2023

An examination of Pell grant recipient graduation rates and institutional expenditures at public baccalaureate institutions

Lamont Alphonso Sellers

AN EXAMINATION OF PELL GRANT RECIPIENT GRADUATION RATES AND INSTITUTIONAL EXPENDITURES AT PUBLIC BACCALAUREATE INSTITUTIONS

By

Lamont A. Sellers

B.A., Shaw University, 1999
M.A., University of Denver, 2006

A Dissertation Submitted in Partial Fulfillment of
the Requirements for the degree of Doctor of Education

Division of Educational Leadership

Adult and Higher Education Program
In the Graduate School
University of South Dakota
August 2023

COMMITTEE SIGNATURE PAGE

The members of the Committee appointed to examine
the Dissertation of Lamont A. Sellers
find it satisfactory and recommend that it be accepted.

DocuSigned by:
Jesse Sealey
46285B86C4DD42D...
Chairperson

DocuSigned by:
Karen Card
D766CF1D5F9F436...

DocuSigned by:
Carol Voss Ward
8FF6CEFC4FD840C...

ABSTRACT

The present study examines the differences between public baccalaureate institutional expenditures and Pell Grant recipient graduation rates at high and low Pell Grant recipient graduating institutions. IPEDS data were analyzed, including instructional, academic support, student services, institutional support, and Pell Grant recipient 6-year graduation rates from the 2018 academic reporting year. Results from a Mann-Whitney U test compare 99 institutions divided into a high graduation rate group ($N_{high} = 40$) and a low graduation group ($N_{low} = 59$). The analysis showed there are mean rank differences between the groups that are statistically significant. These results support the need for further study to make sense of the differences between the level of spending on these criteria for the two institutional types.

Dissertation Advisor: 

Karen A. Card

Dedication

I dedicate this work to my wife, Myesha, who has survived the process, and my children, Marcus, Mason, Mea, and Myles, for allowing me to see this dissertation through to the end. My parents, Ronnie and Jean Sellers, have always been there for me, and I am grateful for the life that they have provided for me to come this far. My mother-in-love, Dorothy Destin, has been praying and encouraging me all along the way. My sister in this program, Wendy Thorson, would not let me give up, and though miles have separated us, she has kept our connection. My advisor and disciplinarian, Karen Card, stuck with me even beyond retirement to bring this to completion. Lastly, to all the members of my village that have been there for me through the ups and downs, thank you!

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Chapter 1 - Introduction

The mission of higher education institutions is educating students and producing degree recipients via ongoing retention through to graduation. Various populations of students have different levels of success in this endeavor. Low-income students often need to prepare more from under-resourced schools (Berg, 2016). These students are often first-generation and need more informal and formal networks to gain the heuristic knowledge necessary for matriculation and success (Berg, 2016). One of the significant barriers for these students is the financial hurdle to access higher education (Baker, 2019; Baker & Montalto, 2019; Bird & Castleman, 2016; Goldrick-Rab et al., 2016).

This study examines the available data collected via an annual survey by the National Center for Education Statistics, more specifically referred to as the Integrated Postsecondary Education Data System (IPEDS), related to institutional expenditures and Pell Grant recipient graduation rates. Students from low-income backgrounds have unique challenges as a subgroup within higher education institutions. Pell Grant recipients represent low-income individuals and families attending higher education institutions. These students' graduation rates indicate their success as students and the institution's success in getting them to this important finish line. This study situates institutional expenditures in this conversation of student success.

Higher education institutions are the unit of analysis. Breaking away from student-focused studies, I endeavor to refocus attention on institutional financial actions that impact Pell Grant recipient student success. Here student success is defined by graduation in six years or 150% of the time to completion.

This study is informed by John Ryan's (2004) work examining the general relationship between expenditures and undergraduate student graduation rates. His study uses the Integrated

Postsecondary Education Data System (IPEDS) expenditure categories: instruction, academic support, student services, and institutional support. Ryan's research suggests that instruction is a significant, positive predictor of overall student graduation rates. Additionally, his research suggests that cohort characteristics also affect graduation rates and expenditures. I detail Ryan's research in the literature review as the seminal research for this study.

The literature review shares relevant research regarding the study's conceptual framework, the education production function, which is divided into output and input factors, according to Dolan & Schmidt (1985). Institutional inputs are related to an institution's characteristics and student cohort characteristics. Student-level inputs are related to factors students possess that are not based on the cohort institutional-level factors.

Since Ryan's (2004) study of the relationship between institutional expenditures and student graduation rates, relatively few studies continue this line of scholarship. Moreover, studies abound on student departure, retention, persistence, and attrition with students as the unit of analysis (Mayhew et al., 2016; Tinto, 2006; Wolniak et al., 2012). Likewise, studies of students from low-income backgrounds have their place in the scholarship of student outcomes (Berg, 2016). This study seeks to add to student success scholarship that situates institutions as the unit of analysis.

Purpose of the Study

This study examines the difference between comprehensive baccalaureate institutions' expenditures and graduation rates of low-income students. This study used Pell Grant recipient students as a proxy for low-income students. Public postsecondary institutions have mandates to disclose various metrics of institutional performance and student success. This study uses the U.S. Department of Education, National Center for Education Statistics, Integrated

Postsecondary Education Data System (IPEDS) data to examine the differences between institutional expenditures (instruction, academic support, student services, institutional support) and Pell Grant recipient graduation rates.

Research Hypotheses

To explore the differences between institutional expenditures and Pell Grant recipient graduation rates, the following research question informs this study:

Null Hypothesis (H_0): There is no significant difference in instructional expenditures between institutions with high graduation rates of Pell Grant recipients and institutions with low graduation rates of Pell Grant recipients.

Null Hypothesis (H_0): There is no significant difference in academic support expenditures between institutions with high graduation rates of Pell Grant recipients and institutions with low graduation rates of Pell Grant recipients.

Null Hypothesis (H_0): There is no significant difference in student services expenditures between institutions with high graduation rates of Pell Grant recipients and institutions with low graduation rates of Pell Grant recipients.

Null Hypothesis (H_0): There is no significant difference in institutional support expenditures between institutions with high graduation rates of Pell Grant recipients and institutions with low graduation rates of Pell Grant recipients.

Alternative Hypothesis (H_A): The mean ranks of the high and low Pell Grant recipient graduating institutions are unequal.

Definition of Terms

The following definitions have been taken from the IPEDS data dictionary.

Academic Support Expenditures: A functional expense category that includes expenses associated with the activities and services that support the institution's primary mission of instruction, research, and public service. It includes the retention, preservation, and display of educational materials; organized activities that provide support services to the academic functions of the institution; media such as audiovisual services; academic administration; and formally organized and separately budgeted academic personnel development and course and curriculum development expenses (National Center for Education Statistics, 2018).

Graduation Rate: The rate required for disclosure and reporting purposes under Student Right-to-Know Act. This rate is calculated as the total number of completers within 150% of the normal time (six years) for a 4-year degree divided by the revised adjusted cohort (National Center for Education Statistics, 2018).

Instruction Expenditures: A functional expense category that includes expenses of the colleges, schools, departments, and other instructional divisions that includes general academic instruction, occupational and vocational instruction, community education, preparatory and adult basic education, and regular, special, and extension sessions, and includes expenses for both credit and non-credit activities (National Center for Education Statistics, 2018).

Institutional Support Expenditures: A functional expense category that includes expenses for the day-to-day operational support of the institution. This includes expenses for general administrative services, central executive-level activities concerned with management and long-range planning, legal and fiscal operations, space management, employee personnel, and records, logistical services such as purchasing and printing, and public relations and development (National Center for Education Statistics, 2018).

Pell Grant Pell Grant eligibility is determined by a student's completed Free Application for Federal Student Aid (FAFSA) which calculates the amount that a student and their family are expected to pay towards their education, also known as the expected family contribution (EFC). It exhibits whether there is exceptional financial need with awards based on EFC, cost of attendance, full- or part-time status, and length of attendance (National Center for Education Statistics, 2018).

Student Services Expenditures**:** A functional expense category that includes expenses for admissions, registrar activities, and activities whose primary purpose is to contribute to student's emotional and physical well-being and their intellectual, cultural, and social development outside the context of the formal instructional program (National Center for Education Statistics, 2018).

Delimitations

The sample in this study has been limited to four-year, baccalaureate public institutions. Public institutions must report various data about their institutions, whereas private not-for-profit and for-profit institutions do not have the same reporting requirements. Public institutions were selected for their publicly available data due to laws requiring transparency. Additionally, the institutions included in this study represent teaching-focused missions. Teaching-focused institutions do not have the higher research related expenditures of research-focused institutions. Only institutions with complete data were used in this study to have the best opportunity to compare.

Organization of the Study

Chapter 1 presents an introduction, purpose, research hypotheses, definition of terms, and delimitations of the present study. Chapter 2 reviews the recent relevant literature relating to the conceptual framework, student success, and institutional expenditures. Chapter 3 addresses the

purpose of the study, hypotheses, data source, variables, details of the population and sample, analysis, and descriptive statistics for the sample. Chapter 4 reports the details of the analysis output and a discussion of the results. Chapter 5 is a publication-ready manuscript prepared according to publication standards for the *Journal of College Student Retention: Research, Theory, and Practice*.

Chapter 2 - Literature Review

The present study examines the relationship between institutional expenditures and graduation rates of Pell Grant recipient students. This review of relevant scholarly research uses research articles, government reports, and longitudinal datasets. These were compiled from searches using Google Scholar, university library databases, and NCES IPEDS.

Theoretical Framework

The theoretical framework that informs this study has been included in similar studies. The education production function provides a means to elevate studies from the individual level (student) to institutional-level outputs germane to informing policy (Dolan & Schmidt, 1985). The production function is useful to advance institutional outputs, thus holding policy implications.

Institutional outputs, such as retention and graduation rates, are influenced by many complex characteristics. The education production function proves useful in examining the relationship between student-level and institution-level characteristics related to output measures. What influence do various input measures—student and institution-level—have on producing maximum student retention and graduation rates? The education production function is defined as:

$$O = f(R, S)$$

This function equation *O* represents institutional outputs, *R* represents institutional resources, and *S* represents student inputs.

The education production function is a means to examine outputs in terms of student-level and institution-level inputs. This method moves away from the individual or student-level analysis to consider institution-level characteristics. Education production functions started in K-

12 settings examining the influences of several student factors and school characteristics to understand what maximizes a particular output.

Early studies using the production function examined student inputs such as student demographics, personal backgrounds, family dynamics, and student academic factors (Hanushek, 1997). The outputs in these earlier studies used achievement scores at the classroom, school, district, county, and state levels. Student outputs are related to primary and secondary inputs. Primary inputs include but are not limited to family characteristics, financial realities, and academic preparation. Secondary inputs are those characteristics that may be indirectly related to student outputs. These indirect inputs include but are not limited to cohort demographics, institutional resources and support, faculty engagement, and institutional expenditures.

Seminal Study

One seminal study examining student degree attainment and expenditures is John Ryan's (2004). Ryan situates his work in the large existing body of research that examines persistence (student efforts to stay at an institution), attrition (the number or percentage of students that leave), and retention (institutional efforts to help students stay at an institution). This body of research draws from psychosocial, social integration, and student departure frameworks. However, these frameworks focus on students and do not examine various factors within the institution's purview. His literature review notes that Astin (1993) was the sole researcher to discuss institutional expenditures. Astin's concern was with institutional student services expenditures, suggesting a positive effect on student retention. Ryan's study extended retention and attrition models to include institutional spending. However, Ryan claimed that previous studies omit institutional responsibility for retention instead of focusing on a student's ability to persist.

Ryan examines four expenditure categories: instruction, academic support, institutional support, and student services. His choice of these four expenditure categories captures institutions' substantial expenses, as evidenced in their annual IPEDS surveys. Each category has the potential to influence student experiences with the institution.

Ryan (2004) conceptualizes his study using a conceptual framework previously relegated to primary and secondary levels; the education production function considers the input factors that produce a particular output. He cited those previous researchers who found a positive relationship between the expenditures (input) and student degree attainment (output) in the studies that used the education production function as a conceptual framework. Ryan identifies other input factors that have both direct and indirect effects on the output, including institutional size, institutional control, percentage of the cohort that identifies as a minority, percentage of the cohort that identifies as female, campus residency, whether the institution is an HBCU, academic preparation, and religious affiliation.

Ryan's sample included 363 Carnegie Baccalaureate I or II institutions categorized with complete data. His study's expenditure categories were instruction, academic support, institutional support, and student services calculated per full-time equivalent (FTE) student. Ryan uses multiple regression analysis based on the ordinary least squares approach to analyze the data to calculate summary statistics, ANOVA results, and regression output. I will discuss his results integrated with other relevant research studies as a part of the literature review.

Low-Income Students

The Free Application for Federal Student Aid (FAFSA) collects information on student and family financial resources. This information helps calculate the expected family contribution (EFC), a formula determined by Congress as a part of the Higher Education Act of 1965.

Students with an EFC of zero up to as much as $6,000 can qualify for federal Pell Grants--a need-based aid program for full-time undergraduate students. The Pell Grant program is one of the Title IV programs operated out of the U.S. Department of Education Office of Postsecondary Education. In the 2018-2019 academic year, the maximum Pell Grant award was $6,095 (an increase of $175), and the average student award was $4,160 (College Board, 2019). Across the United States, 31% of undergraduates were Pell Grant recipients, down from a high of 38% in 2011-2012, just after the Great Recession (College Board, 2019). The maximum award for public, four-year in-state institutions covers 28% of tuition, fees, and room and board (College Board, 2019). According to the College Board, this funding represents the country's most extensive higher education aid program and a social mobility mechanism for low-income students.

The first hurdle for low-income students and institutions alike is enrollment (Berg, 2016). Admissions recruiters descend on high school campuses and congregate at college fairs nationwide and worldwide to attract students to their institutions. Low-income and first-generation students add to an institution's economic diversity (Steinberg et al., 2009); however, this comes with opportunities and challenges for both students and institutions (Braxton & Francis, 2017; Ehrenberg, 2012; Swail, 2014).

Many low-income students have yet to take full advantage of these opportunities as they are likely the first in their families to pursue higher education. Also known as first-generation or first-generation college students, they often have difficulty navigating the complex pre-college testing processes, college searches, applications, campus visits, financial aid paperwork, and fees (Campbell & Voight, 2015). With the help of high school counselors and other well-meaning helpers along the way, low-income and first-gen students can be stopped in their tracks by the

sticker shock of the first bill to arrive in the summer before matriculation. This financial hurdle takes time to conceive. Summer melt is when students change their decision to attend college during the summer before matriculation (Castleman & Page, 2014). Many issues complicate low-income and first-gen students' matriculation, including mountains of additional forms, confusing instructions, a daunting new lexicon, more fees, and little help contributing to the summer melt.

Financial aid, particularly the FAFSA, has befuddled even experienced higher education professionals, not to mention how daunting this can be for low-income and first-gen students. Low-income students' perceptions of financial aid have shown that (a) the principles, regulation, and process are difficult to understand, (b) there is not enough consistent support for navigating the ongoing processes, and (c) the norms and values students have related to money, work, debt, and education are not rooted in their economic condition (Ziskin et al., 2014). The authors recommend that institutions work to demystify and simplify financial aid processes, create clear communication through well-designed websites and well-written personal communications, and understand that working is necessary for survival. Britt et al. (2016) put it this way, "students must skillfully navigate a complex financial environment which may include unstable personal finances, rapidly increasing tuition, and eroding financial support from parents and family" (p. 172).

Undergraduate students experience significant financial concerns. Financing their higher education pursuits has been linked to retention (Alon, 2011; Baker, 2019; Britt et al., 2016; Bird & Castleman, 2016; Gershenfeld et al., 2019; Titus, 2006), goal attainment (Andrews et al., 2017; Berg, 2016; Goldrick-Rab et al., 2016; Lowry, 2019; Martinez & Turner, 2015), and stress (Adams et al., 2016; Baker, 2019; Baker & Montalto, 2019; Fosnacht & Calderone, 2017). Researchers have examined the various factors that impact students with the financial means to

pursue their higher education goals. Students from low-income backgrounds experience these financial challenges that result in longer times to degree completion, lower GPAs, increased working hours, decreased engagement in extracurricular activities, and higher loan debt (Andrews et al., 2017; Robinson & Cheston, 2012). These factors impact retention and graduation rates for Pell Grant recipient students more significantly than higher socioeconomic backgrounds students.

Graduation Rates

Serval studies use the first-time, full-time degree-seeking, six-year cohort graduation rate as the dependent variable (Pike & Robbins, 2020; Pike et al., 2014; Pike et al., 2011; Ryan, 2004; Scott et al., 2006; Webber & Ehrenberg, 2010). Graduation is the goal for both students and institutions. When considering graduation for Pell Grant recipient students, we need to learn more about the impact of institutional expenditures on their graduation rates. However, students from low socioeconomic statuses are less likely to complete a four-year degree (Titus, 2006).

Institution-Level Factors

Institutional control refers to whether an institution is public or private, specifically nonprofit. Public institutions, however, have stricter controls that extend from state legislatures to postsecondary governing bodies to state-appointed boards. The state appropriations given to public institutions make them beholden to state restrictions and mandates. This control encompasses academic programs offered, cost of attendance (i.e., tuition, fees), mission, and allowable expenditures.

Large public institutions have the human and financial resources to retain and graduate greater proportions of undergraduate students. Access to human resources, particularly academic support professionals--academic advisors, tutors, and supplemental instructors--increases

students' chances of getting the assistance they need to be successful. Access to public institutions' financial resources makes it possible to hire the professionals necessary for student success and funds to cover tuition, fees, room and board, and retention and graduation. Some states direct appropriations to institutions for various efforts, vehicle others direct funds to students to use at public institutions.

Instructional Expenditures

Powell et al. (2012) suggest an optimal level of expenditures for instruction, academic support, and student services. This optimal level for expenditures accounts for institutional efficiency and effectiveness. Powell et al. (2012) found the optimal level of expenditures "to maximize both efficiency and effectiveness; the model indicated that an institution would spend approximately $6,020 for instruction; $1,400 for academic support; and $1,970 for student services per FTE student" (p. 117).

Instructional expenditures are an institution's expenses related to general academic instruction for credit and non-credit activities. As the single largest expenditure across institutions, instructional expenditures at public institutions represented 27% of expenditures in 2017-18 (DeBrey et al., 2021). Public 4-year institutions in 2017-18 spent, on average, $12,616 per FTE on instruction (DeBrey et al., 2021). Mayhew et al. (2016) summarize the studies related to expenditures and student graduation rates. The authors indicate that the related studies vary in their results; however, instructional expenditures are positively related to 4-year and 6-year graduation rates (Gansemer-Topf &Schuh, 2006; Pike & Robbins, 2020; Webber & Ehrenberg, 2010; Ryan, 2004).

Academic Support Expenditures

Academic support relates to activities outside of instruction that support students' academic experiences, including libraries, course and curriculum development, and activities that enhance student success. Studies suggest a positive relationship between academic support expenditures and graduation rates (Gansemer-Topf & Schuh, 2006; Ryan, 2004). However, Pike and Robbins (2020) study suggests no overall effect on graduation rates.

Student Services Expenditures

The student services expenditure category "includes expenses for admissions, registrar activities and activities whose primary purpose is to contribute to student's emotional and physical well-being and their intellectual, cultural, and social development outside the context of the formal instructional program" (National Center for Education Statistics, 2018). In short, this expenditure category covers most student-related programs and services outside the classroom. Student services are essential to student retention, as designated staff professionals and others work to provide student development. Traditional-age college students benefit the most from the programs and services provided. These programs and services include student organizations, recreational facilities, intramurals, health services, activities, and programming. Peer interactions positively affect student retention and graduation rates (Mayhew et al., 2016). These interactions are the product of student service activities and are associated with students having quality interactions and living on campus. Additionally, student satisfaction is correlated with the programming provided by student services and is positively related to retention and graduation (Mayhew et al., 2016).

Webber and Ehrenberg (2010) suggest that student services expenditures positively affect graduation rates. Additionally, their research suggests that increases in this expenditure category

can positively affect graduation. Ryan (2004) did not find a statistically significant relationship between student services expenditures and graduation rates; however, Gansemer-Topf and Schuh (2006) found a negative relationship.

Institutional Support Expenditures

As an expenditure category, institutional support relates to the day-to-day central operations of the institution. These expenditures include executive leadership, management, strategic planning, legal affairs, human resources, physical plant, public relations, and development. While this category is necessary for the institution, researchers have not linked it to significant retention and graduation rates. The nature of administrative positions covered by institutional support has little to no contact with students and thus has little to no impact on retention and graduation.

Summary

Research examining the relationship between graduation rates and expenditures suggests that instructional expenditures positively affect graduation rates (See Table 2). Likewise, most studies suggest a positive relationship between academic support and graduation rates. The studies that used institutional support as a predictor show no effect on graduation rates. Student services expenditures, however, show mixed effects and no singular reason for these varying effects. These results further emphasize the need for additional context and research.

Table 1

Relationship of Expenditures and Graduation Rates in Prior Literature

Research Article	Instruction	Academic Support	Student Services	Institutional Support
Webber & Ehrenberg (2010)	Positive	Positive	Positive	n/a
Ryan (2004)	Positive	Positive	Negative	No Effect
Gansemer-Topf & Schuh (2006)	Positive	Positive	No Effect	No Effect
Pike & Robbins (2020)	Positive	No Effect	Positive	No Effect
Abington (2014)	Positive*	Positive*	Positive	n/a

Note. * The researcher combined instruction, research, and public service into academic support

Chapter 3 - Methodology

This chapter details the method of analysis for the study. Firstly, I will describe the purpose of the research and state the null hypothesis that informs the analysis. The data source and variables are detailed, followed by the population and sample description. This study has had some changes since its inception, and the analysis section describes that journey. Finally, I share the delimitations of this study.

Purpose of the Study and Hypotheses

This study examines the differences between financial expenditures and institutions with high and low Pell Grant recipients' graduation rates. The null and alternative hypotheses are:

Null Hypothesis (H_0): There is no significant difference in instructional expenditures between institutions with high graduation rates of Pell Grant recipients and institutions with low graduation rates of Pell Grant recipients.

Null Hypothesis (H_0): There is no significant difference in academic support expenditures between institutions with high graduation rates of Pell Grant recipients and institutions with graduation rates of Pell Grant recipients.

Null Hypothesis (H_0): There is no significant difference in student services expenditures between institutions with high graduation rates of Pell Grant recipients and institutions with low graduation rates of Pell Grant recipients.

Null Hypothesis (H_0): There is no significant difference in institutional support expenditures between institutions with high graduation rates of Pell Grant recipients and institutions with low graduation rates of Pell Grant recipients.

Alternative Hypothesis (H_A): The mean ranks of the high and low Pell Grant recipient graduating institutions are unequal.

Data Source and Variables

The National Center for Educational Statistics (NCES) surveys higher education institutions across the United States annually and organizes these data in the Integrated Postsecondary Education Data System (IPEDS). These data are related to institutional characteristics (e.g., undergraduate headcount, size, and size categories), finance (e.g., instructional, academic support, student services, and institutional support expenditures), financial aid (e.g., Pell and non-Pell Grant recipients), and graduation rates. This study uses data from the 2017-18 academic year (2018 fiscal year).

This study uses the IPEDS expenditure categories—instruction, academic support, student services, and institutional support—as independent variables. Pell Grant recipients, six-year graduation rates and non-Pell Grant recipients, six-year graduation rates represent the dependent variables.

Population and Sample

The population used in this study is public higher education institutions that identify as *Baccalaureate Colleges: Arts and Sciences Focus* and *Baccalaureate Colleges: Diverse Fields* as reported to IPEDS according to their Carnegie Classification 2018: Basic. These institutions are known more for their teaching mission, not for high research activity and graduate studies.

Analysis

The initial version of this study was a multiple regression to examine the strength and direction of the relationship between institutional expenditures and Pell Grant recipient graduation rates. When the data were downloaded and assumption checks ran, several assumption checks failed; therefore, other analyses were explored.

The initial dataset included 406 public higher education institutions. Institutions with missing data were not included, nor were parent-child relationship institutions (university systems that report for all institutions under their charge). Descriptive statistics were run for the remaining institutions, outliers for each expenditure category, and retention rates were removed. The 112 institutions were divided into equal groups of high and low Pell Grant recipient graduation rates. Boxplots for each variable showed 13 outliers removed from the dataset yielding above 50% ($N_{high} = 40$) and lower than 49% ($N_{low} = 59$).

After further consideration of the available data, I determined that a Mann-Whitney U test would allow me to analyze the available data using a dummy variable grouping institutions into high and low Pell Grant recipient graduating groups. This categorical or dichotomous variable (graduating groups), in combination with the continuous variables (expenditures: instruction, academic support, student services, and institutional support), does not assume that the data is normally distributed. The previous methods assumed this normal distribution and failed. The Mann-Whitney U test yields helpful results for this study.

Assumption Checks

The Mann-Whitney U test has four assumptions related to the data (Mann & Whitney, 1947). These assumptions are:

1. A dependent variable is measured on a continuous scale.
2. An independent variable is measured on a dichotomous scale.
3. There are independent observations across the sample.
4. The distributions of each grouping of data of the independent variable have a different shape to compare the mean ranks of each distribution.

The institutional expenditures and Pell Grant recipient graduation rates are the dependent variables on a continuous scale. The independent variable is the Pell Grant recipient graduation rate high and low groups which represent dichotomous variables. The institutions included in the dataset are independent observations across the two groups. An initial review of the expenditures and graduation rates shows that each group has a different shape. Therefore, each of the four assumptions is met to conduct the Mann-Whitney U test.

Delimitations

The delimitations of this study relate to the data collection and population. NCES coordinates and organizes institutional data in IPEDS from the annual surveys that collect financial, demographic, and institutional characteristics from U.S. colleges and universities of all types that receive federal funds. Since these institutions vary significantly in various ways, it is challenging to standardize how financials are grouped and reported. The finance data collected by IPEDS are according to the Governmental Accounting Standards Board (GASB), an independent, private-sector organization that sets accounting and financial reporting standards. However, there are differences in reporting from individual institutions' grouping, for instance, admissions expenditures under student services, although these expenditures have little to do with students' health and well-being. Admissions represent a costly part of the matriculation process, with much of it taking place before students come to the institution and having little effect on retention and persistence, like instructional expenditures.

Chapter 4 - Results and Discussion

This chapter details the results of the Mann-Whitney U test, including the assumption checks, descriptive statistics, and test output. I will discuss the results and further implications for the study's usefulness.

Descriptive Statistics

The sample in this study includes 99 institutions divided into two groups, with 59 institutions in the low Pell Grant recipient graduating group and 40 institutions in the high Pell Grant recipient graduating group. All dollar figures are reported as real dollars for the 2018 fiscal year. Instructional expenditures have a maximum of $263,896,955 and a minimum of $48,398,719, yielding a range of $215,498,236, a mean of $112,219,213, and a median of $99,909,016. Academic support expenditures have a maximum of $86,703,000 and a minimum of $6,275,429, yielding a range of $80,427,571, a mean of $30,466,492, and a median of $26,653,939. Student services expenditures have a maximum of $56,223,000 and a minimum of $6,739,597, yielding a range of $49,483,403, a mean of $24,182,773, and a median of $23,290,000. Institutional support expenditures have a maximum of $77,784,000 and a minimum of $10,350,757, yielding a range of $67,433,243, a mean of $33,661,128, and a median of $32,108,946. Pell Grant recipient graduation rates have a maximum of 75% and a minimum of 26%, yielding a range of 49%, a mean of 47.94%, and a median of 46%.

Mann-Whitney U Test Results

Each of the variables has its hypothesis below. The hypotheses for this study are with their respective statistical significance (*p-values*):

Null Hypothesis (H_0): There is no significant difference in instructional expenditures between institutions with high graduation rates of Pell Grant recipients and institutions with low graduation rates of Pell Grant recipients ($p < .001$).

Null Hypothesis (H_0): There is no significant difference in academic support expenditures between institutions with high graduation rates of Pell Grant recipients and institutions with low graduation rates of Pell Grant recipients ($p < .001$).

Null Hypothesis (H_0): There is no significant difference in student services expenditures between institutions with high graduation rates of Pell Grant recipients and institutions with low graduation rates of Pell Grant recipients ($p = .002$).

Null Hypothesis (H_0): There is no significant difference in institutional support expenditures between institutions with high graduation rates of Pell Grant recipients and institutions with low graduation rates of Pell Grant recipients ($p < .001$).

Alternative Hypothesis (H_A): The mean ranks of the high and low Pell Grant recipient graduating institutions are unequal.

Using SPSS statistical software for the nonparametric, independent samples Mann-Whitney U test, each null hypothesis is rejected, and the alternative hypothesis is accepted.

A Mann-Whitney U test was performed to determine if there were differences in instructional expenditures between high and low Pell Grant recipient graduation rate institutions. Distributions of the instructional expenditures for high and low institutions were not similar, as assessed by visual inspection. There was a statistically significant difference in these expenditures between high (mean rank = 66.13) and low (mean rank = 39.07) institutions, $U = 1825, z = -4.599, p < .001$, using an exact sampling distribution for U (Dineen & Blakesley, 1973).

A Mann-Whitney U test was performed to determine if there were differences in academic support expenditures between high and low Pell Grant recipient graduation rate institutions. Distributions of the academic support expenditures for high and low institutions were not similar, as assessed by visual inspection. There was a statistically significant difference in these expenditures between high (mean rank = 61.83) and low (mean rank = 41.98) institutions, $U = 1653, z = -3.373, p < .001$, using an exact sampling distribution for U (Dineen & Blakesley, 1973).

A Mann-Whitney U test was performed to determine if there were differences in student services expenditures between high and low Pell Grant recipient graduation rate institutions. Distributions of the student services expenditures for high and low institutions were not similar, as assessed by visual inspection. There was a statistically significant difference in these expenditures between high (mean rank = 60.75) and low (mean rank = 42.71) institutions, $U = 1610, z = -3.066, p = .002$, using an exact sampling distribution for U (Dineen & Blakesley, 1973).

A Mann-Whitney U test was performed to determine if there were differences in institutional support expenditures between high and low Pell Grant recipient graduation rate institutions. Distributions of the institutional support expenditures for high and low institutions were not similar, as assessed by visual inspection. There was a statistically significant difference in these expenditures between high (mean rank = 65.33) and low (mean rank = 39.61) institutions, $U = 1793, z = -4.371, p < .001$, using an exact sampling distribution for U (Dineen & Blakesley, 1973).

A Mann-Whitney U test was performed to determine if there were differences in Pell Grant recipient graduation rates between high and low Pell Grant recipient graduation rate institutions. Distributions of the Pell Grant recipient graduation rates for high and low

institutions were not similar, as assessed by visual inspection. There was a statistically significant difference in these rates between high (mean rank = 79.50) and low (mean rank = 30.00) institutions, $U = 2360, z = -8.420, p < .0005$, using an exact sampling distribution for U (Dineen & Blakesley, 1973).

Table 2

Descriptive Statistics for Mann-Whitney U Test Examining Institutional Expenditures and Pell Grant Recipient Graduation Rates at High and Low Graduating Institutions

	Instructional	**Academic Support**	**Student Services**	**Institutional Support**	**Pell Recipient Grad Rate**
Mean	$112,219,213	$30,466,492	$24,182,773	$33,661,128	47.94
Median	$99,909,016	$26,653,939	$23,290,000	$32,108,946	46
Range	$215,498,236	$80,427,571	$49,483,403	$67,433,243	49
Min.	$48,398,719	$6,275,429	$6,739,597	$10,350,757	26
Max.	$263,896,955	$86,703,000	$56,223,000	$77,784,000	75
Mann-Whitney U	1825	1653	1610	1793	2360
Z-score	-4.599	-3.373	-3.066	-4.371	-8.420
Statistical Significance	<.001*	<.001*	.002*	<.001*	<.0005*

Discussion

Using the Mann-Whitney U test does not allow for robust assertions to be made about the data presented or the results. What can be said about the results is that the dissimilar distribution of each expenditure category necessitates an examination of the mean ranks. Instruction shows the greatest difference between mean rank groups, followed by institution support, and student services has the least difference. There are differences between the high and low Pell Grant

recipient graduating institutions; however, that is all that can be said about these data for the present study.

Chapter 5 - Article Submission

The following uses this study for an article submission following the guidelines for the *Journal of College Student Retention: Research, Theory, and Practice*.

Abstract

The present study examines the differences between public baccalaureate institutional expenditures and Pell Grant recipient graduation rates at high and low Pell Grant recipient graduating institutions. IPEDS data were analyzed, including instructional, academic support, student services, institutional support, and Pell Grant recipient 6-year graduation rates from the 2018 academic reporting year. Results from a Mann-Whitney U test compare 99 institutions divided into a high graduation rate group ($N_{high} = 40$) and a low graduation group ($N_{low} = 59$). The analysis showed there are mean rank differences between the groups that are statistically significant. These results support the need for further study to make sense of the differences between institutions.

Introduction

Higher education institutions are in the business of educating students and producing degree recipients via ongoing retention through to graduation. Various populations of students have different levels of success in this endeavor. Low-income students must often to prepare more from under-resourced schools (Berg, 2016). These students are often first-generation and need more informal and formal networks to gain the heuristic knowledge necessary for matriculation and success (Berg, 2016). The most significant barrier for these students is the financial hurdle to access higher education (Baker, 2019; Baker & Montalto, 2019; Bird & Castleman, 2016; Goldrick-Rab et al., 2016).

This study examines the available data from Integrated Postsecondary Education Data System (IPEDS) 2018 academic reporting year related to institutional expenditures and Pell Grant recipient graduation rates. Students from low-income backgrounds have unique challenges as a subgroup within higher education institutions. Pell Grant recipients represent low-income individuals and families attending higher education institutions. These students' graduation rates indicate their success as students and the institution's success in getting them to this important finish line. This study situates institutional expenditures in this conversation of student success. Higher education institutions are the unit of analysis. Breaking away from student-focused studies, I refocus on institutional finances impacting Pell Grant recipient graduation rates.

Purpose of the Study

This study examines the difference between comprehensive baccalaureate institutions' expenditures and graduation rates of low-income students. This study used Pell Grant recipient students as a proxy for low-income students. Public postsecondary institutions have mandates to disclose various metrics of institutional performance and student success. This study uses the U.S. Department of Education, National Center for Education Statistics, Integrated Postsecondary Education Data System (IPEDS, 2018) data to examine the differences between institutional expenditures (instruction, academic support, student services, institutional support) and Pell Grant recipient graduation rates.

Theoretical Framework

The theoretical framework that informs this study has been included in similar studies. The education production function provides a means to elevate studies from the individual level (student) to institutional-level outputs germane to informing policy (Dolan & Schmidt, 1985).

The production function is useful to advance institutional outputs, thus holding policy implications.

Institutional outputs, such as retention and graduation rates, are influenced by many complex characteristics. The education production function proves useful in examining the relationship between student-level and institution-level characteristics related to output measures. What influence do various input measures—student and institution-level—have on producing maximum student retention and graduation rates? The education production function is defined as:

$$O = f(R, S)$$

This function equation *O* represents institutional outputs, *R* represents institutional resources, and *S* represents student inputs.

Low-Income Students

The Free Application for Federal Student Aid (FAFSA) collects information on student and family financial resources. This information helps calculate the expected family contribution (EFC), a formula determined by Congress as a part of the Higher Education Act of 1965. Students with an EFC of zero can qualify for federal Pell Grants--a need-based aid program for full-time undergraduate students. The Pell Grant program is one of the Title IV programs operated out of the U.S. Department of Education Office of Postsecondary Education. In the 2018-2019 academic year, the maximum Pell Grant award was $6,095 (an increase of $175), and the average student award was $4,160 (College Board, 2019). Across the United States, 31% of undergraduates were Pell Grant recipients, down from a high of 38% in 2011-2012, just after the Great Recession (College Board, 2019). The maximum award for public, four-year in-state institutions covers 28% of tuition, fees, and room and board (College Board, 2019). According to

the College Board, this funding represents the country's most extensive higher education aid program and a social mobility mechanism for low-income students.

The first hurdle for low-income students and institutions alike is enrollment (Berg, 2016). Admissions recruiters descend on high school campuses and congregate at college fairs nationwide and worldwide to attract students to their institutions. Low-income and first-generation students add to an institution's economic diversity (Steinberg et al., 2009); however, this comes with opportunities and challenges for both students and institutions (Braxton & Francis, 2017; Ehrenberg, 2012; Swail, 2014).

Many low-income students have yet to take full advantage of these opportunities as they are likely the first in their families to pursue higher education. Also known as first-generation or first-generation college students, they often have difficulty navigating the complex pre-college testing processes, college searches, applications, campus visits, financial aid paperwork, and fees (Campbell & Voight, 2015). With the help of high school counselors and other well-meaning helpers along the way, low-income and first-gen students can be stopped in their tracks by the sticker shock of the first bill to arrive in the summer before matriculation. This financial hurdle takes time to conceive. Summer melt is when students change their decision to attend college during the summer before matriculation (Castleman & Page, 2014). Many issues complicate low-income and first-gen students' matriculation, including mountains of additional forms, confusing instructions, a daunting new lexicon, more fees, and little help contributing to the summer melt.

Research Hypotheses

To explore the differences between institutional expenditures and Pell Grant recipient graduation rates, the following research question informs this study:

Null Hypothesis (H_0): There is no significant difference in instructional expenditures between institutions with high graduation rates of Pell Grant recipients and institutions with low graduation rates of Pell Grant recipients.

Null Hypothesis (H_0): There is no significant difference in academic support expenditures between institutions with high graduation rates of Pell Grant recipients and institutions with low graduation rates of Pell Grant recipients.

Null Hypothesis (H_0): There is no significant difference in student services expenditures between institutions with high graduation rates of Pell Grant recipients and institutions with low graduation rates of Pell Grant recipients.

Null Hypothesis (H_0): There is no significant difference in institutional support expenditures between institutions with high graduation rates of Pell Grant recipients and institutions with low graduation rates of Pell Grant recipients.

Alternative Hypothesis (H_A): The mean ranks of the high and low Pell Grant recipient graduating institutions are unequal.

Graduation Rates

Several studies use the first-time, full-time degree-seeking, six-year cohort graduation rate as the dependent variable (Pike & Robbins, 2020; Pike et al., 2014; Pike et al., 2011; Ryan, 2004; Scott et al., 2006; Webber & Ehrenberg, 2010). Graduation is the goal for both students and institutions. When considering graduation for Pell Grant recipient students, we need to learn more about the impact of institutional expenditures on their graduation rates. However, students from low socioeconomic statuses are less likely to complete a four-year degree (Titus, 2006).

Institution-Level Factors

Institutional control refers to whether an institution is public or private, specifically nonprofit. Public institutions, however, have stricter controls that extend from state legislatures to postsecondary governing bodies to state-appointed boards. The state appropriations given to public institutions make them beholden to state restrictions and mandates. This control encompasses academic programs offered, cost of attendance (i.e., tuition, fees), mission, and allowable expenditures.

Large public institutions have the human and financial resources to retain and graduate greater proportions of undergraduate students. Access to human resources, particularly academic support professionals--academic advisors, tutors, and supplemental instructors--increases students' chances of getting the assistance they need to be successful. Access to public institutions' financial resources makes it possible to hire the professionals necessary for student success and funds to cover tuition, fees, room and board, and retention and graduation. Some states direct appropriations to institutions for various efforts, vehicle others direct funds to students to use at public institutions.

Instructional Expenditures

Powell et al. (2012) suggest an optimal level of expenditures for instruction, academic support, and student services. This optimal level for expenditures accounts for institutional efficiency and effectiveness. Powell et al. (2012) found the optimal level of expenditures "to maximize both efficiency and effectiveness; the model indicated that an institution would spend approximately $6,020 for instruction; $1,400 for academic support; and $1,970 for student services per FTE student" (p. 117).

Instructional expenditures are an institution's expenses related to general academic instruction for credit and non-credit activities. As the single largest expenditure across institutions, instructional expenditures at public institutions represented 27% of expenditures in 2017-18 (DeBrey et al., 2021). Public 4-year institutions in 2017-18 spent, on average, $12,616 per FTE on instruction (DeBrey et al., 2021). Mayhew et al. (2016) summarize the studies related to expenditures and student graduation rates. The authors indicate that the related studies vary in their results; however, instructional expenditures are positively related to 4-year and 6-year graduation rates (Gansemer-Topf &Schuh, 2006; Pike & Robbins, 2020; Webber & Ehrenberg, 2010; Ryan, 2004).

Academic Support Expenditures

Academic support relates to activities outside of instruction that support students' academic experiences, including libraries, course and curriculum development, and activities that enhance student success. Studies suggest a positive relationship between academic support expenditures and graduation rates (Gansemer-Topf & Schuh, 2006; Ryan, 2004). However, Pike and Robbins (2020) study suggests no overall effect on graduation rates.

Student Services Expenditures

The student services expenditure category "includes expenses for admissions, registrar activities and activities whose primary purpose is to contribute to student's emotional and physical well-being and their intellectual, cultural, and social development outside the context of the formal instructional program" (National Center for Education Statistics, 2018). In short, this expenditure category covers most student-related programs and services outside the classroom. Student services are essential to student retention, as designated staff professionals and others work to provide student development. Traditional-age college students benefit the most from the

programs and services provided. These programs and services include student organizations, recreational facilities, intramurals, health services, activities, and programming. Peer interactions positively affect student retention and graduation rates (Mayhew et al., 2016). These interactions are the product of student service activities and are associated with students having quality interactions and living on campus. Additionally, student satisfaction is correlated with the programming provided by student services and is positively related to retention and graduation (Mayhew et al., 2016).

Webber and Ehrenberg (2010) suggest that student services expenditures positively affect graduation rates. Additionally, their research suggests that increases in this expenditure category can positively affect graduation. Ryan (2004) did not find a statistically significant relationship between student services expenditures and graduation rates; however, Gansemer-Topf and Schuh (2006) found a negative relationship.

Institutional Support Expenditures

As an expenditure category, institutional support relates to the day-to-day central operations of the institution. These expenditures include executive leadership, management, strategic planning, legal affairs, human resources, physical plant, public relations, and development. While this category is necessary for the institution, researchers have yet to link it to significant retention and graduation rates. The nature of administrative positions covered by institutional support has little to no contact with students and thus has little to no impact on retention and graduation.

Population and Sample

The population used in this study is public higher education institutions that identify as *Baccalaureate Colleges: Arts and Sciences Focus* and *Baccalaureate Colleges: Diverse Fields*

as reported to IPEDS according to their Carnegie Classification 2018: Basic. These institutions are known more for their teaching mission, not for high research activity and graduate studies.

Analysis

The initial version of this study was a multiple regression to examine the strength and direction of the relationship between institutional expenditures and Pell Grant recipient graduation rates. When the data were downloaded and assumption checks ran, several assumption checks failed; therefore, other analyses were explored.

The initial dataset included 406 public higher education institutions. Institutions with missing data were not included, nor were parent-child relationship institutions (university systems that report for all institutions under their charge). Descriptive statistics were run for the remaining institutions, outliers for each expenditure category, and retention rates were removed. The 112 institutions were divided into equal groups of high and low Pell Grant recipient graduation rates. Boxplots for each variable showed 13 outliers removed from the dataset yielding above 50% ($N_{high} = 40$) and lower than 49% ($N_{low} = 59$).

After further consideration of the available data, I determined that a Mann-Whitney U test would allow me to analyze the available data using a dummy variable grouping institutions into high and low Pell Grant recipient graduating groups. This categorical or dichotomous variable (graduating groups), in combination with the continuous variables (expenditures: instruction, academic support, student services, and institutional support), does not assume that the data is normally distributed. The previous methods assumed this normal distribution and failed. The Mann-Whitney U test yields helpful results for this study.

Descriptive Statistics

The sample in this study includes 99 institutions divided into two groups, with 59 institutions in the low Pell Grant recipient graduating group and 40 institutions in the high Pell Grant recipient graduating group. Instructional expenditures have a maximum of $263,896,955 and a minimum of $48,398,719, yielding a range of $215,498,236, a mean of $112,219,213, and a median of $99,909,016. Academic support expenditures have a maximum of $86,703,000 and a minimum of $6,275,429, yielding a range of $80,427,571, a mean of $30,466,492, and a median of $26,653,939. Student services expenditures have a maximum of $56,223,000 and a minimum of $6,739,597, yielding a range of $49,483,403, a mean of $24,182,773, and a median of $23,290,000. Institutional support expenditures have a maximum of $77,784,000 and a minimum of $10,350,757, yielding a range of $67,433,243, a mean of $33,661,128, and a median of $32,108,946. Pell Grant recipient graduation rates have a maximum of 75% and a minimum of 26%, yielding a range of 49%, a mean of 47.94%, and a median of 46%.

Mann-Whitney U Test Results

Using SPSS statistical software for the nonparametric, independent samples Mann-Whitney U test, each null hypothesis is rejected, and the alternative hypothesis is accepted. Each of the variables and the respective hypothesis was statistically significant.

A Mann-Whitney U test was run to determine if there were differences in instructional expenditures between high and low Pell Grant recipient graduation rate institutions. Distributions of the instructional expenditures for high and low institutions were not similar, as assessed by visual inspection. There was a statistically significant difference in these expenditures between high (mean rank = 66.13) and low (mean rank = 39.07) institutions, $U = 1825, z = 4.599, p < .001$, using an exact sampling distribution for U (Dineen & Blakesley, 1973).

A Mann-Whitney U test was run to determine if there were differences in academic support expenditures between high and low Pell Grant recipient graduation rate institutions. Distributions of the academic support expenditures for high and low institutions were not similar, as assessed by visual inspection. There was a statistically significant difference in these expenditures between high (mean rank = 61.83) and low (mean rank = 41.98) institutions, $U = 1653, z = 3.373, p < .001$, using an exact sampling distribution for U (Dineen & Blakesley, 1973).

A Mann-Whitney U test was run to determine if there were differences in student services expenditures between high and low Pell Grant recipient graduation rate institutions. Distributions of the student services expenditures for high and low institutions were not similar, as assessed by visual inspection. There was a statistically significant difference in these expenditures between high (mean rank = 60.75) and low (mean rank = 42.71) institutions, $U = 1610, z = 3.066, p = .002$, using an exact sampling distribution for U (Dineen & Blakesley, 1973).

A Mann-Whitney U test was run to determine if there were differences in institutional support expenditures between high and low Pell Grant recipient graduation rate institutions. Distributions of the institutional support expenditures for high and low institutions were not similar, as assessed by visual inspection. There was a statistically significant difference in these expenditures between high (mean rank = 65.33) and low (mean rank = 39.61) institutions, $U = 1793, z = 4.371, p < .001$, using an exact sampling distribution for U (Dineen & Blakesley, 1973).

A Mann-Whitney U test was run to determine if there were differences in Pell Grant recipient graduation rates between high and low Pell Grant recipient graduation rate institutions. Distributions of the Pell Grant recipient graduation rates for high and low institutions were not

similar, as assessed by visual inspection. There was a statistically significant difference in these rates between high (mean rank = 79.50) and low (mean rank = 30.00) institutions, $U = 2360, z = 8.420, p < .0005$, using an exact sampling distribution for U (Dineen & Blakesley, 1973).

Discussion

Using the Mann-Whitney U test does not allow for robust assertions to be made about the data presented or the results. What can be said about the results is that the dissimilar distribution of each expenditure category necessitates examining the mean ranks. Instruction shows the greatest difference between mean rank groups, followed by institution support, and student services has the least difference. There are differences between the high and low Pell Grant recipient graduating institutions; however, that is all that can be said about these data for the present study.

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