THE CONSEQUENCES OF REVENUE DIVERSIFICATION ON THE FINANCIAL AND RESEARCH OUTCOMES AT U. S. PUBLIC RESEARCH UNIVERSITIES

A Dissertation

by

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ABSTRACT

The decline in state funding for public research universities has brought about a global crisis. The current conditions, coupled with increased costs and the pressure to keep those costs low, is unlikely to normalize anytime soon. The volatility in state funding has prompted public institutions of higher education to seek alternative sources of funding. However, the consequences of diversifying revenue (i.e., finding alternative sources of funding) on financial stability and knowledge productivity are unclear, and thus demand further study. This research examines the consequences of revenue diversification on institutional financial and research outcomes at public research universities in the US, using hierarchical linear modeling, psychometric approaches, and mediation analysis. Panel data from 2006 to 2015 obtained from 81 public research universities via the Integrated Postsecondary Education Data System, Academic Analytics dataset, and national academies wesbsites (i.e., science, engineering, medicine, and education) were used to address three broad questions: (a) What are the consequences of revenue diversification on institutional financial stability? (b) What are the consequences of revenue diversification on institutional research productivity? and (c) How does institutional financial stability mediate the effects of revenue diversification on institutional research productivity?The analysis found that diversifying revenue did not have a positive effect on an institution's financial stability; on average, a one dollar increase in revenue diversification activities led to a 2.68 unit decrease in institutional financial stability. However, the results indicate that the change in financial stability over time was not statistically significant, and such changes significantly differed across

institutions. Institutions dependent on income from net tuition were more financially stable; they became less financially stable when they depended on income from the government. The findings also indicate that several measures of research productivity could be reduced to productivity inputs and outcomes. The high reliability of the two factors for measuring research productivity implies that the factors were accurate, reproducible, and consistent across time points.

The results also indicate that revenue diversification had a positive effect on research productivity. Further analysis found that while institutions dependent on income from tuition increased their research productivity, dependence on income from research and auxiliary services significantly reduced research productivity. However, depending on income from the government and private endowments did not affect research productivity. Finally, the results of the mediation analysis show that institutional financial stability did not influence the relationship between diversifying revenue and research productivity. The findings of this study provide a deeper insight into the consequences associated with diversifying revenue, how institutional functions relate, and the need to seek ways of keeping the funding gap from widening, all topics of importance to policymakers. For institutional leaders, this study suggests the need to develop sustainable long-term financial strategies and advocate for financial predictability.

DEDICATION

To dedicate this work to my late mom Jesca Ashifutswa Wekullo and late dad Sylvanus Rachami Wekullo would not do justice to my debt to them. I owe them everything. Papa “nende” mama, although you are not here to witness my success, I will continue to thank you. You instilled in me the seed of strong work ethics and perseverance that drives me to accomplish my goals and do them well.

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NOMENCLATURE

AAU	Assosciation of American Universities
CFI	Composite Financial Index
EPSRC	Engineering and Physical Sciences Research Council
EU	European Union
FTE	Full-Time Equivalent
GDP	Gross Domestic Product
HHI	Hirschman-Herfindahl Index
IPEDS	Integrated Postsecondary Educational Data System
MAP	Minimum Average Partial test
NCES	National Center for Education Statistics
NCSE	NACUBO-Commonfund Study of Endowments
PCA	Principal Component Analysis
SHEF	State Higher Education Finance
U.K.	United Kingdom
U.S.	United States

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CHAPTER I

INTRODUCTION

The decline in public funding for institutions of higher education has instigated a global emergency (Munroe-Blum & Rueda, 2013; Sanyal & Johnstone, 2011). In 2017, over 71% of higher education institutions were in the midst of a financial crisis. This was up from 56% in 2015 (Auter, 2017). Public support for higher education institutions is not only subsiding but also transforming in nature and form. Moreover, the cost of higher education and pressure to keep that cost low have both continued to increase (Stewart, 2008). The situation is unlikely to normalize anytime soon (Desrochers & Hurlburt, 2016; Doyle & Delaney, 2009; McLendon, Hearn, & Mokher, 2009; Mitchell & Leachman, 2014; Tandberg, 2008, 2010). In particular, Mortenson's (2012) analysis of public institutions over the past three decades has shown that despite a steadily growing demand for higher education, state investment has declined since 1980. Based on these trends, Mortenson projected that the average level of state support would reach zero by 2059, and sooner in some states.

Several reasons have been cited for the decline in state funding. These include a change in the role of the state and its relationship to higher education, a shift in the economy, advancements in technology, and changes in demographics that have made institutions more vulnerable (Altbach, Reisberg, & Rumbley, 2009; Johnstone, 2002b; Long, 2014; Sanyal & Johnstone, 2011). These factors have become increasingly powerful, exerting more pressure on institutions and challenging their capacity to successfully advance their mission. The steady decline in support for higher education has had two

main consequences. First, the decline has caused fear with regards to the dramatic increase in cost (up 400% since the early 1980s) (Auter, 2017), which has in turn led to lower student enrollment, decreased quality, loss of faculty positions, and uncertainty with regards to funding for operations (Doyle & Delaney, 2009). Second, the decline in state support has served as a wake-up call for universities, inspiring them to stop relying on government funding alone (Johnstone, 2002a; McGuinness, 2005; McLendon et al., 2009; Mitchell & Leachman, 2014; Munroe-Blum & Rueda, 2013). To survive and remain relevant, public institutions of higher education must find ways to adapt.

In a broad context, this study addresses the different ways in which public universities are responding to this decline in state support, and the consequences this has had on their core responsibilities and financial stability. Around the world, public institutions are employing different strategies to meet the demands of this new environment. For instance, in Canada the investment in higher education as a proportion of gross domestic product (GDP) declined by 50% between 1993 and 2013. The Canadian provinces "imposed sudden drastic funding cuts [to] their universities" (Munroe-Blum & Rueda, 2013, p. 19). To date, Canadian universities are still operating under these reduced budgets. Based on portfolio theory, Canadian universities are diversifying their income by partnering with commercial real estate and student residences, commercializing intellectual property, engaging students in innovative activities, and fostering increased international enrollment and fees (European University Association, 2010). A similar situation occurred in the European Union (EU). From 2004 to 2008, government spending on education as a percentage of GDP drastically declined. Nonetheless, enrollment continues to rise. In this time of economic crisis, some EU member states have amplified the call for institutions to

seek alternative sources of funding, as well as increase their collaboration with private institutions (Lung & Alexandra, 2012). In places like Japan, the United Kingdom, and Russia, state funding has been unstable and on the decline (Munroe-Blum & Rueda, 2013; Platonova, Bogomolova, Musarskiy, & Igumnov, 2015). The situation is even worse in developing countries because funding from alternative sources is insufficient. For instance, when analyzing international trends in university financing, Sanyal and Johnstone (2011) noted that the scarcity of public and private resources was so severe in developing countries that it necessitated the search for alternative sources of income.

The United States (US) is no exception. Its higher education system has long received disproportionately low levels of state funding. This trend began three decades ago with the fiscal crisis, resulting economic downturn, and consequent escalating healthcare costs (McGuinness, 2005). Since then, state appropriation has fluctuated in relation to the economy (Desrochers & Hurlburt, 2016). McGuinness (2005) and reports by SHEF (2016) and Delaney and Doyle (2007, 2011) noted that whenever the economy improved, state funding increased, and whenever the economy dropped, higher education institutions experienced severe cuts in state support. In most cases, universities are perceived as a "balance wheel" for the state budget. They are envisaged as having the ability to raise outside revenue in the form of tuition and fees, as well as from private sources. Doyle and Delaney (2009) and Delaney and Doyle (2007, 2011) also stated that in good times, the political attractiveness and benefits these institutions provide to the public make them the beneficiary of large budget increases.

Previous research has shown that since the last great recession in 2008, state funding for higher education has continued to decline (Mitchell & Leachman, 2014). In

2012, an average of 44% of the revenue from public institutions of higher education came from state appropriations; this figure dropped to 37% in 2013 (SHEF, 2014), and fell a further 0.7% in 2016 (SHEF, 2016). A report by SHEF (2016) further noted that funding from national, state, and local support was below pre-recession levels. These figures suggest that public institutions of higher education rely heavily on other sources of funding, including tuition.

The long-term financial health of public universities in America, and research institutions in particular, has been a concern for many stakeholders (American Academy of Arts and Sciences, 2015b; National Science Board, 2012). These schools are a critical fixture on the greater educational landscape. Several scholars have noted that public research universities are anchors of stability and growth in their respective regions (Altbach, 2015; American Academy of Arts and Sciences, 2015b, 2016a). They serve the nation's interests through research, discovery, and innovation, yielding immeasurable benefits by improving physical health, enhancing the economy, and bettering life in general (American Academy of Arts and Sciences, 2015b, 2016a).

As centers of discovery, research undertaken at public research universities has led to over 1,012 start-up companies and 879 new product licenses, as well as 6,680 patents and 15,953 applications between 2014 and 2015 alone (Association of University Technology Managers, 2016). American public research universities accounted for approximately 40% of the world's most successful institutions of higher education with regards to creating start-ups that support entrepreneurs (PitchBook, 2014). Moreover, though public research universities represent only 2.5% of the total number of institutions in the American system, they educate approximately 20% of US citizens (American

Academy of Arts and Sciences, 2016a). These institutions provide high-quality, affordable educations to a wide population of students, some of whom are from lower socioeconomic classes (American Academy of Arts and Sciences, 2015b, 2016a). At a minimal cost, these institutions provide academic expertise, technical assistance, and critical education and workforce development through regular engagement with the community and state governments (Leslie, Slaughter, Taylor, & Zhang, 2012).

Public, and in particular, research universities play a crucial role in the nation's economy; they need to be well funded. Surprisingly, however, government funding for these institutions is not commensurate with the public and social benefits they provide. In fact, the literature reports a pronounced decline in funding for public research institutions (American Academy of Arts and Sciences, 2015a, 2015b; SHEE0, 2014) that is greater than what is being seen in other areas of academia. It is widely believed that state appropriation comprises the largest area of support for these institutions, yet various studies have found that state funding for research institutions actually represents less than one-third of the total institutional revenue (American Academy of Arts and Sciences, 2015b; McLendon, Hearn, & Mokher, 2009). A report by the American Academy of Arts and Sciences (2015a) stated that "while public higher education, in general, [has] been hit by the cuts in state support, public research universities [have been] hit harder" (p. 12). For instance, between 2008 and 2013, states cut their support per fulltime equivalent (FTE) student in public institutions by 20%, whereas the reduction seen by public research universities was 28% (American Academy of Arts and Sciences, 2015a; SHEF, 2014). McLendon et al. (2009) indicated that the differences in state financing for research and

non-research universities is believed to have negative effects in the future on students, the education system, and society.

The emerging financial climate for higher education presents similar challenges for private and public universities. For both types of institution, funding agencies have resorted to competitive funding schemes that can have both positive and negative consequences. On the one hand, competitive funding may help improve quality and stimulate efficiency (Daugherty, Miller, Dossani, & Clifford, 2013). On the other hand, when coupled with a decline in state funding, it can endanger a university's financial sustainability, especially when institutions are required to co-fund a project. In such cases, universities are forced to spend their own resources or get additional funding from other areas, which further widens the funding gap (Estermann & Pruvot, 2011). There are burgeoning fears regarding how well public research universities will be able to compete with private institutions for faculty, students, and research support in this newly competitive world (Daniels & Spector, 2016).

Researchers and policy analysts have observed that public research universities have less flexibility to absorb budget cuts; in fact, these institutions invariably require higher than average operating budgets because they engage in a multiplicity of activities (McLendon, Mokher, & Doyle, 2009; National Science Board, 2012). If this trend continues and other sources of funding are not identified, these institutions' overall mission is at risk (Hearn, 2003; Namalefe, 2014). In particular, the continued decline in funding has had an adverse impact on the capacity of public research universities to provide quality education at affordable rates to a diverse student population (Mitchell, Leachman, & Masterson, 2016); a lack of funds will hamper these institutions' ability to attract and

retain high-caliber staff and maintain the quality of their research (Namalefe, 2014; National Science Board, 2012).

In response to declining state support, public research institutions are pursuing alternative sources of revenue, as well as engaging in cost-saving measures. They have increased net tuition and fees (Doyle & Delaney, 2009), derived revenue from sources such as external research grants and contracts, courted gifts from private donors, and found other ways to generate income from private and auxiliary services (American Academy of Arts and Sciences, 2015a; Franklin, 2007). Scholars have noted, however, that the rate at which these institutions are increasing their dependence on private sources of funding is troubling, because of the potential effect this might have on the core mission (Estermann & Pruvot, 2011). Resource dependence theorists, together with some analysts, have also warned that though there are benefits to increasing dependence on private funding, there are also unintended consequences that may negatively affect the core mission of public research universities (American Academy of Arts and Sciences, 2015b; Johnstone, 2002b; McGuinness, 2005; Pfeffer & Salancik, 1978; Tandberg, 2010b). Faculty and staff are not accustomed to generating income. Their engagement in entrepreneurial activities has raised concerns regarding the ability of these institutions to continue providing quality education and conducting innovative research that serves the public (National Science Board, 2012).

Statement of the Problem

Public research universities perform a unique and fundamental role in education (American Academy of Arts and Sciences, 2015b; Daniels & Spector, 2016). These institutions contribute immensely to national economic development, lead to scientific and technological discoveries, and educate and train over 20% of the skilled workforce, all at

minimal cost (American Academy of Arts and Sciences, 2015b; National Science Board, 2012); therefore, they deserve to be well supported by the state. However, these schools are regularly caught between ever-contracting state support and increasing state expectations, further challenging their capacity to meet their mission. How will these institutions survive in this challenging climate? This is a concern for many. Previous studies have shown that the volatility in state support has resulted in structure and policy changes that are forcing public research universities to explore alternative sources of funding.

The rationale at the heart of these diversity initiatives is not only to provide more revenue, but also gain stability and the freedom to pursue their intended mission (Estermann & Pruvot, 2011; Stewart, 2008). However, the literature is unclear regarding the effects of revenue diversification on these institutions' financial stability and knowledge production (Estermann & Pruvot, 2011). Researchers have shown that the trend towards greater diversification will continue in the coming years (Teixeira et al., 2014), but the literature on this topic is underdeveloped (Estermann & Pruvot, 2011; Webb, 2015). Previous studies have focused on revenue from industry, tuition, and fees, and the effects of commercialization on research outcomes and student achievement. A study by Webb (2015) that is closely related to the current research examined the impact of revenue diversification on institutional revenue per student in private universities. He proposed a subsequent study to "examine how revenue diversification affects [the] institutional mission" (p. 90) and determine whether revenue diversification initiatives empower institutions to improve certain outcomes or serve to open them to unforeseen risks. Teixeira et al. (2014) expressed a similar sentiment. Johnstone (2002b) also pointed out

that as higher education continues to explore ways of expanding non-government revenue, they must also consider "the limitations, complexities, and unintended consequences of diversifying sources of finance" (p. 45).

The current study is a response to the calls by Teixeira et al. (2014), Johnstone (2002b), and Webb (2015) to examine the consequences of revenue diversification on institutional outcomes. Unlike Webb, who focused only on private two- and four-year institutions for a five-year period, mainly during the recession, this research analyzed public research universities for a full decade, and thus provides deeper insights into market shifts that will help administrators develop successful long-term financial strategies.

Purpose of the Study

The purpose of this quantitative study is twofold: to examine the consequences of revenue diversification on: (a) institutional financial stability and (b) research productivity at public research universities in the US.

Research Questions

The following research questions guide this research:

1. What are the consequences of revenue diversification on institutional financial stability, and how does the effect vary across institutions, after controlling for state per capita income and membership in the Association of American Universities (AAU)?
2. What is the average change in institutional financial stability per year?
3. What are the effects over time of funding from the government, net tuition, endowments, research funds, and auxiliary services on institutional financial stability over time, after controlling for state per capita income and membership in the AAU?

4. What is the factorial structure and reliability of the factors underlying institutional research productivity?
5. What is the mean effect of diversifying revenue on institutional research productivity across all institutions, and how does the relationship between revenue diversification and research productivity vary by institution, after controlling for faculty workload?
6. What is the average change in research productivity per year? What are the effects of predictors (i.e., the government, net tuition, endowments, research funds, and auxiliary services) on institutional research productivity over time, after controlling for faculty workload?
7. Does institutional financial stability mediate the effects of revenue diversification on institutional research productivity?

Significance of the Study

This study makes several important contributions to the literature on financing in higher education, and thus will be useful to policymakers, administrators, and other stakeholders. First, in light of the burgeoning practice of revenue diversification, the results of this work will help to clarify the relationship between a diversified revenue stream and how well an institution's mission is met (Leslie et al., 2011; Webb, 2015), determine whether diversifying revenue increases innovative research productivity, and decide if such diversification actually leads to institutional financial stability (Teixeira et al., 2014). The results of this study add to the existing literature on the effects of revenue diversification, and thus will benefit the entire academic community. Second, with respect to policymakers, the findings provide a better understanding of the problems facing public research universities, and will inspire those in authority to seek ways of keeping the

funding gap from widening. The results also emphasize the importance of state funding in public research institutions, which is critical to the teaching, research, and service that fuel the nation's economic development.

Third, this analysis acts as a guide to higher education administrators and other stakeholders in developing sustainable long-term financial strategies, since the current literature tends to focus more on short-term and less on structural issues. In particular, the findings will guide public research university administrators as they seek to diversify their revenue sources, establish financial goals, measure progress, incorporate data analysis into their decision-making process, and share information about what revenue strategies appear to work. Finally, this study makes a statistical contribution by proposing valid indicators for measuring research productivity and financial stability. The composite financial index and measures of research productivity have the potential to provide new metrics for measuring institutional financial health and productivity.

Definition of Terms

The following terms were used in the development of this study. These terms are relevant to an understanding of both this research and its findings.

Financial Stability

The term "financial stability" has been defined in a variety of ways. Financial theory considers the concept of financial stability (or sustainability) to be the provision of financial independence, the ability to cover current liabilities (Sazonov, Kharlamova, Chekhovskaya, & Polyanskaya, 2015). The most obvious assumption is that financial stability is concerned with the capacity of an institution's financial system to resist economic shocks and fulfill its essential functions. With regards to higher education,

Stewart (2008) contended that financial stability has a broader meaning than simply surviving hard economic times, stating that financial stability should encompass the institution's investment in its staff, relationships with external institutions, and overall interest in innovation. According to Sazonov et al. (2015), financial stability should also include monitoring the financial health and risk of an institution. For instance, Lapovsky (2014) pointed out that higher education institutions are changing their business models by shifting their discounting policies and publishing lower tuition prices, increasing the enrollment of foreign students, collaborating with private agencies, and increasing operational efficiencies to ensure their financial longevity. In the current research, financial stability is defined as the ability of an institution's financial system to be financially independent, resist economic shocks, and invest resources to meet their core responsibilities.

Public Research Universities

In this study, "public research universities" are institutions that the Carnegie Classification of Institutions of Higher Education has deemed to have Very High Research Activity, as of 2015 (Indiana University Center for Postsecondary Research, 2016). They are "research intensive doctorate-granting institutions that receive a share of funding from state and local appropriations and serve as a critical component of the higher education landscape" (National Science Board, 2012, p. 2). They enroll a majority of undergraduate and graduate students, and maintain relatively low tuition levels compared to private institutions.

Revenue Diversification

The term "revenue diversification" has been used inconsistently in the study of higher education. Some scholars have employed it to refer to sources of income other than government funding and tuition (Hearn, 2003; Johnstone, 2002a), while others have used it as a substitute for new net revenue (Carroll, 2009; Hearn, 2003). The definition differs from study to study and from one context to another. For instance, Pfeffer and Salancik (1978) defined revenue diversification as a means of hedging against a decline in a single large source of revenue. They called it "an explicit attempt to avoid uncertainty" (p. 131). Conversely, Ziderman and Albrecht (1995) defined revenue diversification as the generation of income beyond government support, obtained through the commercialization of activities, technology transfer, consulting, and customized learning, as well as other actions such as adjusting financial decision-making and management. Scholars of higher education have repeatedly used this definition when discussing financial problems facing institutions of higher learning and when proposing ways for organizations to respond to economic austerity (Namalefe, 2014; Teixeira & Koryakina, 2013; Wangenge-Ouma, 2011; Webb, 2015). In this research, I define revenue diversification as a mechanism of finding additional or alternative sources of revenue other than public funding, which contributes to balancing the revenue structure of the institution.

Revenue Diversification Index

In this study, the "revenue diversification index" represents a quantifiable measure of an institution's reliance on revenue sources other than the government. The revenue diversification index shows the extent to which an institutional revenue structure is diversified relative to the theoretical maximum in a particular year. For this study, funding

for “very high” public research universities is categorized into five sources (i.e., government, net tuition, research, endowment, and auxiliary services). Computation of the revenue diversification index is discussed in Chapter III.

Research Productivity

Research productivity has been defined in a variety of ways, and appears to have different meanings to different scholars. In reference to higher education, research productivity is the extent faculty member engages in research activities, such as publishing in refereed journals, writing books and book chapters, presenting at conferences, developing experimental designs, producing artistic or creative works (Iqbal & Mahmood, 2011), conducting research, supervising graduate students , obtaining research grants, performing editorial duties, and procuring patents and licenses (Okiki, 2013). Similarly, Abramo and D’Angelo (2014) defined research activity as a production process where the inputs consist of human, tangible, and intangible resources, and the outputs are comprised of new knowledge that has a complex character and is either tangible (e.g., publications, patents, conference presentations, databases) or intangible (e.g., tacit knowledge, consulting activity) in nature. Since scholars’ understanding of these words tends to differ, in this study research productivity is a latent variable incorporating the concept of research input and outcomes, as well as tangible and intangible features that contribute to research productivity on both the individual and institutional levels.

From Theory to Concept

This section presents the theories framing this study, followed by a conceptual framework based on these theories and the literature reviewed.

Theoretical Framework

In this research, I used a combination of resource dependence and portfolio theories to frame the discussion of the consequences of revenue diversification on financial stability and research outcomes at public research universities. Using more than one theory is justified because higher education is multifaceted and faces various difficulties. Also, using more than one theoretical framework allows for a deeper examination of how financial and institutional outcomes relate to organizational behavior.

Resource Dependence Theory

Resource dependence theory, as an extension of the ideas supporting systems theory, has gained popularity through the works of Pfeffer and Salancik (1978, 2003). Resource dependence theory has been used widely, and its influence has spread to fields such as management, sociology, education, healthcare, public policy, and other related disciplines (Davis & Cobb, 2010). As one of the perspectives employed to examine organizational behavior, the theory's focus is on the context in which an organization operates, the extent to which it depends on various multiple external environments for resources, and how that dependence influences the institution's activities (Pfeffer, 2005; Pfeffer & Salancik, 1978). Researchers have thoroughly documented how organizations rely on their external environment to acquire resources vital to achieving their mission, enhancing their power, and gaining stability (Casciaro & Piskorski, 2005; Davis & Cobb, 2010; Malatesta & Smith, 2014; Pfeffer & Salancik, 1978, 2003). These researchers have argued that in a competitive environment with limited resources, the ability of an organization to acquire and maintain resources is vital to its survival. In some cases, organizations have had to yield to the demands of their external resource providers because

they hold resources that are crucial to the institution's survival (Pfeffer & Salancik, 1978, 2003).

Resource dependence theory rests on three fundamental assumptions. First, reliance on critical external resources influences an organization's choices and actions. Thus, the external environment in which an organization is located, including the pressures and constraints that emanate from the situation (Pfeffer & Salancik, 2003), can explain organizational decisions. The second assumption is that organizations are capable of changing in response to their environment. When the external environment houses crucial resources, an organization must enhance their autonomy, pursue their interests (Davis & Cobb, 2010, p. 23), and reduce uncertainty, as well as dependency (Pfeffer & Salancik, 2003). Similarly, several scholars have argued that organizations either change their goals to suit the available resources, or restructure to cope with new demands. Finally, resource dependence theorists assume that no organization is self–sufficient, and therefore all require dependence on external agencies for their survival. The only alternative is for them to collaborate with outside establishments that have the resources they seek (Casciaro & Piskorski, 2005; Malatesta & Smith, 2014; Pfeffer & Salancik, 1978, 2003).

These assumptions explain the environment in which public universities currently operate: one of persistent financial austerity. As Pfeffer and Salancik (1978) stated, public institutions have more external constraints than do private universities and other less prestigious institutions, as well as less power than the external agencies upon which they depend. In the current economic environment, public research universities are increasingly diversifying their sources of revenue, with the aim of reducing their dependence on state funding. Unfortunately, the power to determine whether an institution receives the

resources they need and how they may use them rests with external entities. In some cases, this exercise has undue influence over institutions, challenging their values, overall mission (Hearn, 2003), means of operation, and research outcomes (Pfeffer & Salancik, 1978, 2003; Namalefe, 2014).

Resource dependence theory is useful in explaining the relationships among higher education and their revenue sources and/or external actors. It can significantly assist in explaining the behavior, structure, stability, and changes in an organization (Nienhüser, 2008). In this study, this theory helped to clarify the influence of external actors on institutional decisions surrounding the choice to diversify sources of revenue. In addition, it helped explain how institutions' decision to diversify their funding sourses affected operations with regards to meeting the desired outcomes (Pfeffer, 2005; Pfeffer & Salancik, 1978). Moreover, resource dependence theory helped to elucidate how environmental constraints and institutional interdependence affect internal organizational dynamics (Pfeffer, 1978, 2005). For instance, several researchers have observed that institutions respond differently when faced with financial austerity (Hearn, 2003; Johnstone, 2002b; Leslie et al., 2012; Munroe-Blum & Rueda, 2013; Pfeffer, 2005; Pfeffer & Salancik, 1978; Sandal & Johnstone, 2011; Teixeira, Rocha, Biscaia, & Cardoso, 2014).

As stated above, dependence on a particular source of revenue may require an institution to submit to that source's demands (Hearn, 2003). In such cases, it is inevitable that the requirements of external supporters exert some influence on the nature and mission of the institution and the level of societal benefits the institution can provide. The same applies to the ways in which internal groups might respond to external pressures. Resource dependence theory stipulates that the institutional unit or department that contributes most

to the mission of the institution should be considered dominant over the others. It is important to note, though, that this theory has been criticized for its narrow scope. It only captures the context in which an institution is situated and the extent it depends on the external environment, rather than mutual interdependence. Also, it fails to explain the influence of dependence on the internal operations of an organization (Casciaro & Piskorski, 2005). These criticisms, among others, led to the need for portfolio theory to be incorporated as a complement.

Portfolio Theory

Modern portfolio theory, originally proposed by Markowitz in 1952, has been associated with public sector management and nonprofit revenue diversification (Carroll, 2005, 2009; Carroll & Stater, 2009), but it is becoming more commonly used in institutions of higher learning as they diversify revenue streams and search for self-sustainment and stability. Portfolio theory posits that diversifying funding streams can decrease the risk of financial crisis (Carroll & Stater, 2009; Mayer, Wang, Egginton, & Flint, 2012) by reducing excessive dependence on any single revenue source, stabilizing an institution's financial position, minimizing program disruption, and increasing efficiency. Primarily, these findings were obtained from a study on nonprofit organizations. In that study, Carroll and Stater (2009) used portfolio theory to address the question of whether revenue diversification stabilizes revenue for nonprofit organizations. The findings imply that a diversified portfolio encourages more stable income and promotes greater organizational longevity. In a different study, Mayer et al. (2012) analyzed the impact of revenue diversification on expected revenue and volatility in nonprofit organizations and came to the same conclusion as Carroll and Stater (2009). Mayer et al. (2012) found that

the more diversified the portfolio, the greater the generated revenue. The authors' findings also suggest that revenue diversification and expected income depend on the composition of and changes in the revenue portfolio.

Previous studies have shown that with the continued sluggishness in the economy after the 2008 recession, public research universities are increasingly relying on a mix of revenue streams such as tuition, donations, gifts, commercialization, external research funding, and investments (American Academy of Arts and Sciences, 2015b; Franklin, 2007) to reduce dependence on a single source of funding and cushion themselves from the effect of volatile state funding. The assumption is that the existence of an optimal portfolio maximizes the expected returns and minimizes variances. However, the fact that institutions can diversify sources of revenue does not guarantee that they will gain financial stability; rather, administrative structures and institutional capacity both play a role. As Mayer et al. (2012) argued, managing revenue from different sources may increase administrative costs. Additionally, even in a resource-rich environment, the financial condition and stability of an organization most likely depends on effective financial management practices (Carroll & Stater, 2009) and institutional capacity (i.e., presigious institutions with plentiful resources as opposed to smaller institutions with meager means). Depending on that capacity, institutions may respond to financial crisis from a position of strength or weakness.

Portolio theory has not been used widely in public institutions. The current research employs portfolio theory, along with resource dependence theory, to examine whether organizations that diversify have higher levels of financial stability and improved research outcomes.

Conceptual Framework

The conceptual framework for this study draws from the literature related to: (a) revenue diversification in postsecondary institutions (Alstete, 2014; Davis & Cobb, 2010; Chiang, 2004; Hearn, 2003; Kohtamaki, 2009; Leslie et al., 2012; Malatesta & Smith, 2014; Stachowiak-Kudła & Kudła, 2017; Teixeira, 2014; Webb, 2015), (b) how external sources of revenue influence an institution's knowledge production (Auranen & Nieminen, 2010; Barnett et al., 2015; Ebadi & Schiffauerova, 2015; Vlăsceanu & Hâncean, 2015), (c) measures of research productivity (Abramo & D'Angelo, 2014; Basu et al., 2016; Capaldi et al., 2015), and (d) revenue diversification and financial stability (Estermann & Pruvot, 2011; Stewart, 2008). From the resource dependence perspective, institutions diversify to reduce instability and external influence on their operations. From the portfolio perspective, an institution with multiple revenue streams is likely to secure more funding and improve operational autonomy (i.e., financial stability), resulting in improved performance. As noted in the literature, the strategies for revenue diversification vary in their scope and ability by which they influence institutional financial stability and operations.

Figure 1 includes the proposed model, which shows the relationship between the key variables in this study. The model includes time, the measures of revenue diversification sources and financial stability, and indicators of research productivity. Time was included as a variable in the model to capture the effects of diversifying revenue that are likely to occur only after the passage of time. For this study, the effects and benefit of diversifying revenue on financial stability and research outcomes may not be felt until after years have passed. The three years prior to the outcome measures were factored into the

model to address any time lag. The choice of time was based on the average longevity of research projects and the effects of prior decisions concerning the level of expenditure. Six variables were included in the model as measures for revenue sources to examine the concentration of revenue and provide a micro-level valuation of financial risk and the dependence rate on revenue streams. The first variable, the revenue diversification index, measured the dispersion/concentration of revenue. The remaning five variables measured an institution's dependence rate on funding from the government, net tuition, research, endowments, and auxiliary services.

The composite financial index derived from four ratios (i.e., primary reserve, net operating revenue, return on net assets, and viability), as proposed by Prager et al. (2005), was included in the model to explain the effects of variations in revenue diversification on financial stability. Research productivity as a latent variable was included to measure institutional research productivity. These measures were based on the literature and included institutional characteristics and factors related to individual professional development. A final latent structure for research productivity was based on thefindings of the principal component analysis. A detailed discription of the composite financial index and indicators of research productivity is presented in Chapter III.

Finally, variables related to an institution's performnce (i.e., membership in the AAU) and environment (i.e., state per capita income) were included in the model to control for the influence of differences in capacity to diversify revenue and participate in research. The arrows in Figure 1 represent the directions of the relationships among the variables in model.

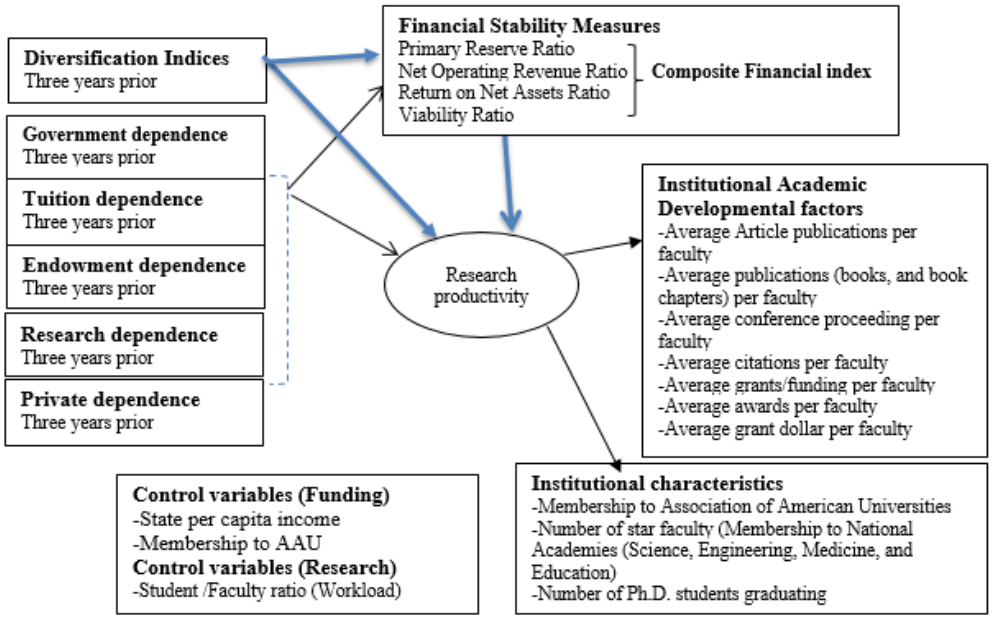

Figure 1. Conceptual framework

Limitations of the Study

This study has the following limitations. While its focus is on public research universities, its scope does not encompass the specific features and actions of individual institutions that might influence the variables. Also, addressing public research universities in the US limits the generalizability of the findings to other American institutions of higher education.

Delimitations of the Study

The delimitations of this study are as follows. As an organization, a university has multiple outcomes. This work only considered financial and research outcomes. Future studies should analyze other products, such as student educational outcomes and the institution's mission. Also, the use of secondary data meant adopting the assumptions associated with

those datasets. For instance, it was assumed that the data that the institutions submitted were accurate and reflected their financial and research performances.

Organization of the Study

This study is organized into five chapters. Chapter I contains the introduction, statement of the problem, purpose, significance of the study, definitions of terms, theoretical framework, research questions, limitations, delimitations, and assumptions. Chapter II is comprised of a detailed review of the literature related to revenue diversification and divided into the following subtopics: trends in funding for research universities, forces moving universities toward revenue diversification, strategies for revenue diversification, and consequences of revenue diversification on financial stability and research outcomes. Chapter III includes the proposed method, design for the study, and description of the sample. Chapter IV presents the results. Finally, Chapter V offers the conclusions and implications for practice, as well as suggestions for further research.

CHAPTER II

LITERATURE REVIEW

This chapter is a review of the literature on the consequences of revenue diversification for institutional financial stability and research productivity in institutions of higher learning. It is based on the argument that in response to continued reductions in state funding, many public universities have turned to alternative sources of revenue (such as increasing tuition and fees) as an option for improving cashflow. Even though revenue diversification has become increasingly common, its effect on financial resources (Estermann & Pruvot, 2011; Stewart, 2008) and knowledge production remains unclear (Barnett, Graves, Clarke, & Blakely, 2015; Whalley & Hicks, 2014). By addressing this issue and focusing on public research universities, my work contributes to the growing body of literature on this topic. This chapter provides deeper insight into current changes in the market economy, and prompts administrators to develop long-term financial strategies for mitigating the damage caused by revenue shortfalls.

For this literature review, I used the narrative method proposed by Lunenburg and Irby (2008). The literature review for this study was restricted to articles related to funding for public universities, revenue diversification in higher education, external funding and research productivity, resource dependency in higher education, diversification portfolios, and the economic climate in institutions of higher education. The inclusion criteria consisted of peer-reviewed articles published between 2000 and 2017. These articles were accessed and reviewed to investigate evolving trends in funding for public research universities, the forces motivating revenue diversification, and the consequences of

incorporating a broader range of revenue streams for institutional financial stability and research productivity. The inclusion criteria included books, book chapters, and government and organizational documents as secondary sources.

This chapter is organized into seven major sections: (a) funding for public research universities; (b) forces motivating revenue diversification; (c) strategies for revenue diversification; (d) revenue diversification and financial stability (e) revenue diversification and research productivity; (f) the relationships among revenue diversification, institutional financial stability, and research productivity; and (g) a summary.

Funding for Public Research Universities

This section discusses the changes that have occurred in funding for higher education, assumptions about financing for research universities, and the future of American public research institutions. Institutions of higher learning in the US have long depended on funding from state and federal governments. Financing education was a top priority in the latter part of the 20th century, but as noted by the American Academy of Arts and Sciences, universities now rank as the third highest priority in general state budgets, after elementary/secondary schools and Medicaid (American Academy of Arts and Sciences, 2015). Likewise, the share of general funds allocated to higher education has been decreasing. For example, the proportion assigned to higher education decreased from 14.6% in 1990 to 9.4% in 2014. Tandberg (2008) analyzed future state budgetary gaps and projections and pointed out that higher education is likely to continue facing immense competition for state funding from other state agencies and programs. This is because in times of financial strife, states cut funding from one area to maintain or increase another. A

Gallup survey in 2017 uncovered waning confidence in the financial stability of colleges and universities. Approximately 71% of higher education institutions were in financial crisis. This was a 15% point increase from 2015 (Auter, 2017). This situation has affected enrollment, quality, and revenue goals, rising the need for alternative revenue streams.

Public research universities perform a distinct role in the American education system, and therefore deserve to be well-funded by the state (McGuinness, 2005). However, several researchers have shown that public research universities are actually substantially underfunded. State finances comprised less than one-third of the total institutional revenue (American Academy of Arts and Sciences, 2015a; McLendon, Hearn, & Mokher, 2009). Subsidies for public institutions depend on the health of the economy. Whenever the economy is weak, institutions lose funding (American Academy of Arts and Sciences, 2015a; Doyle & Delaney, 2009, 2011; McGuinness, 2005; SHEF, 2016), and in good times states do not restore funding to the level it was at before cuts were made (Doyle & Delaney, 2009). For instance, between 2008 and 2013, states reduced funding for public universities by 20% and public research universities by over 28% (American Academy of Arts and Sciences, 2015a; SHEF, 2014), and funding for these types of institutions has continued to decline. Doyle and Delaney (2009) examined trends in state funding for higher education and suggested that institution leaders should consider volatility in state spending for higher education to be normal. Whenever a recession ends, institutional leaders should not focus on restoring funding to every unit that has been cut. Instead, they should strategize how to counter the next downturn.

Beyond this decline in state appropriations, researchers such as Teixeira et al. (2014) and Doyle and Delaney (2009) have noted that traditional sources of revenue for

public institutions have transformed tremendously. Doyle and Delaney (2009) and Johnstone and Marcucci (2010) argued that these sources are no longer as generous as they once were. According to Stachowiak-Kudła and Kudła (2017), the leading motivation for changes in financing for higher education is to enhance financial stability and increase institutions' accountability to the public, because such institutions are perceived as responsible for a sizeable part of society's necessary educational and research. To accomplish this accountability, governments have implemented a funding system focused on teaching and research outcomes, and strived to encourage the participation of private funders.

Nevertheless, researchers have found that public sources of revenue have become very demanding, highly competitive, and substantially selective. Science-oriented research and co-funded projects (which have been found to add pressure to institutional financial sustainability) are preferred (Estermann & Pruvot, 2011; Hsiang & Liao, 2017). One of the concerns is whether introducing such regulations will actually increase funding from private sources and make institutions financially stable. Stachowiak-Kudła and Kudła (2017) noted that the positive effect of introducing such regulations is desirable in times of financial crisis, such as when funding from the state is limited. However, it should be noted that different financial regulations can have a wide variety of effects on the process. In one study, Stewart (2008) noted that most of the traditional sources of funding cannot be depended upon as a means of sustaining institutional financial stability. Thus, many public universities now rely heavily on private money to advance their mission of teaching, research, and service. The current study examines whether these private sources actually make institutions financially stable.

Forces Motivating Revenue Diversification

Many factors have been cited as motivation for diversification in colleges and university funding, but the majority of the blame rests on the economic recessions of the past three decades. These recessions have caused a nationwide decline in state support for institutions that has affected tuition prices (Doyle & Delaney, 2009; Long, 2014). Higher education has also experienced cuts to multiple revenue sources, such as philanthropy and endowment returns (Long, 2014). In addition to the decline in state funding, the literature has highlighted other forces motivating revenue diversification, such as: (a) the increase in unit cost of higher education rising faster than the overall economy, (b) growth in student enrollment compared to the limited institutional capacity to meet that demand, and (c) political instability (Johnstone, 2002b; McLendon et al., 2009; Teixeira et al., 2014; Webb, 2015). This section discusses the social, economic, and political forces motivating revenue diversification.

Forces Related to Cost

The unit cost of higher education has risen rapidly, far outpacing other price increases (Archibald & Feldman, 2008a, 2008b). Previous studies of cost pressures in higher education have highlighted features of colleges and universities that may be responsible for such increases. Some studies compared cost factors in higher education to those in particular industries (Archibald & Feldman, 2008a, 2008b). One key finding was that higher education, like other sectors of the economy, provides services that depend on well-educated work force. Research has also shown that higher education experiences cost pressures similar to those of other industries. Importantly, these studies summarized a list of factors contributing to rapid cost increases, including the revenue theory of cost

(Bowen, 1980). According to Bowen (1980), universities must try to maximize their revenue and spend every dollar they raise. In most cases, an institution's costs are determined by its revenue, such as state appropriation, returns from endowments, research grants, and net tuition and fees. According to Archibald and Feldman (2008b), the revenue theory of cost, also known as the "cost disease" concept, is the primary reason why higher education expenses have skyrocketed s in the past several decades.

Other factors affecting the price of higher education include: (a) a product mix focused on more expensive disciplines (Archibald & Feldman, 2008a, 2008b; Getz & Siegfried, 1991), (b) a shortage of higher education input, (c) a growing interest in high-quality services (Archibald & Feldman, 2008a, 2008b; Getz & Siegfried, 1991; Teixeira et al., 2014), (d) poor management, (e) expanded duties for colleges and universities, (f) growing administrative staffing needs (i.e., the administrative lattice), and (g) government regulations that create additional duties for institutions of higher learning. Capital costs have also risen, due to the need for additional facilities to accommodate an ever-increasing student body (Archibald & Feldman, 2008a; Stewart, 2008) and the desire to keep abreast with advancing technological innovations, which are highly valued, especially in research institutions. Universities must also spend money to attract highly qualified staff and students.

Teixeira et al. (2014) analyzed the differences in revenue diversification between universities and polytechnics, finding that public universities have been unable to benefit on a large scale from the types of production associated with industrialized economies. Unlike for-profit organizations that can replace their work force with capital or outsource production at lower costs, these institutions find it difficult to contain expenses, especially

in response to the increasing cost of living being set by organizations experiencing greater productivity. Together, these studies highlighted how the high per unit cost (in terms of expensive labor, equipment, and the price of student living) strained budgets, arguing that the only way to achieve their mission was for higher education institutions to increase their operational income from alternative sources.

Increase in Student Enrollment

The growth in the number of students enrolling in college and declining institutional capacity also motivate revenue diversification. In the last three decades, students' enrollment in both public and private four-year universities has been steadily increasing. Public research universities currently admit about 85% of undergraduate and 75% of graduate students (American Academy of Arts and Sciences, 2015b). As reported by the National Center for Education Statistics (2015), enrollment at four-year public universities increased by 17%, from 9,479,273 in 1985 to 11,092,374 in 1995, and from 1995 to 2005 the enrollment of 13,021,834 represented an additional increase of 7.4%. In 2015, enrollment increased another 17.6% to 15,319,000.

Under normal circumstances, such an upsurge in admissions would be accompanied by a proportionate increase in funding. However, McLendon et al. (2009) empirically analyzed state appropriations across research and non-research universities and found a negative relationship between the rate of student enrollment at post-secondary institutions and the amount of state spending. Tandberg (2008) also noted that public higher education experienced an increase in enrollment during economic downturns. This means that institutions have been forced to do more with less appropriations. Previous studies have shown that whenever there was a cut in state funding, institutions raised net

tuition to cover the shortfall (Auter, 2017; Mitchell, Leachman, & Masterson, 2016). However, state regulations with regards to how much students should pay leaves institutions with unaddressed operational costs that must be met. Overall, the above literature has found that the effect of an increase in enrollment coupled with the decline in state appropriations and regulation of tuition fees together put pressure on institutions' expenditures (Stachowiak-Kudła & Kudła, 2017; SHEF, 2013; Tandberg, 2008). The only alternative is for these schools to develop multiples sources of funding, in order to reduce the risk of financial crisis (Mayer et al. 2012), decrease overreliance on any single revenue source, and have several options to be stable financially.

Political Influences

The politicizing of higher education tops the list of fundamental issues that the industry currently faces (Auter, 2017), because the political system has a significant impact on schools' relationship with the state (McLendon et al., 2009; Tandberg, 2010a; Tandberg & Ness, 2011). Studies by Weerts and Ronca (2006), Tandberg (2008, 2010b, 2013), and Tandberg and Ness (2011) all considered the effects of politicizing higher education to be more significant at major public research universities. First, the appropriations process is not immune to politics and budgetary forces; therefore, for universities to benefit, they must be politically involved. Second, changes in a state's political context can significantly alter governance structures and the politics of the appropriations process. The later concurs with hypotheses put forth by Auter (2017), McLendon et al. (2009), and Tandberg (2008); political parties differ in the ways in which they allocate funding to public higher education institutions. Tandberg (2008) and Tandberg and Ness (2011) traced these differences to variations in states' respective political systems, which further affect the

outcomes of state budgetary processes. In most cases, democratic leadership tends to allocate more funds to schools than do Republican governments (McLendon et al., 2009; Tandberg, 2008).

Increases in tuition and the pursuit of private support are being used to fill budget shortfalls at many public research universities. Weerts and Ronca (2006) noted that the shift towards increasing private funding was accompanied by an enhanced tension between higher education and stakeholders such as economists, consultants, and policy advisors. On the one hand, some have strongly advocated for public research universities "going private," claiming that schools must reduce their dependency on government funding, diversify their sources of revenue, and increase cost sharing (Johnstone, 2002b, 2004). On the other hand, institution leaders have feared that a move towards alternative private funding will leave public research universities with insufficient resources and a declining level of competitiveness (Yudof, 2002). A study by Teixeira and Koryakina (2010) examined the patterns in, challenges to, and risks of funding diversification, noting that the adverse financial and social context and ever-changing policy climate had put revenue diversification on the agenda of public institutions of higher education around the world. Whether such efforts actually force schools to become more efficient or only open them up to unexpected risks is one of the main topics of the present study.

Strategies for Revenue Diversification

Public institutions of higher education are increasingly pursuing funding from numerous alternative sources (Alstete, 2014; American Academy of Arts and Sciences, 2015b; Franklin, 2007; Hearn, 2006a) in order to provide the financial support they need to achieve their mission, become financially stable, and diversify their risk. The many ways

institutions are diversifying their revenue include commercializing intellectual property, adopting alternative pricing strategies, providing auxiliary services, and pursuing endowments and charitable giving, as well as collaborating with other research organizations. The degree to which public research institutions rely on alternative funding sources differs by region, the demographics of the students served, the state aid programs, and schools' relationships with local organization and industry (American Academy of Arts and Sciences, 2016b). This also implies that some institutions may fare better than others, depending on the environment.

Commercialization of Intellectual Property

Commercializing intellectual property is one way in which universities can increase revenue. Many American institutions of higher education have expanded their funding base through patents, technology transfer, and spinoffs from startups. According to the Association of University Technology Managers 2015 licensing survey, the US's new and existing licensed products from public universities generated over $28.7 billion in net product sales. In the same year, the number of patents issued grew by 15%, startups increased by 12%, and 879 new products were made. Although technology transfer and intellectual property have the potential to generate additional revenue, a report by the American Academy of Arts and Sciences (2015b) maintained that an institution's goal of serving the public interest should continue to be primary.

In a comparative analysis of revenue diversification and sustainability in the UK and US, Stewart (2008) found that although the total amount collected from US licensing was substantial in the aggregate, it provided little to no significant benefit to most universities and did not contribute to institutional financial sustainability. This finding

confirms Hearn's (2003) conclusions that this source of revenue was neither cost effective nor predictable. It was successful in some situations and unprofitable in others. Stewart (2008) suggested that schools needed to be realistic about the potential revenue that could be generated, selective in the streams pursued, and willing to explore a wider range of commercialization.

Pricing Initiatives

Pricing initiatives are unrestrictive sources of non-government revenue, mainly accomplished by raising tuition and implementing fees for services that previously had been free (Hearn, 2003, 2006a). Several earlier studies have shown that raising tuition and fees have always been fallbacks for whenever institutions were faced with financial constraints (Desrochers & Hurlburt, 2016; Leslie et al., 2012; SHEF, 2016; Teixeira & Koryakina, 2013; Webb, 2015). Universities have tended to raise tuition and fees to compensate for declining government funding and rising operational costs, but not to increase spending (Mitchell & Leachman, 2014). Desrochers and Wellman (2011) reported on trends in college spending, showing that revenue from tuition and fees averaged more than half the core education expenditure at public research universities. Similarly, in 2016, a report by SHEF (2016) indicated that net tuition comprised 47.8% of the funds that institutions received, the report also showed that public universities received approximately 38% of their total revenue in the form of government appropriations, grants, and contracts, implying that the remaining 21.4% came from a variety of alternative sources(SHEF, 2016). The percentage of support from state was even lower for public research universities.

Other researchers have noted that tuition and fees, especially those from international students, have become a significant source of revenue for many institutions of higher education, even more than research grants (Stewart, 2008). According to a survey conducted by the Institute of International Education (2016), in 2014 and 2015, foreign students contributed approximately $36 billion to the US economy. However, reliance on this revenue source may not be viable in the future, since the majority of these students are in collaborative programs, and sponsor countries are currently improving their own systems of higher learning (Stewart, 2008). Studies suggest that institutions cannot entirely depend on net tuition as a means of generating alternative income. Research has shown that even with the rise in tuition and fees, these funds often cover only one-third to one-half of the total cost of education (American Academy of Arts and Sconces, 2016b). Furthermore, a report by the American Academy of Arts and Sciences stated that despite the increase in net tuition, only 17% of the first-year students in the 2013-2014 academic year paid full tuition, without financial support.

Auxiliary Services

Auxiliary services such as vending, bookstores, dining services, facilities, and real estate are some of the ways in which institutions garner more revenue. However, the revenue generated does not usually exceed their cost (Hearn, 2006a, 2006b), except in very few cases where athletics revenue exceeds expenses (American Academy of Arts and Sciences, 2016b). As Rullman, Strong, Farley, Keegan, and White (2008) noted, such services are greatly affected by societal, economic, policy, and educational matters, and it is infrequent that they generate any significant income. Moreover, most of these enterprises are self-supporting, and surplus revenue is mainly reinvested in the operation of the

service. Thus, income from auxiliary services is restricted (American Academy of Arts and Sciences, 2016b). In the same vein, Carey-Fletcher (2014) examined the sustainability of campus auxiliary services given the complex business climate of higher education, and found that such services were ineffective.

Endowment and Charitable Giving

Public research universities have increasingly turned to charitable sources of income such as endowments, philanthropy, and alumni donations, in order to generate additional revenue. Funding from these sources is usually restricted, and often the amount received is minimal when compared to that obtained by private institutions (American Academy of Arts and Sciences, 2016b). According to Stewart (2008), only 21% of endowment funds were available for unrestricted purposes. The remaining 79% were earmarked by donors for particular efforts. What is attractive about this type of income is that it is created and controlled by the institutions themselves, with the aim of improving the quality of educational programs and stabilizing expenditures (Weisbard & Asch, 2010).

Previous studies have shown that both the number of offerings and overall size of endowment income have grown. Nineteen institutions reported endowment funds of over $1 billion in 2013 (NCSE, 2014); this increased to 299 institutions in the 2016 fiscal year (NCSE, 2017). Endowment spending has increased despite low returns. A report by the National Association of College and University Business Officers (NACUBO), based on data from 805 US colleges and universities, showed that on average, participating institutions had a -1.9% return on endowments in the 2016 fiscal year. This negative return followed a low return of 2.4% in the 2015 fiscal year (NCSE, 2017). According to this

NCSE (2017) study, endowment spending in the previous 10 years dropped to 5.0%, from 6.3% in the 2015 fiscal year.

On average, institutions have derived approximately 10% of their operating funds from their endowments, and lower returns have made it more difficult for these universities to adequately support their operations (NCSE, 2015). This finding is similar to what Stewart (2008) and Jaramillo and Melonio (2011) determined, which was that although American endowments may seem large, in many cases their contribution to annual operating budgets was actually quite small. As Stewart (2008) concluded, endowments were not a panacea in cases where institutional financial stability was concerned.

Besides endowments, public institutions have heightened their dependence on philanthropy and alumni as sources of funding. According to a Council for Aid to Education (2017) annual survey of charitable contributions to institutions of higher education, voluntary support of education increased to $41 billion in 2016, a 1.7% increase from $40.3 billion in 2015. At public and "very high" research universities, philanthropy supported an average of 7.8% and 8.9% of the operating budgets, respectively (American Academy of Arts and Sciences, 2016b). The majority of funds were channeled into operations and not endowments. As noted by the Council for Aid to Education report, generous funding depends on the health of the economy and a few wealthy donors. This increases the risk associated with this type of funding, especially when sustainable levels of support are the concern (Stewart, 2008). Moreover, this source still experiences challenges (Johnstone, 2004) and will always be limited, uneven, and slow to develop.

Collaborating with External Parties

Collaborating with external parties for resources can take several forms, such as instruction (Hearn, 2006a, 2006b), provision of services, use of an institution's name (Hearn, 2003, 2006b), and internship programs (Thursby & Thursby, 2002). This portion of the literature review focuses on research contracts and institutional collaboration with particular industries. Universities accept contracts for research projects as a way of diversifying their revenue stream. Sponsors may include businesses, non-governmental agencies, and nonprofit organizations. Of these sponsors, the business sector (i.e., industry) is the predominant source of funding for research and development conducted in the US (National Science Board, 2016). In 2013, industry funding accounted for $297.3 billion, 65% of the total US research and development budget. However, this funding has fluctuated since the most recent recession. As stated by the National Science Board (2016), only 2% of the business sector's funding for research and development went to higher education; the remaining 98% was spent on business performance.

This percentage undermines the contributions of researchers, and is a clear indication that like other strategies of diversification, research contracts are not a sufficient generator of revenue. Thomas (2001) suggested that universities considering this option should understand that schools differ in their ability to earn significant funding from the private sector. Some funding agencies prefer to sponsor research in science-oriented institutions, while others may opt for applied research over more broad-based studies. The literature confirms that despite an increasing number of diversification strategies, their effect on financial stability and institutional performance continues to be unclear. As stated

by Stewart, diversification cannot necessarily be depended upon, especially when financial sustainability is a concern.

Revenue Diversification and Financial Stability

Central to the success of public higher education is adequate and stable funding. Only through financial stability are institutions able to reach and advance their stated goals (Estermann & Pruvot, 2011). Financial stability has become the top fundamental issue facing public higher education around the world. From the resource dependence and portfolio perspectives, public research universities are strategically diversifying their sources of revenue. The question for these types of institutions now is: does diversifying revenue enhance institutional financial stability, especially in this unfavorable economic climate? Below is a discussion of the effects diversification is likely to have.

The Consequences of Revenue Diversification on Institutional Financial Stability

This section includes both intended and unintended consequences, addressing topics such as financial stability, increased administrative and accounting costs, loss of expected revenue from prospective funders, loss of status, increases in co-funding, and unhealthy competition.

Financial Stability

Several researchers have maintained that revenue diversification is a desirable source of stability and sustainability (Teixeira & Koryakina, 2013; Pfeffer, 2003; Pfeffer & Salancik, 1978). However, most of these studies are theoretical in nature and each has a unique way of measuring financial stability. For instance, Teixeira and Koryakina (2013) used changes in budget spending as a measure of financial stability in their examination of trends in institutional funding structures and the factors explaining the evolution of

revenue diversification. These researchers found that diversifying revenue may increase a university's cashflow, up to a certain celling. Diversification was also found to be a useful means of gaining budget flexibility and providing greater revenue constancy (Estermann & Pruvot, 2011). In many cases, institutions enjoy full control in terms of the allocation and use of the funds generated.

Other researchers have noted that diversifying income streams increases net revenue and allows institutions to survive, and even thrive, in increasingly austere conditions (Hearn, 2003; Teixeira & Koryakina, 2013; Wangenge-Ouma, 2011). Ultimately, diversification mitigates the risk inherent in losing any single source of income. Some have argued that it provides a more consistent and improved revenue flow, which ensures prosperity by balancing risk and efficiently generating needed funds (Alstete, 2014; Hearn, 2003; Wangenge-Ouma, 2011). In the same vein, some researchers have found that diversifying revenue helps institutions avoid excessive dependence on a single fiscal source (Pfeffer & Salancik, 2003), and reduces the risk of a sudden decrease in resources (Estermann & Pruvot, 2011; Wangenge-Ouma, 2011).

Conversely, over-diversification can also result in problems. Wangenge-Ouma (2011) examined the funding challenges faced by public universities in Africa, and found that revenue diversification was highly unpredictable and that alone it could not mitigate problems stemming from resource dependence. Instead, Wangenge-Ouma suggested that multiple factors such as shifts in economic markets and capacity-related challenges should be considered means of achieving useful revenue diversification. Most stable revenue that honors the public good that higher education does could be stable with adequate state support. However, in the current political climate, this does not seem likely. Although

there is a need for diversification, this should not be the primary strategy. The fiscal foundation of public universities should be a government that honors the educational needs of its citizenry. New funding sources have proven to be unstable; therefore, stability must come from multiple sources so that institutions do not suffer if one revenue stream ceases.

Increased Administrative and Accounting Costs

Hearn (2003) and Teixeira et al. (2014) observed that institutions tend to diversify their revenue without rigorously considering the associated costs. From the stakeholder perspective, a new source of income should only be considered if it yields important nonfinancial benefits and the net costs are acceptable (Hearn, 2003). Moreover, schools must have enough resources to meet their current needs before they attempt to diversify into new ventures (Gray, 2005). However, this is often not the case when most institutions make the move to diversify. Many only begin to search for diversification options in times of austerity. As Gray (2005) has asserted, it is risky to divert limited resources marked for the core mission to the pursuit of new ventures, especially in difficult economic times.

Moreover, it has been noted that when planning to diversify, some institutions of higher education tend to simply imitate whatever appears to be prevalent and appropriate (Malatesta & Smith, 2014), without considering either the implications of hidden costs (Liu, 2007) or differences among institutions (Teixeira et al., 2014). The result is budget deficits that further exacerbate existing financial problems. For instance, many schools have moved towards offering online courses, continuing professional education, executive programs, and more evening courses (Allen & Seaman, 2010; Ehrenberg, 2000) to generate income. However, the opposite is often the result. Many universities have experienced financial deficits due to an increased demand coupled with the higher cost of

offering such classes (Allen & Seaman, 2010), as well as increased technical expenses in terms of production and operation (Sife, Lwoga, & Sanga, 2007).

Another unintended consequence of diversification is excessive administrative processes that can be complex and costly. In some cases, it is necessary to hire experienced human resources to handle the work demands that arise (Gray, 2005), as well as train staff to make effective decisions, coordinate efforts, and control various initiatives. In other cases, the administrative costs associated with operating different sources of revenue can be enormous. Estermann and Pruvot (2011) noted that public institutions are often faced with technical and financial requirements, such as in cases where different accounts must be established for every source of revenue. The authors found that having a separate account for every revenue source can in itself be costly. It can also further complicate reporting, especially when an institution is required to summarize expenses from several areas.

Loss of Revenue from Prospective Funders

Previous studies have demonstrated that an aggressive move towards revenue generation may have adverse effects on institutional finances (Hearn, 2003; Hillman, 2012). Such efforts can put the institution's reputation and market position at risk, translating into a further loss of revenue from prospective students and sponsors who may find the new initiatives and character of the institution off putting (Hearn, 2003). Conversely, supporters contend that universities have built their reputations over many years and have brand names that keep enrollment steady, even in low times and in the face of financial pressure (Lundy & Ladd, 2016). Therefore, when done wisely, revenue diversification initiatives are an opportunity for institutions to maximize their robust and

lasting brands, generate additional revenue, reduce dependence on state appropriations, and improve financial stability (Johnstone, 2002b; Lundy & Ladd, 2016). Teixeira and Koryakina (2013) added that an institution's reputation, mandate, and scientific composition can all help make it successful in exploring alternative sources of funding.

Loss of Status and Expected Revenue

With the growing emphasis on new revenue streams, there are fears that public and political leaders may continue viewing public universities as just another interest group or industry capable of competing favorably with market forces to achieve their interests (Newman, 2000). This may result in the state completely withdrawing funding, worsening the already strained financial situation of many of these institutions (Hearn, 2003). Diversification of revenue streams may also cause public universities to lose status, which could ultimately affect their expected revenue. As stated by McGuinness (2005) and SHEF (2016), a school's ability to diversify may cause politicians and policymakers to conclude that they can obtain sufficient funding elsewhere and therefore do not require state support.

However, public institutions cannot survive without support from the government (American Academy of Arts and Sciences, 2015a). In fact, scholars such as Johnstone (2002b) and Newman (2000) have argued that institutions of higher learning should dispel the opinion that they can obtain new revenue sufficient to achieve their mission without support from the state and public. Yet this contradicts certain university administrators who maintain that since it is impossible to obtain adequate funding from the state, revenue diversification is inevitable (Alstete, 2014).

Increases in Co-funding

Co-funding, though a common practice, also has the potential to harm a school's financial sustainability (Estermann & Pruvot, 2011). In this mechanism, funders finance only a part of a given activity, and the university must match the offered funds with money from the core budget. Estermann and Pruvot (2011) used data from European universities to explore the different income generation activities available, finding that 65% of the participating universities co-funded their work with public grants and core government allocations, while 35% co-funded using a mix of resources from core government funding, private sources, and fees. According to the authors, over an extended period, these indirect costs endangered schools' financial sustainability. Excessive administrative requirements was another modality hindering the success of this type of endeavor.

Unhealthy Competition between Institutions

Revenue diversification is slowly but steadily pushing higher education towards greater levels of competition. As stated in the literature, the practices of fundraising and philanthropy as means of revenue generation were at one point entirely the domain of private universities (Vasic, Jelavic, & Silic, 2012). However, faced with declining state support coupled with limits on tuition increases, public higher education has been forced to seek alternative sources of revenue (Cheslock & Gianneschi, 2008; Sawal & Maxwell, 2014; Teixeira et al., 2014). Research has shown that public institutions lag behind their private counterparts in securing support sources like charitable donations (Toutkoushian, 2003). If public institutions are to compete favorably with their already-established private counterparts, they must work hard to engage their alumni and friends as potential donors.

Public funding at both the state and local levels has a profound effect on the dollar amount provided by private donors. Fransz and Sidford (2011) examined the ways in which private donors responded to cuts in state funding, finding that many private sources looked for evidence of public funding as a prerequisite for their own grants. Cheslock and Gianneschi (2008) also found an unusual relationship between private donations and government funding in higher education. These researchers used archival data to examine the effects of replacing state appropriations with private donations on resource disparities in four-year public institutions. They noted that private giving was unequally distributed compared to state funding, and more likely to perpetuate resource inequality in public institutions. They also observed that some "public universities have stronger student demand, wealthier alumni, or a better research infrastructure than other public institutions; these schools will be able to generate greater revenue from alternative sources" (p. 209).

Overall, some scholars have maintained that diversifying sources of revenue can increase funding levels; however, they cannot replace public funding in either the long or short term (Estermann & Pruvot, 2011). Others have argued that the benefits of diversification are unclear (Barnett et al., 2015; Whalley & Hicks, 2014). Sources remain limited in scope, and require upfront investment. Moreover, not all universities have the potential to explore these alternative revenue streams (Mamo, 2015).

Revenue Diversification and Institutional Research Productivity

The core mission of public research universities is research production and the training of students to engage in research. Around the world, research productivity is not only considered a performance indicator, but also used to enhance a school's reputation and rank. Moreover, through research, universities have become essential to the

knowledge economy of the 21st century; thus, most governments have focused on improving the standards of their research institutions. However, a harsh economic climate coupled with unfavorable social and political conditions have led to a decline in state funding, thereby transferring the ever-increasing research expenditures to the institutions themselves. In response, universities have been aggressively diversifying their funding to sustain their operations. Whether these new revenue streams actually improve research productivity has been the concern of many stakeholders (Auranen & Nieminen, 2010). Before examining the effects of diversifying revenue on research outcomes, it is important to discuss the ways in which research outcomes are measured and the determinants of research productivity.

Research Productivity Measures

Although research productivity is often used as a measure of performance, there is no objective consensus on what constitutes productivity, how it should be measured, or how it ought to be interpreted by scholars, faculty, and administrators of institutions of higher learning (Kumar, 2010; Toutkoushian, Porter, Danielson, & Hollis, 2003). Several measures of research productivity have been proposed. The current literature review focuses on both the individual faculty and institutional levels to identify the most acceptable measures of research productivity.

Individual Research Productivity Measures

The most commonly used measure of research productivity is a summative index constructed from counts of conference papers, refereed journal publications, books, and book chapters, over a certain period (Altbach, 2015; Busch, 2017). Busch (2017) pointed out that many faculty members and administrators give great weight to articles published

in refereed journals, and tend to underestimate all other measures of productivity. Similarly, Kotrlik, Bartlett, Higgins, and Williams (2002) examined factors explaining the research productivity of agricultural faculty in universities, finding that refereed journals were considered the most important aspect. Other publications such as books, book chapters, monographs, and attending research conferences were considered to have less value. Although a summative index as a measure of research productivity was still used, there were concerns regarding whether straight or weighted counts should be employed to construct the index.

An h-index comprised of publication and citation counts has also commonly been used to measure faculty research productivity (Abramo & D'Angelo, 2014; Hirsch, 2005, 2010; Huang, 2012). However, researchers such as Altbach (2015), Abramo and D'Angelo (2014), and Toutkoushian et al. (2003) have criticized the use of h-indexes as a measure of research productivity, arguing that they are limited to a specific period and ignore the impact of prestigious publications with several citations. This type of index also fails to normalize citations, or account for co-authors or differences in publications across fields. Quimbo and Sulabo (2014) found that the use of publications and citations were crude measures of research output, because they failed to consider the vast differences in resources among schools. Moreover, the measure was unclear with regards to whether a citation was positive or critical.

Scholars such as Porter and Umbach (2001) used the number and amount of research grants received as a measure of research productivity. The literature is undecided as to whether research grants should be considered research input or output. Toutkoushian et al. (2003) argued that research grants represented the resources available for producing

research, rather than the quantity or quality of research produced. Despite the conflicting information on this topic, grants are also used (alongside other indicators) as measures of research productivity. For example, in an attempt to build capacity in research universities, Wootton (2013) used grant income, publications, and number of PhD students supervised to develop a measure of individual research productivity. The three indicators were assigned equal weights and employed to calculate the research productivity of two similar research groups in different countries. Wootton's (2013) findings show that the three indicators could be used to explore the effects of change in capacity and productivity on research output. Based on the results of a sensitivity analysis, Wootton concluded that there was no right answer or method to measuring individual research outcomes. Different metrics for measuring research productivity can be used in different circumstances.

Institutional Research Productivity Measures

Several different variables have been used to measure research productivity at the institutional level. For instance, Capaldi, Lombardi, Abbey, and Craig (2015) employed nine different indicators to measure performance in American research universities. The indicators included "total research expenditures, federal research funding, endowment assets, annual giving, the number of national academy of science members, faculty awards, doctorates granted, postdoctoral appointees, and SAT scores" (p. 11). Surprisingly, they did not consider direct measures of research productivity, such as publications and citation counts. Capaldi et al. (2015) provided most of the measures of research productivity used in the present study.

Conversely, Huang (2012) used data from 678 world universities' scientific performance over 11 years to extend the applicability of the h-index to the institutional

level. Their findings indicated a high correlation (0.804) between the h-index rankings generated by the study and the Shanghai Ranking – Academic Ranking of World Universities, which employs five criteria: quality of education, quality of faculty, research (papers published in nature and science), output (SCI index), and size of institution (measured by number of students, number of faculty, and tradition/history of the institution). Each was assigned different weights to measure university research productivity. The results confirmed the validity of the h-index in the assessment of research performance at the university level. In addition, they suggested that the h-index was an accurate measure in this capacity.

In analyzing how research productivity should be defined and measured, Abramo and D'Angelo (2014) also criticized the h-index model, arguing that research activity is a production process; thus, it should be investigated from the context of the microeconomic concept of production. They suggested that before calculating research productivity, several simplifications and assumptions should be adopted. Further, they proposed a Fractional Scientific Strength (FSS) model, claiming that it was a more accurate measure of research productivity and could be applied at different organizational levels. The model accounted for publication periods and citation windows, aspects that the h-index overlooks. They also argued that there is a need for additional examination of how external funding for research can skew both the research itself and its dissemination. Importantly, the authors suggested that institutions needed to use valid indicators to measure research productivity, because such findings have a substantial influence when employed by policymakers and research institutions. This conclusion provides the underlying purpose of the current study.

Several other indicators for measuring research have also been suggested. For instance, Basu, Bansal, Singhal, and Singh (2016) proposed the use of bibliometric data as a measure of research productivity at the institutional level. They claimed that a multidimensional quality/quantity composite index could be used for ranking, decision-making, and policy purposes at both the national and regional levels. Basu and colleagues used average citations per paper and citations per faculty member as their two measures of quality, and number of publications as the measure of quantity. Unlike the h-index, Basu and colleagues' composite index was comprised of additional factors such as funding awards, faculty size, and institutional ranking. These factors were all assigned equal weights. Basu et al. (2016) validated the composite index by comparing its effects on research outcomes with that of the h-index and Leiden ranking. Importantly, they concluded that it was possible to design simple composite indices that could be used at the state level, where a relative performance measure was required.

Similarly, Academic Analytics, a company that measures scholarly productivity, combined various variables such as peer reviewed articles in indexed journals, citations, books, book chapters, research grants, number of awards, and faculty count to measure research productivity (Academic Analytics, n.d.). Each variable was represented as a national quantile that could be used to compare faculty performance to national benchmarks. Although the Academic Analytics group was silent as to how they weighted the variables, like other measures of research productivity, their Faculty Scholarly Productivity Index (FSPI) has been criticized for not reflecting the actual productivity of individual faculty members (Wexler, 2015). This is because the index was designed to measure departmental productivity. With only slight modifications, the Academic

Analytics measure of research productivity fits well with the current study, which focuses primarily research productivity on the institution level.

It is clear from the literature that measuring research productivity is still problematic (Altbach, 2015; Kumar, 2010; Webber, 2011), and the process requires further refinement. A wide range of methods has been proposed, such as the h (Huang, 2012; Quimbo & Sulabo, 2014), Fractional Scientific Strength (Abramo & D'Angelo, 2014), and composite (Altbach, 2015; Basu et al., 2016; Capaldi et al., 2015) indexes. However, none has achieved widespread acceptance (Abramo & D'Angelo, 2014; Altbach, 2015; Wootton, 2013). According to Toutkoushian et al. (2003), the significant variations among these measures suggest that the developers did not rely on a theoretical framework when making their selections. In addition, the measures were not in line with the goals and objectives of the institutions. Toutkoushian et al. (2003) and Altbach, (2015) further stressed that both research (grants and awards) and education indicators should be included in any measure of research productivity.

A few researchers have examined research productivity at the institutional level as an independent variable. None has examined the influence of various sources of revenue on institutional research productivity. Nonetheless, the above-mentioned research acts as a guide to the current study in several ways; these studies provide variables for measuring research productivity that include factors related to individual and institutional environments. It remains, though, that no study has tested whether the proposed factors actually measure research productivity. The current work intends to fill this gap by examining whether these factors actually measure the quality in question.

Determinants of Research Productivity at Research Universities

The determinants of research productivity are countless. Chen, Nixon, Gupta, and Hoshower (2010) argued that apart from external funding, factors such as: (a) teaching load, (b) tenure status, (c) time allocated to research activities, and (d) length of tenure probation period all significantly influence institutional research productivity. Other studies have highlighted the presence of research centers and well-equipped libraries (Buchheit, Collins, & Collins, 2001; Cantwell & Mathies, 2012), number of students at an institution, and number of faculty holding research grants. These are all useful determinants of research productivity (Auranen & Nieminen, 2010). Other scholars have proposed that these factors be categorized into clusters for a better understanding of the major elements affecting research productivity. In the current study, the determinants are classified into individual, institutional, and developmental factors, as discussed below.

Individual Factors

The contributions of individual faculty to institutional research productivity cannot be overstated (Walker & Fenton, 2011, 2013). Through their time management skills (Mayrath, 2008; White et al., 2012), internal self-drive (Bland et al., 2005), and strong work ethic (Ransdell, Dinger, Beske, & Cooke, 2001), individual faculty members have remained central to institutional research productivity. In the current study, factors related to faculty rank, discipline, experience (in years after PhD) and workload (i.e., staff-to-student ratio) were all considered. Several previous studies have found that highly ranked academic staff have higher research productivity (Bland et al., 2005; Rachal et al., 2008; White et al., 2012). Institutions with larger percentages of highly qualified full-time professors and "stars" (Smeby & Try, 2005) also have higher output. This is partly due to

their reputation and the influential research they produce, as well as lower teaching loads for junior faculty, and general career length. Although in economic theory a strong relationship exists between career length and research productivity, this connection has been found to be less direct in higher education, and vary by specialization (Bland et al., 2005; Porter & Umbach, 2001; Smeby & Try, 2005). Nevertheless, studies have offered substantial evidence that tenured professors at research universities tend to accumulate advantages (i.e., lower teaching loads and more experience) over assistant and associate professors, resulting in higher productivity levels (White et al., 2012).

A faculty member's particular discipline also affects their research productivity. Some are regarded as important drivers for innovation and economic growth. Thus, those individuals tend to be favored by administrators (Bush, 2017), receiving generous funding that facilitates increased productivity. Compared to other disciplines, faculty in STEM tend to be more productive, for several reasons. Bonzi (1992) summarized them as follows. Faculty in STEM are more likely to collaborate, and thus it takes a shorter amount of time for them to produce a publication. Also, the average length of an article in the sciences is shorter than that of the humanities and social sciences. Furthermore, there is more self-citation in the sciences because the majority of faculty write a large number of brief articles that build upon their previous research. About 67% of publications in the sciences are journal articles that are highly cited, as compared to book-length works, which are much more common for professors in the humanities and social sciences.

However, as Sabharwal (2013) noted, this trend is changing. Though there seems to be variations in research productivity across disciplines, especially when books and articles are compared, the majority of these previous studies focused on one or only a few

scientific disciplines. According to Leahey (2006), research specialization has been neglected in studies of academic productivity. Although the current work does not include disciplines as one of the indicators, it is assumed that variables such as membership in national academies and the Association of American Universities are more representative indicators. However, a future analysis could examine how adding discipline to the proposed model might change the structure of research productivity as a latent variable.

Faculty Workload

Although a positive relationship between teaching and research has been claimed, teaching load has also been found to hurt research productivity (Porter & Umbach, 2001; Walker & Fenton, 2013; Webber, 2011; Wolszczak-Derlacz & Parteka, 2010). Faculty teach different loads depending on the type of institution at which they work and the responsibilities they hold. Lodhi (2012) explored the determinants of research culture in Pakistani public universities and found that time, especially for junior faculty, was one of the main barriers to engaging in research. Approximately 70% of the junior faculty spent their time teaching and had no time left for research or research-related activities. As a remedy, Hemming et al. (2007) suggested that increasing training and workshops could help faculty at predominantly teaching universities lessen the adverse effects of teaching and administrative duties on their research performance, chiefly in terms of writing proposals.

Elsewhere, research has shown that public universities have changed; faculty workload has increased, and perhaps become a restraint on research productivity. As Rose and Dustin (2009) stated:

> It is no longer sufficient to publish in top-tier journals. A professor's work now must have external money behind it, preferably adorned with a significant overhead. Increasingly, professors feel obliged to cater to outside entities willing to pay for answers to [the] question of interest to them (e.g., the Active Living research agenda). Professors assume the role of 'independent contractors' as they go about the 'business' of securing grants and contracts. (p. 399)

Chase et al. (2013), advancing the debate regarding faculty workload and research productivity, suggested that university leaders should lighten the teaching and service workloads for faculty at research-oriented institutions because it is a challenge for faculty at research- oriented institutions to find adequate and uninterrupted time to do research in the face of pressing teaching deadlines and administrative duties.. These studies suggest that in the future, faculty might find it even more difficult to engage in research, especially with the added responsibility of generating income for the university.

Faculty workload can be measured either by calculating the workload itself or the student/faculty ratio. For this study, the focus was on the latter. According to the National Center for Education Statistics, the national average for postsecondary faculty-to-student ratio was estimated at 18:1. Although a low ratio suggests smaller class sizes, it is also a good foundation for creating an environment with a high level of interaction, engagement, and academic support, all of which facilitate faculty engaging in research.

Characteristics of the Institution

Research activities do not occur in a vacuum (Musiige & Maassen, 2015). Despite faculty occupying a vital role in the overall research productivity of their school, their work does evolve within a particular institution. Therefore, it is important when examining research productivity to consider the institutional context, because of the critical influence it can have (McGill & Settle, 2012; Musiige & Maassen, 2015). Previous research has

suggested that factors such as financial and non-financial incentives may stimulate research productivity (David, 2013; Musiige & Maassen, 2015). The primary incentives include the institution's research culture, availability of research assistants, PhD mentoring programs, internal research funding, and financial incentives for conducting research (Cloete et al., 2011; Musiige & Maassen, 2015). Wolszczak-Derlacz and Parteka (2010) listed several characteristics of individual universities that influence research outcomes, such as year of establishment, location, and level of prestige. For instance, institutions with longer traditions are more flexible and have more infrastructure, enabling more efficient research.

An institution's location also plays a major role. Wolszczak-Derlacz and Parteka (2010) found a strong correlation between the gross domestic product per capita of the region where the university was located and the level of research performance, though they also underscored that this correlation did not apply to all institutions. Although individual characteristics of single universities are important in determining research productivity, they have not been adequately empirically studied. The current work focuses on institution-level factors; however, it is recommended that future studies incorporate individual and institution-level elements.

Membership in the Association of American Universities

Membership in the Association of American Universities is widely recognized as a mark of being among the best research institutions in the country. These universitiess enroll the most students, invest more in research, and have highly qualified faculty who are also members of prestigious national academies (Association of American Universities, 2017). AAU institutions are assessed based on the number of competitive federal research

grants they have been awarded, as well as the number of faculty members belonging to national academies, awards faculty members have won, and volume of prestigious publications (Deutsch, 2016). Thus, it follows that AAU member institutions have higher levels of research productivity, and being affiliated with such institutions is likely to improve an individual researcher's output.

From another perspective, Quimbo and Sulabo (2014) used data from 377 faculty members from five universities in the Philippines to analyze research productivity and its implications for higher education. The authors found that the productivity of institutions with strong research cultures also depended on strong faculty development programs, research collaboration, improved research infrastructure, and desirable incentives. Quimbo and Sulabo concluded that although research cultures vary across institutions and countries, research culture itself does matter to institutional research productivity.

Mentoring Programs

Mentoring has been found to positively correlate with research productivity, and universities have enhanced their research productivity through formal mentoring programs (Cohen et al., 2012). According to Cohen and colleagues, programs incorporate features such as formalized report progress and mentoring feedback, as well as additional years of research; all of these are significantly associated with improved research productivity. Scholars such as Webber (2011), Lodhi (2009), Mayrath (2008), Holosko and Barner (2016), and Mullen (2009) also found that the mentoring one receives early on in a career has a substantial effect on later research productivity. Studies by Hemmings, Rushbrook, and Smith (2007) and Mullen (2009) pointed out that interacting with renowned scholars underscores the importance and value of engaging in research. Thus, mentoring programs

contribute significantly to the establishment of a sustainable research culture, which in turn enhances research productivity.

Number of Faculty with Grants

Some studies have argued that a large number of faculty working on research is a critical element facilitating both research and funding. Smeby and Try (2005) examined the relationship between departmental attributes and university faculty research productivity, finding that a large number of individuals engaged in research had a positive overall effect on research productivity. In a different study, Wang and Shapira (2015) examined the relationship between sponsored research and publication impact, determining that sponsored research had a higher impact on publications, as well as citation counts.

Conversely, other work has found that a high percentage of faculty with research grants did not necessarily translate into high research productivity. Auranen and Nieminen (2010) examined the relationship between research funding and performance and found no straightforward connection between funding and a university's efficiency in terms of publication productivity. Thus, they raised concerns regarding whether financial incentives boosted publication productivity and if policymakers should emphasize other factors relevant to high output.

Funding for Research

Previous studies have overwhelmingly pointed to a strong relationship between funding devoted to research (regardless of the source) and research productivity (Auranen & Nieminen, 2010; David, 2013; Drivas, Balafoutis, & Rozaklis, 2015; Jacob & Lefgren, 2011). An institution's research performance depends on the availability of funding and its research capacity. Every year, billions of federal and non-federal dollars are spent on

research activities in universities. Nevertheless, some researchers have found that the benefits of investing in research are unclear (Rosenbloom, Ginther, Juhl, & Heppert, 2015; Whalley & Hichs, 2014). Yet the practical reality facing research universities is that an insufficient amount of resources are invested in research (Altbach & Salmi, 2011; Sanyal & Varghese, 2006). Maassen (2012) added that institutions rely mainly on external funding for this type of work, which is unsustainable, especially in flagship universities. However, as a significant indicator of research productivity, funding and grant dollars have been used as predictors in this study.

The Consequences of Revenue Diversification on Research Productivity

The development of research activities has remained one of the primary reasons research universities diversify their sources of revenue. A regional university may do the same, but primarily to keep tuition down. However, diversifying sources of revenue comes with both intended and unintended consequences. This section focuses on how revenue diversification influences research productivity as a latent variable. The various repercussions have been divided into the following subtopics: increase in research productivity, quality and quantity of research ideas, changes in research agenda, competition among institutions, changes to the research culture, and faculty workload.

Increase in Research Productivity

Several previous studies have shown that receiving funding increases research productivity. Whalley and Hicks (2014) examined the effects of financial resources on knowledge production in universities and found that research spending had a substantial positive effect on the number of publications, but no effect on quality. In a different study, Jacob and Lefgren (2011) estimated the impact of receiving a grant on subsequent

publications and citations, finding that external research grants had a slight positive effect on the number of publications and citations, especially in new applicants. Jacob and Lefgren (2011) used a sample of 18,135 research applicants for standard research grants that were submitted between 1980 and 2000 to the National Institutes of Health. Their analysis demonstrated that the receipt of a research grant worth $1.7 million led to only one new publication – a 7% increase – over five years. Gush, Jaffe, Larsen, and Laws (2017) reached the same conclusion as Jacob and Lefgren (2011) and Whalley and Hicks (2014). Gush et al. (2017) used a regression model analysis of 1,263 Marsden proposals from second reviews submitted between 2003 and 2008 to test the hypothesis that research funding had no impact on productivity. Gush and colleagues found that research funding was associated with a 6% to 15% increase in publications and 11% to 22% increase in citation-weighted papers for research teams. Faculty that had previously been funded were better off and had higher chances of being funded again, as compared to new applicants.

While the above studies indicated a positive relationship between external funding and research productivity, other work found that external research funding contributed to low research productivity (Banal-Estañol, Jofre-Bonet, & Lawson, 2015; Maassen, 2012; Musiige & Maassen, 2015). These studies differed primarily in their measures of research productivity. For instance, Musiige and Maassen (2015) used the amount of grant funding, while Banal-Estañol et al. (2015) employed the number of publications, patents, and faculty ranks. Maassen (2012) used the number of graduate students enrolled, and their supervision to graduation. In particular, Maassen (2012) examined the effects of external funding on universities in sub-Saharan Africa and the Nordic countries, finding that external funding had at least four attributes that contributed to low research productivity.

First, Maassen (2012) claimed that research funding from donors was not distributed through an open competition that relied on peer review to select the proposal that was academically best. Second, donor agencies did not require academics who had received funding to produce academic publications. Third, a majority of donor projects were more for consultancy activities than academic research. Fourth, most donor agencies preferred having direct contact with the leaders of the projects receiving funding (rather than the institutions), implying that they invested in projects or faculty and not institutions. Musiige and Maassen (2015) added that in such cases, leadership had little to no influence regarding how the money was spent.

Yet there are also those who would disagree with both sides of this debate. These researchers have argued that diversifying revenue sources, and in particular the commercialization of research, has no effect on academic productivity. For instance, Gulbrandsen and Smeby (2005) examined the relationship between commercialization (in terms of entrepreneurial output) and academic performance on scientific publishing, and found that there was no statistically significant connection between the two.

Quality and Quantity of Research Ideas

Revenue diversification has been found to influence the quality and quantity of research. Banal-Estañol et al. (2015) and Hottenrott and Thorwarth (2011) analyzed the effects of private funding from industry on academic research outcomes of universities in the United Kingdom. While Banal-Estañol et al. (2015) used a 20-year longitudinal dataset of all researchers in the engineering departments of 40 universities in the UK, Hottenrott and Thorwarth (2011) employed a dataset created from different sources addressing science and engineering departments. Both found that external funding could boost

research outcomes. First, through collaborations with private businesses, institutions could develop new ideas, improve them, and later transform them into high-quality academic papers. Second, private funding could boost the quality of research by providing the funds necessary for hiring additional researchers and investing in laboratory equipment.

These two studies also identified a curvilinear relationship between university and industry collaborations and publication rate. In particular, Banal-Estañol et al. (2015) used homogeneous information on collaborative grants from the Engineering and Physical Sciences Research Council (EPSRC), the most important funding source for engineering research in the UK, to measure university/industry collaboration over a 20-year period. The authors found that EPSRC funding, supplemented by the university, increased the number of publications, but only up to a certain point. Research outcomes decreased when the degree of collaboration rose above 30% to 40%. Similarly, Hottenrott and Thorwarth (2011) used a sample of 678 professors from 46 universities in Germany to examine the effects of industry funding on professors' scientific productivity, finding that at the start, funding from industry increased professors' research publication outcomes; however, as time progressed, higher shares of industry funding reduced publication outcomes in terms of both quality and quantity.

Similarly, Hottenrott and Lawson (2014) examined the relationships among research grants, sources of ideas, and academic research, finding that institutions that sourced funding and ideas from large firms had fewer patents, publications, and citations compared to institutions that received revenue from smaller donors. Banal-Estañol et al. (2015) supported these findings, arguing that although the pool of ideas for collaboration might be large, not all ideas were worth pursuing or likely to increase publications. Also,

external research funding, especially from large organizations, often has strings attached. For instance, the investigator may not be able to publish until the ideas have been patented, thus reducing research productivity.

Changes in Research Agenda

Some studies have demonstrated that over-diversification can influences institutions' research agendas and overall productivity. External funders such as private donors and industry determine how a research project should progress. In many cases, donors' research priorities differ from those of scholars and their institutions (Hottenrott & Lawson, 2014; Musiige & Maassen, 2015). This difference in research priorities can hinder growth because universities often have no independent funding or capacity to specialize in their own research agenda. For instance, Hottenrott and Thorwarth (2011) examined the effects of industry funding on university research and scientific productivity, finding that the traditional incentives in scientific research, the dissemination of knowledge and rapid disclosure of research outcomes, were being compromised. Hottenrott and Thorwarth (2011) also determined that researchers were induced to conduct research projects solely for the benefit of the private sector and not for scientific progress. Focusing more on the research agendas of those providing the funding has caused a shift in scientists' priorities, as well as the incentives for disclosure, leading to a smaller number of academic publications. Furthermore, Hottenrott and Thorwarth found that less funding was devoted to basic research as compared to applied studies (Thomas, 2001).

Changes in Research Culture

As Estermann and Pruvot (2011) and Hearn (2003) argued, the income from diversified sources should support institutions in their efforts to achieve pre-existing and

new missions. Some studies have noted that as universities become more entrepreneurial, they also become more productive and strengthen their norms, including research and teaching (Gulbrandsen & Smeby, 2005; Newman & Courturier, 2001). A common concern among universities is grounded in the fear that pursuing private funding infringes on academic autonomy and distracts scholars from their core research and teaching missions (Estermann & Pruvot, 2011). Similarly, Stewart (2008) and Auranen and Nieminen (2010) underscored some of the unintended consequences of increasing entrepreneurial initiatives in higher education, such as redirecting the faculty's focus from their institution's core activities, emphasizing quantity over quality, and refocusing attention on less innovative research, thus weakening the positive impact of research on society. These two studies suggested that it is imperative for institution leaders and policymakers to consider these risks. Clark (2004) recommended that in any diversification initiative, academic criteria should dominate over financial matters. Although understanding schools' particular research cultures is vital when discussing their research productivity, doing so requires extensive analysis and is beyond the scope of this study.

Increased Faculty Workload

Another consequence of revenue diversity is the additional workload for faculty involved in research (Rosinger et al., 2016). According to Rosinger et al. (2016), there is generally a consensus that some of the requirements of external funding interfere with other core responsibilities. However, the magnitude of the effect has yet to be examined. With the current decline in state funding, it is now common for external sponsors and university boards to ask researchers to pursue new ways of generating revenue (Alstete, 2014; Hearn, 2003). Since many faculty members are not accustomed to revenue

generation, they often lose out to their more experienced colleagues, which affects their overall performance.

Collectively, these studies provide valuable insights into the influence of external funding on research outcomes. However, they focused only on one external source of funding: either industry or private organizations. The current research considers wider sources of revenue diversification and their effects on university research productivity. Also, studies on this topic have used a variety of measures for research productivity (though primarily publication and citation counts) as independent variables. In the current work, research productivity is a latent variable measured by several indicators.

Relationship between Financial Stability and Research Productivity

The literature has shown that institutions diversify their revenue streams to achieve financial sustainability, which, while not an end unto itself, is a way of advancing academic and research activities. Undoubtedly, the level of funding has an influence on research opportunities. More resources implies better infrastructure, a conducive environment for continuous education of the research staff, and the possibility of participating in conferences (Wolszczak-Derlacz & Parteka, 2010). Other research has demonstrated that an institution's potential to generate additional revenue correlates strongly with their level of financial stability (Cheslock & Gianneschi, 2008; Fransz & Sidford, 2011; Stachowiak-Kudła & Kudła, 2017). For instance, Fransz and Sidford (2011) analyzed how private funders responded to the decline in state funding, finding that private donors only invested in institutions that had evidence of public funding and other stable financial resources or that were involved in major research projects.

Ebadi and Schiffauerova (2015) and Vlăsceanu and Hâncean (2015) determined that the best way to improve research productivity was to increase the flow of funds. From a different perspective, Stachowiak-Kudła and Kudła (2017) argued that the potential for institutions to diversify their funding and increase their overall financial stability was due to legal factors (i.e., policy regulations). Whenever public sources are insufficient, regulations for increasing financial stability are expected. Such policies improve the possibility of private sources, at the expense of public money. Together, the above studies illustrated that funding from both private and public matters was necessary not only for research, but also for institutions' general operation. Apart from government and private funding, scholars such as Estermann and Pruvot (2011) and Vlăsceanu and Hâncean (2015) also recognized that an increase in research productivity could be attributed to a mixture of factors such as income diversification, growth in net revenue, and institutional incentives that stress performance criteria. However, it is yet to be determined how much funding is enough to adequately improve research productivity. With the decline in state funding forcing institutions to aggressively seek out other sources, it is essential to determine the extent to which alternative sources of funding actually improve an institution's financial stability. These issues serve as motivation to examine the magnitude of the relationship between funding from alternative sources, institutional financial stability, and research outcomes.

This study focuses on the relationships among three variables: diversification of revenue, institutional financial stability, and research productivity. Thus, a mediation analysis to examine the underlying relationships was essential. This analysis clarified how the financial stability of an institution influences the effects of revenue diversification on

research productivity. The mediation analysis offers a deeper understanding of the association that exists between higher education funding variables and why research institutions require ongoing support. This study is the first of its kind, and the results of the analysis will guide policymakers and institutional leaders in decisions related to revenue diversification.

Summary

The literature related to funding for research universities, forces motivating revenue diversification, and the effects of that diversification on institutional financial stability and research productivity were examined and described above. This review illustrated that despite the vital role public research universities play in the knowledge economy, the government gravely underfunds them. State funding for these types of institutions accounts for less than one-third of the total institutional revenue. The traditional system has transformed; states are no longer generous, have become more demanding, and insist on institutions seeking alternative revenue streams. The effect that this decline in state funding may have on institutional outcomes has yet to be fully understood. This review identified several of the forces motivating institutions to diversify their sources of revenue. In the current study, these forces are categorized into three groups: economic, social, and political conditions. Together with policy directives, they put pressure on institutions' already constrained budgets, forcing them to seek alternative sources of revenue. The main purpose of diversification is not only to provide more funds, but also to establish stability and greater control over finances such that these institutions are better able to pursue their desired missions.

Previous studies have shown that with the decline in government funding for higher education, public research universities are increasingly relying on alternative sources of funding to achieve their mission (Alstete, 2014; American Academy of Arts and Sciences, 2015b, 2016b; Franklin, 2007; Hearn, 2006a). These sources of income include commercialization of intellectual property, pricing strategies (i.e., tuition and fees from the sale of services), auxiliary services, endowments and charitable giving, and collaboration with other research organizations. While a number of income sources are being pursued, the literature has demonstrated that they are not a panacea to this financial crisis. The review indicated that these sources do not contribute to institutional financial stability (Stewart, 2008), tend to be unpredictable (Hearn, 2003; Stewart, 2008), and mainly come in the form of restricted income such that after costs, many schools only break even (American Academy of Arts and Sciences, 2016b; Carey-Fletcher, 2014). These scholars also argued that the impact of diversification is often unclear, claiming that though funding from external sources may seem significant with regards to the margin of growth, it comprises only a small percentage of the total operating budget (Jaramillo & Melonio, 2011). In addition, sources are often limited in scope and require upfront investment (Estermann & Pruvot, 2011).

Thus, there is an ongoing need to examine whether revenue diversification is actually the right decision, or whether it opens institutions to greater risks. Though a significant number of diversification strategies exist, the majority of previous work has focused on one or a small category of alternative income sources. The current study incorporates multiple sources of funding, categorizing them into five groups: the

government, research, net tuition, endowments, and auxiliary services (including private income).

The literature provides evidence that revenue diversification is a burgeoning practice in institutions of higher education. However, it is inconsistent with regards to the effects diversification strategies might have on increasing institutions' financial stability and knowledge production. For instance, prospective revenue diversification has been conceptualized as a means of reducing the volatility of university finances, because a shortfall in one source can be offset by an increase in another (Teixeira & Koryakina, 2013; Pfeffer, 2003; Pfeffer & Salancik, 1978). As stated by Webb (2015), though the net revenue may not increase, revenue portfolios may enable administrators to come up with long-term initiatives and improve institutional performance, despite challenges in external funding conditions. Conversely, other scholars have maintained that revenue portfolios do not provide sufficient resources to make schools financially stable (Leslie et al., 2011; Teixeira et al., 2014; Webb, 2015). Instead, diversifying and over-diversifying can have unintended consequences related to demanding procedural and structural changes, such as increased accountability and greater differentiation, both which may outweigh the benefits of a net increase in revenue (Allen & Seaman, 2010; Sife, Lwoga, & Sanga, 2007). Other consequences may include a decrease in institutional revenue due to the hidden costs involved in complexities related to diversification. This finding implies the need for empirical research exploring these factors through a statistical analysis of the data.

From the resource dependence perspective, the literature seems to indicate that diversifying revenue can reduce institutional dependence on external parties and provide more autonomy for institutions. Additionally, it may enable these institutions to devote a

larger portion of their resources to diversification initiatives identified as useful in promoting institutional goals. However, there is no quantifiable evidence to prove the nature of the relationship between revenue diversification, financial stability, and research productivity. The current study addresses this gap.

The literature also offers contradictory findings on the relationship between revenue diversification and research productivity. While some scholars have argued that diversification increases research productivity in terms of publications, citations, number and amount of grants, and awards given to faculty, others have claimed that it may have unintended consequences, including contributing to low research productivity (Banal-Estañol, Jofre-Bonet, & Lawson, 2015; Maassen, 2012; Musiige & Maassen, 2015), changing the research agenda (Hottenrott & Lawson, 2014; Musiige & Maassen, 2015), and yielding a lower quality and smaller quantity of research ideas (Banal-Estañol et al., 2015; Hottenrott & Thorwarth, 2011). The literature review also showed that several measures of research productivity have been proposed to evaluate this variable at both the individual and institutional levels. However, none of these measures has achieved widespread acceptance (Abramo & D'Angelo, 2014; Altbach, 2015; Wootton, 2013). Several studies focused only on one or two measures for examining research productivity, mainly publication and citation counts. These were criticized for not incorporating the vast differences in resources among institutions. The review also uncovered several other indicators of research productivity, ranging from individual characteristics to the institutions themselves. However, no study tested whether the proposed indicators were actually effective in measuring research productivity.

The current study considers a composite measure of research productivity that consists of multiple indicators at the individual level, as well as academic development factors. These indicators include: publication and citation counts (Abramo & D'Angelo, 2014; Hirsch, 2005, 2010; Huang, 2012); number and amount of research grants (Auranen & Nieminen, 2010; Capaldi et al., 2015; David, 2013; Drivas et al., 2015; Jacob & Lefgren, 2011; Porter & Umbach, 2001); number of PhD students supervised to graduation (Cohen et al., 2012; Wootton, 2013); number of faculty who are members of national academies (i.e., "star faculty") and faculty awards (Capaldiet et al., 2015); number of faculty receiving research grants (Auranen & Nieminen, 2010; Smeby &Try, 2005); size of the institution (as measured by the number of students, number of faculty, and tradition or history of the institution) (Huang, 2012); faculty size (Basu et al., 2016); individual characteristics of the institution, such as year of establishment, location, and prestige (Wolszczak-Derlacz & Parteka, 2010); and membership in the AAU (Association of American Universities, 2017; Deutsch, 2016). The current study used a principal component analysis to extract the mechanisms underlying the latent structure of research productivity and test the reliability of the factors.

Although the measures for research productivity seem appropriate, no empirical analysis has examined how revenue diversification might influence revenue volatility, research agendas, and productivity at public research universities. Most importantly, the previous literature has demonstrated the need for determining which revenue diversification programs work best in terms of increasing research productivity. Finally, the literature has offered evidence that many institutions have not recognized the complexity of building and sustaining research capacity, nor the resources such an

endeavor requires (Altbach & Salmi, 2011). This failure to provide a link between research production and diversification strategies represents a significant gap in the existing literature. In sum, there is a need for this empirical study, which examines whether institutions that have widely diversified their sources of income actually achieve financial stability and improve their research outcomes to an extent greater than those which are less diverse.

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CHAPTER III

METHODS

This study examined the consequences of revenue diversification on institutional financial stability and research productivity in American public research universities. Research productivity was a latent variable, based on indicators deduced from a review of the literature. This chapter is organized into seven sections: (a) research design, (b) population and sample, (c) data sources, (d) study variables, (e) statistical model, (f) data analysis, and (g) summary.

Research Design

A correlational panel-based research design was used to examine the consequences of revenue diversification on the financial stability and research outcomes of public research universities. The design was deemed appropriate because the goals of this study were to: (a) investigate and describe the changes in revenue over time, (b) predict the effect of revenue diversification (as an independent variable) on institution-based finance and research outcomes (the dependent variables), and (c) make inferences. Researchers such as Cohen, Cohen, West, and Aiken (2013), and Meyers et al. (2013) suggested that such concerns are best addressed using a correlational research design. Both the independent and dependent variables were continuous and required the computation of means, standard deviations, and correlations to describe their relationships.

Population and Sample Size

The population for this study was comprised of American research universities. According to the Indiana University Center for Postsecondary Research (2016), the United

States has approximately 4,665 institutions of higher education. These are classified as "very high research," "high research," "doctoral/research," and "master's/baccalaureate" universities (Indiana University Center for Postsecondary Research, 2016, p. 9). Of the total, 115 (2.47%) are considered "very high" public and private research universities.

The sample for this study was comprised of 81 "very high" public research universities located in 25 states. These institutions were selected first because they were assumed to be similar in scope and research activities (Indiana University Center for Postsecondary Research, 2016). Second, this type of university plays a major role in training the manpower required for the knowledge economy; that is, they educate approximately 20% of students nationwide (American Academy of Arts and Sciences, 2016). Third, "very high" public research universities are "a critical component of [the] higher education landscape" (National Science Board, 2012, p. 2), and are expected to meet their missions "efficiently, effectively, and affordably" (American Academy of Arts and Sciences, 2015a, p. 25). Private universities were excluded because they tend to have more established sources of income compared to public research universities. Also, they are believed to have various revenue streams through which they can attract students and conduct research (Leslie et al., 2012).

Data Sources

Several data sources were used for this study. The two primary sources were the Integrated Postsecondary Educational Data System (IPEDS) and Academic Analytics. The IPEDS database was considered appropriate because it features extensive longitudinal information on institutional revenue and is organized by source and use, and also includes data on each institution's particular characteristics. Many scholars on this and related

topics have employed this database (e.g., Leslie, 2012; McLendon, 2009; Webb, 2015). The Academic Analytics dataset was considered vital for this work, as it is comprised of data on fundamental areas of scholarly research activities, and is organized on the institution, broad field, department, PhD program, and individual faculty member levels. The other data sources for this research included the National Academies of Science, Engineering, Medicine, and Education; AAU; and individual university websites.

From the above data sources, information on key variables was extracted for the 2006-2007 to 2014-2015 academic years. This period was chosen because it included several years of the Great Recession, the time when most institutions intensified revenue diversification strategies to sustain their missions. Examining these changes and how the effects of revenue diversification varied across institutions was the focus of this study.

Study Variables

The variables for this study included sources of revenue diversification as the independent variable, two dependent variables (i.e., institutional financial stability and research productivity), and control variables related to an institution's performance and environment.

Independent Variable

The revenue diversification index and dependence rates of five major revenue sources for public research universities were used as predictors in this research. A predictor was developed for each measure three years prior to the outcome variable. For instance, an average measure for the years 2006, 2007, and 2008 was used to predict the dependent observations regarding 2009. This approach was considered appropriate because the effects of diversifying revenue on institutional financial stability and research productivity take

time to evolve (Yan, 2012). As mentioned earlier, the choice of time lag was also based on the average longevity of research projects and effect of prior decisions concerning the level of expenditure.

The revenue diversification index and five dependence measures were derived as follows. First, the main sources of revenue for public research universities were aggregated into five mutually exclusive categories, similar to those found in the IPEDS dataset. These included: (a) net tuition, consisting of the amount of money received from students after excluding institutional student aid; (b) government funds, representing the amount of funds received from federal, state, and local government agencies (but excluding research grant dollars); (c) research, meaning funds received from private and corporate sources, as well as state, local, and federal funding in the form of grants and contracts specifically meant for research; (d) endowment income, indicating investment income from trusts held by others and funds related to the endowment; and (e) private and auxiliary income, consisting of monies received from auxiliary enterprise operations such as residence halls, food services, athletics, and hospitals, as well as revenue from private or public sources of non-research services rendered (adjusted from Desrochers & Hurlburt, 2014). It was assumed that these five categories captured 100% of university revenue.

A revised Hirschman Herfindahl Index (HHI) developed by Suyderhoud (1994) was used to compute the diversification indices. The diversification index value was calculated by first determining the relative shares of each of the five revenue categories in a fiscal year. Each share was squared, and then summed to form the HHI. Drawing from previous studies, an HHI of 1 represented an institution depended on only one revenue source (i.e., no diversification). Ann HHI closer to zero showed an institution depended on

multiple sources (i.e., high diversification). With five categories of revenue sources, the maximum level of diversification would equals to an index of 0.2 (i.e., each revenue source represented precisely 20% of the total revenue). This would occur only in perfectly diversified institutions. Conversely, the minimum level of diversification would yield a diversification index of 1.00 (i.e., one source represented 100% of the revenue). This would happen only if an institution relied on a single source of funding. The diversification measure was then calculated by subtracting the HHI for each category from 1. Finally, the diversification index was determined by taking its diversification measures as a ratio of the maximum diversification value. Previous theories on this model have suggested that holding all other factors constant, institutions would benefit from lower diversification index values.

This study considered five sources of revenue; thus, when an institution was not perfectly diversified, the actual minimum diversification index was 0.53 and the maximum was 0.99. The dependence measure for each of the five categories was calculated. For instance, the measure of dependence on net tuition was determined by taking the revenue from net tuition and dividing it by the sum of the revenue from the five sources of income. A similar calculation was applied to obtain the measures of dependence on government funding, endowment income, research, and auxiliary services. All of the independent variables were continuous.

Dependent Variables

Measures of Financial Stability

This study used a composite financial index to measure institutional financial stability (CFI). The CFI was developed in 1999 and has been accepted as a metric for

measuring an institution's overall financial stability or health (Prager et al., 2005). Stewart (2008) used a CFI analysis to compare revenue diversification and sustainability trends in the US and UK. Similarly, the Texas Higher Education Coordinating Board (2016) employed the CFI to measure the financial health of Texas public community colleges. Based on previous studies, the CFI was determined to blend four core financial ratios into a single figure, thus providing a balanced view of the state of an institution's finances, at least as much as possible. Proponents have asserted that when the four ratios are combined, the strength of one measure can offset weaknesses in another. Moreover, researchers have suggested that the CFI is the best at measuring the financial index over time, because it provides a glimpse of the institution's progress towards achieving its financial goals (Prager et al., 2005).

The calculation of the CFI was accomplished using the four steps suggested by Prager and colleagues. The first step was to compute each of the four core ratios. These included: (a) the primary reserve ratio, expressed as an expendable net assets/position divided by the total expenses (both operating and non-operating). This ratio illustrated the sufficiency of resources and their flexibility. (b) The viability ratio was articulated as expendable net assets/position divided by long-term debt. This ratio indicates the potential of an institution to repay its total debt through reserves. (c) The return on net asset ratio was the change in net assets/position divided by the beginning net assets/position. This ratio indicated whether an institution was better off financially in the current or previous year. (d) Finally, the net operating/unrestricted revenues ratio was denoted as income (or loss) divided by operating and nonoperating revenues. The net unrestricted ratio explained whether an institution was operating within its available resources.

The second step involved converting the four ratios into strength factors, using the standard scale shown in Table 1, Column 2. The primary reserve ratio was divided by 0.133; the net operating revenue ratio was divided by 0.133 or 0.17, depending on how the institution calculated their ratio. The return on assets ratio was divided by 0.02, and the viability ratio by 0.417. Computing the strength factors allowed the four ratios to be calculated on different bases and then combined into a CFI (Prager et al., 2005).

The third step entailed multiplying the converted strength factors by a corresponding weighting factor, as shown in Table 1, Column 3. The primary reserve was multiplied by a weight of 35%, net operating revenues by 10%, return on net assets by 20%, and viability ratio by 35%. The weights were used to accommodate differences in the ratios that have varying impacts on institutions. In the current study, these weights were consistently applied and skewed more towards retaining wealth (similar to a normalized institution) and less towards operations.

The last step involved combining of the four weighted values to obtain the CFI, which was the dependent variable for this study. A score below 3, including negative scores, indicated financial stress. A score of 3 was considered to be the threshold for a strong financial position. Higher scores, those above 6, showed stronger financial positions (i.e., stability), whether or not an institution was having financial difficulties or could invest in new programs and activities. Also, previous studies have shown that a CFI analysis can help institutions make the financial decisions needed to achieve their missions. Table 1 summarizes the computation of the CFI.

Table 1. Summary of Composite Financial Index Analysis

Core Ratio	Strength Factor	Weight	Score
Primary Reserve Ratio	/0.133	X 35%	=a
Net Operating Revenue Ratio	/0.007	X10%	=b
Return on Net Assets Ratio	/0.02	X20%	=c
Viability Ratio	/0.417	X35%	=d
Composite Financial Index score			**Total score (a+b+c+d+e)**

Measure for Research Productivity

The measure of research productivity used in this study was developed from the literature. The literature review showed that a wide range of methods and indicators for measuring research productivity currently exist. However, most past studies employed either one, or at most three of the proposed indicators, with the exception of Capaldi et al. (2015), Academic Analytics, and the Shanghai Ranking of World Universities; these used nine, seven, and five indicators, respectively. No proposed method has received widespread acceptance. In the current study, the measure of research productivity as a latent variable was derived from factors highlighted in the literature. These factors were categorized into two groups: those related to an institution's overall performance, and those associated with individual academic/career development factors.

An institution's performance includes those factors that emerge from an institution's unique context and are related to research outcomes. These factors include membership in the Association of American Universities, percentage of educators considered "star faculty," and mentoring programs for future researchers (measured in number of PhD students supervised to graduation). The average number of PhD students who graduated within the study period was also employed in this research. The academic

development factors came from faculty achievements, including the average number of publications (i.e., journal articles, books, and book chapters), conference proceedings, citations, grants, awards, and grant dollar amounts per faculty member; most of these data were provided by Academic Analytics.

Since the current research considered several indicators for measuring research productivity, Principal Component Analysis (PCA) was used to reduce the factors' dimensions. The reliability retained after factor extraction was tested using a Cronbach's alpha, in order to determine the consistency of the factorial structure of research productivity. While the simplest way to compute factor scores for each observation is to sum all of the scores of the items assigned to a factor, this approach has been found to neglect the potential differences in each variable's contribution to each factor (Sarstedt, Hair, Ringle, Thiele, & Gudergan, 2016). Therefore, a composite score was computed using the prediction command. The composite research index was then calculated by averaging the two scores.

Control Variables

Two variables were included to control the influence of institutional differences in revenue on financial stability. These variables were the state per capita income and membership in the Association of American Universities. Higher levels of difference in institutional revenue indicated the potential for state funding, and likely led to higher per capita expenditures. The state per capita income was derived from the Bureau of Economic Analysis. AAU member institutions are generally considered prestigious (Wolszczak-Derlacz & Parteka, 2010) and have a greater ability to fund most of their operations, primarily research (AAU, 2015).

Faculty workload (measured by the student-to-faculty ratio) was included in the model to control for differences in institutions' characteristics and determine how they might impact research outcomes. Faculty with lighter workloads have more time to conduct research (Walker & Fenton, 2013; Webber, 2011; Wolszczak-Derlacz & Parteka, 2010). Table 2 presents a summary of the variables employed in this study.

Table 2. Summary of Proposed Variables, Coding, and Sources

Variable	Source
Revenue Diversification –Independent Variable	
Government funds	IPEDS
Net tuition	Delta Cost Project database
Endowment	
Private and Auxiliary services Research	
Financial stability – Dependent variable	
Primary Reserve Ratio	IPEDS
Net Operating Revenue Ratio	Delta Cost Project database
Return on Net Assets Ratio	
Viability Ratio	
Research Outcomes- Dependent Variable	
Institution performance	
Number of Ph.D. students graduating	IPEDs
Membership to AAU	AAU Website
Number of Star faculty who are members to National Academies (Science, Engineering, Medicine, Education)	National Academy of Sciences Website
Research/ development factors	
Average Article published per faculty	Academic Analytics
Average books published per faculty	
Average citations per faculty	
Average grant /funding per faculty	
Average awards per faculty	
Average dollar amount per faculty	
Average conference proceedings per faculty	
Control variables	
Student /Faculty ratio	IPEDS
State per capita income	Bureau of Economic Analysis

Statistical Models

Three types of analysis were used in this research: multilevel, principal component, and multiple regression analysis. Multilevel modeling was deemed appropriate because of the nested nature of the data. That is, the repeated measures, which are also the observations overtime, were nested within each institution, which was the unit of analysis. The multilevel model has also been considered the best at capturing differences in the unit of analysis (i.e., the institution) across time. Multilevel modeling was used to answer Research Questions 1, 2, 3, 5, and 6.

A principal component analysis was used to answer Research Question 4. The PCA approach was employed to reproduce the data structure underlying research productivity, using only a few factors. This method was essential due to the number of indicators currently available for measuring research outcomes. Dealing with such a large set of indicators can be cumbersome because together they provide a complex dataset. Finally, multiple regression was used to test the mediation analysis in Question 7. Despite the existence of advanced methods for examining a mediation analysis in panel data, the regression method was preferred due to the small sample size for this study. Below are the models related to the research questions.

Models 1 through 4 relate to questions of revenue diversification and financial stability. The first sought to determine the effect of diversifying revenue (i.e., the independent variable) on institutional financial stability (i.e., a dependent variable) and how that effect might vary across institutions, after controlling for other predictors. A hierarchical linear model was used for the analysis due to the nested structure of the data. The intercept-only and random coefficient models were specified as Equations (1) and (2),

as follows.

$$Y_{ij} = \gamma_{00} + \mu_{0j} + \varepsilon_{ij} \quad (1)$$

$$Y_{ij} = \gamma_{00} + \gamma_{10}\,RDIij + \gamma_{01}SPCj + \gamma_{02}AAj + \mu_{0j} + \mu_{1j}\,RDIij + \varepsilon_{ij} \quad (2)$$

where *i* is the index of the repeated measure and *j* is the index of the institutions, γ_{00} represents the average intercept, γ_{10ij} indicates the slope of the revenue diversification index (RDI), and γ_{01} and γ_{02} represent the effects of state per capita income and AAU status of the institution on financial stability, respectively. The variables u_{0j} and u_{1j} are the random effects associated with the intercept and slope of the diversification index, respectively, and ε_{ij} represents the Level 1 residual. It was assumed that the random effects associated with the intercept (u_{0j}) and random slope (u_{1j}) followed a bivariate normal distribution, with a mean of zero and certain variances and covariances.

The second research question examined whether institutional financial stability changed over time. A linear growth model without individual-level predictors was specified in a combined model, as follows:

$$Y_{ti} = \beta_{00} + \beta_{10}Time_{ti} + \mu_{0i} + \mu_{1j}Time_{ti} + \varepsilon_{ti} \quad (3)$$

where Y_{ti} is the outcome (i.e., financial stability) at point *t* for institutions, $Time_{ti}$ is the unit of the predictor for each l institution *i* at time point *t* (i.e., the elapsed time between the *t* occasion and 2006), β_{00} is the average intercept, β_{10} is the average rate of change (i.e., the expected change in dependent variable as a function of *i* unit change in the new time independent variable), and μ_{0i} and μ_{1i} are the covariance structures for the random intercept and random slope, respectively, which allowed the intercepts to vary across individual

institutions. Finally, ε_{ti} is a time-specific error showing the variation between an institution's fitted linear trajectory and the observed data.

The third research question examined the relationship between the sources of funding (i.e., government (GOV), net tuition (NET), endowment (END), research funds (RES), and income from auxiliary services (AUX)) and institutional financial stability over time, after controlling for state per capita income and membership in the AAU. The five predictors and two control variables were added to the model to test their fixed effects on the outcome. The combined model was specified as follows:

$$Y_{ti} = \beta_{00} + \beta_{01}Time_{ti} + \beta_{02}GOV_{ti} + \beta_{03}NET_{ti} + \beta_{04}RES_{ti} + \beta_{05}END_{ti}$$
$$+\beta_{06}AUX_{ti} + \beta_{10}SPC_i + \beta_{20}AAU_i + \mu_{0i} + \mu_{1i}Time_{ti} + \varepsilon_{ti} \quad (4)$$

where Y_{ti} is the outcome (i.e., financial stability) at time point *t* for distinct institutions, $Time_{ti}$ is the value of the independent variable for individual *i* values at time point *t* (i.e., the time elapsed between the *t* occasion and 2006), β_{00} is the average intercept, β_{01} is the average growth rate (i.e., the expected change in dependent variable as a function of *i* unit change in the new time independent variable), β_{02} to β_{06} are the mean effects of the five predictors in the model , β_{10} and β_{20} are the effects of the SPC and AAU, respectively, and μ_{0i} and μ_{1i} are the covariance structures for the random intercept and random slope, respectively, which allowed the intercepts and growth rates to vary across individual institutions. Finally, ε_{ti} is a time-specific residual.

Question 4 examined the structure and reliability of the factors underlying research productivity. Since several indicators for measuring research outcomes have been proposed. A principal component analysis was considered appropriate (Tabachnick &

Fidell, 2007) to reduce the component structure underlying research productivity. Factor scores were then predicted, and a Cronbach's alpha used to test the reliability of the construct.

The fifth research question examined the consequences of revenue diversification on institutional research productivity, and how the effect varied across institutions. Similar to Questions 1 and 2 above, a hierarchical linear model was used for the analysis, due to the nested structure of the data. The intercept-only and random coefficient models were specified as follows:

$$Y_{ij} = \gamma_{00} + \mu_{0j} + \varepsilon_{ij} \quad (5)$$

$$Y_{ij} = \gamma_{00} + \gamma_{10} RDIij + \gamma_{01} WLDj + \mu_{0j} + \mu_{1j} RDIij + \varepsilon_{ij} \quad (6)$$

where Y_{ij} (i.e., research productivity) represents the dependent variable, *i* is the index of the repeated measure, *j* is the index of institutions, γ_{00} represents the average intercept, γ_{10ij} indicates the slope of the revenue diversification index (RDI), and γ_{01}, γ_{02}, and γ_{02} represent the effects of workload, faculty experience, and faculty rank on research productivity, respectively. The variables μ_{0j} and μ_{1j} are the random effects associated with intercept and slope, respectively, and ε_{ij} represents the Level 1 residual. It was assumed that the random effects associated with the intercept (μ_{0j}) and slope (μ_{1j}) would follow a bivariate normal distribution, with a mean of zero and certain variances and covariances.

Research Question 6 examined the effects of five predictors (i.e., government (GOV), net tuition (NET), research (RES), endowment (END), and auxiliary services (AUX)) on institutional research productivity over time, after controlling for faculty workload. Equation 7 is similar to Equation 4, except for differences in the outcome and control variables. The outcome for Equation 7 was the research outcome and the variables

controlled for were those that strongly related to research outcomes (i.e., faculty workload, rank, and experience). The combined model was specified as follows:

$$Y_{ti} = \beta_{00} + \beta_{01}Time_{ti} + \beta_{02}GOV_{ti} + \beta_{03}NET_{ti} + \beta_{04}RES_{ti} + \beta_{05}END_{ti}$$
$$+\beta_{06}AUX_{ti} + \beta_{10}WLD_i + \mu_{0i} + \mu_{1i}Time_{ti} + \varepsilon_{ti} \quad (7)$$

The seventh research question determined whether an institution's financial stability influences the effect of revenue diversification on research productivity. A cross-lagged panel model with three time points (i.e., 2013, 2014, and 2015) was run to determine how the focal predictor (i.e., revenue diversification) and mediator (i.e., financial stability) affected the dependent variable (i.e., research productivity). The total effect of the predictors (i.e., the revenue diversification index (X) and CFI (M)) on the criterion variable (i.e., the composite research index (Y)) was determined at each time point. The corresponding equations relating to X, M, and Y at any given time were expressed as follows:

$$X_t = xX_{t-1} + ex_t$$
$$M_t = mM_{t-1} + axX_{t-1} + eM_t$$
$$Y_t = yY_{t-1} + bM_{t-1} + cX_{t-2} + eY_t \quad (8)$$

where X_t is the value of X at time *t*, x represents the relationship between the variable X at time *t* and the same variable measured at an earlier time, *t*-1, and ex_t is a random disturbance that is different at each time.

The same applies to the terms for $M_{[t]}$ and $Y_{[t]}$. During the path estimation, a balance between the most parsimonious model and meaningful paths was evaluated to ensure that the paths were not constrained to zero. In this model, the three time points were assumed to be constant. That is, the direct and indirect effects were considered to be

the same across the measurement intervals. The cross-lagged model also did not account for the presence of measurement errors (Cole & Maxwell, 2003; Maxwell & Cole, 2007).

Data Analysis

Prior to the analysis, the data screening, missing data, and assumptions related to multilevel modelling were all checked. Also, a Hausman test was conducted to determine whether the random effect model was appropriate. Tests were also conducted regarding the assumption that the Level 1 residual was independently, identically, and normally distributed, with a mean of zero and variance of σ^2 $\left[\varepsilon_{ij} \sim iidN(\sigma^2)\right]$, as well as the assumption of homogeneity of the Level 1 residuals across the level of predictors and clusters.

The data were analysed in three parts. The first (consisting of Questions 1 to 3) focused on the influence of revenue diversification on financial stability. The second (Questions 4, 5, and 6) addressed the effects of diversication on research productivity, and the third considered the relationships among the three variables of revenue diversification, financial stability, and research productivity. In part two, the variables first were standardized (i.e., Z-scores were computed). Then, a principal factor analysis was used to extract the factorial structure underlying research productivity. Next, the number of variables loaded on each of the retained factors was determined. The reliability of the factor groupings was tested using a Cronbach's alpha. The indices for measuring research productivity were then generated using the prediction command. Lastly, the weighted values were used to construct a composite index for measuring overall research productivity.

In part three, a cross-lagged panel model was used to determine institutional

financial stability, diversified revenue, and research productivity. At each time point, the ability to diversify revenue was the independent variable, while institutional financial stability was the mediation variable and research productivity was the dependent variable. In every section, descriptive statistics such as means, standard deviations, correlations, and bar graphs for some of the variables were computed to provide a clearer understanding of the study sample.

Summary

Chapter III presented the methodology for this quantitative study. Using a sample of 81 public research universities, the consequences of revenue diversification on schools' financial stability and research outcomes were examined. Six predictors (i.e., diversification indices, government, tuition, endowment, research, and auxiliary services) were included in the model. For each predictor, the three years prior to the outcome measure were computed. Data sources and the statistical model were then discussed. The results of the analysis and conclusions are presented in Chapters IV and V, respectively

CHAPTER IV

RESULTS

This chapter first presents the process implemented to screen the data, and then the results of the analyses used to resolve the research questions. The results are presented in three sections: (a) analyses of Research Questions 1, 2, and 3, which relate to revenue diversification and financial stability; (b) analyses of Research Questions 4, 5, and 6, which concern revenue diversification and research productivity; and (c) analysis of Research Question 7, which deals the relationships among revenue diversification, financial stability, and research productivity.

Descriptive Results

Table 3 presents the descriptive statistics for the observed variables, after slight transformation. The first six variables were continuous and used as predictors. In this study, a Composite Financial Index (CFindex) served as an outcome variable for measuring financial stability. The next 10 variables were indicators for measuring research productivity, and were employed in the principal component analysis. The scores for measuring research productivity were predicted and used for further analyses. The mean and standard deviation presented were accumulative, and thus may not have shown trends for the period under investigation. Among other tests, skewness and kurtosis were used to evaluate the normality of the variables, as discussed in the assumptions check.

Assumptions Check

The variables in Table 3 were screened for normality, outliers, and missing values. Given that most inferential statistics and statistical testing rely on the normality of the

assumptions in the data, assumptions related to multilevel modeling (that is, the assumption of normality in the Level 1 residuals), and homogeneity of and across Level 1 residuals, the skewness and kurtosis were examined to confirm univariate normality in the data. A skewness of 0 and kurtosis of 1 indicates that individual variables are close to the normal distribution. As shown in Table 3, several variables were highly skewed. The graph box of homogeneity across clusters, shown in Figure 2, illustrates how institutions differed. Overall, the results of the assumption indicate that the data violated normality. The robust standard error estimates in STATA 15 was used to correct for any violations of the assumptions.

Missing Data

The test for missing data showed that the data were missing completely at random; 95% of the data were complete. The highest percentage of missing data was 6% for the six financial variables: diversification index (Dindex), government (Gov), net tuition (NeT), research (ReS), endowment (End), and auxiliary services (Aux). The remaining 13 variables had no missing data. Listwise, the deletion function in STATA 15 was used to handle the missing the data.

Hausman Test

A Hausman test was conducted to choose between using either a random or fixed effect model. The results of the Hausman test indicate that the random-effect model was more appropriate than the fixed effect model (i.e., chi^2 (1) = (b-B)'[(V_b-V_B) ^ (-1)] (b-B) = 3.13, p = 0.0769). The p-value was not significant, so the random effect was used in the multilevel analysis.

Table 3. Descriptive Statistics of Observed Variables without Data Transformation

(N = 81, n = 810 observations)

Variable	%Mis	Mean	SD	Min	Max	Skew	Ku
Dindex	5.46%	.91	.07	.53	.99	-2.40	10.45
Gov	5.46%	23.67	11.15	.14	74.38	0.79	5.12
NeT	5.46%	20.83	9.72	2.57	52.18	0.54	2.68
Res	5.46%	22.16	9.90	7.58	59.24	1.23	4.87
End	5.46%	9.89	5.28	.11	36.15	1.08	4.58
Aux	5.46%	23.41	15.08	0	74.49	1.05	3.40
CFi	0%	3.70	3.80	-9.98	14.62	-0.06	2.88
NAT	0%	7.93	12.23	0	61	2.67	10.44
Av Art.Pub P/F	0%	0.91	0.80	0.09	5.04	2.60	10.80
Av Grant P/F	0%	0.05	0.47	0.001	0.32	2.50	10.66
Av citatn P/F	0%	22.71	27.88	0.52	191.73	3.56	17.92
Av Books P/F	0%	0.045	0.042	0.001	0.28	2.25	8.60
Av DollaG P/F	0%	9976	11223	9175	90914	3.35	17.67
Av Award/F	0%	0.23	0.93	0 00	11.44	7.04	68.54
Av Conf Pro P/F	0%	0.14	0.16	0.09	1.18	2.99	14.77
Av Gradst~s	0%	596	283	138.9	1439	.84	3.45
State PCI	0%	28462	3652	21063	39373	0.66	3.11
S/fratio	0%	11.84	4.28	2.55	24.03	0.68	3.31
Categorical V	**%Mis**	**Freq.**	**%**	**Cum**		**Skew**	**Ku**
AAU (0)	0%	460	56.79	56.79		0.27	1.08
(1)	0%	350	43.21	100		0.27	1.08

Note: Dindex = Diversification index; Gov =government; Net = net tuition; ReS= Research; End = endowment; Aux =Auxiliary services; CFi= composite financial index; NAT = membership to national academy; Av Art.Pub P/F = Average articles published per faculty; Av Grant P/F = Average Grant per faculty; Av Citatn P/F =Average citations per faculty; Av Book P/F= Average books published per faculty; Av DollaG P/F= Average dollar grant per faculty; Av Award P/F = Average awards per faculty; Av Conf pro. P/F= Average conference proceedings per faculty; Av Gradst~s= Average Ph.D. student supervised to graduation; AAU= Association of American University; State PCI= state per capita income; S/fratio= student faculty ratio; Skew =Skewness; Ku =Kurtosis

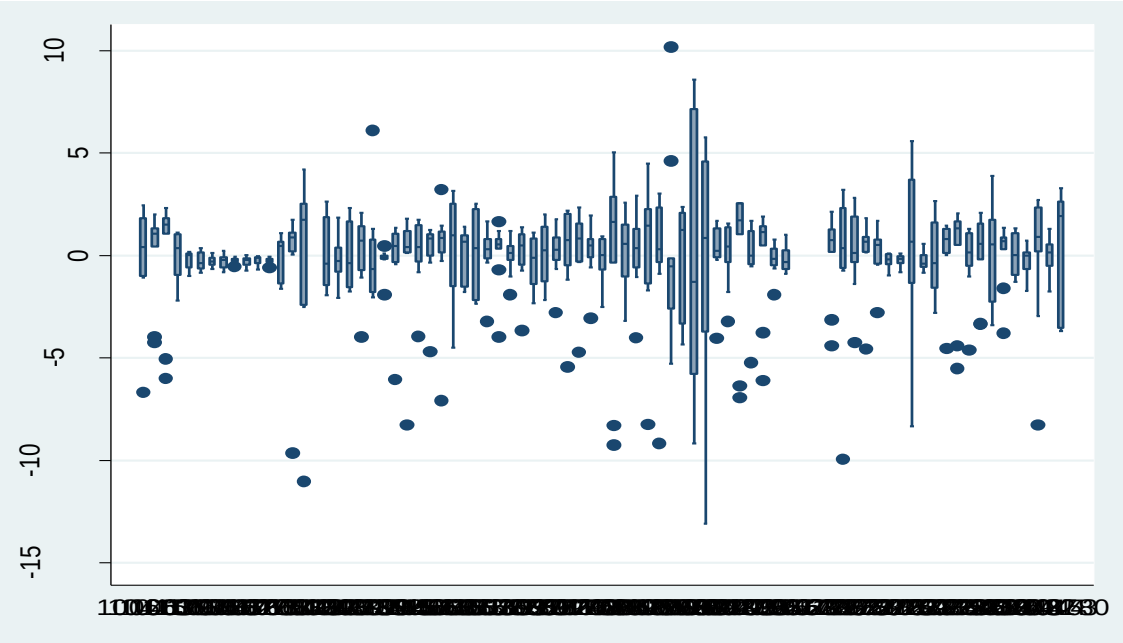

Figure 2. Graph box of homogeneity across clusters

Revenue Diversification and Financial Stability

Table 4 presents the mean and standard deviation values for the variables related to revenue diversification and financial stability. In addition, Figure 4 indicates the graphical representation of the dependence rate on the five sources of funding for the period under investigation. The descriptive information showed that the mean dependence on funding from the government was highest in the year 2011 (mean of 25.33), after which it drastically declined to its lowest mean of 16.6 in 2013. Since then, dependence on funding from the government remained low. The mean for net tuition for the study period showed a steady increase in dependence on net tuition as a source of income. The lowest mean dependence on net tuition was 17.6, which was experienced in 2006; that year also saw the lowest standard deviation, 7.3.

For most years (i.e., 2007, 2008, 2009, 2010, 2011, and 2012), the mean rate of dependence on income from net tuition steadily increased, with the highest mean being 28.4, experienced in 2012. The dependence on net tuition dropped to 17.67 in 2013 and then increased to above 23.0 in 2014 and 2015. The years 2014 and 2015 had the highest standard deviations of 10.2 and 10.5, respectively, implying that the rate of dependence on net tuition differed across institutions. This fluctuation could have been due to variations in the regions; different states have different tuition prices. Also, such shifts could be attributed to differences in the nature of the institutions; some are endowed with resources and whenever there is volatility in funding, they do not have to resort to increasing tuition as their immediate fallback (Newman, 2000).

The dependence rate on endowment as a source of funding was the lowest of all the sources. The rate of dependence on the same source of income declined for the study period. The highest mean dependence on income from endowments was 12.3 in 2008, followed by 12.0 in 2009. The lowest dependence level was in 2013, with a mean of 7.0. That year, there was minimal difference among all institutions in the rate of dependence on endowment income. This was also a time when endowments lost value, due to the Great Recession. Dependence on funding from research was stable and changed little. Except for 2013, which had a mean of 18.9, all study years had mean dependence rates of over 21.0. The years 2014 and 2015 had the highest mean dependence rates on income from research (i.e., 23.9 and 23.3, respectively) and also the highest deviations of 10.8 and 10.9, respectively. The year 2006 had the lowest standard deviation of 7.5.

The descriptive information showed a steady increase in the mean dependence on income from private and auxiliary services, from a mean of 20.3 in 2006 to a value of 29.7

in 2013. Although there was a slight decline after 2013, dependence on this source of income remained high above the mean of 24. The highest standard deviation in income from auxiliary services occurred in 2013. Overall, the results indicate an increasing dependence on income from private and auxiliary services by public research institutions.

The descriptive information included in the diversification index demonstrated a slight variation on average, for the period under consideration. Except for 2013, the average diversification index remained above 0.90, implying that after the Great Recession, institutions were forced to depend on multiple sources of revenue. The minimum diversification index was 0.53, experienced in 2013. The year 2013 also had the highest standard deviation in the diversification index, 0.13. Figure 4 presents a graph of the diversification indexes for institutions examined in this study. Table 4 indicates that between 2006 and 2009, public research universities had an average score of 3 for their financial stability, which is the minimum threshold for a strong financial position.

In 2010, the mean composite of financial stability for these institutions dropped to 2, which is considered weak. Although the CFI values later became strong (above 4 between 2011 and 2014), it dropped again to 2.2 in 2015, which is below the threshold. For a detailed discussion of the financial positioning, the CFI must be decomposed. However, this is not the focus of this study. The CFI trend does, however, suggest financial volatility among the institutions being evaluated.

Table 4. Descriptive Statistics of the Study Variables (Standard deviation in parenthesis)

			N=767				N=810
Year	Dindex	Gov	NetT	Endw	Resh	Aux	CFI
	M (SD)	M (SD)	M (SD)	M (SD)	M(SD)	M (SD)	M (SD)
2006	.93	28.0	17.6	11.4	22.8	20.3	3.7
	(.05)	(10.0)	(7.3)	(6.1)	(7.5)	(13)	(3.2)
2007	.93	27.0	18.5	11.5	22.8	20.2	3.9
	(.05)	(10.3)	(7.9)	(6.0)	(7.7)	(13.2)	(3.3)
2008	.93	26.6	18.9	12.3	22.1	20.1	3.6
	(.05)	(10.7)	(8.2)	(6.5)	(7.7)	(12.8)	(3.2)
2009	.93	26.9	19.3	12.0	21.5	20.3	3.1
	(.05)	(11.3)	(8.6)	(5.7)	(7.7)	(12.7)	(3.3)
2010	.92	26.9	20.0	10.0	21.7	21.3	2.0
	(.06)	(11.3)	(8.9)	(4.6)	(7.9)	(13.5)	(2.0)
2011	.92	25.3	20.7	0 8.8	22.9	22.3	4.8
	(.07)	(11.0)	(9.2)	(4.5)	(8.7)	(13.8)	(4.1)
2012	.91	20.8	28.4	7.9	21.6	21.3	4.5
	(.05)	(10)	(11.5)	(3.5)	(9.1)	(13.4)	(3.9)
2013	.86	16.6	17.7	7.1	19	29.7	4.5
	(.13)	(10)	(8.9)	(3.4)	(9.7)	(17.5)	(3.7)
2014	.91	19.6	23.2	8.9	23.9	23.9	4.7
	(.074)	(10.3)	(10.3)	(4.4)	(10.8)	(17.1)	(4.3)
2015	.91	19.1	23.9	7.8	23.3	24.7	2.2
	(.079)	(10.5)	(10.5)	(3.7)	(10.9)	(15.3)	(5.1)

Note: Dindex=diversification index, Gov=government, NetT=Net Tuition, Endw=Endowment, Resh= Research, Aux= Auxiliary services, CFI= Composite Financial Index.

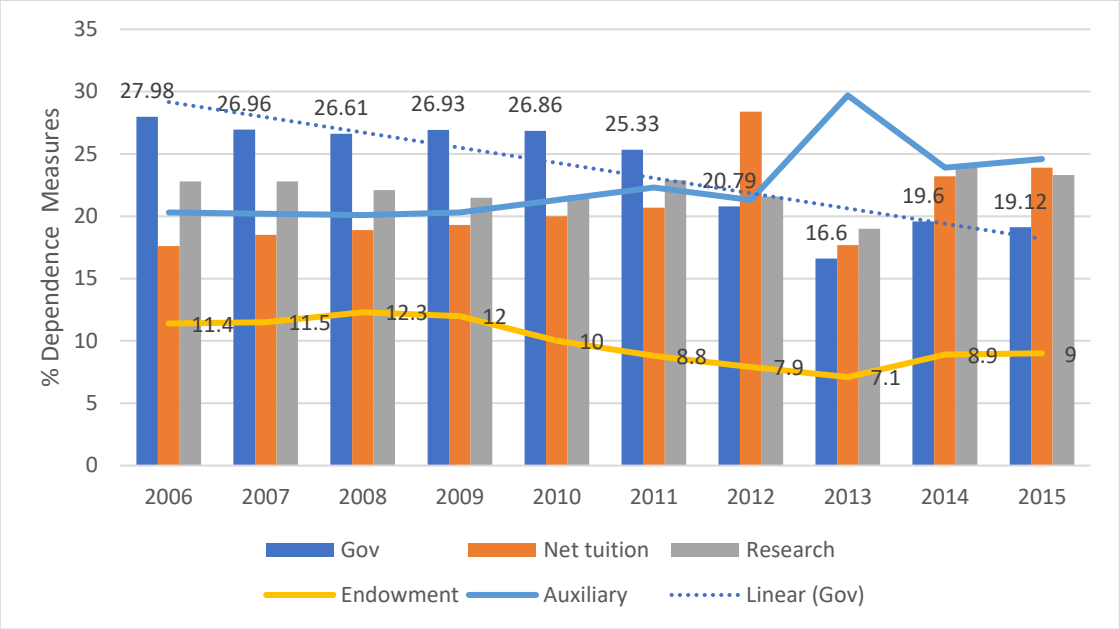

Figure 3. Graphical representation of the dependence rates for funding sources.

Figure 4. Graphical representation of the diversification indexes for the institutions being examined

Research Question 1

A multilevel analysis was conducted to answer the research question regarding the consequences of diversifying revenue on institutional financial stability, and determine how this might vary across institutions. First, the unconditional Model 1 was fitted. Table 5 presents the results of two models. Model 1, the intercept-only model, estimated the intercept as 3.70[z = 10.74, p = <0.001], which indicated the average financial stability across all institutions. The variance within institutions was estimated as 5.43, while the variance between institutions was approximately 8.97. The interclass correlation (ICC) of the dependent variable was 0.62291, showing that 62.3% of the variance in individual institutional financial stability was accounted for by the difference in institutions, with the balance being the variability between years at each institution. The relatively higher ICC was most likely due to the longitudinal nature of the data (Kwok et al., 2008), where the same measures were assessed over 10 years.

Model 2 presents the results of Question 1, which examined the effect of diversifying revenue on institutional financial stability, after controlling for state per capita income and membership in the AAU., The mean effect of diversifying revenue on institutional financial stability was estimated as -2.68(z = -1.38, p = 0.169), with a 95% confidence interval of [-6.6097, 1.1573]. The findings show that with a 1 unit increase in revenue diversification, institutional financial stability decreased by 2.68 units, on average; however, this decrease was not statistically significant. The variance of the random slope of the diversification index was estimated as 15.139, with a 95% confidence interval of [0.009, 2.5455]. The results suggest that there were statistically significant differences in revenue diversification across institutions, after controlling for the effects of state per

capita income and membership in the AAU. The model fit indices, deviance, and AIC showed that the model with predictors was a better fit to the data.

Table 5. Effect of Revenue Diversification on Institutional Financial Stability

Parameter	Model 1 Intercept only	Model 2 With predictor
Fixed Effects		
Intercept (γ_{00})	3.70***(.343)	3.90***(.35)
Diversification index (γ_{10})		-2.68(2.04)
State per capita income(γ_{01})		-0.0001(.00009)
AAU Institutions (γ_{02})		0.43(0.76)
Random Effects		
Var (intercept)(μ_{0j})	8.97*(1.50)	8. 45*(.943)
Var(Diversification index)(μ_{1j})		15.14*(57.37)
Residual Variance(ε_{ij})	5.43*(0.284)	5. 67*(.882)
Deviance	3901.133	3725.015
AIC	3907.133	3739.015

Note: Three levels of significant *p < 0.05, **p < 0.010, ***p < 0.001.
A unit represents $ 100.

Research Question 2

To answer Research Question 2 regarding whether financial stability changed over time and across institutions, a linear growth model without individual-level predictors was fitted. Table 6 presents the results of the analysis for Models 3 and 4. The results of Model 3 show the predicted mean for institutional financial stability in the 2006 reference year as approximately 3.63, which was statistically significantly different from zero [Z = 11.02, p = 0.000]. Also, the results indicate that on average, an institution's financial stability changed by 0.0130 units per year, which was not statistically significantly different from zero [Z = 0.32, p = 0.746]. The results of the likelihood ratio test show that the random

slope of time varied across institutions, and the variance was statistically significantly different from zero [chi-square (2) = 53.11, p = 0.001].

The results of the analyses suggest that time as a variable had the potential to influence an institution's ability to diversify revenue, which further had a positive relationship with financial stability. That is, with time, institutions that diversify their revenue sources may become more financially stable. The variance in financial stability among institutions was estimated as 4.99, with a 95% confidence interval of [3.82, 6.55], which was statistically significant.

Research Question 3

A growth model was conducted to answer Research Question 3, regarding the predictive ability of the five revenue sources (i.e., government funding, net tuition, funding from research, endowments, and auxiliary services) for institutional financial stability over time, after controlling for state per capita income and AAU membership. All of the predictors were grand-mean centered to improve the resulting interpretation. The results are presented in Model 4. The average financial stability across institutions (i.e., the intercept) for Model 4 was estimated as 4.719 (z = -8.68, p = <0.001), which was statistically significant. These results differ from those of Model 3, without predictors, and suggest that with time, depending on income from several sources may have the potential to strengthen an institution's financial stability.

The results of the model show that controlling for the effect of income from other sources, including state per capita income and AAU membership status, resulted in the dependence on funding from the government increasing by 1 unit; there was a predicted decrease of 0.063 in institutional financial stability, which was statistically significant [z =

-3.07, p < .002]. The results imply that when institutions were more reliant on government funding, they were less financially stable. Similarly, controlling for other predictors in the model, a 1 unit increase in dependence on income from net tuition resulted in a 0.042 increase in institutional financially stability, which was statistically significant [z = 2.81, p = 0.005]. The findings suggest that research institutions that were more reliant on net tuition were also more financially stable. Also, institutions were more financial stable when they depended on income from auxiliary services. The results of the analysis demonstrate that a 1 unit increase in dependence on income from auxiliary services led to a 0.0292 increase in institutional financial stability, which was statistically significant [z = 2.90, p = 0.004].

The analysis also uncovered that while depending on income from research positively influenced institutional financial stability, the effect was not statistically significant at 0.023 [z = 0.81, p = .420]. Furthermore, after adjusting for other predictors in the model, revenue from endowments negatively influenced institutional financial stability; however, the effect was not statistically significant at -.0201 [z = -0.79, p = 432]. The model fit estimates indicate that the Model 4 parameters explained the variance at both the within- and between-level residual variances, as demonstrated by an increase in both intercept and residual variances. The variance between institutions (U_{oj}) was estimated at 3.47%. The predictors of an institution's financial stability caused a decline in deviation of 190.983. The smaller AIC and BIC for Model 4 implies that a model with more predictors is a better fit to the data and generally more preferable.

Table 6. Effects of Time and Predictors on Financial Stability

Parameters	Model 3	Model 4
Fixed Effects		
Intercept(β_{00})	3. 63*(.329)	4. 72* (.543)
Time (β_{10})	.013(.040)	-0.120*(.060)
Government (β_{02})		-0.063** (.021)
Net Tuition (β_{03})		0.043** (.015)
Research (β_{04})		0.023(.029)
Endowment(β_{05})		-0.020(.026)
Auxiliary (β_{06})		0.029**(.010)
State per capita income (β_{10})		-0.00008(.00009)
AAU Institutions(β_{20})		-0.686(.805)
Random Effects		
Var (Intercept)(μ_{0i})	7. 19* (.860)	6.948* (.890)
Var(Time)(μ_{1j})	.066* (0.028)	.071* (.026)
Residual Variance (ε_{ti})	4.99* (0.687)	4.99* (.716)
Deviation	3866.35	3675.367
AIC	3876.35	3701.367
BIC	3899.836	3761.719

Note: Three levels of significant *p < 0.05, **p < 0.010, ***p < 0.001. A unit represents $ 100.

Revenue Diversification and Research Productivity

This section presents the results for Questions 4, 5, and 6, which relate to the effects of revenue diversification on research productivity. Question 4 presents the procedure for extracting the measures of research productivity, Question five examines the relationship between diversification and research productivity, and Question 6 analyzes the effects of the various strategies of diversification on institutional research productivity.

Table 7 presents the means and standard deviations of the variables related to the measures of research productivity. The highest value for average articles published per faculty member was 1.016, experienced in 2012. This was followed by an average of 1.001

articles published in 2015. The years 2012 and 2015 had the highest standard deviations of 0.892 and 0.882, respectively. Table 7 also shows a decline in the average citations per faculty member. Between 2006 and 2012, the average citations remained above 25, but dropped to an average of less than 20 in 2013 and 2014. In 2015, the average citations per faculty member was 9.047. The standard deviation in 2015 was the lowest of all the study years, at 9.155. Overall, the average number of books published per faculty member was below 0.05, except in 2011 when the value was 0.057. The average number of grants per faculty member was generally low, and declined in 2011. The year 2014 had the lowest average number of grants at 0.037, followed by 2015 with 0.038. The year 2009 had the highest average grant dollars per faculty member at $13,397.40. In 2010, the average dollar value was $11,433.84 per faculty member. The lowest of all the study years was $8,175.13, in 2013.

Table 7 also indicates that the average conference proceedings per faculty member was above 0.140 between 2006 and 2012. The value then declined to the lowest average of 0.122 in 2015, the year that also saw the lowest standard deviation of 0.137. The year 2010 had the highest average number of awards per faculty member at 2.196, with a standard deviation of 2.1. The lowest average awards was 0.011, experienced in 2013. The year 2010 had the highest average number of PhD students supervised to graduation at 936.519, followed by 2011, which had an average of 735.778. The lowest number of PhD students supervised to graduation was 326, in 2006.

Table 7. Means and Standard Deviations of the Research Productivity Measures

Year	Av1	Av2	Av3	Av4	Av5	Av6	Av7	Av8
2006	.798	29.381	.0420	.0534	9519.009	.152	.013	326
	(.704)	(33.445)	(.042)	(.048)	(11366.71)	(.166)	(.017)	(189.839)
2007	.802	28.273	.0414	.057	10108.243	.151	.013	347.469
	(.711)	(32.904)	(.038)	(.055)	(11519.895)	(.177)	(.017)	(202.314)
2008	.836	28.099	.041	.055	9329.2634	.140	.014	343.683
	(.724)	(32.554)	(.038)	(.047)	(8676.498)	(.155)	(.016)	(187.825)
2009	.871	26.246	.043	.069	13397.396	.151	.012	480.975
	(.774)	(31.201)	(.038)	(.063)	(12583.846)	(.166)	(.021)	(360.281)
2010	.873	25.499	.049	.0562	11433.844	.159	2.196	936.519
	(.776)	(31.033)	(.045)	(.052)	(13634.541)	(.176)	(2.1)	(598.731)
2011	.961	23.831	.057	.046	9203.588	.153	.014	735.778
	(.837)	(27.764)	(.054)	(.041)	(10601.283)	(.164)	(.015)	(404.261)
2012	1.016	26.919	.0489	.044	10141.558	.145	.015	697.691
	(.892)	(28.526)	(.045)	(.041)	(10679.575)	(.165)	(.015)	(393.986)
2013	.990	16.836	.047	.0387	8175.130	.136	.011	711.247
	(.859)	(18.323)	(.043)	(.035)	(8485.148)	(.153)	(.019)	(404.504)
2014	.975	12.997	.0424	.037	9195.103	.129	.015	732.802
	(.847)	(13.880)	(.039)	(.036)	(11965.007)	(.147)	(.018)	(411.757)
2015	1.001	9.047	.0367	.038	9256.401	.122	.015	724.136
	(.882)	(9.155)	(.032)	(.038)	(11442.575)	(.137)	(.018)	(393.418)

Note: Av1= Average Articles published per faculty; Av2= Average Citation per faculty; Av3= Average Books published per faculty; Av4= Average number of grants per faculty; Av5= Average Dollar per faculty; Av6= Average Conference proceedings per faculty; Av7 = Average number of award per faculty; Av8 = Average Ph.D. students supervised to graduation. Standard deviation in parenthesis.

Research Question 4

A PCA was conducted to answer Research Question 4, which sought to establish the factorial structure underlying research productivity, test the reliability, and compute the scores based on factors extracted for further analysis. Table 8 presents the means, standard deviations, and correlation matrixes of the variables. The results show a high correlation of 0.5 and above among the averages per faculty member of numbers of articles and book publications, citations, grants/funding, grant dollars, and conferences attended. Other variables, such as average number of PhD students supervised to graduation, membership

in the AAU, and representation at national academies (i.e., “star faculty”) had moderate correlations.

The average number of awards per faculty member was very low and correlated negatively with other variables. A Bartlett’s test of sphericity was used to capture the essence of the correlations in the matrix. The results were statistically significant (X^2 (45) = 6,594.595; $p < 0.001$), and led to a rejection of the null hypothesis of a lack of sufficient correlation among the variables. The findings suggest that there were high correlations among the variables, implying that they were satisfactory for the factor analysis. Kaiser-Meyer-Olkin (KMO), a measure of sampling adequacy, yielded a value of 0.8496, showing that the sample was adequate (Meyers, Gamst, & Guarino, 2006) and conducting a principal component analysis on the variables was both useful and necessary.

Table 8. Mean, Standard Deviation, and Correlation of Research Productivity Measures

Variable	1	2	3	4	5	6	7	8	9	10
M	0.91	22.71	0.05	0.05	9975.95	0.15	0.232	595.99	7.93	0.43
SD	0.80	27.88	0.04	0.05	11222.84	0.16	0.93	282.86	12.23	0.50
1	1.00									
2	0.84	1.00								
3	0.80	0.74	1.00							
4	0.89	0.90	0.75	1.00						
5	0.85	0.79	0.66	0.88	1.00					
6	0.71	0.65	0.63	0.74	0.56	1.00				
7	-0.04	0.004	-0.01	0.01	0.02	-0.05	1.00			
8	0.39	0.34	0.29	0.36	0.35	0.16	0.05	1.00		
9	0.49	0.56	0.45	0.49	0.46	0.32	0.03	0.35	1.00	
10	0.49	0.45	0.36	0.48	0.42	0.39	0.05	0.57	0.42	1.00

Note. Variables; 1= Average Article published per faculty; 2 = Average citations per faculty; 3= Average books per faculty; 4= Average grants/ funding per faculty; 5= Average grant dollar per faculty; 6= Average conference proceedings per faculty; 7= Average awards per faculty; 8=Average Ph.D. students supervised to graduation (within the period of this study); 9= Representation at National Academies; 10 = Membership to AAU.

Four strategies were used to determine the number of factors to retain: eigenvalue, residuals between sample and reconstructed correlations, Velicer's Minimum Average Partial (MAP) test, and parallel analysis. Orthogonal varimax and oblique rotation were used to improve the interpretability of the factors. The results of the eigenvalue showed that two factors in the model underlay research productivity's latent structure (i.e., an eigenvalue greater than 1.00). These two factors accounted for 68.36% of the total variance in the model. The residuals between the sample and reconstructed correlations were small. Only five of the 79 observations had a residual correlation of 0.05 and above, implying that there was a small difference between the factor model and the data. Furthermore, a factor extraction using a MAP test suggested that two principal components should be extracted. Parallel analysis also revealed two components greater than 1 that should be retained, as shown in Table 9. An examination of the scree plot generated as part of the parallel analysis also revealed that there were two components above the elbow and 95th percentile line, as shown in Figure 5, which should be retained. The results of the eigenvalue, MAP test, and parallel analysis were all similar. Therefore, two factors were found to underlie the latent structure for research productivity.

Table 9. Adjusted and Unadjusted Eigenvalues and Estimated Bias from the Parallel Analysis of Principal Components of Research Productivity

Component or Factor	Adjusted Eigenvalue	Unadjusted Eigenvalue	Estimated Bias
1	5.4638499	5.6278751	.16402519
2	1.095035	1.2083339	.11329889
3	.86422667	.96749231	.10326564
4	.61004235	.65301312	.04297078
5	.52735006	.52117687	-.00617319
6	.39166973	.37928549	-.01238424
7	.33268719	.29855674	-.03413045
8	.24392695	.18205852	-.06186843
9	.19489741	.10541021	-.0894872
10	.27631474	.05679774	-.21951699

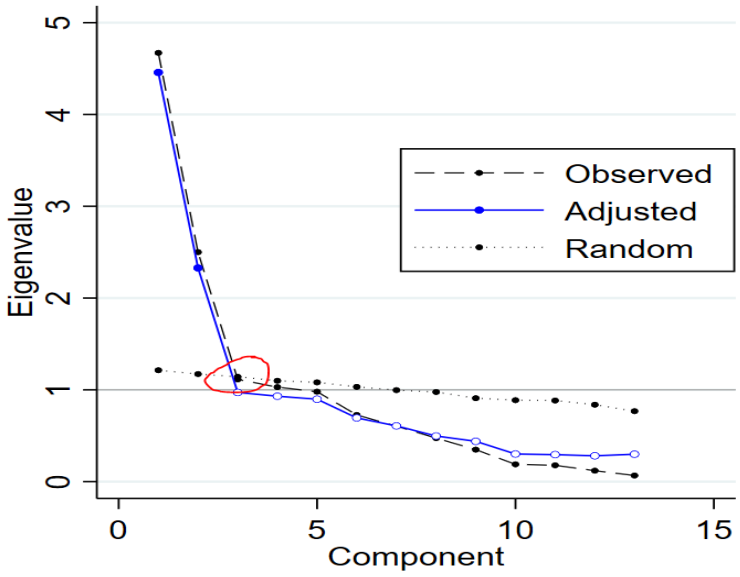

Figure 5. Scree plot of the parallel analysis illustrating the retention of two factors.

A principal component analysis was run to determine the factor loadings for the two factors, with the number of factors fixed at two. Table 10 presents the results of the analysis, which show that six variables (i.e., average publications, citations, books published, number of grants/funding, grant dollars, and conference proceedings per faculty member) had strong relationships with Factor A, and three variables (i.e., average number of graduate students supervised to graduation, representation at a national academy, and membership in the AAU) had strong relationships with Factor B. The average number of awards per faculty member had a weak relationship with both Factors A and B.

Table 10. Structure Coefficient Matrix Displaying Alignment of the Variables for each Factor

Variables	Factor loadings	
	Factor A	Factor B
zPArt -Average articles published per faculty	0.908	0.056
zPCIT- Average citation per faculty	0.877	0.060
zPBookc -Average book published per faculty	0.833	-0.033
zPgrant- Average number of grants/funding per faculty	0.955	0.015
zPgrdollar -Average grant dollar amount per faculty	0.833	0.066
zPconf- Average conference proceedings per faculty	0.845	-0.165
zPAward- Average awards per faculty	**-0.092**	**0.137**
zPGradst- Average graduate students supervised to graduation	-0.043	0.711
zPNacd-Representation at National Academies	0.327	0.355
ZPAAU -Membership to AAU	0.121	0.647

An oblique rotation was used to correct the indeterminacy of the variables in the model. The final model was comprised of two factor components, as shown in Figure 6. The final factors for measuring research productivity included all of the variables with

structure coefficient values of 0.300 or greater, according to common practice (Stevens, 2002). Based on the factor loading characteristics, Factor A was named Productivity Outcomes and Factor B was called Productivity Inputs (and comprised of factors related to inputs, in terms of the environment and development that support research outcomes). The average awards per faculty member variable had weak relationships with Factors A and B, even after oblique rotation. Therefore, the variable was dropped.

The Cronbach's alpha for factors related to productivity inputs was estimated as 0.6167 (acceptable), while that of factors related to productivity outcomes was 0.9498, which is considered very good. The Cronbach's alpha for the 10 factors combined was 0.9127, which is considered good. Generally, the Cronbach's alpha coefficient ranges from 0 to 1, while the generally agreed upon lowest level for the coefficient is 0.070. In exploratory studies such as the current work, however, a value of 0.60 is commonly considered acceptable (Hair, Ringle, & Sarstedt, 2011). The high level of reliability implies that the two factors were accurate, reproducible, and consistent across both items and at all-time points. Finally, the factor scores (i.e., the component scores) for further analysis were computed using a prediction command. The factor scores were transformed variable values corresponding to particular data points. The loadings represented the weights by which each standardized original variable was multiplied to get the component score. Table 11 presents the weightings for each variable. Of the nine measures of research productivity, the average number of grants/funding per faculty member had the highest weight at 0.47, followed by the average number of articles published per faculty member with a weighting of 0.314; the third highest was the average number of citations per faculty member, weighing 0.12568.

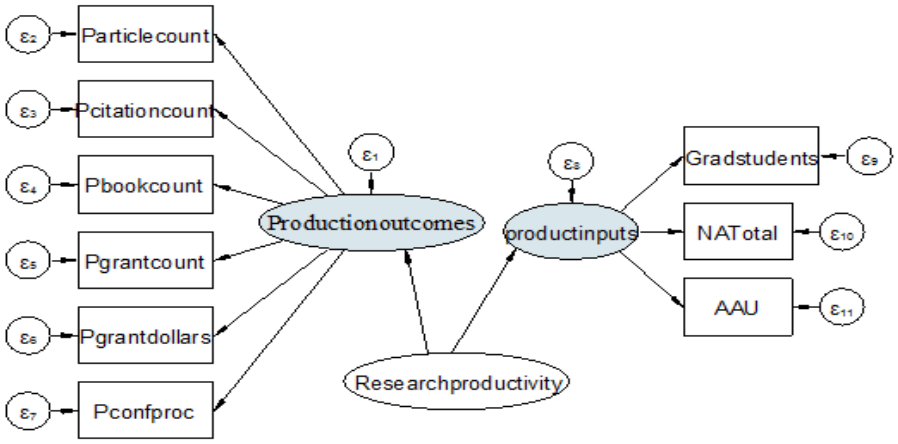

Figure 6. The two factor components extracted from the PCA analysis.

Table 11. Weightings for Each Research Productivity Variable

Variable	Factor 1	Factor2
zPArt - Average articles published per faculty	0.314	0.148
zPCIT - Average citation per faculty	0.126	0.105
zPBookc - Average books published per faculty	0.0741	-0.032
zPgrant- Average number of grants/funding per faculty	0.468	0.058
zPgrdollar- Average grant dollar amount per faculty	0.010	0.044
zPconf - Average conference proceedings per faculty	0.040	-0.143
zPGradst - Average graduate students supervised to graduation	-0.019	0.322
zPNacd - Representation at National Academies	0.028	0.157
zPAAU - Membership to AAU	0.011	0.365

Research Question 5

Research Question 5 sought to examine the mean effect of revenue diversification on institutional research productivity and how the relationship between the two varied by institution, after controlling for faculty workload. Table 12 presents the results for Models 5 and 6. In Model 5, the unconditional model, the interclass correlation (ICC) of the

dependent variable was estimated at 0.9758, showing that 98% of the variance in the institutions' research productivity could be attributed to differences among the particular institutions. In Model 6, after controlling for faculty workload, the mean effect of diversifying revenue on research productivity was estimated at 0.5392($z = 4.14$, $p < 0.001$), with a 95% confidence interval of (0.2838, 0.7946), showing that a 1 unit increase in revenue diversification increased research productivity by an average of 0.5392 units. The variance in the random slope of income from diversification was 0.3486, with a 95% confidence interval of (0.1376, 0.8831), suggesting that the effects of diversification on research productivity among the institutions differed significantly.

Table 12. Effect of Revenue Diversification on Research Productivity

Parameter	Model 5	Model 6
Fixed effects		
Intercept(γ_{00})	8. 23(.093)	-0.0295(.0894)
Diversification index(γ_{10})		0.5392** (.1303)
Faculty workload(γ_{01})		-0.322*(.0164)
Random-effects		
Var(intercept) (μ_{0j})	0.695*(.109)	0.6165*(.1672)
Var(Residual)(ε_{ij})	0.0123*(.0006)	0.01016*(.0026)
Var(Diversification index) (μ_{1j})		0.3486*(.1653)
Model Fit		
Deviation	-79.841	-931.2054
AIC	-743.841	-921.2054
BIC	-729.7498	-897.993

Note: Three levels of significant *p < 0.05, **p < 0.010, ***p < 0.001.
A unit represents $ 100.

Research Question 6

A linear growth model was fitted to answer Question 6, which examined the average change in research productivity per year and the effects of predictors (i.e., the government, net tuition, research, endowments, and auxiliary services) on institutional research productivity over time. Faculty workload was included in the model as a control variable. Table 13 presents a summary of the analysis of Models 7 and 8. Model 7 is the unconditional linear growth model with a linear growth slope (coded 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9), while Model 8 is a linear growth model with time-varying predictors.

In Model 7, at Time = 1 in 2007 and after controlling for faculty workload, the average research productivity was estimated at 0.05168 (z = 0.53, p = 0.574). The results of the analysis show that mean research productivity decreased at a rate of 1.365% (z = -7.83, p = 0.001) per year, which was statistically significantly different from zero. The intercept across all institutions in the sample (i.e., the random intercept) was statistically significant (y_{00} = 0.6501), with a 95% confident interval of (0.396, 1.067). The findings suggest that the research productivity of institutions in the study varied significantly. Faculty workload, as a control variable in the model, had a significantly negative effect on institutions' research productivity. On average, a 1 unit increase in faculty workload led to a 4.21% decrease in research productivity, -.0421(z = -2.18, p = 0.029).

Model 8 is comprised of the five sources of revenue, which serve as the main predictors; faculty workload is the control variable. The intercept, estimated as 0.0065 (z = 0.07, p = 0.945), represents the average research productivity of the institutions in the year 2007. Holding the predictors constant at 0, the mean research productivity decreased at a

rate of 1.1% per year, which was statistically significant (z = -5.65, p = 0.001). Controlling for other predictors in the model, the average effect of the income from net tuition on research outcomes was 0. 0041, which was significantly different from zero (z = 6.96, p = 0.001). The results suggest that institutional research productivity was high whenever institutions relied on funding from net tuition. A 1 unit increase in funding from net tuition increased research production by approximately 0.04%.

The results of the analysis also showed that after controlling for other predictors, depending on income from endowments and the government increased research production for "very high" public research universities. In particular, a 1 unit increase in funding from the government increased institutions' research productivity by 0.04% (z = 2.78, p = 0.005), whereas a 1 unit increase in income from endowment funds was associated with an increase in research production of 0.02%, which was statistically significant (z = 2.46, p = 0.014). However, after controlling for other predictors in the model, the mean effect of income from research was a negative influence on research productivity. The results show that a 1 unit increase in funding related to research reduced institutions' research production by 0.03% (z = -2.86, 0.004).

Regarding the rate of dependence on revenue from auxiliary services, the results show that such revenue positively influenced research production; however, the effect was not meaningfully different from zero, 0.0003 (z = 1.01, p = 0.314). The results of the analysis also show that a high faculty workload negatively influenced research productivity. Overall, the findings regarding whether various strategies of revenue generation had effects on institutional research productivity suggest that when schools depended on three sources of income – net tuition, the government, and endowments –

they experienced an increase in research productivity, while depending on income from research served to significantly reduce research production.

Table 13. Effects of Strategies for Revenue Diversification on Research Productivity

Parameter	Model 7	Model 8
Fixed effects		
Intercept(β_{00})	.0517(.0970)	.00654(.0949)
Time (β_{01})	-.0137***(.0017)	-.0108***(.0020)
Faculty workload(β_{10})		-.0421*(.0193)
Government (β_{02})		.0040**(.0014)
Net Tuition (β_{03})		.00409***(.0006)
Research(β_{04})		-.0037**(.0013)
Endowment(β_{05})		.0024*(.0010)
Auxiliary services(β_{06})		.0003(.0003)
Random-effects		
Var(intercept)(μ_{0i})	.6501*(.1643)	.62954*(.1606)
Var(Residual)(ε_{ti})	.0129(.0039)	.0122(.0041)
Covariance(rho)	.5814*(.0621)	.6174*(.05079)
Var(Time)(μ_{1i})	2.31e-17(--)	3.16e-22*(1.71e-21)
Model Fit		
Deviation	-1223.288	-1271.187
AIC	-1211.288	-1257.187
BIC	-1183.106	-1224.69

Note: Three levels of significant *p < 0.05, **p < 0.010, ***p < 0.001.
A unit represents $ 100.

Revenue Diversification, Financial Stability, and Research Productivity

Research Question 7

A cross-lagged panel mediation analysis was conducted to answer Research Question 7, which aimed to determine if and to what extent revenue diversification affected research productivity, as mediated (or influenced) by institutional financial stability. This model was based on Maxwell and Cole (2007), who suggested that prior

measures of the focal predictor (X), mediator (M), and outcome (Y) should be included in the model to allow for autoregressive effects and time lags in the presumed casual outcomes. First, the preliminary results are presented below, followed by the cross-lagged mediation analysis.

Preliminary Results

Table 14 presents the means, standard deviations, observed scores, and inter-correlations for the following variables at each wave of measurement (i.e., 2013, 2014, and 2015): diversification index, financial stability, and research productivity. These years were considered because they were the most current in the panel and thus would provide the most up-to-date autoregressive effects and time lags. An inspection of the variable levels showed high stability (i.e., only small changes from one time to another) for the research productivity and revenue diversification variables, and lower (i.e., medium to strong) stability for the variable of financial stability. The coefficient for high stability showed that the change in institutional differences was relatively small, meaning that there was some fluctuation in the waves, with a decrease occurring at the third wave of the measurements for financial stability. In terms of variability, research productivity was fairly consistent across the three waves; however, there seemed to be slight variability in the diversification index and financial stability variables across all time points. Evidence for these observations can be seen in the correlation values of the revenue diversification index, composite financial stability, and institutional research productivity illustrated in Table 14.

Table 14. Correlation Matrix for Longitudinal Data relating to the Diversification Index, Financial Stability, and Research Productivity across Four Waves

Variable	1	2	3	4	5	6	7	8	9
1	1.00								
2	0.71	1.00							
3	0.69	0.98	1.00						
4	0.03	0.19	0.21	1.00					
5	-0.08	0.15	0.15	0.74	1.00				
6	-0.08	-0.04	-0.05	0.48	0.58	1.00			
7	-0.27	-0.17	-0.15	-0.08	-0.01	0.13	1.00		
8	-0.27	-0.16	-0.13	-0.06	0.01	0.14	0.99	1.00	
9	-0.29	-0.17	-0.15	-0.05	0.01	0.14	0.99	0.99	1.00
Mean	.86	.90	.91	4.48	4.70	2.22	-.07	-.9	-.10
SD	.13	.07	.08	3.72	4.33	5.12	.62	.76	.76

Note. X= independent variable, M= mediator, and Y= dependent variable 1 1=Diversification index2013(X1);2=Diversification index2014(X2);3 =Diversification index2015(X3);4=CFindex2013(M1);5=CFindex2014(M2);6=CFindex2015(M3;7=Research outcome 2013(Y1);8=Research outcome 2014(Y2);9=Research outcome 2015(Y3)

Figure 7 depicts the cross-lagged panel mediation model with the effects constrained to be invariant over time and the correlated residuals at simultaneous time points. The timing and spacing of the measurements were assumed to be perfect for detecting the effects of predictors in the model. The mediation model includes the unstandardized estimates for the causal paths for both direct and indirect effects. Both predictors were centered to improve the interpretation of the results. Since mediation unfolds over the course of a study, it was important to capture the overall indirect effect, which was the degree to which the institution's financial stability (M) at any time between

Waves 1 and 3 mediated the effect of revenue diversification (X_1) on research productivity (Y_3).

Previous studies have shown that the overall indirect effect in a three-wave cross–lagged model can be estimated as *a*b* or *c-c`* (Cole & Maxwell, 2003). Research has also provided evidence that the effects of variables X_2, Y_1, and Y_2 are the same in an unlikely way, where $X_2 = Y_1 = Y_2 = 0$. Figure 8 displays the overall indirect effect of the three-wave cross–lagged model of interest in the current study, where *c* represents the direct effect of diversifying revenue, $-X_1$ (i.e., the independent variable), on research productivity, $-Y_3$ (i.e., the dependent variable), whereas *a* and *b* represent the indirect (i.e., mediated) effect of the independent variable, X_1, on the dependent variable. The overall indirect effect was the sum of the indirect and direct effects.

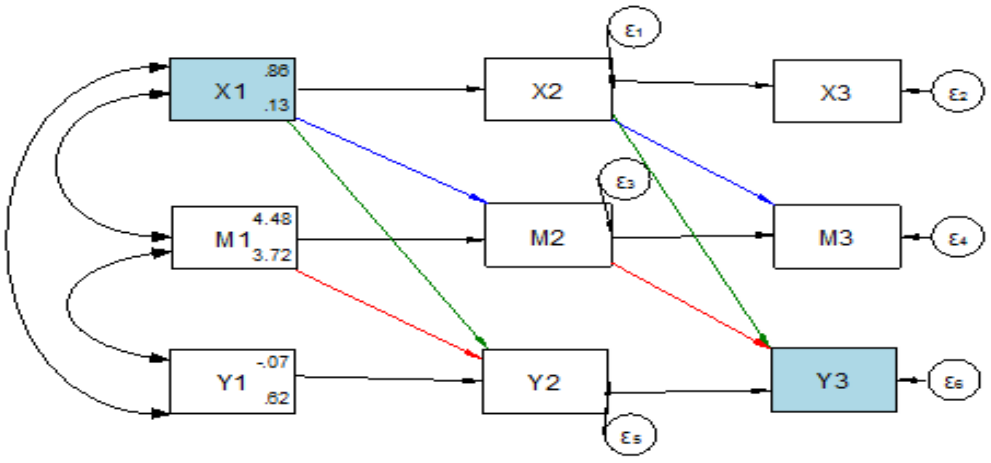

Figure 7. Cross-lagged panel mediation model.

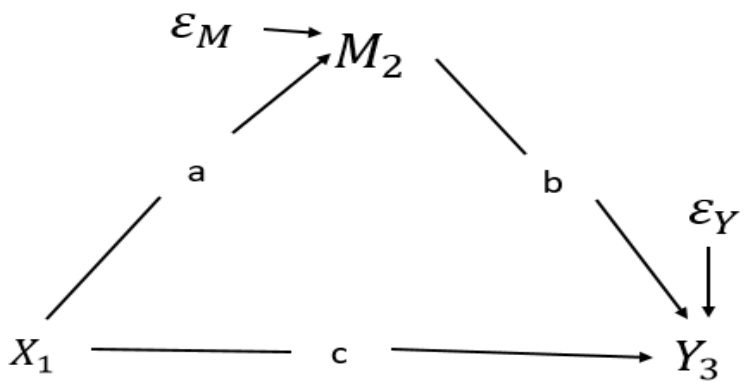

Figure 8. Simple mediation model of interest from cross-lagged panel model.

Table 15 presents the results of the cross-lagged panel model, with the effects constrained over the time points. The effect of revenue diversification on institutional financial stability (path *a*) was significant. The results imply that with a 1 unit increase in revenue diversification, institutional financial stability decreased by 2.501(t = - 0.66, p = 0.508). The direct effect of institutional financial stability on research productivity (path *b*) was 0.0015 (t = -0.08, p = 0.935), with a 95% confidence interval of [-.0381, 0.0351], which was not significant. The total effect (i.e., direct effect or path *c*) of diversifying revenue on institutional research was -1.5584 (t = -2.62, p = 0.011), with a 95% confidence interval of [-2.7418, -.3751]. The effect was statistically significant. Based on the parameter estimates from the three regression models, the overall indirect effect was estimated as 0.00376. The results suggest that with every 1 unit increase in revenue diversification, institutional financial stability decreased by 2.501 units on average, which in turn led to an average of a 0.004 unit increase in research outcomes.

The bootstrap approach was used to test the significance of the indirect effect. The bootstrap results show that the observed coefficient was -0.0296, with the bias- corrected 95% confidence interval ranging between 0.0038 and 0.0062 (z = 1.60, p = 0.110), with a 95% confidence interval of [-0.0061, 0.0595]. The range included zero, implying that the estimated mediation effect was not statistically significant. It was therefore concluded that institutional financial stability does not influence the effect of revenue diversification on research outcomes.

Table 15. Regression Results for Mediation of the Effect of Revenue Diversification on Research Productivity by Financial Stability

Model	Estimate	SE	95% C I	
			LL	UP
a`(Diversification Index -> Financial stability)	-2.501	3.762	-9.995	4.993
b`(Financial stability-> Research Productivity)	0.002	0.018	-0.038	0.036
c (Diversification index -> Research Productivity)	-1.558*	0.594	-2.742	-.375
c`(Direct Effect)	-1.562*	2.27	-2.757	-.367
Overall Indirect Effect(ab or c-c`)	0.004			
RMSEA(90%CI)	0.687			
R- squared(*X,M,Y*)	0.084			
Adj. R-Squared(*X,M,Y*)	0.059			

Note: Three levels of significant *p < 0.05, **p < 0.010, ***p < 0.001.
A unit represents $ 100.

Summary

A multilevel analysis was used to answer questions regarding the effects of revenue diversification on financial stability and research productivity. A PCA was employed to reduce the variables for measuring research productivity. The results of the PCA generated two components. Based on their characteristics, the two factors were named Productivity Outcomes and Productivity Input. The reliability of the two factors was excellent (i.e., 0.91). The extracted factors were a consistent measure of research productivity. Factor scores were then predicted for further analysis. A cross-lagged panel mediation analysis was used to examine the relationships among revenue diversification, financial stability, and research productivity. These quantitative findings led to the discussion regarding research questions, which can be found in Chapter V.

CHAPTER V

CONCLUSIONS

This chapter provides a summary of the study, discusses the findings, reviews the implications for the field, and makes recommendation for further research.

Summary of the Study

This study examined the effects of revenue diversification on institutional financial stability and research productivity within the framework of Pfeffer and Salancik's (1978) resource dependence theory and Markowitz's (1952) portfolio theory; the goal was to determine the extent to which institutions depend on the external environment for resources, and how that dependence influences institutions' activities. Portfolio theory assisted in determining whether having multiple sources of funding reduced the risk of financial crisis. Seven research questions were addressed. For Research Questions 1 to 3, multilevel and linear growth models were used to examine the extent to which diversifying revenue, obtaining funding from the government, and receiving money from research, net tuition, endowments, and auxiliary services all influenced institutional financial stability. State per capita income and membership in the AAU were also included in Questions 1 and 3 to serve as control variables.

For Research Question 4, a principal component analysis was used to extract the factors underlying the latent structure for research productivity, and those factors were tested for robustness. For Research Questions 5 and 6, a multilevel analysis was used to examine the effects of diversifying revenue on research productivity. The seventh and the final question took a brief look at the possible mediation effect of institutional financial

stability on the effect of revenue diversification on research productivity. The findings offer a variety of answers to the research questions. The discussion and implications for practice and research are presented.

Findings

Preliminary Findings

Descriptive statistics showed that public research universities are highly diversified. On average, these institutions had a diversification index of 0.91 for the period under investigation. Over the years, the rates of dependence on income from the government, net tuition, endowments, research, and auxiliary services differed across institutions. This level of volatility in funding suggests that financial planning has been challenging for administrators. Figure 8 shows a graphical representation of the rate of dependence on the different sources of funding examined in this study. From 2011 to 2015, as the rate of dependence on income other than from the government increased, the rate of dependence on government funding declined. Funding from auxiliary services, research, and net tuition were the largest sources of replacement funding. As depicted in Figure 4, between 2012 and 2015, institutions depended more on funding from net tuition, auxiliary services, and research. In that same period, state funding declined. Endowment funding was the smallest source of revenue. This descriptive information is in line with the findings of previous studies, which found that government funding made up less than a third of schools' operating budgets (Desrochers & Hurlburt, 2016; Mitchell & Leachman, 2014), and declined precipitously during the recession.

The descriptive information also showed that despite diversifying their sources of funding, public research universities still struggled with financial instability. For instance,

in the years 2010 and 2015, their mean composite financial index score was estimated as 2, which is below 3 (the threshold for financial health). The findings suggest that volatility in state funding has had a negative effect on the financial stability of institutions of higher education. This result was similar to those of previous studies that rejected the common notion that state funding comprised the largest portion of support for public research institutions (American Academy of Arts and Sciences, 2015b; McLendon, Hearn, & Mokher, 2009). State funding actually represented only about 20% of the total institutional revenue in recent years.

Discussion

This discussion is centered on key findings related to three topics: (a) revenue diversification and institutional financial stability, (b) revenue diversification and institutional research productivity, and (c) the interactions among revenue diversification, institutional financial stability, and research productivity. Table 16 presents a summary analysis of the effects of diversifying revenue and various sources of funding on institutional financial stability and research production.

Revenue Diversification and Institutional Financial Stability

Research Question 1

This study found no significant relationship between revenue diversification and institutional financial stability; the effects varied across institutions. These findings combine what researchers such as Sazonov et al. (2015) and Carroll and Stater (2009) argued: that while diversifying income may provide some of the revenue that institutions need to achieve their missions, diversification does not increase financial stability. This finding potentially contradicts the notion that depending on multiple sources of revenue

will serve to stabilize an institution's financial position (Carroll & Stater, 2009), as well as the commonly held belief that public research universities are financially stable due to their ability to generate income from other sources. To some extent, this finding also contradicts portfolio theory, which suggests that the diversification of revenue sources increases financial stability.

The lack of improvement in financial stability could partly be due to complexities associated with diversification, such as management and the limitations within which these institutions must operate (Johnstone, 2002b), as well as the administrative and accounting costs associated with diversification, lack of sufficient capital to invest, and co-funding requirements. Previous studies have shown that such activities have the potential to actually harm the financial stability of an institution (Estermann & Pruvot, 2011). The current study found that the effect of diversification on institutional financial stability varied across institutions, which confirmed Stachowiak-Kudła and Kudła's (2017) argument that the capacity of universities to become financially stable depended on the institutional framework and policy regulations within those institutions.

Research Question 2

Regarding whether institutions' financial stability changed over time, the results show that institutional financial stability of US public research universities changed by 0.0130 (1.3%) per year, though the change was not significantly different from zero. Changes in financial stability varied by a mean of 4.99. These fluctuations could imply that only institutions with stable income and funding structure in place can achieve their multiple outcomes and respond to changes in the increasingly challenging and complex financial environment. Variances in financial stability could be due to differences in the

sizes and ages of these institutions. Previous studies have shown that older schools tend to have lower levels of debt. In addition, institutions with longer histories tend to have greater experience in resource management, and thus are in a better position to maintain their financial sustainability (Alonso-Cañadas, Sáez-Martín, Saraite, & Caba-Pérez, 2017).

Research Question 3

Regarding the effects of various sources of revenue on institutional financial stability, the results show that depending on income from net tuition and auxiliary services served to improve institutions' financial stability. Conversely, depending on income from research was not associated with an increase in financial stability. The results also show that after controlling for other predictors such as net tuition, research, auxiliary services, state per capita income, and membership in the AAU, depending on funding from the government made institutions more financially unstable.

The positive relationship between net tuition and financial stability can be explained by the fact that whenever there are cuts in state funding, many institutions resort to net tuition as their immediate financial fallback (Desrochers & Hurlburt, 2016; Leslie et al., 2012; SHEF, 2016; Teixeira & Koryakina, 2013; Webb, 2015). Net tuition is easier to adjust in the short term, while the impact of increasing funding from sources such as endowments, research, and auxiliary services are slow to emerge. However, like other studies, this work cautions institutions against over-relying on net tuition to improve financial stability, because there may be unintended consequences such as an increasing disparity in access, retention, and achievement for under-represented students, as compared to their wealthier peers. However, the finding that income from auxiliary services might improve institutional financial stability was encouraging. Several previous studies have

found that this form of income is not sustainable (American Academy of Arts and Sciences, 2016b; Rullman et al., 2008). Researchers claimed that this type of revenue was flat and could only marginally affect an institution's overall financial outlook. Other scholars, such as Carey-Fletcher (2014), cautioned institutions against this type of revenue claiming that it is not a route to financial stability.

The finding that government funding was negatively associated with financial stability reflected the most significant change in recent years, which is the decline in state allocations to institutions. This coincides with work done by the American Academy of Arts and Sciences (2015a), Doyle and Delaney (2009), Delaney and Doyle (2011), and SHEF (2016), indicating that public institutions are used as a balance wheel for state budgets. Recovery from state cuts took longer in the most recent recession because funding continued to be low once the times improved; states did not restore their allocations to the pre-cut level as quickly as they had in years past, and in some cases not at all (Doyle & Delaney, 2007, 2011). Doyle and Delaney (2009) explained that whenever a recession ended, institutional leaders concentrated on restoring funding to every program that had been cut, instead of planning within the resources they had available. As a result, universities now deal with shrinking government support by diversifying, and this diversification has not improved their financial stability. Mitchell, Leachman, and Masterson (2017) pointed out several consequences of state cuts, such as increases in tuition and a decline in quality resulting from faculty reductions, as well as limitations in the number of courses offered.

The finding that endowment money was negatively associated with an institution's financial stability contradicts the assumption that endowment funding would make schools

more financially stable, especially in response to revenue fluctuations resulting from changes in enrollment, donor interest, and public (both state and federal) support. This result could partly be due to the decline in returns from endowment investments in the last 10 years, due to the recession (NCSE, 2015, 2017), or the significant cuts in state support for public research institutions that have made them resort to spending their endowment funds on operations (American Academy of Arts and Sciences, 2016b; Stewart, 2008; Weisbard & Asch, 2010). Endowments may also be a longer, rather than a more short-term solution. Investment in fundraising is an immediate cost, but the return on this investment in the form of actual endowments does not come until later.

Revenue Diversification and Institutional Research Productivity

Research Question 4

This study sought to obtain the factorial structure underlying research productivity, test its reliability, and compute scores based on the extracted factors for use in further analysis. The results show that many of the variables proposed to measure research productivity could be reduced to two factors: those related to productivity outcomes (i.e., the average numbers of article publications, citations, book publications, grants/funding, grant dollars, and conference proceedings per faculty member) and those associated with productivity input (average number of graduate students supervised to graduation, representation in one of the national academies, and membership in the AAU). It was interesting to note that the average number of national awards per faculty member, a variable that researchers have mainly used as a predictor for research productivity, did not strongly correlate with any of the other elements. Thus, it was dropped from the final

analysis. The overall reliability of the factors extracted was 0.9127, which is considered very good.

The literature review showed that research productivity is a complex concept that requires a comprehensive measure, including both input and output factors. Previous studies have used a variety of indicators to measure research productivity, resulting in a wide range of outcomes. This study is unique in that it considered research productivity to be a latent variable and examined its structure. The results, therefore, provide initial evidence of the construct validity of this measure by establishing and testing the consistency of its internal structure. If anything, the results clarify that there are many measures of research productivity, but they can be reduced to two main variables: productivity outcomes and inputs. These variables are excellent measures for research productivity because they are inclusive. Also, they form a new measure for research productivity that can be used in future studies.

Research Question 5

This study examined the effects of diversifying revenue on institutional research productivity and how the relationship varied across institutions after controlling for workload. The results of the analysis show that a 1 unit increase in funding from revenue diversification resulted in a 54% increase in research productivity, on average. Another main finding was that the effect of diversifying revenue on research productivity varied significantly, by 35% across all institutions. No previous work has examined this topic. The most closely related studies focused mainly on the effect of a single source of revenue on research outcomes. Research productivity was measured either by quantity (e.g., the number of publications), quality (e.g., the number of citations), patents (Jacob &

Lefgren, 2011; Whalley & Hicks, 2014), or faculty rank (Maassen, 2012). Some researchers found that funding from a single revenue source had an effect on certain measures of research productivity (such as quantity) but had no effect on quality. The present work provides a unique contribution to the literature because it controlled for faculty workload and thus used the most comprehensive model. This work also modeled a latent variable for measuring research productivity. These measures incorporated quality, quantity, the individual, the institution's unique environment, and educational outcomes, all of which are pertinent to research productivity. Therefore, these results add value to the existing literature on diversification and research productivity.

The percentage difference in the relationship between research productivity and revenue diversification across institutions could be due to differences among "very high" research public universities; some institutions may or may not have the ability or enough capital to properly engage in diversification. Variations could also be due to differences in infrastructure; some institutions are well-resourced and prestigious, and thus have an improved ability to attract funding (Cheslock & Gianneschi, 2008; Estermann & Pruvot, 2011; Fransz & Sidford, 2011). These schools can comfortably finance individual activities without jeopardizing the entire system.

Research Question 6

This study also examined the average change in research productivity per year and the effects of various diversification strategies (i.e., government allocations, net tuition, research, endowments, and auxiliary services) on institutional research productivity over time. The results show that research productivity decreased by 1.1% per year, which was statistically significant ($z = -5.65$, $p = 0.001$); over time, it varied significantly.

When the effects of other predictors in the model were held constant, the study found that funding from net tuition, the government, and endowments increased institutional research productivity by 0.04%, 0.04%, and 0.02%, respectively. It is important to note that although the rate of dependence on net tuition and the government differed significantly, the effects of the two sources on research productivity were similar: 0.04. Conversely, depending on income from research reduced institutional research productivity by 0.03%, whereas depending on funding from auxiliary services had no effect. These findings suggested that not all alternative sources of funding have a positive effect on research productivity, and therefore cannot be depended upon in times of financial need.

The result that revenue from the government increased research productivity was not a surprise. Institutions of higher learning depend largely on government funding for their operations, and these funds are not committed to specific projects. However, this minimal effect could be due to the recent volatility in state funding, which in most cases depends on the health of the economy (SHEF, 2016). When the economy is weak, state cuts for public research universities tend to be high because there is a widely-held notion that public research universities are well established and have the potential to generate income from other sources (American Academy of Arts and Sciences, 2015a; McGuinness, 2005; SHEF, 2016); also, making sure universities have adequate funding tends to be of a lower priority than other state expenses.

Regarding the positive correlation between net tuition and research productivity, previous studies have found that net tuition and fees have become significant sources of revenue for many institutions of higher learning, exceeding even research grants

(Estermann & Pruvot, 2011; Stewart, 2008). Tuition and fees average more than one-half of the core educational expenditures at these institutions (SHEF, 2016). Moreover, this resource is often considered an immediate fallback whenever universities are faced with financial constraints. These funds are especially attractive because they can be spent as the institution chooses, rather than be committed to specific projects.

The significant effect of income from endowments could be due to several reasons. First, institutions have been increasing the size of their endowments in the recent past (NCSE, 2014, 2017). Second, endowment spending has also been growing, despite the negative return on investment. In 2015, about 10% of institutions derived their operating funds from endowments (NCSE, 2015). Overall, and similar to previous findings, this research determined that endowment dollars only contributed a small percentage of schools' operating budgets, even though they initially appeared to be larger. It is important to also note that there was a three year lag in the data collected for this study; this may have hindered the examination of the effects of endowment growth.

It was unexpected to find that income from research had a negative effect on research productivity. These findings contradict those of Wolszczak-Derlacz and Parteka (2010), who found a positive relationship between revenue from research and research outcomes. However, this result is similar to that of Payne and Siow (2003), Hottenrott and Thorwarth (2011), Hottenrott and Lawson (2014), and Musiige and Maassen (2015), who found that external funding for research reduced research outcomes. These scholars highlighted several possible reasons for the negative effect of this type of funding, ranging from differences between institutions' and external agents' research agendas, to a slowing or compromising of the dissemination of knowledge and disclosure of research outcomes,

and selectivity in funding where external agencies would only devote dollars to applied research. These negative effects could also be due to the additional workload and responsibilities that come with external funding (Rosinger et al., 2016), which interfere with researchers' core responsibilities. The contradictory results could also be attributed to differences in the measures of research productivity, but the present work, with its complex method of measurement, offers strong evidence that external funding does indeed reduce research productivity.

The insignificant effect of income from auxiliary services confirms the findings of previous researchers such as Alstete (2014) and Hearn (2003), who found that faculty members are not accustomed to revenue generation. Therefore, the practice of pursuing entrepreneurial activities may affect their performance. Moreover, the literature has shown that income from auxiliary services does not always exceed operational costs (Hearn, 2006a, 2006b). Auxiliary services are self-supporting and only a small percentage of surplus, if any, is invested in the core mission (American Academy of Arts and Sciences, 2016b), which makes it ineffective as a revenue source. Thus, the effect could be positive but still not significantly different from zero. Moreover, funding from auxiliary services may not go to faculty to support research, but rather to administration or facilities maintenance.

Table 16. Summary of the Effects of Revenue Diversification from Various Funding Sources on Institutional Financial Stability and Research Productivity

Factors	Financial Stability	Effect Between Institutions	Research Productivity	Variation Between Institutions
Revenue Diversification Index	Negative	Vary*	Positive **	Vary*
Government (Revenue)	Negative**		Positive **	
Net Tuition	Positive **		Positive***	
Research Funding	Positive		Negative**	
Endowment Funds	Negative		Positive*	
Auxiliary Services	Positive**		Positive	

Note: Three levels of significant *p < 0.05, **p < 0.010, ***p < 0.001; Vary * means the effect of diversifying revenue on financial stability was significantly different between the institutions in the study.

Relationship among Revenue Diversification, Financial Stability, and Research Productivity

Research Question 7

The mediation analysis showed that institutional financial stability did not influence the effect of revenue diversification on research productivity. Also, the present study found that the change in stability from one time point to another was small, which implies that the status differences among the institutions examined were minimal. Several previous studies found a strong correlation either between revenue from alternative sources of funding and an institution's financial stability (Cheslock & Gianneschi, 2008; Fransz & Sidford, 2011) or revenue diversification and research productivity (Banal-Estañol et al., 2015; Jacob & Lefgren, 2011; Maassen, 2012; Musiige & Maassen, 2015; Whalley & Hicks, 2014). However, no research has examined the relationships among the three variables. It is in this way that this study contributes to the existing literature on the topic.

It is also important to contextualize the findings on financial stability by underscoring that a major recession occurred during the period of this study, and thus it was a particularly unstable time in government funding.

Implications for Practice

Four practical implications of the effects of revenue diversification on institutional finances and research outcomes are discussed below. These implications are meant for institution leaders, policymakers, and stakeholders for use in determining ways to improve their schools' financial stability and research outcomes.

Implications of Revenue Diversification for Institutional Financial Stability

Consistent Support for Research Universities

Several models in this study repeatedly suggested a need for consistency in government support for public research universities. In particular, the finding indicating that revenue diversification does not actually increase institutional financially stability has significant implications for governments and policymakers seeking to find mechanisms of consistent support for public research universities. This study confirms the important contribution of state support; research institutions require that this source of income be consistent. Stable government support is essential to their fulfilling the critical role they play in contributing to the public good. If such support cannot be guaranteed, these institutions' financial health and the quality of their service are likely to decline.

Apart from net tuition, which has a positive effect on both financial stability and research outcomes, revenue diversification, and even specific sources of revenue such as government funding, endowments, and auxiliary and private sources, cannot be considered reliable. This work provides evidence that is critical to policymakers when making

budgeting decisions. In particular, it is important to note that many of the sources believed to generate alternative income cannot produce sufficient funds, suggesting that universities cannot survive and serve the public without support from the government. Policymakers should cease in their belief that public research universities can be made financially stable by accessing alternative sources of income, and stop using them as a balance wheel for state budgets. These findings also have significant implications for institution leaders who must advocate for more funding and funding predictability.

It is clear that funding volatility adversely affects public research universities; thus, there is no doubt that the effects will eventually diminish the possibility of universities generating additional income from net tuition. Although net tuition has shown to correlate positively with financial stability and research productivity, the increased dependence on income of this type will almost surely have unintended consequences. It's critical that institutions set a limit on how much net tuition should be increased. These findings show that institution leaders should focus on improving revenue sources that have the potential to positively influence research productivity, such as by improving endowment funding, advocating for greater state allocations, and earning money from external research. It is also essential to better support the general research mission before engaging in collaborations.

Institutional Financial Planning and Evaluation

The findings of this study have significant implications for institution administrators seeking to develop long-term financial strategies, especially in the current era (characterized by slow economic recovery and minimal dependence on income derived from available sources of funding). Universities should conduct cost analyses of their

alternative financial sources. Fully understanding the associated costs would help mitigate and manage risks and enhance the contribution of alternative funding to research outcomes and institutional financial stability. However, institutions should also be cautious not to allow policymakers to believe that these outside sources generate enough revenue that they make government funding unnecessary.

Moreover, in times when state support is strong, if those days ever return, schools should set aside funds in reserve to serve as a buttress in low-support years. If instability in state funding remains unchanged, and some predict it will only worsen, then universities must provide their own buffer. However, states should not see these protective measures as accounts to be raided or excuses to cut higher education even further. Therefore, it is also essential that legislators enact policies to support and protect these reserves.

Implications of Revenue Diversification for Research Productivity

Improvement in Research Performance

The findings of the present research have significant implications for institution leaders hoping to improve research production at public research universities. Institutions should implement policies that attract alternative sources of funding. More specifically, business officers should diversify long-term investments in sources that show evidence of positively increasing their institution's research performance over time. The result indicating that funding related to research reduced research outcomes has significant implication for policymakers, who should refocus their commitment to support very high public research institutions' mission of contributing to the nation's economy and overall development through research and innovation. To institution leaders, the negative effect of

research funding on research outcomes should necessitate cost benefit analyses before engaging in any research contracts.

Understanding Measures of Performance

Institutions of higher learning have multiple outcomes. This study examined research productivity as one of these products. The literature review showed that several indicators have been proposed as measures, but none has received wide acceptance. This study developed a comprehensive measure for research productivity that can be used in future work of this type. Moreover, these findings are vital to understanding institutional measures of performance, and therefore are significant for policymakers, institution leaders, and researchers in higher education. Research productivity is a complex concept that requires a multifaceted approach to measuring its presence, essential in any serious discussion of the topic.

Implications for Research

Replication of the Study

This study has delimitations; it focused only on "very high" public research universities, therefore preventing the generalizability of the findings to other institutions of higher learning. However, given the ongoing volatility in state support, a fruitful area for future research would be a similar study using multiple institutions and time lags to test whether diversification varies in other situations. Also, a closer analysis of financial stability could be conducted at the institution level, to examine how the four ratios for calculating composite financial stability vary at individual universities.

Multiple Measures of Financial Stability

The literature review suggested that in addition to the segment of the CFI used in this study as a measure of financial stability, there exist several other determinants of institutional financial stability related to management structure (Johnstone, 2002b), cost (i.e., administrative and investment capital) (Lapovsky, 2014; Sazonov et al., 2015; Stewart, 2008), autonomy (Chiang, 2004; Kohtamaki, 2009), and policy regulations (Stachowiak-Kudła & Kudla, 2017). Research has shown that these factors have the potential to harm the financial stability of an institution (Estermann & Pruvot, 2011), and the current work suggests that future research should broaden the measure of financial stability to include the effects of these factors.

Multiple Measures of Research Productivity

The current study used a deductive approach to extract factors for measuring research productivity. Since there is increasingly more work being done on research productivity, future scholars may consider incorporating deductive and inductive approaches when constructing measures. Such analyses are likely to improve on the current model and further validate it by demonstrating its success in measuring research productivity. For instance, adding variables such as faculty members' demographic information and issues related to faculty motivation are possible avenues of improvement. Additionally, this measure of research productivity should be tested across different categories of institutions to determine whether measurement invariants exist.

Relationships among Institution Outcomes

Funding is related to a number of outcomes in institutions of higher learning. This analysis showed that cross-lagged panel designs are capable of answering research

questions related to the possible causality of variables, including: funding stability, the ability of institutions to diversify their revenue, and how these variables might further influence other institution outcomes (i.e., whether the effects of the factors considered as mediators precede changes in the dependent variable). This work provides an opportunity for replication in testing mediation theory in a variety of applications in the field of higher education. Future studies might consider mediation analysis as a way of gaining a deeper understanding of the existing relationships among institutional financial stability, revenue diversification, and research outcomes.

Conclusion

This study examined the effects of revenue diversification on institutional financial stability and research outcomes. This work also considered the relationships among diversification, financial stability, and research productivity, all three highly complex concepts. This study was based on simplified assumptions at both the theoretical and statistical levels. The analysis showed that revenue diversification was not a solution to institutional financial stability, merely a way to financially survive. In fact, some sources of additional income had negative effects on financial stability. Apart from funding-related factors, other elements such as management risks, hidden costs, and economic shifts may also significantly affect the potential of an institution to successfully diversify its revenue. However, diversification did have a positive effect on research productivity. Income from sources such as the government, net tuition, and endowments all increased research outcomes, while money from research contracts had the opposite effect. The analysis did not support the common notion that institutional financial stability influenced the effects of diversification on research productivity.

These findings form a basis for important decision-making in response to declining state support for public research universities. For instance, institution leaders must develop ways not only to save costs by becoming more effective in their operations, but also to generate revenue through long-term strategic planning. Moreover, institution leaders should conduct rigorous cost analyses to determine the viability of their projects and activities before engaging in any form of revenue diversification, particularly with regards to auxiliary services. More importantly, the results of the study suggest a need for continued public funding of higher education, greater stability in state funding, and long-term portfolio management.

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