and the probability of receiving an Aa3 rating changing from an increase of 2.2% to an increase of 5%. As discussed in the literature, research-intensive universities on average have higher levels of debt per student (Rubinoff & Marion, 2007). This is one of the reasons for including leverage, to separate total debt amount from debt service capacity. It is also known, from the extant literature, that large research universities generally receive a greater share of federal research dollars (Bogaty, 2013; Standard & Poor's Ratings Services, 2013). Furthermore, these institutions tend to have more pricing power, especially when it comes to tuition and fees, due to their improved market position (Standard & Poor's, 2007). This study has shown that all of these variables (federal operating grants and contracts, tuition and fees, enrollment) positively impact credit ratings. Since the first two of these factors are measured in revenue diversification, albeit in a more aggregate manner, the increase in the DBS estimate can thus be understood as a spillover from HHI's emphasis upon diversification over specific categories.

This coefficient spillover is also exemplified in leverage. In the revenue structure model, a decrease in debt service capacity (decrease in debt to revenue ratio) is associated with a population of institutions being almost 53 times (1/.019) as likely to receive a lower credit rating. This translates to a 15.2% increase in the probability of receiving an A1 rating and a 6.1% decrease in the probability of receiving an Aa3 rating. In the revenue diversification model, the odds ratio for receiving a lower credit rating increases to 200. The average marginal effects for this model show that the probability of

receiving an A1 rating increases by 24.5% and the probability of receiving an Aa3 rating decreases by 11.2 percent, for a small increase in leverage. Since this variable is composed of total long-term debt, which is measured in DBS, and total revenue, which is captured in HHI, the magnification of this variable in the revenue diversification models can therefore be attributed to the growth in the impact of log DBS and the aggregation of categories in the HHI measure.

**Severe Economic Downturns**

The final research question examines the role played by the Great Recession in determining public research university credit ratings. It asks, *How do severe economic downturns, specifically the Great Recession, impact public research university credit ratings?* For this question, the models used for the first question were re-run, with the inclusion of a binary variable for recession (1 = ≥ FY 2009). Estimation results are shown in Table 10. Odds ratios, and exponentiated 95% confidence intervals for the ordered logit are also provided. Average marginal effects (AME) for the ordered probit and ordered logit estimators are displayed again in Appendix E.

**Hypothesis 14.** The binary variable for recession is positive in both the ordered probit and ordered logit models, at a statistical significance of .01. With the inclusion of this variable, the odds of receiving a higher credit rating increase 5.4 times. The probability of receiving an A1 rating decreases by 5.4% to 5.8%, while the probability of receiving an Aa3 rating increases by 2.6%, an Aa2 rating by 6.3% to 7%, and an Aa1 or above rating by 6.5% to 7.1%. This provides strong evidence that for FY 2009 and beyond, public research universities, on average, received higher credit ratings.

Table 10

*Ordered Probit and Ordered Logit Results for Recession and Revenue Structure*

| Variable | Ordered Probit Coefficient (Robust Std. Error) | Ordered Logit Coefficient (Robust Std. Error) | Odds Ratios (Exp. 95% C.I.) |
|---|---|---|---|
| Recession | .849*** (.198) | 1.69*** (.406) | 5.40*** (2.43 \| 11.96) |
| Freshman Selectivity | -.852 (.562) | -1.66 (1.03) | .190 (.025 \| 1.44) |
| Research Intensity | -2.77 (1.75) | -4.43 (348) | .012 (.00001\| 10.96) |
| Undergraduate Full-Time Equivalents (ln) | 1.74*** (.240) | 3.14*** (.458) | 23.18*** (9.45 \| 56.89) |
| Tuition and Fees per FTE (ln) | .802** (.329) | 1.18* (.624) | 3.24* (.953 \| 11.01) |
| State Appropriations per FTE (ln) | .530** (.264) | .929* (.488) | 2.53* (.973 \| 6.59) |
| Federal Operating Grants and Contracts per FTE (ln) | .797*** (.160) | 1.36*** (.294) | 3.90*** (2.20 \| 6.94) |
| State and Local Operating Grants and Contracts per FTE (ln) | -.296*** (.105) | -.517*** (.191) | .596*** (.410 \| .868) |
| Endowment Value per FTE (ln) | .517** (.249) | 1.18** (.578) | 3.25** (1.05 \| 10.09) |
| Academic Medical Center (AMC) | -.455* (.267) | -.994* (.510) | .370* (.136 \| 1.00) |
| High Regulation | .134 (.273) | .190 (.502) | 1.21 (.452 \| 3.23) |
| Debt Limit | .161 (.289) | .383 (.546) | 1.47 (.503 \| 4.27) |
| High State Credit Rating | .849*** (.207) | 1.38*** (.419) | 3.98*** (1.75 \| 9.05) |
| Debt Burden per Student (ln) | .640** (.266) | 1.11** (.522) | 3.04** (1.09 \| 8.47) |
| Leverage | -2.34*** (.899) | -4.00** (1.88) | .018** (.001 \| .730) |

***denotes statistical significance at the .01 level; **denotes statistical significance at the .05 level; *denotes statistical significance at the .10 level

These findings are surprising and run counter to the sector-wide negative outlooks that began being issued in 2009 (Bogaty, 2013; Goodman & Nelson, 2009; Tuby, 2014; Tuby & Nelson, 2012). This literature cites factors such as macroeconomic conditions weakening postsecondary budgets, uncertainty around philanthropic support, investment losses, and decreased net tuition growth as reasons for these outlooks. All of these are financial, and if credit ratings are revenue dependent (Research Question 1), which this study has shown to be largely true, then it can be inferred that in spite of these warnings revenues have continued to grow during and after FY 2009. Thus, credit ratings at public research institutions have remained largely immune to the warned recessionary pressures. As a result, with regard to question three, the effects of the Great Recession have not negatively impacted public research university credit ratings based on the evidence provided here.

**Spillover effects.** Examining the other covariates in Table 10, further conclusions surrounding the behavior of individual determinants in recessionary years can be developed. The intent of the following discussion is not to imply a direct, possibly causal, impact of The Great Recession on these covariates. Instead, changes in the model covariates can be understood as the product of spillover effects from the recession. To aid in this comparison, Table 11 shows the odds ratios from Table 6, listed alongside those from Table 10, as well as the difference and direction in magnitude changes.

Table 11

*Comparison of Odds Ratios from Ordered Logit Estimations with and without Recession*

| Variable | No Recession Odds Ratio (Exp. 95% C.I.) | Recession Odds Ratio (Exp. 95% C.I.) | Change |
|---|---|---|---|
| Freshman Selectivity | .071*** (.009 \| .535) | .190 (.025 \| 1.44) | + (.119) |
| Research Intensity | .038 (.00005\| 28.58) | .012 (.00001\| 10.96) | − (.026) |
| Undergraduate Full-Time Equivalents (ln) | 20.04*** (8.66 \| 46.35) | 23.18*** (9.45 \| 56.89) | + (3.14) |
| Tuition and Fees per FTE (ln) | 4.30** (1.28 \| 14.39) | 3.24* (.953 \| 11.01) | − (1.06) |
| State Appropriations per FTE (ln) | 1.41 (.566 \| 3.53) | 2.53* (.973 \| 6.59) | + (1.12) |
| Federal Operating Grants and Contracts per FTE (ln) | 3.12*** (1.73 \| 5.62) | 3.90*** (2.20 \| 6.94) | + (.78) |
| State and Local Operating Grants and Contracts per FTE (ln) | .647** (.440 \| .949) | .596*** (.410 \| .868) | − (.051) |
| Endowment Value per FTE (ln) | 2.48* (.932 \| 6.58) | 3.25** (1.05 \| 10.09) | + (.77) |
| Academic Medical Center (AMC) | .463* (.184 \| 1.16) | .370* (.136 \| 1.00) | − (.93) |
| High Regulation | 1.18 (.452 \| 3.09) | 1.21 (.452 \| 3.23) | + (.03) |
| Debt Limit | 1.47 (.510 \| 4.21) | 1.47 (.503 \| 4.27) | No Change |
| High State Credit Rating | 4.50*** (2.13 \| 9.50) | 3.98*** (1.75 \| 9.05) | − (.52) |
| Debt Burden per Student (ln) | 4.09*** (1.65 \| 10.16) | 3.04** (1.09 \| 8.47) | − (1.05) |
| Leverage | .019*** (.001 \| .412) | .018** (.001 \| .730) | − (.001) |

***denotes statistical significance at the .01 level; **denotes statistical significance at the .05 level; *denotes statistical significance at the .10 level

***Market position and demand factors.*** While the odds ratio for freshman selectivity increases by .119, indicating a decrease in the odds of receiving a lower credit rating by a factor of 8.8 times (1/.119), it is difficult to compare these two estimates, since freshman selectivity is not statistically significant in the latter model. In this model, research intensity also remains statistically insignificant. However, the log of undergraduate FTEs retains its statistical significance in the recession model. The odds ratio increases from 20.04 to 23.18, a difference of 3.14. Without the recession variable, a one percent increase in undergraduate FTEs increased the odds of receiving a higher credit rating 20.04 times. With recession, the increase in odds is 23.18 times. Undergraduate FTEs appear to be an even greater predictor of creditworthiness when recession is included in the model.

This makes sense in the context of the research literature. As a measure of increased demand for an institution (Heller, 1999; Kedem, 2011; Koshal & Koshal, 2000; McLendon, Hearn, & Mokher, 2009; Serna, 2012, 2013a, 2013b), increased enrolment allows institutions to generate additional revenue. The greater uncertainty around household income and wealth, philanthropic support, investment returns, state appropriations, and federal funding that was generated during The Great Recession is likely to have placed additional emphasis on the ability to accrue revenues through enrollments. This emphasis is further accentuated upon consideration of increased concerns over adequate liquidity and greater debt issuance (Blumenstyk & Field, 2008; Field, 2008; Gephardt, 2011; Goodman & Nelson, 2009; Kiley, 2012; Krantz, 2015 Serna, 2013b;Wilson, 2008; Wolverton, 2008). With institutions shifting more of the cost burden onto students in the form of tuition and fees (Bogaty, 2013; Serna, 2013a),

increased enrollment likely equates to institutions better able to their service debt, which eases concerns among credit rating agencies after the economic downturn.

***Finances and operations variables.*** Tuition and fees per FTE remains positively associated with increased credit ratings, but the odds ratio drops from 4.3 to 3.24, a change of 1.06. When recession is added to the model, a one unit increase in tuition and fees per FTE increases the odds of receiving a higher credit rating by 3.24 times. This decrease in the positive impact of the tuition and fee variable is likely a reflection of the slowed growth in this funding source during recessionary years, however its statistical significance shows that it is still highly important for credit ratings.

One of the most interesting changes in the recession model is state appropriations per FTE. Whereas this variable is not statistically significant in the earlier models, when recession is added it is both significant at the .10 level and positively associated with improved creditworthiness. For a one percent increase in state appropriations per FTE, *ceteris paribus*, a population of institutions is 2.53 times more likely to receive a higher credit rating. The average marginal effects (Appendix E, Table E3) show that for a one percent increase the probability of receiving an A1 rating drops 3.2% to 3.4%, and the probability of receiving an Aa2 rating increases by 3.9% to 4%.[43] These results are surprising, since the research literature highlight the instability in this funding source, especially with performance requirements (Tuby, 2014), state budget cutbacks (Zumeta, 2013; Zumeta & Kinne, 2011), and vulnerability to ratings downgrades placed on institutions that are dependent on these monies (Gephardt & Nelson, 2010). One explanation is that this variable reflects an increase in these funds, *ceteris paribus*, and

[43] The average marginal effects at Aa3 are also positive, indicating an increased probability of receiving this rating with an increase in state appropriation dollars; but, neither of the estimates for the ordered probit nor ordered logit at this response are statistically significant.

does not reflect increased dependence or decreases in other funding sources. Therefore, in light of Moody's report that all non-tuition revenue sources either slowed or declined since FY 2008 (Bogaty, 2013), the positive parameter estimates for state appropriations are likely a reflection of the ability to accrue greater revenue, rather than dependence on a specific revenue source. In other words, increased revenues in the form of state appropriations appear to take on a more important role after the recession than before it.

The signs on both operating grant variables remain constant and the magnitude increases for both. Whereas the odds ratio for federal grants increases from 3.12 to 3.90, suggesting a greater impact on improved creditworthiness for a one percent increase, the odds ratio for state and local grants decreases from .627 to .596. That is, for a one percent increase in state and local operating grant funding the odds ratio of a receiving lower credit rating increases from 1.55 to 1.68. The magnitude changes for federal grants likely reflect increased emphasis on greater operational scope (i.e., federal research grants). Similarly, the greater negative impact associated with state and local grant funding evidences rating agency caution surrounding narrower operational scope (i.e., state and local grants), largely due to state budget cutbacks in recent years and the role played by macroeconomic conditions.

The variables for endowment value per FTE and academic medical center follow similar patterns as the two operating grant variables. The odds ratio for endowment increased with the inclusion of recession from 2.48 to 3.25, while the odds ratio for AMC decreased from .463 to .370. In other words, for a one percent increase in the market value of endowment fund per FTE, a population of universities is 3.12 times as likely to receive a higher credit rating when recession is not accounted for, and 3.90 times as

likely to receive a higher credit rating when recession is measured. These results follow the literature highlighting endowment losses in recent years (Bogaty, 2013; Goldstein, 2012), and the strong correlation between high credit ratings and endowment value in recent years (Standard & Poor's Rating Services, 2014); that is, greater value is placed on the ability to grow investments after accounting for recessionary pressures. With AMC, the odds ratio for receiving a lower credit rating increased from 2.16 to 2.7. This follows the literature highlighting the greater liability from association with an AMC, due in recent years to reductions in funding to graduate medical education, cuts to Medicare and Medicaid, and uncertainty over the effects of healthcare reform (Bogaty, 2013; Tuby, 2014).

***Governance variables.*** In the recession model, both high regulation and debt limits remain statistically insignificant. Since the other covariates remain the same between the models, failure to return statistically significant parameter estimates is probably still due to the effects being absorbed by variables such as debt burden per student (DBS), state credit rating, and tuition and fees per FTE. High state credit rating remains statistically significant and positively associated with improved creditworthiness. However, while the impact of the other financial/operations covariates intensify with the addition of recession, high state credit rating lessens. Without recession, a high state credit rating (≥Aa2) is associated with an increase in the odds of a higher university credit rating by 4.5 times. But with recession included, universities in states with high GO ratings are only 3.98 times as likely to receive a higher credit rating. Although both of these odds ratios suggest that state fiscal strength plays a strong role in determining improved institutional creditworthiness, the change may reflect increased uncertainty

surrounding state finances and/or less weight appointed to the state's role in public university financing.

***Debt variables.*** Debt burden per student (DBS) remains positively associated with improved creditworthiness, but the magnitude lessens with the inclusion of recession. Prior to including recession, a one percent increase in DBS is associated with a population of institutions being 4.09 times as likely to receive a higher credit rating. With recession, the odds ratio of a higher credit rating drops to 3.04. This variable may be capturing the spillover effects from rating agency concerns regarding high levels of institutional debt and inadequate liquidity in the years following the economic downturn (Blumenstyk & Field, 2008; Field, 2008; Gephardt, 2011; Goodman & Nelson, 2009; Kiley, 2012; Krantz, 2015 Serna, 2013b; Wilson, 2008; Wolverton, 2008); however, it is still likely that total long-term debt is a strong indicator of effective debt market usage and strategic planning.

Rating agency caution can be seen in the change in the leverage parameter estimate. Prior to including recession, a population of institutions is 52.6 times as likely to receive a lower credit rating if its debt servicing capacity decreases (leverage ratio increase); with the recession, institutions are 55.6 times as likely to receive a lower rating. This is a fairly small change; yet, it suggests equivalent and possibly greater emphasis being placed on universities' ability to service their debt during and after the Great Recession.

## Limitations

While this study is one of the most extensive analyses of university credit ratings to date, it does suffer from several limitations. The first is related to data availability.

Originally, the data set included 151 public research universities, classified as having a high or very high level of research activity by the Carnegie Foundation for the Advancement of Teaching. 76 institutions were omitted because of reasons such as being rated at the system level, lacking sufficient years worth of credit ratings, or reporting data via different accounting standards (i.e., FASB). Each omitted university is listed in Appendix A, with the reason for its removal. This left 75 institutions with 12 years of data on each. While 900 observations (75 × 12) is a fairly large data set, if data were available on the initial list of institutions, there would have been 1,812 observations. This would have significantly increased the study's statistical power.

What is more important than the total number of institutions omitted, is the decrease in similar institutions. By omitting universities, there are effectively fewer similar institutions in the data set. What this means is that there is an increased chance of separation in the data due to greater heterogeneity within units.

As shown in this study, data separation was a problem with the continuous variables. Covariates such as endowment per FTE, undergraduate FTEs, and federal operating grants and contracts per FTE, were especially problematic. While the log transformation of these variables improved estimation, they still proved difficult for estimation of more advanced models, such as correlated random effects and partial proportional odds. Attention to bias correction methods (e.g., penalized maximum likelihood) for ordered response models is just now starting to take root in the statistical literature (e.g., Kosmidis, 2014; Lipsitz et al., 2013). But, the quantity of work remains extremely small and mainly theoretical. That is, software programs that are able to implement the methods being developed have yet to be written. As compared to other

estimators, such as OLS and those for binary responses, ordered response models are still largely underdeveloped.

Because of the data issues, and insufficient technology, the study was not able to take full advantage of the longitudinal nature of the data. Subject-specific estimates (e.g., correlated random effects models) were run for the data, but the data separation resulted in false convergence. Therefore, the study had to resort to treating the data as a large cross section, using traditional pooled ordered probit and pooled ordered logit estimators and robust standard errors clustered by group (i.e., university). While this is not an ideal approach to estimating longitudinal data, it helps correct for serial correlation, reducing the likelihood of committing Type I error. What this approach is not able to do is estimate how changes in the covariates impact a single university over time (i.e., subject specific estimates). So, the modeling approach utilized in this study should be thought of more as a *less-ideal* approach, rather than a full limitation. Since it is doubtful that the data will change in the future, so that perfect prediction is not an issue, more advanced analyses, which utilize panel data methods, will have to wait for technology to advance. Furthermore, as credit rating agencies, such as Moody's, begin rating more public universities, data sets can be expanded to potentially help reduce problematic heterogeneity.

## Chapter Conclusion

This chapter reported descriptive statistics and estimation results from the ordered probit and ordered logit models for the three research questions. With regard to the first question, factors involved in a public research university's fiscal structure, such as tuition and fees, federal operating grants, and endowment value, are all positively associated

with improved creditworthiness. These factors reflect the importance of broad operational scope, a diverse revenue base, and the ability to generate expansive funding. Market position variables, such as enrollment and selectivity, are also positively associated with increased creditworthiness. These variables demonstrate demand for institutions, as well as the ability to generate revenue through adequate student demand for enrollment spaces, as positively viewed by credit rating agencies. High state credit rating and debt burden per student are both positively associated with improved credit ratings. Whereas the former signifies the state's ability to consistently fund its public institutions, the latter implies active and efficient debt market usage by institutions, which allow for successful implementation of short- and long-term plans. Negative factors include state and local operating grants, affiliation with an academic medical center (AMC), and increased leverage. The first demonstrates the negative view of narrower operational scope, the second a financial liability, and the third concerns an institution's ability to service its outstanding debt.

With regard to question number two, increased revenue diversification positively impacts public research university credit ratings. In light of the extant literature, this is not surprising. Finally, in response to the third research question, The Great Recession is positively associated with improved credit ratings. This is surprising, considering the repeated negative outlooks issued by the rating agencies. However, from the model estimates, it can be inferred that public research universities consistently grew their revenues during these recent years, and revenue structure and flexibility trumps other conditions.

Chapter five revisits these findings. Examining the variables estimated to answer the study's three research questions, it contextualizes the results. That is, implications for institutional planners, governing board officials, budget officers, and senior administrators are addressed. Specifically, the relationship between the knowledge developed thus far and institutional growth and longevity are expounded. In doing so, the final chapter also discusses the implications of the study's findings for institutions of various sizes, and credit rating agency values that are implicated by the model estimates.

# CHAPTER V

# SUMMARY, IMPLICATIONS, AND CONCLUSONS

This final chapter of the study returns to the findings discussed in Chapter IV in order to examine their implications for higher education. Emphasis is placed not only on how these findings relate to the study's three primary research questions, but also the importance of these results for policy, practice, and research. Attention is specifically focused on how the study's results inform higher education budgeting, planning, and debt policy.

## Revenue Structure

As the primary focus of the first research question, revenue structure was modeled with attention to four distinct variables– tuition and fees, state appropriations, federal operating grants and contracts, and state and local operating grants and contracts–all of which, based on the extant literature, were judged to best represent revenue categories that determine public research university credit ratings (Bogaty, 2013; Kedem, 2011; Moody, 2008; Serna, 2013a, b; Tuby, 2014). Each of these variables was divided by undergraduate FTEs, in order to control for scale effects. Additionally, they were also log transformed, a common practice in higher education finance literature (e.g., Baldwin & McCraken, 2013; Dar & Lee, 2-14; Delaney & Kearney, 2015; Doyle, 2010 2012; Hearn, Griswold, & Marine, 1996; Lacy & Tandberg, 2014; Morphew & Baker, 2004; Ness & Tandberg, 2013; Serna, 2012; Serna & Harris, 2014; Tandberg, 2010; Tandberg

& Ness, 2011, 2013; Zhang, 2007, 2011); in addition to standardizing interpretation (as percent changes) and correcting for positive skewness, the natural log transformation helped with issues of model convergence related to data separation.

Prior to running any of the estimations, federal operating grants and contracts was hypothesized to positively impact public research university credit ratings, while the other three variables were hypothesized to have a negative impact. These assumptions were driven by the literature suggesting that rating agencies positively view federal grant monies as a sign of an institution's operational scope, market position, and stability. Tuition and fees, state appropriations, and state and local operating grants and contracts were hypothesized to have a negative impact, due to slowed growth and greater instability in these funding sources. As expected, federal operating grants and contracts returned statistically significant positive parameter estimates, while state and local operating grants and contracts returned statistically significant negative estimates. Surprisingly, tuition and fees showed a statistically significant positive relationship with improved credit ratings. Neither the ordered probit or ordered logit models for the first research question reported statistically significant coefficients for state appropriations.

From a ratings perspective, where credit ratings are viewed as an *objective* indicator of the probability of an institution defaulting on a debt issue, it makes sense that federal operating grants and contracts are positively associated with improved creditworthiness. With cuts to state budgets and increased competition for federal research dollars, the ability to grow federal grant monies can be understood as both a sign of an institution's national presence, as well as evidence of a broader fiscal base. Additionally, by increasing federal grant funding, universities can increase the extent of

their national recognition, thus potentially broadening their geographic reach for student recruiting; in other words, increased federal operating grant revenues signal an increased likelihood of a continued stream of applicants, student related funding, and research dollars. On a related note, a similar logic can be applied to interpreting the negative impact associated with state and local operating grants and contracts. Not only do increases in this source suggest a narrower scope associated with an institution's funding base, but also with the geographic scope of student recruitment. This could also suggest that these institutions are actually better at serving the local population and region.

Moreover, what this interpretation does not provide is a measure of the subjective bias inherent in valuing these funding sources. In other words, it can be assumed that an institution's reputation plays a factor in its ability to generate federal grant monies, because of its ability to attract high profile researchers, build cutting edge research facilities, and because of its positive bias among grant reviewers. Therefore, already "prestigious" institutions, that have an active agenda that includes federal grant funding, are better situated to continue receiving funding from this source. In a sense, money and reputation beget revenues and high credit ratings.

These results may send the message to public institutions to focus more on research funding and less on instruction and public service. This assumption is supported by the positive estimates for tuition and fees. As discussed in the context of governing boards in Chapter III, high levels of centralization are associated with a public model of higher education, where institutions tend to closely align their own interests with those of the state, and emphasize low tuition and greater reliance on state funding. Conversely, low levels of centralization are associated with a private model of higher education,

where more emphasis is placed on high levels of research and tuition dollars (Knott & Payne, 2004; Lowry, 2001). Therefore, although it was hypothesized that tuition and fees will be negatively associated with higher credit ratings, the positive impact may be attributed to this public/private, high/low centralization duality. These results warrant questions about whether credit rating agencies are unintentionally incentivizing public universities to "privatize" and further depart from their core mission of serving the needs of the state and its residents. Answers to these questions are beyond the scope of this study, but definitely merit future consideration.

**Market Position and Demand**

In addition to the above variables that constitute revenue structure, a number of market position and demand related factors were modeled in Chapter IV. The first, freshman selectivity, measured as the percentage of applicants admitted, is negatively associated with higher credit ratings (or positively associated with negative credit ratings). This suggests that although credit rating agencies view increased revenue as a sign of creditworthiness, they also desire for institutions to demonstrate a high degree of selectivity. This variable is intended to reflect increased student demand for an institution. Thus, greater selectivity signifies a higher probability that institutions will consistently be able to generate revenues, due to their high level of student demand. It is important to note that this variable is not a measure of institutional quality; rather, it is merely a reflection of student demand. This finding could suggest that the most well-funded, highly selective public universities actually face an incentive from credit rating agencies to choose more competitive students, regardless of whether they reside in the state or local region. Because of its potential to exclude a portion of the state/regional

population, such admissions policies may actually work to the detriment of in-state students.

What is masked by the parameter estimates for selectivity is the impact of institutional size. That is, as the number of acceptances increases, applicants must increase at a greater rate in order to maintain the same level of selectivity. For example, if an institution has 5000 applicants and admits 3000 of those, its selectivity is 60% (3000/5000). If the number of admissions increases by 500, in order to maintain a selectivity level of 60% the number of applicants must increase by 833 (3500/5833 = .60). So, it appears from selectivity that institutions are in a sense penalized for increasing the number of students accepted. But, revenue variables such as tuition and fees and federal operating grants suggest that institutional growth is rewarded by credit rating agencies. That is, larger institutions are better able to generate increased tuition and fee revenues through a larger student body, as well as increased federal operating grants from building larger research facilities and increasing their presence. Therefore, freshman selectivity shows that the process of improving credit ratings is more complicated than simply increasing revenues. It also shows that freshman selectivity on its own does not provide a complete picture of institutional demand and creditworthiness.

Related to selectivity is the number of undergraduate full-time equivalents, which is positively associated with higher credit ratings. On the surface, the impact of this variable is fairly straightforward. As a proxy for enrollment demand, changes in an institution's undergraduate FTEs reflect changes in student demand (Heller, 1999; Koshal & Koshal, 2000; McLendon, Hearn, & Mokher, 2009; Serna, 2012). In addition to reflecting demand for an institution, increased enrollment can be understood as positively

impacting revenues (e.g., greater tuition and fees dollars). Yet, as evidenced by selectivity, increasing an institution's credit rating is not simply a product of increasing the size of its student body. The acceptance percentage must also be maintained, which as discussed above requires a disproportionately greater number of applicants as admissions increase. Still, based on previous research, this is likely to be more feasible for already wealthy, well-positioned institutions, due to their ability to attract a larger number of students nationwide through greater tuition subsidies (Winston, 1999). So, the issue raised with revenue structure arises once again: wealthier institutions may be in a better position to increase and maintain high levels of creditworthiness; in other words, there appears to be an uneven playing field when it comes to university credit ratings.

As institutions grow the size of their plants, market position, and student body, it is also likely that they will build an academic medical center (AMC). These facilities help support graduate medical education and biomedical research, as well as serve the state through patient care services. However, as shown in Chapter IV, affiliation with an AMC negatively impacts creditworthiness. Explanations for this are provided by the literature emphasizing the revenue challenges (e.g., reductions in funding to graduate medical education, cuts to Medicare and Medicaid, and uncertainty over the effects of healthcare reform) associated with these facilities (Kedem, 2013; Tuby, 2014). So, it would seem that in order to improve creditworthiness, institutions would want to distance themselves from AMCs. But, since a large portion of federal research grants are awarded for biomedical research (Tuby, 2014), and federal operating grants positively impact credit ratings, these facilities may be a necessity for large research universities. Furthermore, AMCs help institutions develop and maintain large, nationally known

graduate medical education programs, thus enhancing their national presence. This presents a bit of a conundrum for institutional planners and senior administrators seeking to maximize creditworthiness. One potential outcome of this situation is increased privatization of these facilities. Such a policy approach begs the same question raised by the positive relationship between tuition and fee revenue and credit ratings—whether ratings agencies unintentionally incentivize policies that distance public research universities from their core mission of serving a state's interests and population. If institutions begin privatizing their AMCs in order to distance themselves in the eyes of credit rating agencies, they in effect neglect part of their mission to serve the state and overall public good.

Finally, university endowment is shown to positively impact credit ratings. This finding is not surprising, considering that endowment size serves as a measure of an institution's ability to accumulate wealth and reserves (Serna, 2013a, b; Winston, 1999). These funds also provide evidence of an institution's ability to meet debt obligations, since endowments tend to grow proportionally with the value of an institution's assets (Moody, 2008), and also since institutions are able to use portions of these funds to pay for operating expenses (Goldstein, 2012). What is not shown by this study's results is whether institutions are equally able to grow their endowment funds. The answer is probably no, since larger institutions, with greater market position and larger endowments, are more likely to be able to garner greater philanthropic support (Sharma & Smith, 2015; Winston, 1999). Thus, increases in endowments positively impact creditworthiness, but endowment growth disproportionately benefits wealthier

institutions. Once again, this exposes the gaps between the wealthiest institutions and others.

## Oversight and Governance

High state credit rating is shown to positive impact university credit ratings. This finding is not surprising, since a state's General Obligation (GO) rating reflects its fiscal health and ability to support its public institutions (Serna, 2013a). As discussed in Chapter IV, it is likely that this variable also provides insight into how credit rating agencies view the presence of an umbrella debt limit. Although the variable for debt limit was not statistically significant in the models, theory shows that debt limits negatively impact state credit ratings (Johnson & Kriz, 2005). Therefore, high state credit ratings may reflect the absence, or marginality, of such fiscal restraints. However, without statistically significant estimates for debt limit on its own, this is merely an assumption. Furthermore, institutional planners and senior administrators have the least influence over this category, since these factors are at the state level. In other words, though these variables may be related to university credit ratings in some way, institutions respond to rather than set these policies and factors. But, if state legislators and governing board members wish to aid their public institutions in developing and maintaining strong creditworthiness, it would be prudent for them to consider how their state fiscal policies impact public higher education.

## Debt Factors

Although debt limits did not return statistically significant parameter estimates, the two measures of institutional debt, debt burden per student (DBS) and leverage, were both statistically significant. As hypothesized, DBS positively impacts public research

university credit ratings. Larger debt levels likely signify greater and more diverse debt market usage, as well as increased experience with debt issuance and management. They also imply that institutions are fully leveraging their assets and most effectively instituting short- and long-term plans. However, this variable is also likely to favor larger universities, since these institutions tend to carry larger debt loads (Rubinoff & Marion, 2007). Another issue that is raised is whether strong credit ratings cause institutions to issue more debt and weak credit ratings deter debt issuance, where the former reaffirms stronger ratings and the latter weaker ratings. In other words, it may be that the credit rating/debt burden relationship promotes a cycle that favors and insulates highly creditworthy universities.

Furthermore, there remains the issue of whether there is a maximum level of acceptable debt; that is, whether there exists a point where institutions are penalized for issuing larger amounts of debt. The results for DBS suggest that there is not, based on total debt; but leverage tells a different story. As a measure of the level of debt to revenue, this variable shows that decreased debt servicing capacity (i.e., larger amounts of debt relative to revenue) negatively impacts credit ratings. So, institutions are not rewarded by credit rating agencies for simply issuing large amounts of debt. Instead, leverage highlights rating agency concerns regarding whether debt levels can be properly managed. The variable's large odds ratio and average marginal effects evidence the importance of this finding. For administrators, this harkens back to whether issuing large bonds to build consumption amenities attracts students. Jacob, McCall, and Stange (2013) argue that it does for middle and lower performing students, but not for those in the academic top-tier. However, it is important to remember that the purpose of a public

university is education. So, reforming the system based on academic performance related demand factors would in fact mean that some institutions should realign resource allocation decisions to make the education component less of a focus and the contrary for others. This is highly problematic, in that it reifies a form of class stratification based on current, typically flawed, notions of merit. Instead, it would behoove institutions to revisit this question of debt levels when examining capital spending policies in order to ensure that education is always at the forefront, and not an afterthought once students are on campus.

An additional concern is the burden placed onto students for this additional debt. While institutional credit ratings may be rewarded for larger debt burdens and lower leverage ratios, the latter is calculated by including all revenues. This includes tuition and fees, which also positively impact credit ratings. While increasing tuition and fees to maintain debt service coverage may be beneficial from a capital planning perspective, the human impact needs to be considered as well. That is, are the increased costs going to be borne by current and future generations? By itself, cost shifting and intergenerational transfers are not necessarily be a bad thing, especially since capital projects can provide infrastructure needed for students to obtain their education; however, it is important that the added costs to students do not begin to negatively impact access and affordability to a postsecondary education. When institutions of higher education accrue too much debt (i.e., when debt servicing capacity begins suffering from additional debt), they can boost tuition revenue by either increasing tuition and fees or decreasing revenue discounts (e.g., decreasing tuition subsidies). These policies tend to impact the most price-sensitive students; that is, those at the lower end of the demand curve. Thus, while additional

capital projects may appear as a sure way to increase student enrollments, in some cases such approaches can work to the detriment of access and affordability. So, when addressing the costs and benefits of capital projects, it is important that institutional planners and administrators understand how resource allocation decisions can impact current and future student populations.

**Revenue Diversification**

Related to the first research question, the second views revenue structure from the perspective of diversification. Specifically, the second research question examines whether diversification in revenue streams positively impacts credit ratings. The empirical literature shows that this is true at the state level (Grizzle, 2012; Yan, 2011), and credit rating methodologies argue that the same is true at the public university level (Kedem, 2011). The parameter estimates for revenue diversification in both the ordered probit and ordered logit models were statistically significant and strongly associated with improved creditworthiness. These findings add another level of nuance to the understanding of public research university credit ratings. In addition to healthy revenue generation, strong market position and demand, active debt market usage, and sufficient debt servicing capacity, it would be prudent for institutions to also maintain a well-diversified revenue portfolio. This means ensuring that not too much of their revenue is coming from a single source, so as to reduce the impact of variance in specific revenue streams especially during economic downturns or business cycle fluctuations. As discussed in the section on revenue structure, this may be easier for certain institutions, which have greater access to federal funding.

What are not reflected in the revenue diversification measure are the varying weights assigned to different revenue streams. The Hirschman-Herfindahl Index (HHI) is designed to treat each source equally. That is, perfect diversification is defined by equal revenue coming from each source. However, this study's findings indicate that not all revenue sources are equal in the eyes of credit rating agencies. Certain revenue sources have a greater impact on improved credit ratings, and some (e.g., state and local operating grants and contracts) impair creditworthiness. In light of the findings of this study, it seems wise for institutional planners and senior administrators to seek diversification in funding, so as to effectively manage their risk, but at the same time properly weigh different sources of funding. That is, if institutions are able to access all sources equally, they may want to place greater emphasis on federal operating grants, versus state and local operating grants. This is not to say that the latter category should be ignored completely, but rather that an acceptable balance between diversification and targeted funding should be sought. In other words, a policy that maximizes the funding sources that are shown most strongly to positively impact credit ratings, for an established level of diversification should be pursued. This is actually similar to Markowitz's (1952) *E-V* rule, but instead of maximizing returns for an accepted level of variance, public research universities will want to maximize funding sources most strongly associated with a desired level of variance. Calculation of this equilibrium, or efficient point, is beyond the focus of this study, but warrants future attention. It must be emphasized, that this point focuses purely on balancing revenue and variance, and does not account for the social impacts of these resource allocation decisions, which cannot be ignored.

**Recessionary Impacts**

In order to evaluate the impacts of severe economic downturns, The Great Recession of 2007 to 2009 was modeled as a treatment variable since it is clear that both macroeconomic fluctuations and business cycles impact revenues. The results were some of the most surprising. Though the research literature suggested that the impact on university credit ratings would be negative, due to poor macroeconomic conditions affecting a multitude of factors the binary variable used to model recession (≥FY 2009) showed a positive association with higher credit ratings.[44] Given the many negative outlooks and reports for the sector since 2009 (Bogaty, 2013; Gephardt, 2011; Gephardt & Nelson, 2010; Goodman & Nelson, 2009; Inside Higher Ed, 2012 Tuby, 2014; Tuby & Nelson, 2012), this result seems even more puzzling. One explanation is that The Great Recession disproportionately impacted colleges and universities. As discussed in Chapters I and III, this study focused on public research institutions with either a high or very high level of research activity. Thus, the universities in the data set may have simply *weathered the storm*, so to speak, better than their regional and small liberal arts counterparts. Related to this is the fact that during times of economic hardship, college applications tend to increase (Dunbar et al., 2011; Fain, 2014). With research universities having stronger market position, these institutions may have been able to maintain, and possibly increase, revenues, demand, and selectivity as more individuals sought to attend these institutions.

[44] Examples of negative conditions emanating from the Great Recession include slowed consumer spending, increased unemployment levels, decreased state and postsecondary budgets, less stable interest rates, decreased access to university assets, insufficient liquidity, slowed tuition and fee growth, diminished investment earnings, and fewer federal grant dollars (Blumenstyk & field, 2008; Bogaty, 2013; Field, 2008; Peng et al., 2014; Tuby, 2014; Wolverton, 2008; Zumeta, 2010; Zumeta, 2013; Zumeta et al., 2012; Zumeta & Kinne, 2011).

However, without examining the changes in individual predictors between the models, with and without recession, it is difficult to generate a clear picture around this issue. As stated in Chapter IV, examining changes in individual predictors is not meant to imply a causal relationship with recession, nor is it intended to demonstrate the direct interaction of this economic variable with each of the covariates. Rather, by studying changes in predictors between the models, inferences can be made based on spillover effects from the recession, which arguably served as a natural cut-off to makes these comparisons.[45]

**Revenue Structure**

Beginning with revenue structure, federal operating grants and contracts maintained their positive impact on credit ratings, while increasing the magnitude of their effect. Tuition and fees also maintained their positive relationship, albeit one of decreased magnitude. This makes sense, in the context of the literature citing slowed tuition and fee growth and increased competition for federal grants (Bogaty, 2013; Tuby, 2014; Zumeta, 2013). Yet, the positive coefficients on this variable may still suggest that the credit ratings process is promoting a private model of higher education. This argument is bolstered by the greater negative estimate associated with state and local operating grants and contracts in the recession models. If federal operating grants and contract are primarily allocated to only a small segment of wealthy, highly prestigious institutions, and funding from this source is strongly rewarded by credit rating agencies, public higher education may be at risk of becoming increasingly segregated, based

[45] Since the Great Recession is a purely exogenous shock, including it for the third question essentially turns the analysis into a pre- and post-test. Since all institutions experienced this treatment (i.e., recession), the research design is not quasi-experimental. But the results and inferences come close to the level of causality.

primarily on wealth. That is, the credit rating process may work to promote an economically and socially stratified system, where the financial, operational, and educational benefits that come with high creditworthiness may be less available to the majority of higher education and disproportionately favor a small segment of "elite" universities.

One of the most surprising findings from the revenue variables is the statistically significant positive coefficient for state appropriations, which was returned in both recession models. The evidence up to now suggests that credit rating agencies favor private institutional models that are driven more by tuition and fees and research, rather than state funding. However, estimates for state appropriations should not be interpreted as a negation of this thesis. Rather, it may simply reflect credit rating agencies rewarding institutions in states where there are increases in state appropriation revenues, especially since this is a source of postsecondary funding that has received significant budget cuts in recent years (Zumeta, 2013; Zumeta & Kinne, 2011). Additionally, since this variable measures growth in state funding, rather than a percentage/representative share of total institutional revenues, the positive estimate may actually represent the impact of increasing revenue. Institutions that are able to increase their revenues, especially from a source that has been largely withdrawn, may be viewed as effectively lobbying for funds in a highly competitive process. From the lobbying perspective, state appropriations can thus be interpreted in a similar fashion as federal operating grants and contracts. That is, institutions that are able to increase these sources are the ones most effectively leveraging their reputation and national standing.

**Market Position**

Moving to market position and demand variables, undergraduate FTEs remained statistically significant and the magnitude of its positive impact increased; AMC remained statically significant and the magnitude of its negative impact increased; and endowment value remained statistically significant and the magnitude of its positive impact increased. What can be taken away from these results is that institutions are being rewarded for increasing their market position and philanthropic support, while AMCs are still viewed as an increased liability. In the context of this chapter's discussion of wealthy universities being disproportionately rewarded by credit ratings agencies for specific fiscal behaviors, these findings further evidence such an argument. Wealthier institutions are better positioned to receive higher credit ratings due to their ability to attract greater enrollments, offer larger tuition subsidies, leverage their reputation, and grow endowments through the accumulation of significant donative resources. As a result, credit ratings may be furthering the division between the wealthiest institutions and others, by providing those at the top higher credit ratings, which in-turn allow for easier access to debt financing and lower interest rates. That is to say, the budgetary and financial behaviors and practices incentivized by the rating agencies, and reflected in higher credit ratings, may be driving the growing wealth gap between institutions at the top and bottom. Moreover, that the demographics of schools along the hierarchy reflect social and economic stratification should be particularly important for public institutions, whose missions are ostensibly related to serving the public interest and serving a state's residents.

Of course, increases in prestige and market position often come with the affiliation with an AMC. Because these medical facilities are increasingly being viewed by credit rating agencies as liabilities to institutional creditworthiness, public institutions of higher education, in an effort to strengthen their creditworthiness, may pursue policies geared toward disassociating themselves from AMCs through methods such as privatization. Again, such a policy action could work to distance public universities from their core missions of public service and serving a state's populace.

**Governance**

While high state credit rating remained positively associated with improved creditworthiness in the recession models, the magnitude of its positive impact decreased. The change is minor, and it is likely due to the macroeconomic impacts of The Great Recession being felt by the states. Regardless, public research universities housed in states with high GO ratings are still impacted positively. To reiterate the point made earlier, the estimate on high state credit rating implies that state legislators, governing board members, and other state officials should consider how state fiscal policies and budget rules impact the creditworthiness of their public institutions.

**Debt Factors**

Both debt variables remain statistically significant in the recession models, and the directions of their signs remain consistent. The impact associated with DBS is smaller when recession is added. While this change could be attributed to differences in model specification, it can also be looked at as being due to spillover effects of The Great Recession. This makes substantive sense, in that some of the immediate impacts of the recession included institutions' lack of access to assets (Blumenstyk & Field, 2008; Field,

2008) and concerns over adequate liquidity to service debt obligations (Gephardt, 2011; Wolverton, 2008). In fact, in 2011, Moody's stated that they were still uncertain about liquidity risks for some universities (Gephardt & Nelson, 2011). Although DBS remained a credit positive in the recession models, due to it representing institutions actively utilizing debt markets and effectively managing debt portfolios, some of this caution over large debt loads may be expressed in the smaller positive coefficients. While public research university credit ratings are still rewarded in the recession models for increases in DBS, the reward is less than in the first models thus suggesting that rating agencies may approach overall debt burden with more caution after the recession.

This interpretation is bolstered by the variable for leverage. Although the parameter estimate change for this variable in the recession models is marginal, the important aspect that needs to be highlighted is that it is still highly impactful on creditworthiness. Regardless of the changes in the impact of DBS, increased leverage (i.e., decreased debt servicing capacity), strongly impacts university credit ratings in a negative manner. While institutions are rewarded, albeit at a lower level, for increasing their debt burden in the recession models, there is still a strong expectation that they will be able to service said obligations. As with the first models, what is not expressed is how institutions will pay for this debt. This means asking which resources will be allocated toward debt service. The concern, especially for students from lower socioeconomic backgrounds, is that the costs will be borne by future students, in the form of tuition and fees. While public finance theory dictates that future students should share the financial burden of project costs, due to these individuals realizing many of these projects' future benefits (Oates, 1972), the question around the size of the burden is one that looms

heavy, and particularly when considering issues of access. To reiterate the point made earlier, institutional planners and senior administrators must not lose sight of how resource allocation decisions impact access and affordability for their current and future student populations.

## Avenues for Future Research

In its detailed analysis of public university credit ratings, this study sheds light on possible avenues for future research. First, as discussed in this chapter's implications, positive associations between federal operating grants and contracts and tuition and fee revenues may be unintentionally incentivizing private models of higher education. Future work may wish to examine these relationships in more depth. Specifically, is there evidence of a direct correlational, or even causal, relationship between credit rating determinants and the higher education models adopted by postsecondary institutions?

Second, the findings for freshman selectivity reveal that the process of improving creditworthiness is more complicated than simply increasing revenues or enrollment. In fact, as enrollment increases, and by extension revenues, institutions must receive a disproportionately greater number of applicants in order to maintain their levels of selectivity. Future research might examine how selectivity interacts with various other credit rating determinants. That is, for different levels of selectivity, do other credit rating determinants become more or less impactful in increasing or decreasing creditworthiness.

Third, the implications on revenue diversification suggest that while revenue diversification positively impacts public research university credit ratings, the varying impacts for the individual revenue streams implies that perfect diversification (i.e., even

funding from each source) may not be the most effective policy. Following the work of Markowitz (1952), there may exist ideal points, or equilibria, where the *E-V* rule is maximized. Research into this area may examine various ideal *E-V* points, based on institutional size, mission, and policy.

Fourth, while this study utilized longitudinal data, the methods employed essentially treat the data as a single cross section, albeit while still accounting for serial correlation. One of the benefits of panel data methods is their ability to account for dynamic effects associated with repeated observations over time. As methods for ordered response models develop, research into the short- and long-term impacts of credit rating determinants would provide a more nuanced understanding of how resource allocation and fiscal decisions by postsecondary institutions impact credit ratings over time.

Fifth and finally, this study focused on public research universities with either a high or very high level of research activity. This leaves many sectors of higher education unexamined (e.g., regional public institutions, small liberal arts colleges, private colleges and universities, minority-serving institutions). As ratings data become more readily available on some of these other sectors, analyses of the impacts of determinants on credit ratings for these types of institutions would greatly enhance knowledge around access to credit and the costs of borrowing for other types of colleges and universities.

## Chapter Conclusion

This study has examined the impact of various credit rating determinants on public research university credit ratings. Using ordered response models, this study has greatly enhanced the understanding of how institutional creditworthiness is impacted by changes in various revenue, market position, debt, and state-level factors. In addition, it

also examined the impacts of revenue diversification and The Great Recession on institutional credit ratings. Following the work of Moody (2008) and Serna (2013a, b), this study has significantly added to the research literature, by filling gaps in the empirical literature on university debt financing and credit ratings.

The results of this study indicate that revenue structure impacts credit ratings differently for various funding streams. Federal operating grants and contracts and tuition fees revenue show positive impacts with improved creditworthiness, while state and local operating grants and contracts show a negative impact. These findings suggest that credit rating agencies value broad fiscal bases, and possibly revenue structures aligned more closely with private models of higher education.

Additionally, market position factors, such as selectivity, enrollment levels, and endowment fund values positively impact credit ratings, while affiliation with an AMC plays a negative role. Supporting the findings from revenue structure, these findings bolster the argument that expanded market presence, associated with stability in student demand and philanthropic support, are greatly valued. These findings also suggest that wealthy institutions and their financial choices and behaviors are favored by credit rating agencies, and that creditworthiness improvement and maintenance favors the wealthiest universities.

Finally, debt variables demonstrate that while credit rating agencies favor large debt loads, they also strongly emphasize the ability to service these obligations. That is, as debt burdens increase, credit ratings are positively impacted, but if the level of debt service coverage decreases institutional credit ratings may be greatly penalized. As with the previous findings, debt variables also support the argument concerning credit rating

bias for large, wealthy institutions, since these universities are most easily able to generate additional revenues (e.g., through federal grants, increased enrollment, and tuition revenue) and as a result increase their debt loads without sacrificing their debt servicing capacity.

The findings for research question two show that revenue diversification has a strong, positive impact on public research university credit ratings. As institutions further diversify their revenue base, they are better able to decrease the impacts of variation within a single revenue source; thus, revenue diversification reduces risk emanating from funding source fluctuations, especially when institutions face significant macroeconomic changes or substantial business cycle fluctuations. However, when viewed alongside the findings for revenue structure, credit rating improvement is not simply a game of maximizing revenue diversification. Rather, various funding sources must be weighed accordingly, and an appropriate level of diversification for a desired level of revenue generation needs to be identified.

Turning to the third and final research question, severe economic downturns, as measured in this study by The Great Recession, positively impact credit ratings. This may seem questionable, especially in light of the repeated warnings and negative outlooks from credit rating agencies. But, the sample of institutions analyzed in this study may have simply performed better during and after the recession, due in part to their increased market position, ability to maintain student demand, and their ability to continue generating revenues, as compared to smaller postsecondary institutions.

Finally, it is appropriate to end this study by briefly discussing the social impacts associated with debt issuance policy and resource allocation decisions related to this

study's findings. While the results from the various econometric models shed much light on how changes in revenue, enrollment, selectivity, philanthropic support, debt issuance, and servicing capacity impact credit ratings, these findings are exactly that, a measure of how changes in these factors impact receiving a higher or lower credit rating. What they do not show is how these decisions may affect student populations or the public service mission, As public postsecondary institutions continue to issue bonds to fund capital projects, it makes sense that they will want to maximize their creditworthiness, as a strategy for ensuring the lowest interest rates possible. However, it is imperative that the decisions driving these actions do not result in neglecting the interests of students, nor that of the public good. That is, as debt levels increase, cost shifting may ultimately result in students bearing the brunt of the burden, in the form of increased tuition and fees, and/or decreased subsidies. Furthermore, behaviors associated with higher credit ratings, and undertaken by these institutions (e.g., increased tuition and fees, decreased state alignment), may further exacerbate social and institutional stratification.

Finally, the findings from this study suggest that factors associated with more of a private model of higher education are desired by credit rating agencies. However, planners and senior administrators must not lose sight of the fact that one of a public university's core functions is serving the state's needs. This must not be forgotten. Higher education researchers, policy makers, and administrators have a duty to ensure that public universities are continually bettering society through service and education, and not simply competing for the top spot in a credit ratings arms race.

## REFERENCES

Afonso, A., Gomes, P., & Rother, P. (2009). Ordered response models for sovereign debt ratings. *Applied Economic Letters, 16,* 769-773.

Afonso, A., Gomes, P., & Rother, P. (2011). Short- and long-run determinants of sovereign debt credit ratings. *International Journal of Finance and Economics, 16,* 1-15. doi: 10.1002/ijfe.417

Agresti, A. (1996). *An introduction to categorical data analysis*. New York, NY: John Wiley & Sons, Inc.

Agresti, A. (2010). *Analysis of ordinal categorical data* (2nd ed.). Hoboken, NJ: John Wiley & Sons, Inc.

Agresti, A. (2013). *Categorical data analysis* (3rd ed.). Hoboken, NJ: John Wiley & Sons.

Albert, A., & Anderson, J. A. (1984). On the existence of maximum likelihood estimates in logistic regression models. *Biometrika, 71*, 1-10. doi: 10.2307/2336390

Allison, P. D. (2008). *Convergence failures in logistic regression*. Paper presented at SAS Global Forum, San Antonio, TX. Retrieved from http://www2.sas.com/proceedings/forum2008/360-2008.pdf

Allison, P. D. (2009). *Fixed effects regression models.* Thousand Oaks, CA: SAGE Publications, Inc.

Ambler, D., Burr, J., McManus, K., Mischel, H., & Roswick, D. (1993). Revenue bond credit analysis. In R. Lamb, J. Leigland, & S. Rappaport (Eds.), *The handbook of municipal bonds and public finance* (pp. 143-165). New York, NY: New York Institute of Finance.

Ananth, C. V., & Kleinbaum, D. G. (1997). Regression models for ordinal responses: A review of methods and applications. *International Journal of Epidemiology, 26*, 1323-1333. doi: 10.1093/ije/26.6.1323

Anderson, J. A., (1984). Regression of ordered categorical variables. *Journal of the Royal Statistical Society: Series B (Methodological), 46,* 1-30.

Anderson, J. A., and Philips, P. R. (1981). Regression, discrimination and measurement models for ordered categorical variables. *Applied Statistics, 30,* pp. 22-31.

Archibald, R. B., & Feldman, D. H. (2006). State higher education spending and the tax revolt. *The Journal of Higher Education, 77*, 618-644. doi: 10.1353/jhe.2006.0029

Archibald, R. B., & Feldman, D. H. (2008a). Explaining increases in higher education costs. *The Journal of Higher Education, 79*, 268-295. doi: 10.1353/jhe.0.0004

Archibald, R. B., & Feldman, D. H. (2008b). Why do higher-education costs rise more rapidly than prices in general?. *Change: The Magazine of Higher Learning, 40*(3), 25-31. doi: 10.3200/CHNG.40.3.25-31

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

Association of Academic Health Centers. (2014). *Association of academic health enters 2014 annual report*. Washington, DC: Association of Academic Health Centers. Retrieved from http://www.aahcdc.org/Portals/0/pdf/2014/2014%20AAHC%20Annual%20Report.pdf

Bahl, R., & Duncombe, W. (1993). State and local debt burdens in the 1980's: A study in contrast. *Public Administration Review, 53*, 31-40. doi: 10.2307/977274

Baldwin, J. N., & McCraken IIIm W. A. (2013). Justifying the ivory tower: Higher education and state economic growth. *Journal of Education Finance, 38*, 181-209. doi: 10.1353/jef.2013.0001

Barr, M. J., & McClellan, G. S. (2011). *Budgets and financial management in higher education*. San Francisco, CA: Jossey-Bass.

Basken, P. (2015, March 27). Mississippi meets the pitfalls of running a medical center and a university. *The Chronicle of Higher Education*. Retreived from http://chronicle.com/article/Mississippi-Meets-the-Pitfalls/228845/

Benton, T., & Craib, I. (2011). *Philosophy of social science: The philosophical foundations of social thought* (2nd ed.). New York, NY: Palgrave Macmillan.

Blumenstyk, G. (2009, April 10). Debt bomb is ticking loudly on campuses. *The Chronicle of Higher Education*. Retrieved from http://chronicle.com/article/Debt-Bomb-Is-Ticking-Loudly-on/19565/

Blumenstyk, G., & Field, K. (2008, October 17). Credit squeeze exposes weaknesses in investments. *The Chronicle of Higher Education, 55*(8). Retrieved from http://chronicle.com/article/Credit-Squeeze-Exposes/5908/

Blustain, H. Bruszewski, R. V., Daigneau, W., Roloff, C., & Ledbetter, R. R. (2009). Facilities management. In *College & university business administration* (7th ed.). Washington, DC: National Association of College and University Business Officers.

Blustain, H., Cobine, S. T., Gore, E. S., Palmucci, J. A., Townsley, M. K., & Van Gorden, J. (2009). Strategic debt management. In *College & university business administration* (7th ed.). Washington, DC: National Association of College and University Business Officers.

Bogaty, E. (2013, January 16). *US higher education outlook negative in 2013* (Industry Outlook Report No. 148880). New York, NY: Moody's Investors Service.

Bowman, W. (2002). The uniqueness of nonprofit finance and the decision to borrow. *Nonprofit Management & Leadership, 12*, 293-311. doi: 10.1002/nml.12306

Brant, R. (1990). Assessing proportionality in the proportional odds model for ordinal logistic regression. *Biometrics, 46,* 1171-1178. doi: 10.2307/2532457

Bunch, B. (1991). The effect of constitutional debt limits on state governments' use of public authorities. *Public Choice, 68*, 57-69.

Burgess, B. (2011). Evaluating the policies that lead to substantial tuition variation at public land-grant universities. *Planning for Higher Education*, *39*(2), 25-33.

Calabrese, T. D. (2011). Testing competing capital structure theories of nonprofit organizations. *Public Budgeting & Finance, 31*(3), 119-143. doi: 10.1111/j.1540-5850.2011.00989.x

Callan, P. (2002). *Coping with recession: Public policy, economic downturns and higher education* (National Center Report No. 02-2). San Jose, CA: The National Center for Public Policy and Higher Education. Retrieved from http://www.highereducation.org/reports/cwrecession/cwrecession.shtml

Cameron, A. C., & Trivedi, P. K. (2005). *Microeconometrics: Methods and applications*. New York, NY: Cambridge University Press.

Cameron, A. C., & Trivedi, P. K. (2010). *Microeconometrics using Stata* (Rev. ed.). College Station, TX: Stata Press.

Carlson, S. (2013a, January 28). What's the payoff for the 'country club' college? *The Chronicle of Higher Education*. Retrieved from http://chronicle.com/blogs/buildings/whats-the-payoff-for-the-country-club-college/32477/

Carlson, S. (2013b, November 6). As deferred maintenance piles up, colleges face hard choices. *The Chronicle of Higher Education*. Retrieved from http://chronicle.com/article/As-Deferred-Maintenance-Piles/142833/

Carnegie Foundation for the Advancement of Teaching. (2010). *Methodology*. Retrieved April 1, 2015, from Basic Descriptions: http://carnegieclassifications.iu.edu/methodology/basic.php

Carroll, D. A. (2005). Are state governments prepared for fiscal crises? A look at revenue diversification during the 1990s. *Public Finance Review, 33*, 603-633. doi: 10.1177/1091142105276440

Carroll, D. A. (2009). Diversifying municipal government revenue structures: Fiscal illusion or instability? *Public Budgeting & Finance, 29*(1), pp. 27-48. doi: 10.1111/j.1540-5850.2009.00922.x

Carroll, D. A., & Stater, K. J. (2009). Revenue diversification in nonprofit organizations: Does it lead to financial stability? *Journal of Public Administration Research and Theory, 19*, 947-966. doi: 10.1093/jopart/mun025

Chang, C. F., & Tuckman, H. P. (1994). Revenue diversification among non-profits. *Voluntas: International Journal of Voluntary and Nonprofit Organizations, 5*, 273-290.

Chernick, H., Langley, A., & Reschovsky, A. (2011). Revenue diversification and the financing of large American central cities. *Public Finance and Management, 11*, 138-159.

Cheslock, J. J., & Gianneschi, M. (2008). Replacing state appropriations with alternative revenue sources: The case of voluntary support. *The Journal of Higher Education, 79*, 208-229. doi: 10.1353/jhe.2008.0012

Clingermayer, J. C., & Wood, D. B. (1995). Disentangling patterns of state debt financing. *American Political Science Review, 89*, 108-119. doi: 10.2307/2083078

Clogg, C. C., & Shihadeh, E. S. (1994). *Statistical models for ordinal variables*. Thousand Oaks, CA: SAGE Publications, Inc.

Cox, D. R., & Snell, E. J. (1989). *Analysis of binary data* (2nd ed.). Boca Raton, FL: Chapman & Hall/CRC.

Creswell, J. W. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches* (3rd ed.). Thousand Oaks, CA: SAGE Publications, Inc.

Crotty, M. J. (2013). *The foundations of social research: Meaning and perspective in the research process*. Thousand Oaks, CA: SAGE Publications, Inc.

Dar, L. (2012). The political dynamics of higher education policy. *The Journal of Higher Education, 83*, 769-794. doi: 10.1353/jhe.2012.0039

Dar, L., & Lee, D-W. (2014). Partisanship, political polarization, and state higher education budget outcomes. *The Journal of Higher Education, 85,* 469-498. doi: 10.1353/jhe.2014.0023

Delaney, J. A., & Doyle, W. R. (2014). State spending on higher education capital outlays. *Research in Higher Education, 55*, 433-466. doi: 10.1007/s11162-013-9319-2

Delaney, J. A., & Kearney, T. D. (2015). The impact of guaranteed tuition policies on postsecondary tuition levels: A difference-in-difference approach. *Economics of Education Review, 47*, 80-99. doi: dx.doi.org/10.1016/j.econedurev.2015.04.003

Denison, D. V. (2009). Which nonprofit organizations borrow? *Public Budgeting & Finance, 29*(3), 110-123. doi: 10.1111/j.1540-5850.2009.00939.x

Denison, D., Fowles, J., & Moody, M. J. (2014). Borrowing for college: A comparison of long-term debt financing between public and private, nonprofit institutions of higher education. *Public Budgeting & Finance, 34*(2), 84-104. doi: 10.1111/pbaf.12035

Denison, D., Hackbart, M., & Moody, M. (2006). State debt limits: How many are enough? *Public Budgeting & Finance, 26*(4), 22-39. doi: 10.1111/j.1540-5850.2006.00860.x

Denison, D., Yan, W., & Zhao, Z. (2007). Is management performance a factor in municipal bond credit ratings? The case of Texas school districts. *Public Budgeting & Finance, 27*(4), 86-98. doi: 10.1111/j.1540-5850.2007.00889.x

Dougherty, K. J., Natow, R. S., Jones, S. M., Lahr, H., Pheatt, L., & Reddy, V. (2014). *The political origins of Performance Funding 2.0 in Indiana, Ohio, and Tennessee: Theoretical perspectives and comparisons with Performance Funding 1.0* (CCRC Working Paper No. 68). New York, NY: Columbia University, Teachers College, Community College Research Center. Retrieved from http://ccrc.tc.columbia.edu/media/k2/attachments/political-origns-performance-funding-2.0.pdf

Dougherty, K. J., & Reddy, V. (2011). *The impacts of state performance funding systems on higher education institutions: Research literature review and policy recommendations* (CCRC Working Paper No. 37). New York, NY: Columbia University, Teachers College, Community College Research Center. Retrieved from http://ccrc.tc.columbia.edu/media/k2/attachments/impacts-state-funding-higher-education.pdf

Doyle, W. R. (2010). Does merit-based aid "Crowd Out" need-based aid? *Research in Higher Education, 51*, 397-415. doi: 10.1007/s11162-010-9166-3

Doyle, W. R. (2012). The politics of public college tuition and state financial aid. *The Journal of Higher Education, 83,* 617-647. doi: 10.1353/jhe.2012.0033

Dunbar, A., Hossler, D., Shapiro, D., Chen, J., Martin, S., Torres, V., Zerquera, D., & Ziskin, M. (2011, July). *National postsecondary enrollment trends: Before, during, and after the Great Recession*. National Student Clearinghouse Research Center Signature Report. Herndon, VA: National Student Clearinghouse Research Center.

Ellis, M. A., & Schansberg, D. E. (1999). The determinants of state government debt financing. *Public Finance Review, 27*, 571-587. doi: 10.1177/109114219902700601

Farnham, P. (1985). Re-examining local debt limits: A disaggregated analysis. *Southern Economic Journal, 51*, 1186-1201. doi: 10.2307/1058388

Federal Research Bank of St. Louis. (2015). Consumer price index for all urban consumers: All items (CPIAUSCL). In *FRED economic data*. Retrieved from https://research.stlouisfed.org/fred2/series/CPIAUCSL/downloaddata

Fitch Ratings. (2015). *Rating U.S. public finance short-term debt: Cross-sector criteria*. New York, NY: Fitch Ratings.

Feldstein, S. G. (2008). General analytical framework for assessing the credit worthiness of revenue bonds. In S. G. Feldstein & F. J. Fabozzi (Eds.), *The handbook of municipal bonds* (pp. 809-812). Hoboken, NJ: John Wiley & Sons, Inc.

Feldstein, S. G., & Goode, T. J. (2008). How to analyze general obligation bonds. In S. G. Feldstein & F. J. Fabozzi (Eds.), *The handbook of municipal bonds* (pp. 789-808). Hoboken, NJ: John Wiley & Sons, Inc.

Field, K. (2008, October 1). Bank freeze leaves hundreds of colleges cut off from short-term funds. *The Chronicle of Higher Education*. Retrieved from http://chronicle.com/article/Bank-Freeze-Leaves-Hundreds-of/114682/

Firth, D. (1993). Bias reduction of maximum likelihood estimates. *Biometrika, 80*, 27-38. doi: 10.2307/2336755

Fitch Ratings. (2015). Sector: U.S. public finance. In *Fitch ratings*. Retrieved from https://www.fitchratings.com/gws/en/sector/entity/USPublicFinance?Ns=dateSorted%7c1&Ne=4294281954&N=4294281759+416+1211&_=1422750571360

Fitzgerald, S. (2005, November). *Consolidated public university revenue pledges: Public higher education moves to broaden pledge provided to bondholders* (Special Comment Report No. 95216). New York, NY: Moody's Investors Service.

Forsythe, D. W. (1993). Municipal financing and the budget process. In R. Lamb, J. Leigland, & S. Rappaport (Eds.), *The handbook of municipal bonds and public finance* (pp. 181-193). New York, NY: New York Institute of Finance.

Gephardt, D. M. (2011, May 12). *U.S. colleges and universities increase liquidity as credit pressures continue* (Special Comment Report No. 132922). New York, NY: Moody's Investors Service.

Gephardt, D. M., & Nelson, J. C. (2010, July 8). State funding cuts make public universities more vulnerable to downgrade. *Moody's Investors Service Global Credit Research*. New York, NY: Moody's Investor's Service. Retrieved from https://www.moodys.com/research/Moodys-State-funding-cuts-make-public-universities-more-vulnerable-to--PR_202157

Gephardt, D. M., & Nelson, J. C. (2011, May 12). Moody's: U.S. colleges and universities increase liquidity as credit pressures continue. *Moody's Investors Service Global Credit Research*. New York, NY: Moody's Investors Service. Retrieved from https://www.moodys.com/research/Moodys-US-Colleges-and-Universities-Increase-Liquidity-as-Credit-Pressures--PR_218755

Goldstein, L. (2012). *A guide to college & university budgeting: Foundations for institutional effectiveness* (4th ed.). Washington, DC: National Association of College and University Business Officers.

Goodman, R., & Nelson, J. C. (2009, January 6). Moody's: U.S. higher education outlook is negative through at least '09. *Moody's Investors Service Global Credit Research.* New York, NY: Moody's Investor's Service. Retrieved from https://www.moodys.com/research/Moodys-US-higher-education-outlook-is-negative-through-at-least--PR_170354

Greene, W. H., & Hensher, D. A. (2009). *Modeling ordered choices*. New York, NY: New York University. Retrieved from http://pages.stern.nyu.edu/~wgreene/DiscreteChoice/Readings/OrderedChoiceSurvey.pdf

Grizzle, C. (2010). The impact of budget stabilization funds on state general obligation bond ratings. *Public Budgeting & Finance, 30*(2), 95-111. doi: 10.1111/j.1540-5850.2010.00958.x

Grizzle, C. (2012). Revenue diversification in the states: The credit quality and interest cost impacts. *Municipal Finance Journal, 33*(1), 33-52.

Grünwald, P. (2000). Model selection based on minimum description length. *Journal of Mathematical Psychology, 44*, 133-152. doi: 10.1006/jmps.1999.1280

Guba, E. G., & Lincoln, Y. S. (2005). Paradigmatic controversies, contradictions, and emerging confluences. In N. K. Densin, & Y. S. Lincoln (Eds.), *The SAGE handbook of qualitative research* (3rd ed.) (pp. 191-215). Thousand Oaks, CA: SAGE Publications Inc.

Hackbart, M. M., & Leigland, J. (1990). State debt management policy: A national survey. *Public Finance & Budgeting, 10*(1), 37-54.

Harris, A. D. (2011). *A national study of state tax appropriations for capital needs in public higher education* (Doctoral dissertation). Available from ProQuest Dissertations and Theses database. (UMI 3461053)

Harris, D., Manns, D., & Katsinas, S. (2012). Appropriations for capital needs in U.S. public higher education. *Facilities Manager, 28*(2), 24-29.

Hearn, J. C., Griswold, C. P., & Marine, G. M. (1996). Region, resources, and reason: A contextual analysis of state tuition and student aid policies. *Research in Higher Education, 37*, 241-278.

Heller, D. E., (1999). The effects of tuition and state financial aid on public college enrollment. *The Review of Higher Education, 23*, 65-89. doi: 10.1353/rhe.1999.0023

Hildreth, W. B., & Miller, G. J. (2002). Debt and the local economy: Problems in benchmarking local government debt affordability. *Public Budgeting & Finance, 22*(4), 99-113. doi: 10.1111/1540-5850.00091

Hillman, N. W., Tandberg, D. A., & Gross, J. P. K. (2014). Performance funding in higher education: Do financial incentives impact college completions? *The Journal of Higher Education, 85,* 826-857. doi: 10.1353/jhe.2014.0031

Horrigan, J. O. (1966). The determination of long-term credit standing with financial ratios. *Journal of Accounting Research, 4*, 44-62. doi: 10.2307/2490168

Hosmer, D. W., Jr., Lemeshow, S., & Sturdivant, R. X. (2013). *Applied logistic regression* (3rd ed.). Hoboken, NJ: John Wiley & Sons.

Hossler, D., Lund, J. P., Ramin, J., & Irish, S. (1997). State funding for higher education: The Sisyphean task. *The Journal of Higher Education, 68*, 160-190. doi: 10.2307/2959955

Internal Revenue Service. (n.d.). *Module b: Introduction to federal taxation of municipal bonds*. Washington, DC: Internal Revenue Service. Retrieved from http://www.irs.gov/pub/irs-tege/teb_phase_1_course_11204_-3module_b.pdf

Jacob, B., McCall, B., & Stange, K. M. (2013). *College as country club: Do colleges cater to students' preferences for consumption?* (NBER Working Paper No. 18745). Cambridge, MA: National Bureau of Economic Research. Retrieved from http://www.nber.org/papers/w18745

Jaquette, O., & Curs, B. R. (2015). Creating the out-of-state university: Do public universities increase nonresident freshman enrollment in response to declining state appropriations? *Research in Higher Education.* Advance online publication. doi: 10.1007/s11162-015-9362-2

Jaschik, S. (2013, January 29). Many students opt for colleges that spend more on nonacademic functions, study finds. *Inside Higher Ed*. Retrieved from https://www.insidehighered.com/news/2013/01/29/many-students-opt-colleges-spend-more-nonacademic-functions-study-finds

Jenny, H. H., Hughes, G. C., & Devine, R. D. (1983). The capital margin in collegiate finance. In *NACUBO writers on financial management: A compilation of Business Officer articles* (pp. 41-44). Washington, DC: National Association of College and University Business Officers. (Reprinted from *Business Officers*, 1981, Washington, DC: National Association of College and University Business Officers).

Johnson, C. & Kriz, K. (2005). Fiscal institutions, credit ratings, and borrowing costs. *Public Budgeting & Finance, 25*(1), 84-103. doi: 10.1111/j.0275-1100.2005.00356.x

Johnson, F. C. (1993). Credit fundamentals—The rating agency perspective. In R. Lamb, J. Leigland, & S. Rappaport (Eds.), *The handbook of municipal bonds and public finance* (pp.117-126). New York, NY: New York Institute of Finance.

Johnstone, D. B. (2004). The economics and politics of cost sharing in higher education: Comparative perspectives. *Economics of Education Review, 23*, 403-410. doi: 10.1016/j.econedurev.2003.09.004

Johnstone, D. B., & Marcucci, P. N. (2010). *Financing higher education worldwide: Who pays? Who should pay?* Baltimore, MD: The Johns Hopkins Press.

Kedem, K. (2011, August). *U.S. not-for-profit private and public higher education* (Rating Methodology Report No. 134044). New York, NY: Moody's Investors Service.

Kiewiet, D. R., & Szakaly, K. (1996). Constitutional limitations on borrowing: An analysis of state bonded indebtedness. *The Journal of Law, Economics, & Organization, 12*, 62-97.

Kiley, K. (2012, April 10). Public universities will take on more debt as states decrease spending on capital projects. *Inside Higher Ed.* Retrieved from https://www.insidehighered.com/news/2012/04/10/public-universities-will-take-more-debt-states-decrease-spending-capital-projects

Kiley, K. (2013, February 4). Moody's: Higher ed downgrades vastly exceeded upgrades in 2012. *Inside Higher Ed*. Retrieved from https://www.insidehighered.com/quicktakes/2013/02/04/moodys-higher-ed-downgrades-vastly-exceeded-upgrades-2012

Kennedy, P. (2008). *A guide to econometrics* (6th ed.). Hoboken, NJ: John Wiley & Sons.

King, G. A., Anderson, R. E., Cyganowski, D. M., & Hennigan, P. J. (1994). *NACUBO guide to issuing and managing debt*. Washington DC: National Association of College and University Business Officers.

Knott, J. H., and Payne, A. A. (2004). The impact of state governance structures on management and performance of public organizations: A study of higher education institutions. *Journal of Policy Analysis and Management, 23*, 13-30. doi: 10.1002/pam.10176

Koshal, R., & Koshal, M. (2000). State appropriation and higher education tuition: What is the relationship? *Education Economics, 8*, 81-89. doi: 10.1080/096452900110319

Krantz, L. (2015, March 22). After building boom, UMass $3 bllion in debt: Tab could hinder future growth, but trustees undaunted. *The Boston Globe*. Retrieved from http://www.bostonglobe.com/metro/2015/03/21/after-building-boom-umass-sizes-debt/rnbYFtGVZsp11mZn9buJAM/story.html

Lacy, T. A., & Tandberg, D. A. (2014). Rethinking policy diffusion: The interstate spread of "Finance Innovations". *Research in Higher Education, 55*, 627-649. doi: 10.1007/s11162-0149330-2.

Lall, R., Campbell, M. J., Walters, S. J., & Morgan, K. (2002). A review of ordinal regression models applied on health-related quality of life assessments. *Statistical Methods in Research, 11*, 49-67. doi: 10.1191/0962280202sm271ra

Lamb, R. B. (1993). The primary market: Underwriting municipal bonds. In R. Lamb, J. Leigland, & S. Rappaport (Eds.), *The handbook of municipal bonds and public finance* (pp. 22-38). New York, NY: New York Institute of Finance.

Lancaster, T. (2000). The incidental parameters problem since 1948. *Journal of Econometrics, 95*, 391-414.

Leigland, J. (1993). Overview of public authorities and special districts. In R. Lamb, J. Leigland, & S. Rappaport (Eds.), *The handbook of municipal bonds and public finance* (pp. 375-396). New York, NY: New York Institute of Finance.

Leslie, L. L., Slaughter, S., Taylor, B. J., & Zhang, L. (2012). How do revenue variations affect expenditures within U.S. research universities? *Research in Higher Education, 53,* 614-639. doi: 10.1007/s11162-011-9248-x

Long, J. S., & Freese, J. (2006). *Regression models for categorical dependent variables using stata* (2nd ed.). College Station, TX: Stata Press.

Longanecker, D. (2006). A tale of two pities. *Change: The Magazine of Higher Learning, 38*(1), 14-25. doi: 10.3200/CHNG.38.1.14-25

Lowry, R. C. (2001). The effects of state political interests and campus outputs on public university revenues. *Economics of Education Review, 20*, 105-119.

Manns, D. (2003/2004). An assessment of capital budgeting practices for public higher education. *Planning for Higher Education, 32*(2), 5-11.

Manns, D., & Katsinas S. (2006). Capital budgeting practices in public higher education. *Facilities Manager, 22*(1), 36-42.

Markowitz, H. (1952). Portfolio selection. *The Journal of Finance, 7*(1), 77-91. doi: 10.2307/2975974

Martin, R. & Gillen, A. (2011a, January). Measuring college affordability. *Social Science Research Network*. Retrieved from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1734914

Martin, R., & Gillen, A. (2011b). *How college pricing undermines financial aid*. Washington D.C.: Center for College Affordability. Retrieved from http://centerforcollegeaffordability.org/uploads/How_College_Pricing_Undermines.pdf

Maxwell, J. A. (2012). *A realist approach for qualitative research*. Los Angeles, CA: SAGE Publication, Inc.

McCullagh, P. (1980). Regression models for ordinal data. *Journal of the Royal Statistical Society: Series B (Methodological), 42,* 109-142.

McCullagh, P., & Nelder, J. A. (1989). *Generalized linear models* (2nd ed.). Boca Raton, FL: CRC Press LLC.

McElvey, R. & Zavoina, W. (1975). A statistical model for the analysis of ordered level dependent variables. *Journal of Mathematical Sociology, 4,* 103-120.

McGuinness, A. C. (2001, December). *Governance and coordination: Definitions and distinctions.* Denver, CO: Education Commission of the States. Retrieved from http://www.ecs.org/clearinghouse/31/62/3162.htm

McGuinness, A. C. (2003, February). *Models of postsecondary education coordination and governance in the states.* Denver, CO: Education Commission of the States. Retrieved from http://www.ecs.org/clearinghouse/34/23/3423.pdf

McKeown-Moak, M. P., & Mullin, C. M. (2014). *Higher education finance research: Policy, politics, and practice*. Charlotte, NC: Information Age Publishing, Inc.

McLendon, M. K., Hearn, J. C., & Mokher, C. G. (2009). Partisans, professionals, and power: The role of political factors in state higher education funding. *The Journal of Higher Education, 80*, 696-713. doi: 10.1353/jhe.0.0075

Millett, J. D. (1952). *Financing higher education in the United States*. New York, NY: Columbia University Press.

Moody, M. (2007). Do state debt policies and oversight impact how much public universities borrow? *Municipal Finance Journal, 28*(3), 1-17.

Moody, M. J. (2008). State debt policies and the credit ratings of public universities. *Public Finance Review, 36*, 287-307. doi: 10.1177/109142107311460

Inside Higher Ed. (2012, July, 27). Moody's gives higher education a bleak outlook. Retrieved from https://www.insidehighered.com/quicktakes/2012/07/27/moodys-gives-higher-education-bleak-outlook

Moody's Investors Service. (2014, August). *Ratings symbols and definitions*. New York, NY: Moody's Investors Service. Retrieved from https://www.moodys.com/researchdocumentcontentpage.aspx?docid=PBC_79004

Moody's Investors Service (2015a, March). *Rating symbols and definitions*. New York, NY: Moody's Investors Service. Retrieved from https://www.moodys.com/researchdocumentcontentpage.aspx?docid=PBC_79004

Moody's Investors Service (2015b). *Look up a rating*. Retrieved from https://www.moodys.com/page/lookuparating.aspx

Morgan, G. (2002, September). *Moody's rating approach for private colleges and universities*. New York, NY: Moody's Investors Service. Retrieved from http://www.nacubo.org/Documents/prof_dev/Higher_Ed_Credit_Outlook_2002_Private_University_Methodology.pdf

Morphew, C. C., & Baker, B. B. (2004). The cost of prestige: Do new Research I universities incur higher administrative costs? *The Review of Higher Education, 27*, 365-384. doi: 10.1353/rhe.2004.0005

Mundlak, Y. (1978). On pooling of time series and cross section data. *Econometrica, 46,* 69-85. doi: 10.2307/1913646

National Association of College and University Business Officers. (2012). Governance. In *College and university business administration* (7th ed.). Retrieved from http://www.nacubo.org/Products/Online_Publications/CUBA_7.html

National Association of College and University Business Officers. (n.d.). *Endowment market values and investment rates of returns*. Retrieved from http://www.nacubo.org/Research/NACUBO-Commonfund_Study_of_Endowments/Public_NCSE_Tables/Total_Market_Value_of_Endowments.html

National Association of State Budget Officers. (2002, January). *Budget Processes in the States*. Washington, DC: National Association of State Budget Officers. Retrieved from http://www.nasbo.org/sites/default/files/budpro2002.pdf

National Association of State Budget Officers. (2008, Summer). *Budget Processes in the States*. Washington, DC: National Association of State Budget Officers. Retrieved from http://www.nasbo.org/sites/default/files/BP_2008.pdf

Nemes, S., Jonasson, J. M., Genell, A., & Steineck, G. (2009). Bias in odds ratios by logistic regression modelling and sample size. *BMC Medical Research Methodology, 9*(56). doi: :10.1186/1471-2288-9-56

Ness, E. C., & Tandberg, D. A. (2013). The determinants of state spending on higher education: How capital project funding differs from general fund appropriations. *The Journal of Higher Education, 84*, 329-362. doi: 10.1353/jhe.2013.0016

Neyman, J., & Scott, E. (1948). Consistent estimates based on partially consistent observations. *Econometrica, 16*, 1-32. doi: 10.2307/1914288

Nolan, K., & McGee, P. (2012, February 22). 2112: A rush for bonds from University of California system. *The Wall Street Journal*. Retrieved from http://www.wsj.com/articles/SB10001424052970203918304577239564073447788

Oates, W. E. (1972). *Fiscal federalism*. New York, NY: Harcourt Brace Jovanovich, Inc.

O'Hara, N. (2012). *The fundamentals of municipal bonds* (6th ed.). Hoboken, NJ: John Wiley & Sons, Inc.

Palumbo, G., & Zaporowski, M. P. (2012). Determinants of municipal bond ratings for general purpose governments: An empirical analysis. *Public Budgeting & Finance, 32*(2), 86-102. doi: 10.1111/j.1540-5850.2011.01009.x

Peduzzi, P., Concato, J., Kemper, E., Holford, T. R., & Feinstein, A. R. (1996). A simulation study of the number of evenets per variable in logistic regression analysis. *Journal of Clinical Epidemiology, 49*, 1373-1379.

Peng, J., Kriz, K., & Wang, Q. (2014). The two worlds of municipal bonds: Are lower-rated bonds punished more by financial crisis? *Public Budgeting & Finance, 34*(1), 18-38. doi: 10.1111/pbaf.12028

Peterson, B., & Harrell Jr., F. E. (1990). Partial proportional odds models for ordinal response variables. *Journal of the Royal Statistical Society: Series C (Applied Statistics), 39,* 205-217. 10.2307/2347760

Pollack, R. H. (2000). Bond issues. *Currents, 26*(1), 44-49.

Pogue, T., & Soldofsky, R. (1969). What's in a bond rating? *Journal of Financial and Quantitative Analysis, 4,* 201-228.

Purcell, J., Harrington, C., & King, B. (2012). Supporting institutional governance. In R. D. Howard, G. W. McLaughlin, W. E. Knight, & Associates (Eds.), *The handbook of institutional research* (pp. 133-144). San Francisco, CA: Jossey-Bass.

R Core Team. (2015). R: A language and environment for statistical computing. Vienna, Austria: R Foundation for Statistical Computing. URL http://www.R-project.org/

Rabe-Hesketh, S., & Skrondal, A. (2012). *Multilevel and longitudinal modeling using Stata volume II: Categorical responses, counts, and survival.* College Station, TX: Stata Press.

Rabson, E. A. (2008). The role of the rating agencies. In S. G. Feldstein & F. J. Fabozzi (Eds.), *The handbook of municipal bonds* (pp. 223-233). Hoboken, NJ: John Wiley & Sons, Inc.

Rubinoff, D., & Marion, S. (2007, August). *Methodology for rating public universities* (Rating Methodology Report No. 103498). New York, NY: Moody's Investors Service.

Russell, J. D. (1954). *The finance of higher education* (revised ed.). Chicago, IL: The University of Chicago Press.

S&P Capital IQ. (2014, February 6). Ratings direct: Many factors burden the U.S. higher education sector in 2014. *Global Credit Portal*. Retrieved from https://www.globalcreditportal.com/ratingsdirect/renderArticle.do?articleId=1256366&SctArtId=212965&from=CM&nsl_code=LIME&sourceObjectId=8446154&sourceRevId=3&fee_ind=N&exp_date=20240207-19:55:16

Serna, G. R. (2012). *Tuition and fees and tax revolt provisions: Exploring state fiscal policy impacts using fixed-effects vector decomposition* (Doctoral dissertation). Available from ProQuest Dissertations and Theses database. (UMI No. 3517117)

Serna, G. R. (2013a). Employing college and university credit ratings as indicators of institutional planning and effectiveness. *Planning for Higher Education Journal, 41*(4), 1-11.

Serna, G. R. (2013b). Rating public colleges and universities: Process, practice, and implications for finance, administration, and policy. *Journal of Higher Education Management, 28*(1), 52-69.

Serna, G. R. (2013c). Understanding the effects of state oversight and fiscal policy on university revenues: Considerations for financial planning. *Planning for Higher Education, 41*(2), 93-108.

Serna, G. R., & Harris, G. (2014). Higher education expenditures and state balanced budget requirements: Is there a relationship? *Journal of Education Finance, 39*, 175-202. doi: 10.1353/jef.2014.0015

Sharpe, W. F. (1963). A simplified model for portfolio analysis. *Management Science, 9*, 277-293.

Shin, J., & Milton, S. (2006). Rethinking tuition effects on enrollment in public four-year colleges and universities. *The Review of Higher Education, 29*, 213-237. doi: 10.1353/rhe.2005.0086

Standard & Poor's. (2007). *Public finance criteria*. New York, NY: Standard & Poor's Financial Services.

Standard & Poor's Ratings Services. (2013). Ratings direct: U.S. higher education sector could experience a rise in rating and outlook changes in 2013. New York, NY: McGraw Hill Financial.

Standard & Poor's Ratings Services. (2014a, July 8). Ratings direct: U.S. public colleges and universities' fiscal 2013 median ratios: Enrollment and budget pressures continue despite improved state funding and investment performance. New York, NY: McGraw Hill Financial.

Standard & Poor's Ratings Services. (2014b, November 20). *Standard & Poor's ratings definitions*. Retrieved from http://www.standardandpoors.com/ratings/articles/en/us/?articleType=HTML&assetID=1245378053126#ID133

State Higher Education Executive Officers. (2013). *State higher education finance FY 2013*. Retrieved from http://www.sheeo.org/sites/default/files/publications/SHEF_FY13_04292014.pdf

Supiano, B. (2008, April 11). Swanky suites, more students? *The Chronicle of Higher Education*. Retrieved from http://chronicle.com/article/Swanky-Suites-More-Students-/33537/

Suyderhoud, J. P. (1994). State-local revenue diversification, balance, and fiscal performance. *Public Finance Quarterly, 22*, 168-194. doi: 10.1177/109114219402200202

Tandberg, D. A. (2008). The politics of state higher education funding. *Higher Education in Review, 5*, 1-36.

Tandberg, D. A. (2010). Politics, interest groups, and state funding of public higher education. *Research in Higher Education, 51*, 416-450. Doi: 10.1007/s11162-010-9164-5

Tandberg, D. A. (2013). The conditioning role of state higher education governance structures. *The Journal of Higher Education, 84*, 506-543. doi: 10.1353/jhe.2013.0026

Tandberg, D. A., & Ness, E. C. (2011). State capital expenditures for higher education: "Where the real politics happens". *Journal of Education Finance, 36*, 394-423.

Thau, A. (2011). *The bond book: Everything investors need to know about treasuries, municipals, GNMAs, corporates, zeros, bond funds, money market funds, and more* (3rd ed.). New York, NY: McGraw Hill.

The Economist. (2006). An education in finance: America's colleges embrace the capital markets. *The Economist*. Retrieved from http://www.economist.com/node/6958688

Thelin, J. R. (2004). Higher education and the public trough: A historical perspective. In E. P. St. John & M. D. Parsons (Eds.), *Public funding of higher education: Changing contexts and new rationales* (pp. 21-39). Baltimore, MD: The Johns Hopkins University Press.

Toutkoushian, R. K., & Hillman, N. W. (2012). The impact of state appropriations and grants on access to higher education and outmigration. *The Review of Higher Education, 36,* 51-90. doi: 10.1353/rhe.2012.0063

Trautman, R. R. (1995). The impact of state debt management on debt activity. *Public Budgeting & Finance, 15*(2), 33-51. doi:10.1111/1540-5850.01038

Trochim, W. M. K., & Donnelly, J. P. (2008). *Research methods knowledge base* (3rd ed.). Mason, OH: Atomic Dog.

Tuby, K. (2014, December 1). *2015 outlook – US higher education: Slow tuition revenue growth supports negative outlook*. New York, NY: Moody's Investors Service.

Tuby, K. S. (2009, July). *Primer on key Moody's private higher education ratio calculations* (Special Comment Report No. 118340). New York, NY: Moody's Investors Service.

Tuby, K. S., & Nelson, J. C. (2012, January 23). Moody's: U.S. higher education outlook remains mixed in 2012. *Moody's Investors Service Global Credit Research.* New York, NY: Moody's Investors Service. Retrieved from https://www.moodys.com/research/Moodys-US-higher-education-outlook-remains-mixed-in-2012--PR_235778

Tuckman, H. P., & Chang, C. F. (1991). A methodology for measuring the financial vulnerability of charitable nonprofit organizations. *Nonprofit and Voluntary Sector Quarterly, 20*, 445-460. doi:10.1177/089976409102000407

U.S. Department of Education. (n.d.). *Glossary*. Washington, DC: Institute of Education Sciences, National Center for Education Statistics. Retrieved from http://nces.ed.gov/ipeds/glossary/index.asp?id=853

U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics (2015). *IPEDS data center*. Retrieved from http://nces.ed.gov/ipeds/datacenter/

Viacava, D. F. (2010, December 14). *Primer on key Moody's U.S. public higher education ratio calculations* (Special Comment Report No. 127480). New York, NY: Moody's Investors Service.

Vittinghoff, E., & McCulloch, C. E. (2007). Relaxing the rule of ten events per variable in logistic and cox regression. *American Journal of Epidemiology, 165*, 710-718. doi: 10.1093/aje/kwk052

Volkwein, J. F., & Malik, S. M. (1997). State regulation and administration flexibility at public universities. *Research in higher education, 38,* 17-42.

Weerts, D. J., & Ronca, J.M. (2006). Examining differences in state support for higher education: A comparative study of state appropriations for Research I universities. *The Journal of Higher Education, 77*, 935-957. doi: 10.1353/jhe.2006.0054

Weisbrod, B. A., & Asch, E. D. (2010). The truth about the "crisis" in higher education finance. *Change: The Magazine of Higher Learning, 42*(1), pp. 23-29. doi: 10.1080/00091380903449086

West, R. R. (1970). An alternative approach to predicting corporate bond ratings. *Journal of Accounting Reseearch, 8,* 118-125. doi: 10.2307/2674717

Wickham, H. (2009). ggplot2: elegant graphics for data analysis. New York, NY: Springer.

Williams, R. (2006). Generalized ordered logit/partial proportional odds models for ordinal dependent variables. *The Stata Journal, 6*(1), 58-82. Retrieved from http://www.stata-journal.com/sjpdf.html?articlenum=st0097

Wilson, R. (2008, October 10). As credit crisis chills campuses, worries mount. *The Chronicle of Higher Education, 55*(7). Retrieved from http://chronicle.com/As-Credit-Crisis-Chills/22336/

Winston, G. C. (1999). Subsidies, hierarchy and peers: The awkward economies of higher education. *The Journal of Economic Perspectives, 13*(1), 13-26.

Wolverton, B. (2008, March 14). Colleges' debt is fed by rising bond rates. *The Chronicle of Higher Education, 54*(2). Retrieved from http://chronicle.com/article/Colleges-Debt-Is-Fed-by/22326/

Wooldridge, J. M. (2009). *Introductory econometrics: A modern approach* (4th ed.). Mason, OH: South-Western Cengage Learning.

Wooldridge, J. M. (2010). *Econometric analysis of cross section and panel data* (2nd ed.). Cambridge, MA: The MIT Press.

Yan, W. (2011). Revenue diversification and state credit risk. *Municipal Finance Journal, 31*(4), 41-62.

Yan, W., Denison, D. V., & Butler, J. S. (2009). Revenue structure and nonprofit borrowing. *Public Finance Review, 37*, 47-67. doi: 10.1177/1091142108321239

Zhang, L. (2007). Nonresident enrollment demand in public higher education: An analysis at national, state, and institutional levels. *The Review of Higher Education, 31*, 1-25. doi: 10.1353/rhe.2007.0057

Zhang, L. (2011). Does merit-based aid affect degree production in STEM fields? Evidence from Georgia and Florida. *The Journal of Higher Education, 82*, 389-415. doi: 10.1353/jhe.2011.0024

Zumeta, W. (2009). State support of higher education: The roller coaster plunges downward yet again. *The NEA 2009 Almanac of Higher Education*. Retrieved from http://www.nea.org/assets/docs/HE/HE_NEA_Resources1_al09p29.pdf

Zumeta, W. (2010). The great recession: Implications for higher education. *The NEA 2010 Almanac of Higher Education*. Retrieved from http://www.nea.org/assets/img/PubAlmanac/Zumeta_2010.pdf

Zumeta, W. (2012). States and higher education: On their own in a stagnant economy. *The NEA 2012 Almanac of Higher Education*. Retrieved from http://www.nea.org/assets/docs/2012_Almanac_StatesandHE.pdf

Zumeta, W. (2013). Higher education enters a new era. *The NEA 2013 Almanac of Higher Education*. Retrieved from http://www.nea.org/assets/docs/2013_Almanac_Zumeta.pdf

Zumeta, W., Breneman, D. W., Callan, P. M., & Finney, J. E. (2012). *Financing American higher education in the era of globalization*. Cambridge, MA: Harvard Education Press.

Zumeta, W., & Kinne, A. (2011). The recession is not over for higher education. *The 2011 NEA Almanac of Higher Education*. Retrieved from http://www.nea.org/assets/docs/HE/D-Zumeta_2011_23Feb11_p29-42.pdf

# APPENDIX A

## TABLES OF INCLUDED AND EXCLUDED INSTITUTIONS

Table A1

*Included Institutions and Percent of System Revenue (if applicable)*

| Institution | Location | % of System Revenue |
|---|---|---|
| Arizona State University | Tempe, AZ | 96.0 |
| Auburn University | Auburn, AL | 92.1 |
| Ball State University | Muncie, IN | |
| Bowling Green State University | Bowling Green, OH | |
| Clemson University | Clemson, SC | |
| Colorado School of Mines | Golden, CO | |
| Colorado State University | Fort Collins, CO | 92.4 |
| Florida Atlantic University | Boca Raton, FL | |
| Florida International University | Miami, FL | |
| Florida State University | Tallahassee, FL | |
| Georgia Institute of Technology | Atlanta, GA | |
| Georgia State University | Atlanta, GA | |
| Idaho State University | Pocatello, ID | |
| Indiana University | Bloomington, IN | 86.9 |
| Iowa State University | Ames, IA | |
| Kansas State University | Manhattan, KS | |
| Kent State University | Kent, OH | 85.0 |
| Louisiana State University and Agricultural & Mechanical College | Baton Rouge, LA | 92.2 |
| Louisiana Tech University | Ruston, LA | |
| Miami University | Oxford, OH | 97.4 |
| Michigan State University | East Lansing, MI | |
| Michigan Technological University | Houghton, MI | |
| Mississippi State University | Mississippi State, MS | |
| Montana State University | Bozeman, MT | 85.0 |
| New Jersey Institute of Technology | Newark, NJ | |
| New Mexico State University | Las Cruces, NM | 89.7 |
| North Carolina State University | Raleigh, NC | |
| North Dakota State University | Fargo, ND | |
| Northern Arizona University | Flagstaff, AZ | |
| Northern Illinois University | DeKalb, IL | |

*Note*. Blank cells indicate that institution is not part of a multi-campus system.

Table A1, continued

| Institution | Location | % of System Revenue |
|---|---|---|
| Ohio University | Athens, OH | 92.4 |
| Oklahoma State University | Stillwater, OK | 91.9 |
| Purdue University | West Lafayette, IN | 92.9 |
| Southern Illinois University | Carbondale, IL | |
| The University of Alabama | Tuscaloosa, AL | |
| The Ohio State University | Columbus, OH | 98.7 |
| University of Akron | Akron, OH | |
| University of Alabama- Birmingham | Birmingham, AL | |
| University of Alabama- Huntsville | Huntsville, AL | |
| University of Arizona | Tucson, AZ | |
| University of Arkansas | Fayetteville, AR | |
| University of Central Florida | Orlando, FL | |
| University of Cincinnati | Cincinnati, OH | 94.7 |
| University of Connecticut | Storrs, CT | |
| University of Florida | Gainesville, FL | |
| University of Georgia | Athens, GA | |
| University of Hawaii at Manoa | Honolulu, HI | 85.0 |
| University of Iowa | Iowa City, IA | |
| University of Kansas | Lawrence, KS | |
| University of Kentucky | Lexington, KY | |
| University of Louisville | Louisville, KY | |
| University of Michigan | Ann Arbor | 97.0 |
| University of Minnesota- Twin Cities | Minneapolis, MN | 91.0 |
| University of New Hampshire | Durham, NH | 98.1 |
| University of New Mexico | Albuquerque, NM | 98.4 |
| University of North Carolina | Chapel Hill, NC | |
| University of North Carolina- Greensboro | Greensboro, NC | |
| University of North Dakota | Grand Forks, ND | |
| University of Oklahoma | Norman, OK | |
| University of Rhode Island | Kingston, RI | |
| University of South Alabama | Mobile, AL | |
| University of South Carolina | Columbia, SC | 85.0 |

*Note*. Blank cells indicate that institution is not part of a multi-campus system.

Table A1, continued

| Institution | Location | % of System Revenue |
|---|---|---|
| University of South Florida | Tampa, FL | 94.7 |
| University of Toledo | Toledo, OH | |
| University of Utah | Salt Lake City, UT | |
| University of Vermont | Burlington, VT | |
| University of Virginia | Charlottesville, VA | |
| University of Washington | Seattle, WA | 99.3 |
| Virginia Commonwealth University | Richmond, VA | |
| Virginia Polytechnic Institute and State University | Blacksburg, VA | |
| Washington State University | Pullman, WA | |
| West Virginia University | Morgantown, WV | 96.6 |
| Western Michigan University | Kalamazoo, MI | |
| Wright State University | Dayton, OH | 97.2 |

*Note*. Blank cells indicate that institution is not part of a multi-campus system.

Table A2

*Excluded Institutions*

| Institution | Location | Reason for Omitting |
|---|---|---|
| Cleveland State University | Cleveland, OH | No published ratings prior to July 2012 |
| College of William and Mary | Williamsburg, VA | Only published rating in December 2006 |
| CUNY Graduate School and University Center | New York | Primarily graduate education; only rated at the system level |
| George mason University | Fairfax, VA | No published ratings |
| Indiana University- Purdue University | Indianapolis, IN | No published ratings |
| Jackson State University | Jackson, MS | First published rating in July 2006 |
| Missouri University of Science and Technology | Rolla, MO | No published ratings |
| North Carolina A&T State University | Greensboro, NC | First published rating in November 2011 |
| Old Dominion University | Norfolk, VA | No published ratings |
| Oregon State University | Corvallis, OR | Prior to 2015, rated at state level |
| Pennsylvania State University | University Park, PA | Reports with FASB |
| Portland State University | Portland, OR | Earliest rating September 2008 |
| Rutgers University | New Brunswick, NJ | Missing data |
| Rutgers University | Newark, NJ | Not rated |
| San Diego State University | San Diego, CA | No published ratings |
| South Dakota State University | Brookings, SD | Rated at the state level |
| Stony Brook University | Stony Brook, NY | Rated as part of SUNY system; average operating revenue = 25.9 |
| SUNY Albany | Albany, NY | Rated as part of SUNY system; average operating revenue = 8.3 |
| SUNY Binghamton | Binghamton, NY | Rated as part of SUNY system; average operating revenue = 4.2 |
| SUNY College of Environmental Science and Forestry | Syracuse, NY | Rated as part of the SUNY system; average operating revenue = .59 |
| Texas A& M University | College Station, TX | Rated as part of system; average operating revenue = 76.8 |
| Texas Tech University | Lubbock, TX | Rated as part of system; average operating revenue = 62.7 |

*Note*. Average operating revenue listed as % of system; FASB = Financial Accounting Standards Board.

Table A2, continued

| Institution | Location | Reason for Omitting |
|---|---|---|
| Temple University | Philadelphia, PA | Reports with FASB |
| The University of Montana | Missoula, MT | First published rating in December 2010 |
| The University of Tennessee | Knoxville, TN | No published ratings |
| The University of Texas | Arlington, TX | Rated as part of system; average operating revenue = 4.8 |
| The University of Texas | Austin, TX | Rated as part of system; average operating revenue = 24.1 |
| The University of Texas | Dallas, TX | Rated as part of system; average operating revenue = 3.5 |
| The University of Texas | El Paso, TX | Rate as part of system; average operating revenue = 3.6 |
| The University of Texas | San Antonio, TX | Rated as part of system; average operating revenue = 4.6 |
| University at Buffalo | Buffalo, NY | Rated as part of SUNY system; average operating revenue = 9.2 |
| University of Alaska | Fairbanks, AK | Multi-campus university; average operating revenue = 58.0 |
| University of California | Berkeley, CA | Rated as part of system; average operating revenue = 6.9 |
| University of California | Davis, CA | Rated as part of system; average operating revenue = 12.8 |
| University of California | Irvine, CA | Rated as part of system; average operating revenue = 8.0 |
| University of California | Los Angeles, CA | Rated as part of system; average operating revenue = 20.0 |
| University of California | Riverside, CA | Rated as part of system; average operating revenue = 1.8 |
| University of California | San Diego, CA | Rated as part of system; average operating revenue = 12.6 |
| University of California | Santa Barbara, CA | Rated as part of system; average operating revenue = 2.8 |
| University of California | Santa Cruz | Rated as part of system; average operating revenue = 2.0 |
| University of Colorado | Boulder, CO | Rated as part of system; average operating revenue = 52.2 |
| University of Colorado | Denver, CO | Rated as part of system; average operating revenue = 40.6 |

*Note*. Average operating revenue listed as % of system; FASB = Financial Accounting Standards Board.

Table A2, continued

| Institution | Location | Reason for Omitting |
|---|---|---|
| University of Delaware | Newark, DE | No published ratings before November 2010 |
| University of Houston | Houston, TX | Rated as part of system; average operating revenue = 77.7 |
| University of Illinois | Chicago, IL | Rated as part of system; average operating revenue = 54.0 |
| University of Illinois Urbana | Champaign, IL | Rated as part of system; average operating revenue = 45.0 |
| University of Louisiana at Lafayette | Lafayette, LA | No published ratings |
| University of Maine | Dallas, TX | No published ratings |
| University of Maryland- Baltimore County | Baltimore, MD | Rated as part of system; average operating revenue = 10.5 |
| University of Maryland, College Park | College Park, MD | Rated as part of system; average operating revenue = 46.5 |
| University of Massachusetts | Amherst, MA | Rated as part of system; average operating revenue = 30.9 |
| University of Massachusetts | Boston, MA | Rated as part of system; average operating revenue = 9.4 |
| University of Massachusetts | Lowell, MA | Rated as part of system; average operating revenue = 8.2 |
| University of Memphis | Memphis, TN | Not rated |
| University of Mississippi | Oxford, MS | Only published rating is on August 2013 |
| University of Missouri | Columbia, MO | Rated as part of system; average operating revenue = 77.8 |
| University of Missouri | Kansas City, MO | Rated as part of system; average operating revenue = 12.3 |
| University of Missouri, | St. Louis, MO | Rated as part of system; average operating revenue = 7.5 |
| University of Nebraska | Lincoln, NE | Rated as part of system; average operating revenue = 75.0 |
| University of Nevada | Las Vegas, NV | Rated as part of system; average operating revenue = 48.3 |
| University of Nevada | Reno, NV | Rated as part of system; average operating revenue = 51.8 |
| University of New Orleans | New Orleans, LA | Missing data |
| University of North Texas | Denton, TX | Rated as part of system; average operating revenue = 73.0 |

*Note*. Average operating revenue listed as % of system.

Table A2, continued

| Institution | Location | Reason for Omitting |
|---|---|---|
| University of Oregon | Eugene, OR | Rated at the state level prior to 2015 |
| University of Pittsburg | Pittsburg, PA | Reports with FASB |
| University of Puerto Rico | Rio Piedras | Rated as part of system; average operating revenue = 15.7 |
| University of South Dakota | Vermillion, SD | Rated at the state level |
| University of South Florida | Sarasota, FL | Rated as part of system; average operating revenue = 1.3 |
| University of South Florida | St Petersburg, FL | Rated as part of system; average operating revenue = 4.1 |
| University of South Florida Polytechnic | Lakeland, FL | Not rated |
| University of Southern Mississippi | Hattiesburg, MS | First published rating in April 2013 |
| University of Wisconsin | Madison, WI | Rated as part of system; average operating revenue = 55.3 |
| University of Wisconsin | Milwaukee | Rated as part of system; average operating revenue = 11.0 |
| University of Wyoming | Laramie, WY | First published rating in April 2010 |
| Utah State University | Logan, UT | Not rated |
| Wayne State University | Detroit, MI | First published rating in February 2008 |
| Wichita State University | Wichita, KS | Initially rated in May 2012 |

*Note*. Average operating revenue listed as % of system; FASB = Financial Accounting Standards Board.

# APPENDIX B

# CONTINGENCY TABLES

Table B1

*Debt Limit Counts*

| Debt Limit | Institutional Credit Rating | | | | | | |
|---|---|---|---|---|---|---|---|
| | ≤ A3 | A2 | A1 | Aa3 | Aa2 | ≥ Aa1 | Total |
| No | 1 | 15 | 67 | 20 | 8 | 16 | 127 |
| Yes | 20 | 100 | 205 | 233 | 136 | 79 | 773 |

Table B2

*High Governing Board Regulation Counts*

| | Institutional Credit Rating | | | | | | |
|---|---|---|---|---|---|---|---|
| High Regulation | ≤ A3 | A2 | A1 | Aa3 | Aa2 | ≥ Aa1 | Total |
| No | 12 | 22 | 30 | 55 | 32 | 42 | 193 |
| Yes | 9 | 93 | 242 | 198 | 112 | 53 | 707 |

Table B3

*Academic Medical Center Counts*

| | Institutional Credit Rating | | | | | | |
|---|---|---|---|---|---|---|---|
| High Regulation | ≤ A3 | A2 | A1 | Aa3 | Aa2 | ≥ Aa1 | Total |
| No | 20 | 90 | 204 | 161 | 65 | 19 | 559 |
| No | 1 | 25 | 68 | 92 | 79 | 76 | 341 |

Table B4

*High State Credit Rating Counts*

| | Institutional Credit Rating | | | | | | |
|---|---|---|---|---|---|---|---|
| High State Rating | ≤ A3 | A2 | A1 | Aa3 | Aa2 | ≥ Aa1 | Total |
| No | 17 | 44 | 79 | 38 | 10 | 5 | 193 |
| Yes | 4 | 71 | 193 | 215 | 134 | 90 | 707 |

# APPENDIX C

# MULTIDIMENSIONAL CONTINGENCY TABLES

Table C1

*Debt Limit × High Regulation*

| | | Institutional Credit Rating | | | | | |
|---|---|---|---|---|---|---|---|
| Debt Limit | High Regulation | ≤ A3 | A2 | A1 | Aa3 | Aa2 | ≥ Aa1 |
| No | No | 0 | 9 | 17 | 4 | 8 | 16 |
| | Yes | 1 | 6 | 50 | 16 | 0 | 0 |
| Yes | No | 12 | 13 | 13 | 51 | 24 | 26 |
| | Yes | 8 | 87 | 192 | 182 | 112 | 53 |

Table C2

*Debt Limit × Academic Medical Center*

| | | Institutional Credit Rating | | | | | |
|---|---|---|---|---|---|---|---|
| Debt Limit | AMC | ≤ A3 | A2 | A1 | Aa3 | Aa2 | ≥ Aa1 |
| No | No | 1 | 14 | 47 | 17 | 8 | 4 |
| | Yes | 0 | 1 | 20 | 3 | 0 | 12 |
| Yes | No | 19 | 76 | 157 | 144 | 57 | 15 |
| | Yes | 1 | 24 | 48 | 89 | 79 | 64 |

Table C3

*Debt Limit × High State Credit Rating*

| | | Institutional Credit Rating | | | | | |
|---|---|---|---|---|---|---|---|
| Debt Limit | High State Rating | ≤ A3 | A2 | A1 | Aa3 | Aa2 | ≥ Aa1 |
| No | No | 1 | 7 | 26 | 2 | 3 | 5 |
| | Yes | 0 | 8 | 41 | 18 | 5 | 11 |
| Yes | No | 16 | 37 | 53 | 36 | 7 | 0 |
| | Yes | 4 | 63 | 152 | 197 | 129 | 79 |

Table C4

*High Regulation × Academic Medical Center*

| | | Institutional Credit Rating | | | | | |
|---|---|---|---|---|---|---|---|
| High Regulation | AMC | ≤ A3 | A2 | A1 | Aa3 | Aa2 | ≥ Aa1 |
| No | No | 12 | 15 | 21 | 23 | 16 | 4 |
| | Yes | 0 | 7 | 9 | 32 | 16 | 38 |
| Yes | No | 8 | 75 | 183 | 138 | 49 | 15 |
| | Yes | 1 | 18 | 59 | 60 | 63 | 38 |

Table C5

*High Regulation × High State Credit Rating*

| | | Institutional Credit Rating | | | | | |
|---|---|---|---|---|---|---|---|
| High Regulation | High State Rating | ≤ A3 | A2 | A1 | Aa3 | Aa2 | ≥ Aa1 |
| No | No | 9 | 14 | 12 | 1 | 3 | 5 |
| | Yes | 3 | 8 | 18 | 54 | 29 | 37 |
| Yes | No | 8 | 30 | 67 | 37 | 7 | 0 |
| | Yes | 1 | 63 | 175 | 161 | 105 | 53 |

Table C6

*Academic Medical Center × High State Credit Rating*

| | | Institutional Credit Rating | | | | | |
|---|---|---|---|---|---|---|---|
| AMC | High State Rating | ≤ A3 | A2 | A1 | Aa3 | Aa2 | ≥ Aa1 |
| No | No | 16 | 33 | 53 | 20 | 4 | 1 |
| | Yes | 4 | 57 | 151 | 141 | 61 | 18 |
| Yes | No | 1 | 11 | 26 | 18 | 6 | 4 |
| | Yes | 0 | 14 | 42 | 74 | 73 | 72 |

# APPENDIX D

# SCATTERPLOTS

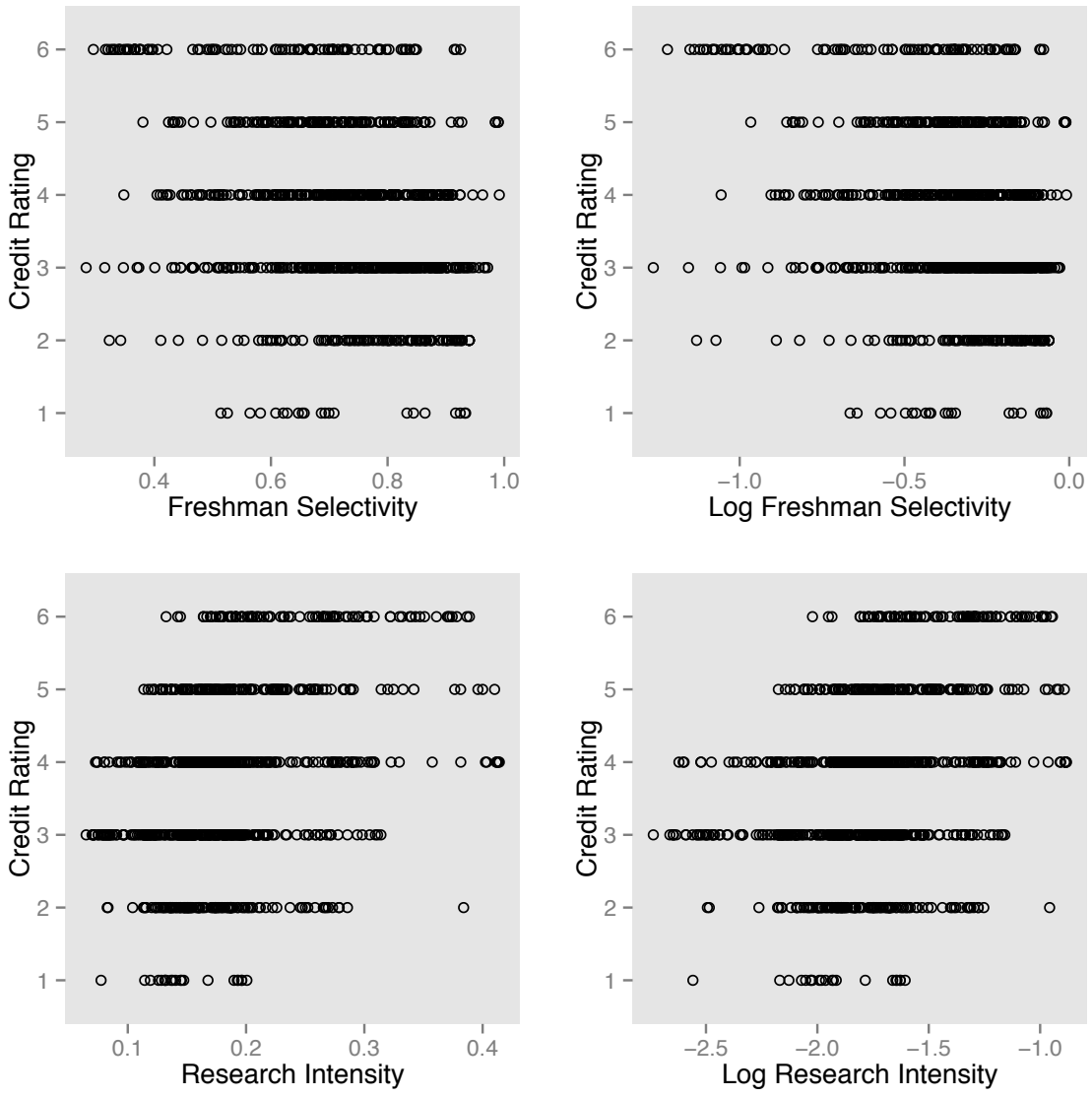


*Figure D1*. Distribution of Freshman Selectivity and Research Intensity among Response Categories.

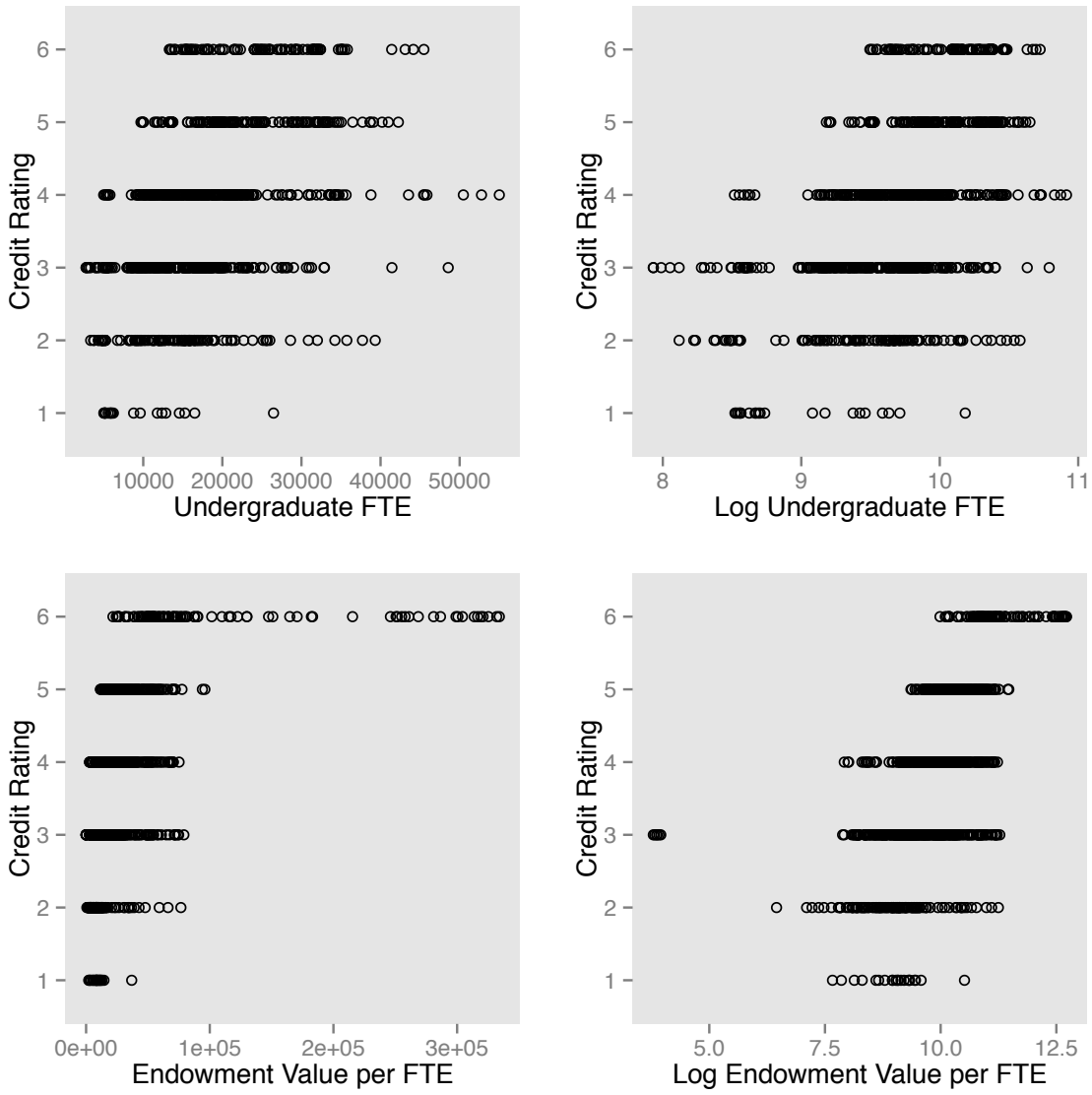


*Figure D2*. Distribution of Undergraduate FTEs and Endowment Value among Response Categories.

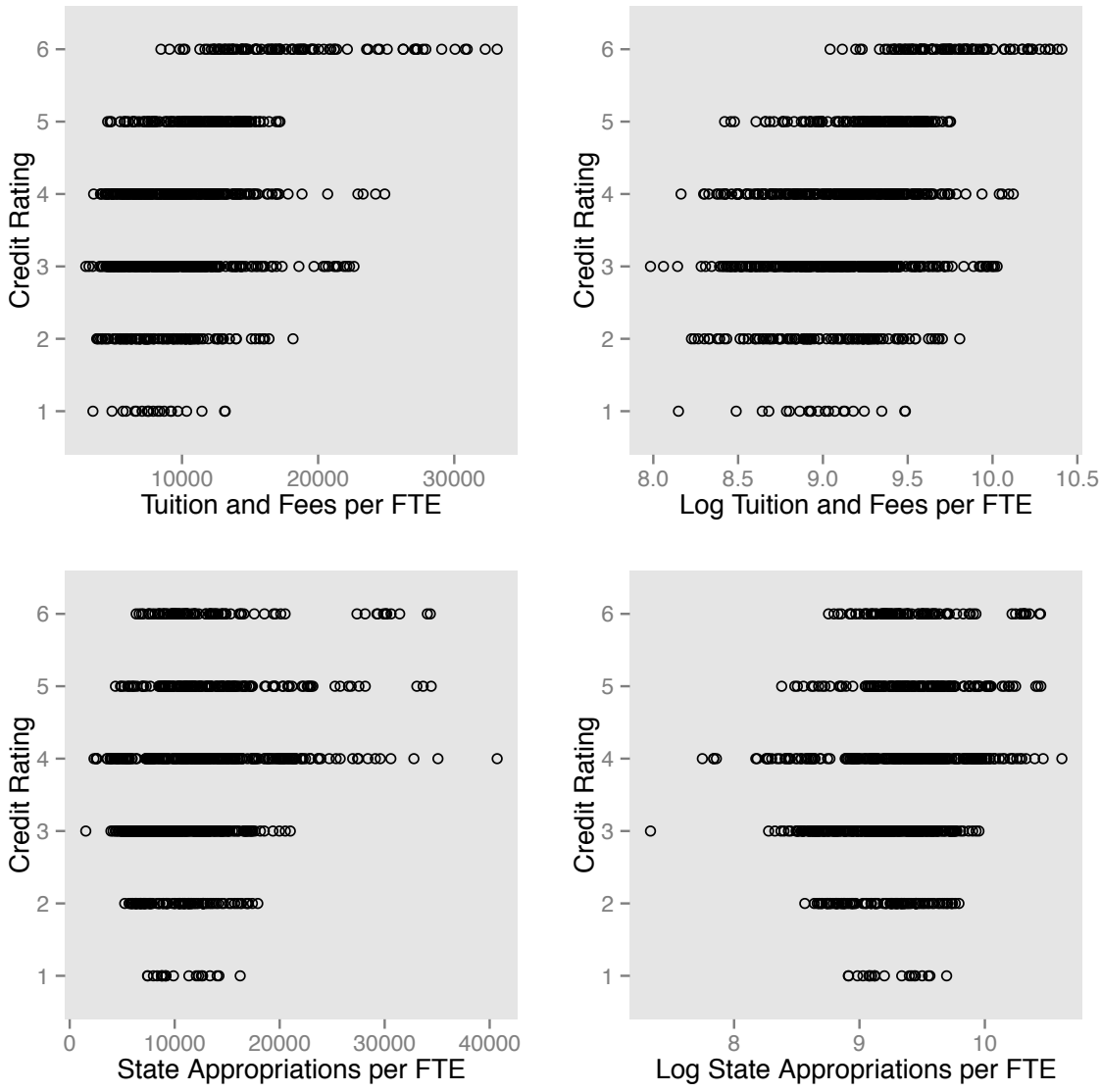


*Figure D3*. Distribution of Tuition and Fees and State Appropriations among Response Categories.

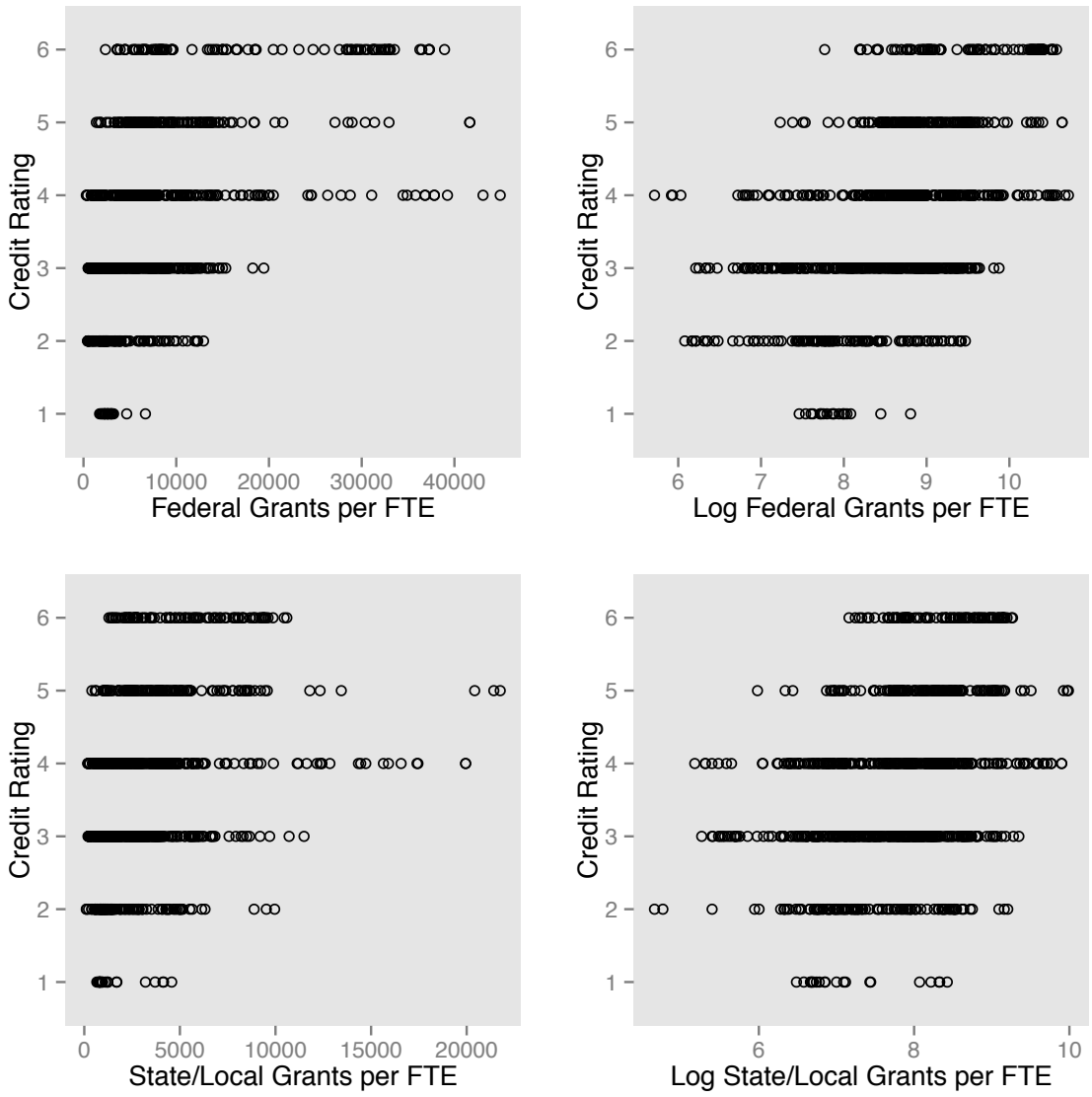


*Figure D4*. Distribution of Federal and State/Local Operating Grants among Response Categories.

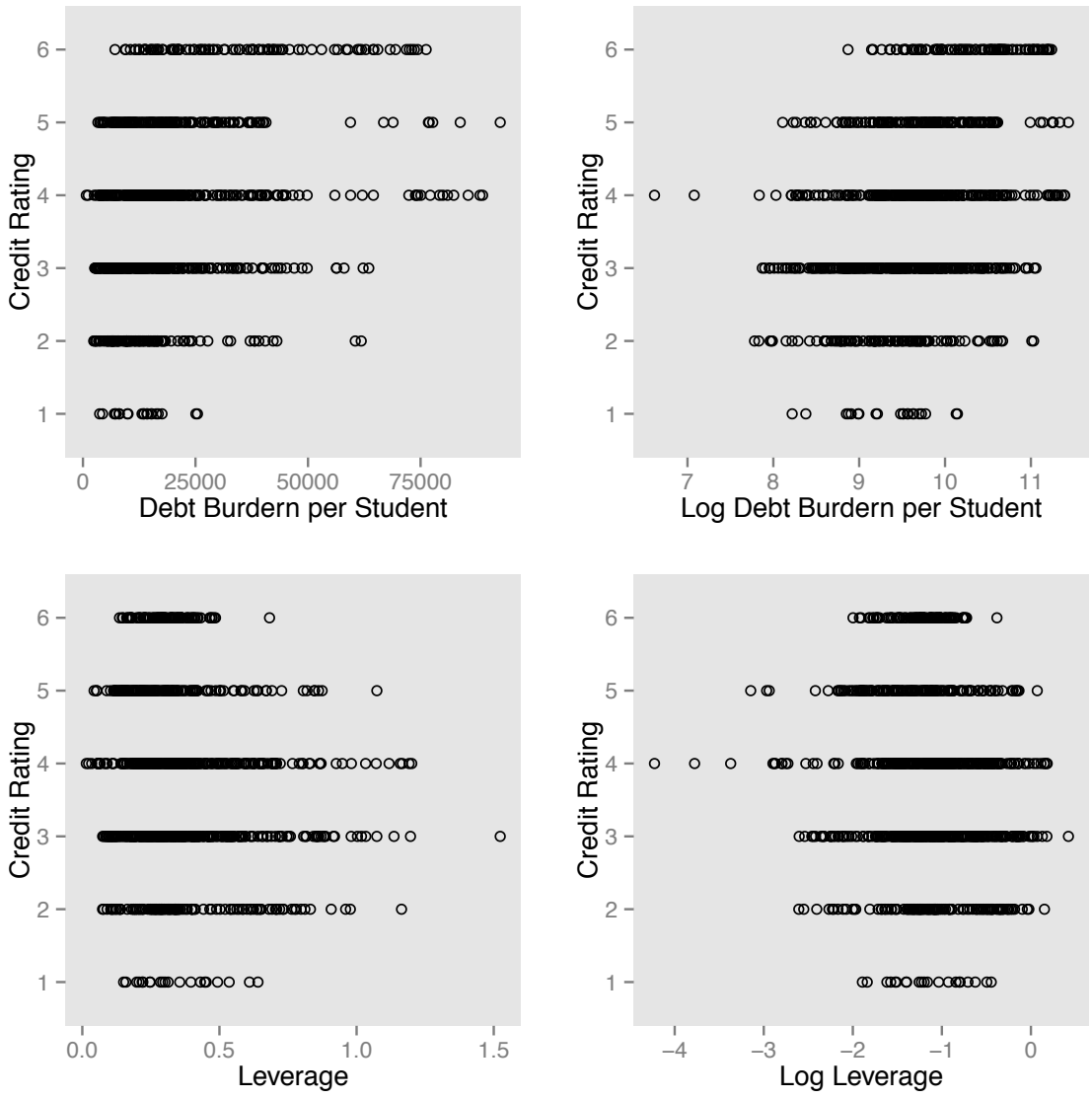


*Figure D5*. Distribution of Debt Burden per Student and Leverage among Response Categories.

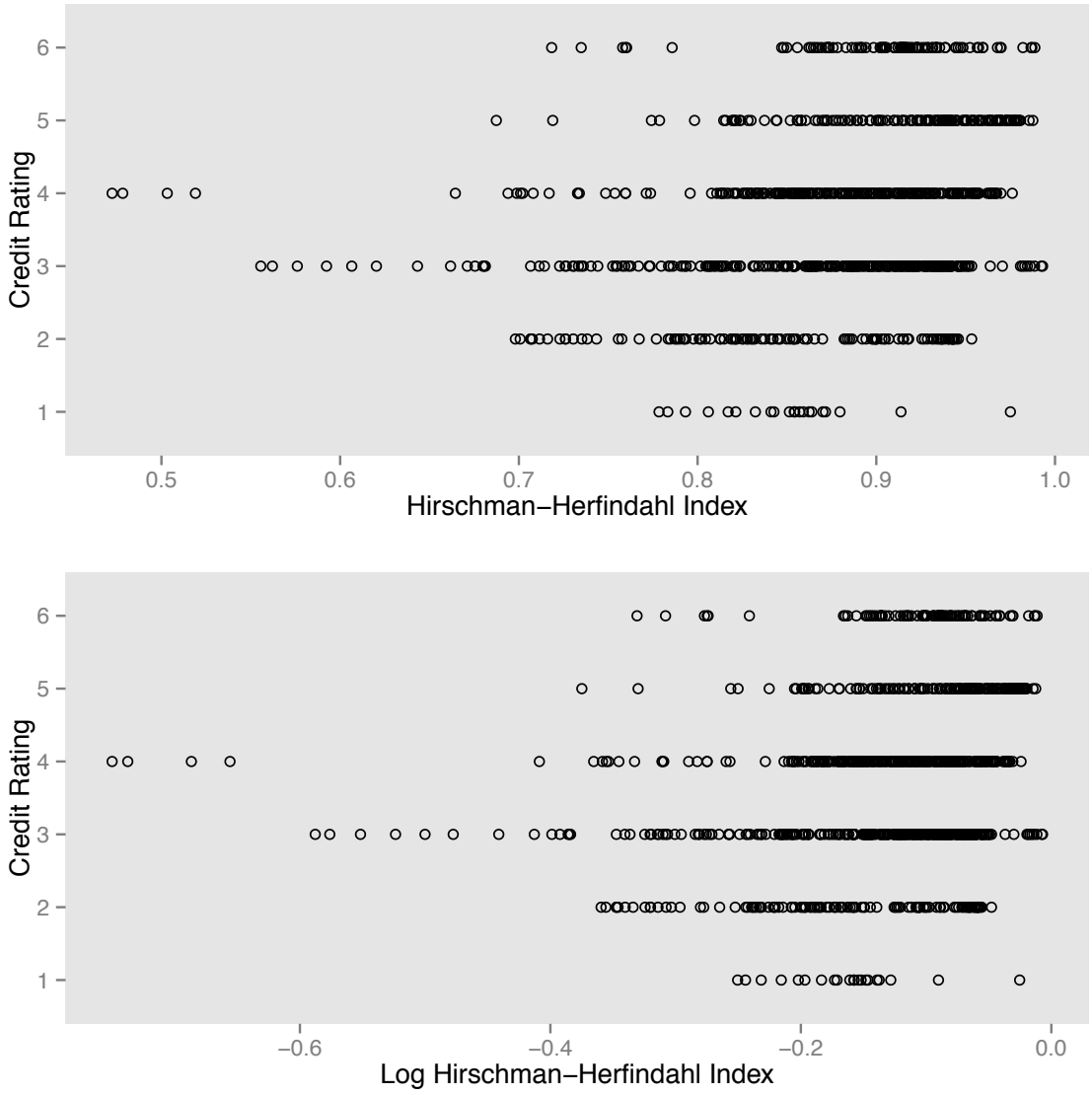


*Figure D6*. Distribution of Hirschman-Herfindahl Index among Response Categories.

# APPENDIX E

# AVERAGE MARGINAL EFFECTS

| Variable | ≤ A3 | A2 | A1 | Aa3 | Aa2 | ≥ Aa1 |
|---|---|---|---|---|---|---|
| Freshman Selectivity | .055** \| .054** | .125** \| .135** | .099** \| .101** | -.049* \| -.041* | -.124** \| -.141** | -.107*** \| -.109*** |
| Research Intensity | .081 \| .066 | .183 \| .167 | .145 \| .125 | -.071 \| -.050 | -182 \| -.174 | -.156 \| -.134 |
| Undergraduate Full-Time Equivalents (ln) | -.065*** \| -.061*** | -.148*** \| -.153*** | -.118*** \| -.115*** | .058*** \| .046** | .147*** \| .159*** | .126*** \| .123*** |
| Tuition and Fees per FTE (ln) | -.036** \| -.030* | -.081** \| -.074** | -.064** \| -.056** | .032* \| .022 | .080*** \| .077** | .069*** \| .050** |
| State Appropriations per FTE (ln) | -.009 \| -.007 | -.020 \| -.018 | -.016 \| -.013 | .008 \| .005 | .020 \| .018 | .017 \| .014 |
| Federal Operating Grants and Contracts per FTE (ln) | -.025*** \| -.023** | -.057*** \| -.058*** | -.046*** \| -.044*** | .022*** \| .017** | .057*** \| .060*** | .049*** \| .047*** |

***denotes statistical significance at the .01 level; **denotes statistical significance at the .05 level; *denotes statistical significance at the .10 level

Table E1

*Ordered Probit and Ordered Logit Marginal Effects for Revenue Structure (without recession variable)*

| Variable | ≤ A3 | A2 | A1 | Aa3 | Aa2 | ≥ Aa1 |
|---|---|---|---|---|---|---|
| State and Local Operating Grants and Contracts per FTE (ln) | .009** \| .009* | .021** \| .022** | .017** \| .017** | -.008* \| -.007 | -.021** \| -.023** | -.018** \| -.018** |
| Endowment Value per FTE (ln) | -.017* \| -.018* | -.037** \| -.046* | -.030** \| -.035** | .015** \| .014* | .037** \| .048* | .032** \| .037** |
| Academic Medical Center (AMC) | .018 \| .019 | .033 \| .038* | .024* \| .025** | -.014 \| -.012 | -.033* \| -.039* | -.029* \| -.031* |
| High Regulation | -.004 \| -.004 | -.008 \| -.009 | -.006 \| -.006 | .003 \| .003 | .008 \| .009 | .007 \| .007 |
| Debt Limit | -.008 \| -.008 | -.017 \| -.020 | -.013 \| -.014 | .008 \| .008 | .016 \| .020 | .013 \| .015 |
| High State Credit Rating | -.040** \| -.035** | -.087*** \| -.087*** | -.058*** \| -.054*** | .056*** \| .050** | .075*** \| .073*** | .055*** \| .052*** |
| Debt Burden per Student (ln) | -.032** \| -.029** | -.072*** \| -.072** | -.058*** \| -.054** | .028** \| .022* | .072*** \| .075*** | .062*** \| .058*** |
| Leverage | .10** \| .080* | .215** \| .203** | .171*** \| .152** | -.084* \| -.061 | -.214*** \| -.211** | -.184*** \| -.163** |

***denotes statistical significance at the .01 level; **denotes statistical significance at the .05 level; *denotes statistical significance at the .10 level

Table E1, continued

| Variable | ≤ A3 | A2 | A1 | Aa3 | Aa2 | ≥ Aa1 |
|---|---|---|---|---|---|---|
| Revenue Diversification | -.092* \| -.076 | -.226** \| -.222* | -.211** \| -.191** | .106** \| .087* | .215** \| .214* | .208** \| .188* |
| Freshman Selectivity | .059*** \| .055** | .144** \| .162** | .135*** \| .139*** | -.068** \| -.064* | -.137*** \| -.156*** | -.132*** \| -.137*** |
| Research Intensity | .034 \| .030 | .083 \| .087 | .077 \| .074 | -.039 \| -.034 | -.079 \| -.083 | -.076 \| -.073 |
| Undergraduate Full-Time Equivalents (ln) | -.061*** \| -.054** | -.149*** \| -.158*** | -.139*** \| -.136*** | .070*** \| .062*** | .142*** \| .152*** | .137*** \| .133*** |
| Endowment Value per FTE (ln) | -.019** \| -.021* | -.047** \| -.060** | -.044** \| -.052*** | .022** \| .024*** | .045** \| .058** | .044** \| .051*** |
| Academic Medical Center (AMC) | .026* \| .026* | .048** \| .057** | .036*** \| .036*** | -.021* \| -.018* | -.045** \| -.053*** | -.045** \| -.047*** |
| High Regulation | -.003 \| -.003 | -.007 \| -.009 | -.006 \| -.007 | .004 \| .004 | .007 \| .008 | .006 \| .007 |

***denotes statistical significance at the .01 level; **denotes statistical significance at the .05 level; *denotes statistical significance at the .10 level

Table E2

*Ordered Probit and Ordered Logit Marginal Effects for Revenue Diversification*

| Variable | ≤ A3 | A2 | A1 | Aa3 | Aa2 | ≥ Aa1 |
|---|---|---|---|---|---|---|
| Debt Limit | -.003 \| -.005 | -.008 \| -.015 | -.007 \| -.012 | .004 \| .006 | .007 \| .014 | .007 \| .012 |
| High State Credit Rating | -.036** \| -.028* | -.084*** \| -.082*** | -.064*** \| -.056*** | .056*** \| .047** | .072*** \| .068*** | .055*** \| .051*** |
| Debt Burden per Student (ln) | -.053*** \| -.044** | -.128*** \| -.128*** | -.120*** \| -.110*** | .061*** \| .050** | .122*** \| .123*** | .119*** \| .108*** |
| Leverage | .120*** \| .097** | .293** \| .285*** | .274*** \| .245*** | -.138** \| -.112* | -.279*** \| -.275*** | -.270*** \| -.241*** |

***denotes statistical significance at the .01 level; **denotes statistical significance at the .05 level; *denotes statistical significance at the .10 level

Table E2, continued

| Variable | ≤ A3 | A2 | A1 | Aa3 | Aa2 | ≥ Aa1 |
|---|---|---|---|---|---|---|
| Recession | -.033*** \| -.031*** | -.067*** \| -.078*** | -.054*** \| -.058*** | .026** \| .026** | .063*** \| .070*** | .065*** \| .071*** |
| Freshman Selectivity | .033 \| .031 | .067 \| .077 | .054 \| .057 | -.026 \| -.026 | -.064 \| -.070 | -.065 \| -.070* |
| Research Intensity | .108 \| .083 | .219 \| .206 | .177 \| .152 | -.085 \| -.069 | -.207 \| -.185 | -.212 \| -.187 |
| Undergraduate Full-Time Equivalents (ln) | -.068*** \| -.059** | -.137*** \| -.146*** | -.111*** \| -.108** | .053*** \| .049** | .130*** \| .131*** | .133*** \| .133*** |
| Tuition and Fees per FTE (ln) | -.031** \| -.022 | -.063** \| -.055* | -.051** \| -.040* | .025* \| .018 | .060** \| .049* | .061** \| .050* |
| State Appropriations per FTE (ln) | -.021* \| -.017 | -.042* \| -.043* | -.034* \| -.032* | .016 \| .014 | .040** \| .039* | .041* \| .039* |
| Federal Operating Grants and Contracts per FTE (ln) | -.031*** \| -.025** | -.063*** \| -.063*** | -.051*** \| -.047*** | .025*** \| .021*** | .060*** \| .057*** | .061*** \| .057*** |

***denotes statistical significance at the .01 level; **denotes statistical significance at the .05 level; *denotes statistical significance at the .10 level

Table E3

*Ordered Probit and Ordered Logit Marginal Effects for Revenue Structure (with recession variable)*

| Variable | ≤ A3 | A2 | A1 | Aa3 | Aa2 | ≥ Aa1 |
|---|---|---|---|---|---|---|
| Other Operating Grants and Contracts per FTE (ln) | .012** \| .010** | .023** \| .024** | .019** \| .018* | -.009** \| -.008* | -.022*** \| -.022*** | -.023*** \| -.022*** |
| Endowment Value per FTE (ln) | -.020** \| -.022* | -.041** \| -.055** | -.033** \| -.041** | .016** \| .018** | .039** \| .049** | .040** \| .050** |
| Academic Medical Center (AMC) | .021 \| .024 | .034* \| .043** | .025** \| .028* | -.014 \| -.015 | -.032* \| -.039** | -.034* \| -.041** |
| High Regulation | -.006 \| -.004 | -.011 \| -.009 | -.008 \| -.006 | .004 \| .003 | .010 \| .008 | .034 \| .008 |
| Debt Limit | -.007 \| -.008 | -.013 \| -.018 | -.010 \| -.013 | .006 \| .007 | .012 \| .016 | .012 \| .015 |
| High State Credit Rating | -.038** \| -.029* | -.073*** \| -.069*** | -.054*** \| -.049*** | .048** \| .041* | .064*** \| .058*** | .054*** \| .049*** |
| Debt Burden per Student (ln) | -.025** \| -.021* | -.051** \| -.052** | -.041** \| -.038* | .020* \| .017 | .048** \| .046** | .049** \| .047** |
| Leverage | .092** \| .075* | .185** \| .186* | .149** \| .138* | -.072* \| -.062 | -.175** \| -.167** | -.179*** \| -.169** |

***denotes statistical significance at the .01 level; **denotes statistical significance at the .05 level; *denotes statistical significance at the .10 level

Table E3, continued

# APPENDIX F

# THRESHOLD PARAMETER ESTIMATES

Table F1

*Threshold Coefficients for Revenue Structure Models (without recession)*

| Threshold | Ordered Probit (Robust Standard Errors) | Ordered Logit (Robust Standard Errors) |
|---|---|---|
| Threshold 1 \| 2 | 37.53<br>(3.62) | 65.57<br>(6.55) |
| Threshold 2 \| 3 | 39.03<br>(3.59) | 68.36<br>(6.45) |
| Threshold 3 \| 4 | 40.76<br>(3.62) | 71.48<br>(6.53) |
| Threshold 4 \| 5 | 42.28<br>(3.67) | 74.13<br>(6.63) |
| Threshold 5 \| 6 | 43.70<br>(3.70) | 76.68<br>(6.68) |

Table F2

*Threshold Coefficients for Revenue Diversification Models*

| Threshold | Ordered Probit (Robust Standard Errors) | Ordered Logit (Robust Standard Errors) |
|---|---|---|
| Threshold 1\|2 | 30.84<br>(3.49) | 55.69<br>(6.82) |
| Threshold 2\|3 | 32.27<br>(3.50) | 58.48<br>(6.83) |
| Threshold 3\|4 | 33.88<br>(3.56) | 61.37<br>(6.96) |
| Threshold 4\|5 | 35.32<br>(3.63) | 63.90<br>(7.11) |
| Threshold 5\|6 | 36.60<br>(3.70) | 66.21<br>(7.25) |

Table F3

*Threshold Coefficients for Revenue Structure Models (with recession variable)*

| Threshold | Ordered Probit<br>(Robust Standard Errors) | Ordered Logit<br>(Robust Standard Errors) |
|---|---|---|
| Threshold 1\|2 | 40.33<br>(3.95) | 71.43<br>(7.08) |
| Threshold 2\|3 | 41.85<br>(3.94) | 74.33<br>(7.02) |
| Threshold 3\|4 | 43.75<br>(3.98) | 77.81<br>(7.14) |
| Threshold 4\|5 | 45.39<br>(4.06) | 80.75<br>(7.32) |
| Threshold 5\|6 | 46.86<br>(4.10) | 83.39<br>(7.41) |

# APPENDIX G

# CORRELATION MATRIX

| | Selectivity | Research Intensity | Undergrad. FTE (ln) | T&F per FTE (ln) | State Appr. per FTE (ln) | Fed. Grant per FTE (ln) | State/Local Grant per FTE (ln) | Endowment per FTE (ln) | DBS (ln) | Leverage | HHI |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Freshman Selectivity | 1.00*** | | | | | | | | | | |
| Research Intensity | -.335*** | 1.00*** | | | | | | | | | |
| Undergrad FTE (ln) | -.205*** | .154*** | 1.00*** | | | | | | | | |
| T&F per FTE (ln) | -.108*** | .264*** | .062* | 1.00*** | | | | | | | |
| State Appr. per FTE (ln) | -.173*** | .493*** | .061* | -.185*** | 1.00*** | | | | | | |
| Fed Grant per FTE (ln) | -.178*** | .461*** | -.016 | .269*** | .515*** | 1.00*** | | | | | |
| State/Local Grant per FTE (ln) | -.174*** | .434*** | .014 | .214*** | .475*** | .681*** | 1.00*** | | | | |
| Endowment per FTE (ln) | -.189*** | .397*** | .187*** | .530*** | .283*** | .486*** | .446*** | 1.00*** | | | |
| DBS (ln) | -.020 | .343*** | -.080** | .548*** | .163*** | .447*** | .214*** | .477*** | 1.00*** | | |
| Leverage | .103*** | -.038 | -.146*** | .274*** | -.265*** | -.140*** | -.277*** | -.002 | .638*** | 1.00*** | |
| HHI | -.068** | .251*** | -.017 | .050 | .362*** | .689*** | .715*** | .253*** | .097*** | -.257*** | 1.00*** |

***denotes statistical significance at the .01 level; **denotes statistical significance at the .05 level; *denotes statistical significance at the .10 level

Table G

*Pearson Product-Moment Correlation Coefficients (Continuous Covariates)*

# APPENDIX H

## DEFINITIONS OF RELEVANT TERMS

- **Capital Budgets**- capital budgets address revenues and expenses for multi-year projects. Typical projects included in capital budgets are construction and acquisition of physical plants and campus infrastructure. Some examples include new building construction, large building renewal projects, facility upgrades, maintenance, and major technology/infrastructure upgrades.
- **Credit Ratings**- Credit ratings are a measure of the likelihood that a debt issuer will make timely payments. Similarly, credit ratings also measure the probability that an issuer will default on a debt obligation. Credit ratings are typically expressed as a letter along with either a numeric or symbolic qualifier.
- **Exogenous**- In economics, something is said to be exogenous if forces outside of a system or model determine it. An example is macroeconomic shocks, such as recessions, which are exogenous to credit ratings. That is, forces outside of the credit ratings process determine these fiscal shocks.
- **Leverage**- In finance, leverage refers to the relationship between debt and equity. As the level of debt increases, compared to equity or assets, the level of leverage increases. In the context of credit ratings and capital budgeting, leverage can be understood as the use of debt to finance operations and capital projects. Leverage is usually expressed as a ratio of liabilities or debt to assets or equity.
- **Liquidity**- In finance, liquidity refers how easily assets can be converted into cash without losing much of their market value. Types of illiquid investments include real estate, futures, and options. Liquid investments include Mutual Funds, Treasury Bills, and cash.

- **Operating Budgets**- operating budgets include revenues and expenses for a fiscal year. Operating budgets are the primary university budgets, in that they address the day-to-day activities. Expenses and revenues from capital projects ultimately spillover into the operating budget, in that these plants require daily maintenance, staff, utilities, furniture, and bring in revenue from service charges.
- **Price-Sensitive Students**- Price-sensitive students are those who are more sensitive to changes in tuition and fee prices. In economic terms, these students tend to be the most elastic, in that they are the most responsive to price changes.