Spring 2018

The Impact of Performance-Based Funding on Graduation Rates at Texas State Technical College

Adam Hutchinson
Old Dominion University

THE IMPACT OF PERFORMANCE-BASED FUNDING ON

GRADUATION RATES AT TEXAS STATE TECHNICAL COLLEGE

by

Adam C. Hutchison
B.S. August 1996, Bob Jones University
M.A. January 2012, Liberty University

A Dissertation Submitted to the Faculty of
Old Dominion University in Partial Fulfillment of the
Requirements for the Degree of

DOCTOR OF PHILOSOPHY

COMMUNITY COLLEGE LEADERSHIP

OLD DOMINION UNIVERSITY
May 2018

Approved by:

____
Mitchell Williams (Chair)

____
Shana Pribesh (Member)

____
William Owings (Member)

ABSTRACT

THE IMPACT OF PERFORMANCE-BASED FUNDING ON GRADUATION RATES AT TEXAS STATE TECHNICAL COLLEGE

Adam C. Hutchison
Old Dominion University, 2018
Director: Dr. Mitchell Williams

As states legislatures seek improved results and increased accountability from higher education institutions, performance-based funding is frequently used as fiscal policy to determine state appropriations. Performance-based funding (PBF) determines an institution's appropriation by its attainment of metrics, usually student outcomes. Early versions of PBF provided incentive funding for institutions that exceeded outcome goals, but later formulas included more intermediate metrics and required institutions meet targets to receive baseline funding. Prior studies examined the impact of PBF on retention and graduation rates at institutions through state-to-state comparisons and explored the political implications of PBF policies. Researchers found states using PBF did not improve student retention and graduation at greater rates than non-PBF states and recommended improvements to future PBF formulas (Dougherty, Natow, & Vega, 2012; Hillman, 2016; Shin, 2010).

Texas implemented the Returned Value Funding model, a PBF formula for Texas State Technical College (TSTC), in 2013 to improve the institution's completion rates (Texas Higher Education Coordinating Board, 2013). The model incorporated recommendations from prior studies, including broad stakeholder collaboration, alignment with institutional mission, and a large percentage of the college's budget determined by PBF. This study addressed a gap in the literature by evaluating the impact of the Returned Value Funding formula on TSTC's graduation rate at the institution as a whole and by academic divisions.

The study used a matched sample design and an interrupted time series analysis to evaluate the impact of the Returned Value Funding model on graduation rates between 2005 and 2016. The tests provided both point-in-time and longitudinal views of the effects of PBF on graduation rates at TSTC. The results of both tests indicated PBF had no statistically significant impact on graduation rates at TSTC as a whole and mixed effects on rates at individual academic divisions.

The study recommends regular review of the outcomes of the Returned Value Funding model and additional disaggregation of the impact of the model by TSTC campus and by demographic populations. Research should also explore operational changes made by institutions in response to PBF, and findings from ongoing research should be incorporated into new or revised PBF formulas.

For my dad,

Michael A. Hutchison,

1948 – 2015.

ACKNOWLEDGMENTS

While it is not possible to adequately thank all of the people who have given to me throughout this effort, I am deeply appreciative for those who have been so generous and supportive, both professionally and personally. First, I gratefully acknowledge my dissertation committee, chaired by Dr. Mitch Williams. Dr. Williams, you have been a masterful guide for me in this process. Through your experience and insight, I have been stretched and challenged, and through your guidance and kindness, I have been encouraged. Your passion and your work for the mission of community colleges have made an immeasurable impact on leaders and institutions around the country, and I am blessed to be counted among your students. Dr. Pribesh, thank you for welcoming us into your classroom as colleagues and for your generous hospitality. You have turned many imposters like me into researchers, and we are all in your debt. Dr. Owings, it has been a privilege to work with you; your feedback and contributions were invaluable to this work.

To my dear classmates of CCL Cohort 13, you are among the richest treasures in my doctoral journey. I never expected to be in such great company. You are among the best college leaders in the country, but more than just scholars, you are my friends. Bill Ashcraft, Caleb Marsh, and Dean Roughton, I'm indebted to you for your kindness, companionship, and scholarship. Thank you for shouldering the load with me, rooting for me, and pushing me forward.

Thank you to my mentors and colleagues in higher education who supported me along the way. Dr. Cesar Maldonado, Dr. Elton Stuckly, Dr. Gary Hendricks, and Jonathan Hoekstra, you each played a vital role in this journey, and I am grateful for your help. To the TSTC family, you have given me more opportunities than I deserve and inspired me with your passion for student success. Texas is better because of you.

Mom, you and Dad taught me that education was an investment worth making, and I could have never taken the first step on this path were it not for all of the sacrifices you both made for me. Over the last few years you have shown me that life can be lived fully, even when it is hard. Thank you for the inspiration.

Emma, Nate, Grace, and Charlotte, no work I will ever do is better than being your dad. You've endured the classes, the projects, and the papers as we have all gone to school together. You have grown up a lot since this process began, and I am excited to see how you will bring truth, beauty, and love into the world.

Most of all, I am thankful for my dear Naomi, who said yes to this adventure. Na, throughout this program you have carried the burdens of home and the busyness of life so I could study and work, and you have been the most important supporter every step of the way. You have cheered each milestone and made incredible sacrifices for me to pursue this dream, and I could not have done this without you. Thank you for dancing in the minefields with me; I cannot wait to see what comes next.

TABLE OF CONTENTS

LIST OF TABLES

Table Page

LIST OF FIGURES

Chapter 1

Introduction

Over the last 30 years, lawmakers and educational policy analysts have challenged activity-based appropriation formulas as inefficient and counterintuitive systems to fund the social service of public higher education (Dougherty, Natow, Hare, & Jones, 2011; Jones, 2012). President Obama also advocated for increased accountability when, in his 2013 State of the Union address, he called on Congress to link federal higher education funding to institutional outcomes (The White House, 2013). As an alternative to enrollment-based models, performance-based funding (PBF) is a method of determining an institution's appropriation by its attainment of key metrics, usually student outcomes. PBF has been used by some states and higher education systems to determine budget allocations, and the PBF model has gained popularity among legislators and private organizations. For example, the Lumina Foundation and the Bill & Melinda Gates Foundation have endorsed PBF as a means of improving the outcomes for U.S. higher education (McKeown-Moak, 2013; Tandberg, Hillman, & Barakat, 2014). Proponents of this type of funding model argue that the PBF system addresses the motivation for colleges and universities to operate more efficiently and focus on a fundamental economic mission to supply qualified individuals to the national workforce (Dougherty, Natow, Bork, Jones, & Vega, 2013; McLendon, Hearn, & Deaton, 2006).

Although there is support for PBF among education policy analysts and lawmakers, implementation of the funding practice has been uneven and with mixed results (Dougherty et al., 2013; Hillman, 2016). The financial and political positions of individual states, the wide variances in the numerous models, and pushback from some stakeholders at colleges and universities have impacted the adoption and effectiveness of PBF. As legislatures wrestle with spending at public institutions of higher education, educational leaders have expressed concern about how changes to the funding formulas, specifically the implementation of PBF, affect their historical missions and student success (Burke & Modarresi, 2001; Lahr, Dougherty, & Natow, 2014; McKinney & Hagedorn, 2015; Rabovsky, 2012).

Researchers have approached the study of the impact of PBF qualitatively and quantitatively. Hillman's 2016 review of 12 quantitative studies on the impact of PBF on colleges and universities between 1990 and 2012 found none of the plans used by the PBF states resulted in a statistically significant improvement in educational outcomes for students (Hillman, 2016). In both state-level and national studies, researchers found that retention rates, graduation rates, and levels of research funding were mostly unaffected by PBF. In the report, Hillman (2016) concluded, "Despite each state having goals related to improving college completions, their performance-based funding policies have not yet achieved the desired results" (p. 6).

Background

In 2016, higher education spending was the third largest expenditure of states' budgets (after elementary and secondary education and health care), and collectively states spent more than $207 billion on higher education in fiscal year 2017 (National Association of State Budget Officers [NASBO], 2017). Budgets for colleges and universities are comprised of a mix of revenue sources, and state and federal funding combine for the largest portion of the budgets of public institutions (Stauffer & Oliff, 2015). To determine the value of these allocations, most states use institutional census-based formulas that correlate with student participation (SRI, 2012). These formulas include factors such as enrollment, credit hours, and contact hours, and the more activity that institutions generate in these areas, the greater the potential allocation from the state to the college. Combined with the tuition and fees paid by students, the majority of institutional budgets are determined by inputs into the system, such as enrollment and courses, rather than outcomes such as graduation and job placement.

Performance-based funding reverses this traditional, enrollment-based allocation method for higher education, and instead of determining appropriations based on inputs, relies on outcome measurements. Burke and Modarresi (2001) identified three distinct approaches that legislatures employ to tie postsecondary education outcomes to fiscal allocation: performance funding, performance budgeting, and performance reporting. Performance funding links state allocation to specific institutional metrics, while performance budgeting directs lawmakers and higher education agencies to consider an institution's performance during budget development. The third approach, performance reporting, mandates regular assessment of institutions on state-established metrics, but this approach does not directly link allocation to metrics. Increasingly, states are turning to performance-based funding in an effort to design funding that incentivizes institutions to improve student outcomes (D'Amico, Friedel, Katsinas, & Thornton, 2014; Hermes, 2012; Tandberg et al., 2014).

Advocates for performance-based funding have promoted this allocation methodology as a means to align public dollars with the public interest, giving institutions the monetary incentive to align their operations to yield higher returns on the state's investment. The Bill and Melinda Gates Foundation and the Lumina Foundation include PBF as public policy initiatives in their work, as do Achieving the Dream and Jobs for the Future. The U.S. Department of Education has challenged states to adopt PBF "based on progress toward completion and other quality goals" (U.S. Department of Education, 2011, p. 10), and President Obama included the initiative as part of his higher education strategy (U.S. Office of the President, 2013).

Performance-based funding in the United States (U.S.) began in 1979 when institutional leaders and Tennessee's higher education agency developed a pilot program to allocate a portion of state funding based on institutional metrics. Other states followed suit and developed their own PBF formulas to determine portions of the allocations given to colleges and universities. Through direct legislation or higher education agency policy, 26 states were operating with some form of PBF by 2007 (Hermes, 2012). These early versions of PBF provided incentive funding to institutions that met or exceeded performance targets, allowing colleges and universities to grow their yearly budgets by focusing on predetermined metrics. Referred to as PBF 1.0, the incentive funding formulas allocated additional monies to institutions but did not jeopardize significant baseline funds (Dougherty et al., 2016; Lahr et al., 2014). However, many of these funding formulas were discontinued by state legislatures in the mid-2000s because of lack of institutional support, political changes, or economic shortfalls (Dougherty, Natow, & Vega, 2012).

During the economic recession of the late 2000s, state legislatures began reintroducing performance metrics as a means of determining fiscal allocations. Unlike the bonus funding provided through the early versions, PBF 2.0 required that institutions meet established performance goals to receive full allocations. These newer performance-based funding formulas included more intermediate metrics than early designs, and though the percentages of institutional budgets allocated by this method varied widely among states, institutions did risk shrinking budgets if they failed to meet the metrics. By 2015, 32 states had implemented some form of PBF for public higher education, and several other states were planning to begin performance funding within the next few years (National Conference of State Legislatures [NCSL], 2015).

As a public policy instrument, performance-based funding serves as more than just an alternative to census-based enrollment allocation methods. Legislatures have implemented PBF with the goal of improving the outcomes such as graduation and placement (Dougherty, Jones, Lahr, Natow, Pheatt, & Reddy, 2016b). Therefore, researchers have examined the impact of some PBF formulas around the country on their target measures. Early quantitative studies of universities on PBF 1.0 revealed no short-term impact on graduation rates or research funding, and the results were similar when researchers considered the formulas over a longer period of time (Hillman, 2016). The studies reviewed by Hillman also found unintended changes in institutional behaviors when universities operated under PBF 2.0, such has more selective admissions criteria and less federal aid. Research on PBF at two-year colleges revealed mixed results as some institutions increased their production of short, workforce-oriented certificates, but no overall gains in associate degree graduates (Hillman, 2016).

Researchers have also evaluated the implementation and persistence of performance funding as a public policy instrument through qualitative studies. After some states discontinued the use of PBF 1.0, studies such as those conducted by Burke and Modarresi (2001) and Harbour and Nagy (2006) reviewed the experiences of lawmakers and higher education leaders. Among their findings, they observed a lack of support and collaboration by college leaders negatively affected the institutions' adoption of PBF and corresponding organizational changes. Administrators were also concerned that objectives set in performance funding policies at the state level ran contrary to their colleges' missions and regional needs. Changing political climates and priorities also undermined the longevity needed for performance funding to affect institutional outcomes. Finally, because the budget amounts at stake in most PBF formulas were a small percentage of an institution's total budget, colleges and universities were not motivated to fully embrace the policies and make functional adjustments to achieve the target metrics.

Texas implemented two versions of PBF in 2013 when the 83rd Texas Legislature established separate formulas for its community colleges and the state's workforce education institution, Texas State Technical College (TSTC). Prior to this new policy, all public two-year colleges received their state allocation based on contact hours. TSTC is a regionally accredited, public institution of 10 campuses serving about 14,000 students statewide, and it shares many of the characteristics of a traditional community college, including open enrollment, general academics, and developmental education. TSTC offers Associate of Science degrees (AS), Associate of Applied Science (AAS) degrees, and Certificates of Completion, and the instructional programs are categorized into academic divisions in accordance with targeted industry sectors. Instructional programs are organized into divisions which include Academics; Allied Health; Business and Professions; Computer and Information Technology; Engineering and Electronics; Environmental, Safety, and Natural Resources; Industrial and Manufacturing; and Transportation.

In the development of TSTC's performance funding formula, the Texas state legislature addressed the shortcomings of PBF identified by research on other states. Lawmakers began discussing PBF for public higher education in Texas in 2008 and directed the Texas Higher Education Coordinating Board (THECB) to collaborate with the Comptroller's Office to conduct a feasibility study of PBF for TSTC. After a favorable review from the Comptroller's Office, the 82nd Legislature in 2011 directed the THECB to finalize the formula with TSTC and other relevant state agencies for implementation in 2013 (THECB, 2013). This cooperation among state agencies for six years prior to the change in the allocation formula resulted in broad consensus among all stakeholders, including college leadership, concerning the methodology and metrics of the formula. In consideration of TSTC's statewide economic development mission, the legislature established a PBF formula for the institution based on the earnings of its students after they leave the college, and the formula applies 100% of its state allocation. Referred to as the Returned Value Funding Model, the formula uses enrollment data from the college as reported to the Texas Higher Education Coordinating Board and cross-references TSTC students with unemployment insurance data collected by the Texas Workforce Commission (THECB, 2013). After students who complete at least one semester leave the college, their wages in Texas are tracked for five years, and a percentage of the difference between their earnings and minimum wages is returned to TSTC in the form of legislative appropriations. Dual credit students are not included in the formula. For fiscal year 2016, TSTC's appropriation was $93.9 million (H.B. 1, 2015).

Problem Statement

Researchers have identified lack of support from higher education leaders, conflict with institutional mission, and inadequate funding as causes of failure in state PBF policies (Dougherty, et al., 2011; Rabovsky, 2014). The development and implementation of the Returned Value Funding Model for TSTC addressed these shortcomings of previous PBF designs, but there are no studies found by this researcher that explore the impact of this type of PBF formula on students. Because the Returned Value Funding Model incorporated recommendations from prior research into a new formula, TSTC provided an opportunity to explore the effects of this PBF model. While previous studies indicated little or no improvement in institutional performance under PBF, it was not known if student completion rates at TSTC were affected by operational changes at the college that may have occurred in response to the change in funding formula.

Purpose Statement

The purpose of this study was to examine the effect of performance-based funding on graduation rates at TSTC. The study focused on the extent to which the implementation of the Returned Value Funding Model affects graduation rates overall and by academic divisions at Texas State Technical College.

Research Questions

The study was guided by the following research questions:

1. To what extent is there a statistically significant difference in the overall graduation rate at Texas State Technical College after the implementation of the Returned Value Fund Model when compared to the graduation rate prior to the implementation of the performance-based funding?
2. To what extent is there a statistically significant difference in graduation rate by academic divisions after the implementation of the Returned Value Funding Model when compared to the graduation rate prior to performance-based funding?

The study examined the effect of PBF on graduation rates at TSTC; specifically, the study focused on the extent to which the implementation of performance-based funding affected graduation rates overall and by academic divisions at TSTC. In addition to disaggregation by academic divisions, the findings were further evaluated through a comparative interrupted time series study.

Professional Significance of the Topic

Since the expansion of PBF in the early 2000s, researchers have studied PBF, but the majority of these evaluations were qualitative and focused on the implementation of or reasons for the discontinuation of PBF 1.0. The previous quantitative studies on performance funding in the U.S. showed little or no improvement in graduation rates or retention rates at institutions operating under PBF. In the recommendations of these prior studies, scholars suggested that the performance of colleges and universities funded by PBF may improve if the amount of funding at stake was sufficient to motivate organizational change (Cavanaugh & Garland, 2012; Shin, 2010). Research on the TSTC Returned Value Funding Model adds to the professional literature because it examines a PBF formula that informs 100% of the state allocation for the college.

Hillman (2016) reported only two quantitative studies that specifically evaluated the impact of PBF on two-year colleges. The largest of these studies covered a 20-year period of PBF in 19 states, including Texas, and it found little evidence of overall improvement in student outcomes (Tandberg et al., 2014). However, the researchers did not consider the Returned Value Funding Model at TSTC, which was implemented after the data used in the study. Further, the study did not include all graduates, but instead focused only on Associates degrees while excluding workforce certificates (Tandberg et al., 2014). Therefore, this evaluation of the TSTC model filled a gap in the existing literature by examining the impact of this new PBF formula on two-year college programs which are focused on workforce preparation.

Prior studies also recommended PBF models should be developed in consideration of colleges' missions in their respective states and communities (Tandberg et al, 2014), accounting for variations in institutional purpose with adjustments to metrics. In development of the TSTC Returned Value Funding Model, policy makers intentionally aligned the institutional mission of economic development with funding formula goal of increased wages for TSTC students. The first-year earnings for TSTC students were highest among technical program graduates, creating an incentive for TSTC to improve graduation rates. This study may inform future efforts in PBF development at other two-year colleges to align performance targets with the missions of institutions in order achieve successful student outcomes. Previously published studies of performance funding evaluated the effects of PBF at the state level, but not at individual institutions (Hillman, Tandberg, & Gross, 2014; Rabovsky, 2012; Volkwein & Tandberg, 2007). By examining the impact on graduation rates for the college and among program areas at TSTC, this research identified technical education disciplines more affected by PBF than others. This information is useful for higher education leaders and policy makers to design more effective funding formulas that account for differences among industry sectors.

Finally, the study also established a baseline for ongoing evaluation of the effectiveness of the formula for TSTC. College leaders have expressed interest in continuous examination of the Returned Value Funding Model in order to provide data-driven feedback to legislators on its impact, and this study may provide information that may be useful for future refinement of the model.

Overview of the Methodology

The current study was a quasi-experimental, quantitative study, using two statistical tests to compare graduation rates before and after the implementation of PBF in 2013. All data used in this study were collected by TSTC and maintained in its student data system, including demographic and academic information. The data were cross-referenced with the publicly available data from the Texas Higher Education Coordinating Board for verification.

TSTC's annual fall enrollment remained steady between 9,000 and 12,000 students from 2000 and 2015, with the exception of a spike from 2008 through 2011. The spike in enrollment during those years may have been caused by federal spending on education through the American Recovery and Reinvestment Act of 2009 or the reauthorization of the Higher Education Opportunity Act in 2008, which included a year-round Pell Grant provision. While the causes of the enrollment increase during those years are beyond the scope of this study, the growth represents an anomaly in TSTC's enrollment trend. Therefore, the current study used a matched sample of students who enrolled in 2005 and a sample from 2009 for comparison to a matched sample of students who enrolled in 2013.

The final samples were matched using the following student demographics:

1. full- or part-time student status,
2. gender,
3. academically disadvantaged,
4. economically disadvantaged, and
5. academic division.

To evaluate the impact of PBF in program discipline areas, the study divided the programs into academic divisions based on discipline area. In 1980, the U.S. Department of Education (USDOE) established the Classification of Instructional Programs (CIP) taxonomy to categorize academic fields of study, and this structure allows for consistent tracking and reporting of student and institutional data (National Center for Education Statistics [NCES], 2017). TSTC's technical programs fit into 11 of the 49 CIP codes. TSTC further organizes its programs into academic divisions of related programs to promote operational efficiencies and provide a consistent management structure. Over the length of this study, changes in curriculum and program focus areas resulted in revisions to the college catalog, and some programs were eliminated, other programs were significantly altered, and new programs were introduced. However, the program emphases of the academic divisions remained consistent and provided an appropriate framework to evaluate the impact of PBF on student graduation in specific academic program areas. It is beyond the scope of this study to examine the effects of PBF on individual programs offered at TSTC. The list of seven academic divisions and related programs that were evaluated in this study is presented in Appendix A, though the common program names are listed and may not reflect the exact program name for each year of the study. For the purposes of this study, students enrolled in a program altered during the timeframe of the study were matched with students in the corresponding program sharing substantively the same learning outcomes.

Statistical methods. After establishing the matched pairs of new students in Fall 2005 to new students in Fall 2013 and new students in Fall 2008 to new students in Fall 2013, the graduation rates of the samples were evaluated by a two-tailed *z* test between the two proportions. Previous quantitative research on the impact of PBF on graduation rates indicated no statistically significant increase in the graduates at institutions after PBF (Rutherford & Rabovsky, 2014; Sanford & Hunter, 2011; Shin, 2010; Shin & Milton, 2004; Umbricht, Fernandez, & Ortagus, 2015; Volkwein & Tandberg, 2007). Therefore, the null hypothesis for this study proposed no statistical difference in graduation rates between students at TSTC before the implementation of PBF and after PBF began. The *z* tests were conducted for the matched samples as a whole and also for each sub-sample of academic division to examine the statistical significance of the differences between graduation rates in program areas.

Additionally, an interrupted time series design was employed to evaluate the impact of the application of PBF in 2013 on the institution as a whole and on academic divisions.

Frequently used in public policy research, interrupted time series analysis was appropriate because of the non-experimental nature of this study, and it accommodated multiple data points collected both before and after the implementation of PBF. The data were further disaggregated by academic divisions.

Delimitations

The current study was confined to the Returned Value Funding Model at TSTC. Though Texas uses a performance-based funding formula to determine some of the appropriations to its community colleges, the allocation method for TSTC is distinct. The college is the only statewide technical college in Texas, and its legislative mission includes contribution to the economic development of the state (Texas Education Code §135, 2017). In light of this charge, the 83rd Texas Legislature implemented a performance-based funding formula that reflected TSTC's impact on the economy through graduates' wages. This study did not consider the graduation rates of TSTC students as compared to area community colleges or other state technical colleges nationwide.

The research also excluded two groups of certificate graduates from TSTC. Advanced Technical Certificates and Enhanced Skills Certificates are awards approved by the THECB but not considered degrees or Certificates of Completion. Advanced Technical Certificates require an associate's or bachelor's degree as a prerequisite, must be clearly related to the prerequisite degree, and must be relevant to industry or external agency requirements. Similarly, Enhanced Skills Certificates consist of optional courses identified by industry, and they are awarded concurrently with the related AAS (THECB, 2015a). The TSTC campuses did not consistently incorporate these awards into their curricula, and after changes in financial aid eligibility for the certificates, less than 10 students completed Advanced Technical Certificates or Enhanced Skills Certificates at TSTC between 2005 and 2013.

Dual credit students at TSTC are high school students taking TSTC courses for which the participating school districts also give high school credit. Because of the low matriculation rate of dual credit students to TSTC after completing high school, the THECB and TSTC leadership agreed that these students should not be included in the Returned Value Funding Model. Therefore, dual credit students were not included in this study.

Finally, the study did not include students completing the Academic Core and AS degrees. The TSTC campus in Harlingen, Texas is more than 30 miles from the nearest community college, and that location is exclusively authorized to offer the Core and AS degrees in support of the area need for transferrable academic awards (Texas Education Code §135, 2017). These awards were not incorporated in the study because neither of the awards were designed for immediate economic impact, and they were not offered at the other nine TSTC campuses.

Definition of Key Terms

The following key terms were used in this study:

Academically disadvantaged student: a student who, based on state- or locally-approved placement tests, did not have college entry level skills in reading, writing, or mathematics. This definition also applied to students who did not receive a high school diploma nor a GED certificate (THECB, 2016d).

Academic divisions: administratively determined classifications of instructional programs by subject area or Classification of Instructional Programs code (NCES, 2017).

Cohort: a group of students who declared a given major in the same term

*Economically disadvantaged studen*t: a student who meets one of the following criteria:

- Annual income at or below the federal poverty line,
- Eligible for Pell Grant or comparable need-based educational assistance,
- Eligible for job training programs included under Title II of the U.S. Department of Labor Job Training Partnership Act,
- Eligible for public assistance programs such as the Women, Infants, and Children and Families with Dependent Children programs, or
- Eligible for assistance under the Food Stamp Act of 1977 or the Health and Human Services Poverty Guidelines (THECB, 2016d).

Full-time student: a student enrolled in at least 12 credit hours per semester.

Gender: a student who self-reported as male or female (THECB, 2016d).

Graduate: a student who completed his or her declared program of study in 150% of normal time or less (NCES, 2016).

Graduation rate: the total number of completers in a sample divided by the total number of students in the sample (NCES, 2016).

Part-time student: a student enrolled in less than 12 credit hours per semester

Performance-based funding: a method of determining an institution's fiscal appropriation by its attainment of key metrics, usually student outcomes.

Returned Value Funding Model: the performance-based funding formula established by the Texas legislature in 2013 for Texas State Technical College (THECB, 2013).

Summary

With 32 states actively linking budget allocation to performance metrics, PBF is no longer considered a novel approach to public funding of higher education. This method of incentive funding is designed to motivate institutions to organizationally focus on successful outcomes for students, and the model has received broad public policy support. However, research on PBF indicates that institutions publicly funded based on performance metrics have not statistically improved graduation rates. The Returned Value PBF design for TSTC presented an opportunity to evaluate a new type of performance formula that was developed with college leaders, accounted for all of its state funding, and was aligned with its institutional mission. Further, this study examined the impact on graduation rates for the college as a whole, as well as academic divisions, adding to the professional significance of the proposed study. The following chapters present a review of the relevant literature on the policy implementations and performance of PBF in the U.S. and an explanation of the methodology of the proposed study.

Chapter 2

Literature Review

Performance-based funding (PBF) in higher education is not new, but it is a significant departure from the historical method of state funding to colleges and universities. PBF models gained popularity in the early 2000s, spurred by public calls for greater accountability and shrinking government allocations, and this led to studies and reviews by higher education researchers and public policy groups (Alexander, 2000; Burke, Minassians, & Nelson, 2003). The changes to existing education financing methods, planned expansion of PBF to additional states, and increased promotion of PBF models by private advocacy groups have led to an increase of available literature to examine the historical and current contexts for PBF, as well as its impact at public colleges and universities.

Purpose of the Literature Review

This literature review presents information related to public funding of higher education, primarily in the U.S., and it provides context for the study of the impact of PBF at Texas State Technical College. The review includes methods and trends for public funding of two-year colleges, the theoretical foundations for PBF, the implementation of PBF, and an examination of select qualitative and quantitative studies of the impact of PBF on colleges and universities. Figure 1 illustrates the sequence and focus of the literature review.

Method of the Literature Review

The researcher examined selected journal, magazine, and periodical articles identified by queries in electronic library databases, such as EBSCO, Wiley Online, and the Education Resources Information Center (ERIC). Search terms included performance-based funding, community college funding, and performance-based funding in higher education. Additionally, the review of literature identified relevant information in published qualitative and quantitative studies and applicable statistical data published by states and policy groups. Finally, the review included examination of relevant books on recent community college innovation, community college finance, and performance funding for higher education.

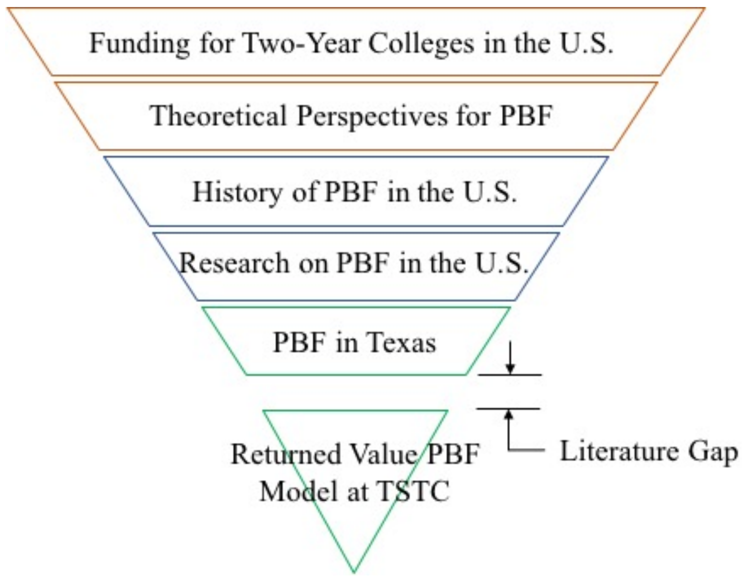


Figure 1. Literature review topic funnel diagram.

Overview of Funding of Public Two-Year Colleges

The 1947 Truman Report marked a turning point in the role of the two-year college in American higher education, promoting the establishment of community colleges that prepared students for the workforce or transfer to university (Gilbert & Heller, 2013). Though there were approximately equal numbers of private and public two-year colleges in the 1950s, the role of the community college as a public entity expanded greatly from 1960 to 1980. By 2010, more than 91% of community colleges in the United States were public (Mullin, Baime, & Honeyman, 2015). The enrollment in community colleges grew rapidly during the same time period, and more than 12 million students were enrolled in community colleges in 2014 (American Association of Community Colleges [AACC], 2016). Community colleges receive funding from three primary sources: state appropriations, local revenue, and student tuition and fees, which includes financial aid awarded to students, such as Pell Grants. State appropriations include monies allocated by the state directly to institutions through legislative or agency formulas; local revenue is determined by local taxes or contributions, usually tied to property values.

State appropriations. All 50 states allocate a portion of revenue to its public colleges and universities, though amounts vary (Mullin et al., 2015). Public funding for higher education in the U.S. is a discretionary expense, not required by the federal or state governments, and Zumeta (1995) asserted that because it is discretionary, public funding for colleges and universities often functions as a budget balancer. When states experience a budget shortfall, public higher education funding is among the first areas cut by legislators in order to fund other priorities, and Delaney and Doyle (2011) suggested college and university budgets were targeted because institutions can raise revenue from tuition and fees.

In 2015, a total of $80.9 billion was allocated by states for higher education (Illinois State, 2015), and in competition with four-year institutions, two-year colleges received between 10% and 20% of state revenue allocated for higher education (Mullin, 2010; National Association of Budget Officers, 2014). The National Center for Education Statistics (NCES) reported that state appropriations totaled about 23% of all community college revenue in 2011-2012 (as cited in Mullin et al., 2015, p. 47), though the percentage of an institution's total budget made up by appropriations varies from state to state. These state funds are historically linked to the student population, either by student enrollment or contact hours.

Local taxing districts. In addition to state legislative allocations, 25 states, including Texas, authorize taxing and service districts to provide revenue and define operational boundaries for community colleges. These taxing districts are also used for matters of governance, such as determining eligible board members. The financing provided by these local communities, usually in the form of assessed property taxes, may support facilities, equipment, or other infrastructure needs, and through the local board, taxpayers can exercise influence on their investments. For fiscal year 2012, local taxes comprised 17% of all community college revenues (Mullin, et al., 2015).

Tuition and fees. The largest source of revenue for community colleges is based on the tuition and fees that institutions charge to students for courses. Though tuition and fee rates vary by institution and by state, the national average annual tuition and fees for community colleges in 2015-2016 was $3,430 (AACC, 2016). Students remit payment to the institution directly or, in the case of some students, use federal financial aid such as Pell Grant or federal loans. In 2011-2012, approximately 57% of community college students received federal grants or loans to fund their education (Juszkiewicz, 2014). For the purposes of this literature review, the category of tuition and fees includes revenues received directly from students and federal non-operating grants, the NCES classification for the Pell Grant. These two sources combined to make up 38% of community college revenues in 2011-2012 (Mullin et al., 2015).

State appropriations, local property taxes, and tuition and fees, including Pell Grant, comprise approximately 78% of the $58.4 billion of community college revenues in 2011-2012 (AACC, 2016). The remaining balance of revenue comes from a combination of federal, state, and local grants, contracts, and fundraising.

Theoretical Perspectives for Performance-Based Funding

Advocates for performance-based funding policies promoted this method of funding as a way of creating business-like financial incentives for educational institutions to operate more efficiently and focused. Dougherty, Jones, Lahr, Natow, Pheatt, and Reddy (2016b) linked this "financial-incentives theory of action" (Chapter 1, Section 5, para. 2) to two theoretical perspectives: the principle-agent theory and resource dependency theory. These conceptual frameworks describe the underpinnings for most performance funding formulas in the United States.

Principle-agent theory. Principle-agent theory centers on economic investment by one party, the principle, into the activities of another, the agent; and it focuses on measures implemented by the principle to manage the behavior of its contracted agent (Dougherty et al., 2011; Hillman, Tandberg, & Gross, 2014; Lahr et al., 2014). States spend more than 10% of their discretionary budgets on higher education on average, and public colleges and universities rely heavily on state appropriations for continued operations NASBO, 2014). Governments contract with colleges and universities to provide the social service of public higher education, and these institutions act as agents for the state (McLendon et al., 2006; Nisar, 2015). In the case of PBF, states that provide public financing to an institution may set clear goals that are in the investor's interest and are measurable in objective ways. If the institution meets those goals, it receives funding from the state (Hillman et al., 2014). While colleges and universities may comply with the legislated standards to receive their fiscal allocation, they also have their own priorities, in addition to the legislative metrics. Therefore, the principle should provide the oversight and consequences, if necessary, to ensure the agent fulfills the implicit or explicit contract (Lahr et al., 2014). Lahr, Dougherty, and Natow (2014) suggested the principle agent theory applied to higher education through PBF is political science in nature, which "allows for multiple principles (such as different regulatory agencies) and even agents" (p. 6). Even when the performance metrics do not explicitly direct operational activities, the existence of the standards may be seen as means of control over an organization (Lewis, 2015). The principle-agent relationship between state government and public higher education institutions, though not strictly contractual, provides the conceptual framework that compels institutions to operate by their state's legislative mandates.

Resource dependency theory. The second theoretical framework for PBF is resource dependency theory. This theory posits that an institution must regularly participate with other organizations within its environment to secure resources and operate effectively (Hillman, Withers, & Collins, 2009; McKinley & Mone, 2003; Pfeffer & Salancik, 2003). This theory may be applied because public colleges rely on cooperative relationships with other entities, such as secondary school districts, state higher education agencies, accreditors, and federal government agencies, for their ongoing success (Jaquette, 2006). In the case of PBF, colleges and universities are dependent on state appropriations, and therefore college leaders will make operational adjustments, implement strategies, and make required changes to preserve or increase their institution's funding from the state (Nisar, 2015). When state legislatures enact PBF for higher education agencies, colleges are expected to respond by implementing strategies designed to align the institution's performance to the funded metrics (Rabovsky, 2012). According to resource dependency theory, more significant and meaningful institutional behavior changes will take place when more resources are at stake (Nisar, 2015).

History of Performance-Based Funding in the United States

PBF policies grew in popularity during the 2000s as state legislatures shifted their focus to institutional outcomes rather than organizational management, but it is not a new practice in the U.S. (McLendon & Hearn, 2013). In 1979, college and university leaders in Tennessee worked directly with the state's higher education agency to implement the nation's first PBF formula and piloted it among some Tennessee institutions. Though it was not a direct result of legislation, the policy development was supported by federal grants and private foundations, and the initial model informed future policy decisions in the state to expand PBF (Dougherty et al., 2011).

Performance-based funding 1.0. Connecticut and other states soon developed their own programs to provide funding to institutions of higher education based on student outcomes, and by 2007, 26 states had passed legislation or higher education policies to fund PBF programs for at least some of their colleges and universities (Hermes, 2012). These initial formula designs, also referred to as PBF 1.0, provided incentive monies to colleges and universities if performance targets were met, allowing institutions to increase their budgets over their baseline funding allocations (Dougherty et al., 2016b; Lahr et al., 2014). PBF 1.0 formulas focused primarily on key performance measures such as retention or developmental education completion and financial rewarded institutional improvements in those areas. (D'Amico et al., 2014; Dougherty, et al., 2016b; Dougherty, Jones, & Natow, 2014: Dougherty & Reddy, 2011; Dougherty & Reddy, 2013; Hermes, 2012).

Researchers at the State University of New York conducted several studies on PBF 1.0 and collected data about states' adoption of various performance funding systems (Burke & Minassians, 2004; Burke, Minassians, & Nelson, 2003). Among their findings, Burke and his colleagues observed "the shift away from performance funding to the less costly and less controversial option of performance reporting" as the formulas were discontinued (Mullin, 2014, p. 116). Because PBF 1.0 formulas offered additional monies to colleges and universities when targets were met, these policies were subject to shrinking state revenues or shifting political priorities (Dougherty et al., 2011). Shulock (2011) proposed four reasons for the discontinuation of PBF 1.0:

1. the policies affected a small percentage of institutional budgets;
2. the policies were not aligned with the colleges' missions;
3. the policies set unreasonable targets; and
4. the policies were set up as pilot programs, putting them at risk for ongoing funding.

In a review of 60 studies of eight states using PBF 1.0 and national completion data, researchers found these policies influenced organizational planning and strategy, but they did not find "firm enough evidence that performance funding significantly increases rates of remedial completion, retention, and graduation" (Dougherty & Reddy, 2013, p. 79).

Performance-based funding 2.0. Concurrent with the economic downturn 2007-2008, a second generation of performance funding emerged. These formulas eliminated bonus or additional funding when institutions achieved or exceeded their performance goals and instead required institutions to meet their targets in order to receive full base funding from the legislature (D'Amico et al., 2014; Dougherty et al., 2014; Dougherty et al., 2016b; McLendon & Hearn, 2013; Tandberg et al., 2014). In addition to changing from a bonus to a base funding formula, this new iteration, or PBF 2.0, was also distinct from early performance funding models as it placed greater emphasis on the economic impact of degree production and skill attainment (McLendon & Hearn, 2013). PBF 2.0 policies improved the design process of performance funding by including a broader range of stakeholders to promote alignment between fiscal priorities and the states' educational goals (Friedel, Thornton, D'Amico, & Katsinas, 2013). Dougherty and Reddy (2011) also observed that PBF 2.0 included more metrics related to intermediate achievement, such as "successful completion of developmental education courses or programs; passage of key gateway courses … and reaching certain credit thresholds such as 15 or 30 credits" (p. 6). PBF 2.0 formulas also committed greater percentages of state higher education budgets to the achievement of designated metrics than PBF 1.0 formulas (Mullin et al., 2015). Massachusetts and Ohio, for example, both allocate 50% of their state's funding to community colleges based on student outcomes (NCSL, 2015).

Implementation of Performance-Based Funding

By 2015, 32 states employed some type of PBF using metrics such as degree completion, transfer rate, and time to degree, and five other states were in various stages of transition to performance formulas (NCSL, 2015). McLendon, Hearn, and Deaton (2006) concluded "legislative party strength and higher-education governance arrangement" (p. 11) were the most significant characteristics of states that adopt PBF. Despite broad implementation of PBF, the systems employed by states are inconsistent, as each state operates with different metrics and various funding levels (NCLS, 2015). Within states, adjustments to formulas and metrics challenge higher education leaders to strategically achieve PBF goals. Dougherty and Natow (2009) observed, "states that have enacted performance funding have often and sometimes substantially changed the amount of funding they devote to it and the criteria by which they award that funding" (p. 1).

Bailey, Jaggars, and Jenkins (2015) asserted that the recent national emphasis on performance funding was prompted by at least several factors. First, after the passage of the Student Right-To-Know Act (1990), the public could evaluate the low graduation rates at public community colleges through federally-required disclosure on college websites. Additionally, college completion became increasingly viewed as the path to economic stability after the downturn in 2008-2009. Finally, Bailey et al. (2015) posited that because the price of higher education has risen much faster than other goods and services, there has been increased scrutiny of college tuition costs, which has stimulated the discussion on PBF.

Research on Implementation of Performance-Based Funding

PBF has encountered some resistance by colleges and universities, and not all higher education administrators have embraced this allocation method. Studies related to states' adoption of PBF have noted that many college and university leaders often oppose PBF, and their resistance contributed to changes in state policy that reversed PBF (Dougherty, Natow, & Vega, 2012; Dougherty & Reddy, 2013). Rabovsky (2014) found administrators generally supported the use of performance metrics for institutional planning and internal budget, but they opposed using PBF as a means of funding allocation. Institutional leaders explained their resistance was "not because they are opposed to performance management in principle, but rather because they perceive the policies as ineffective and perhaps harmful" (Rabovsky, 2014, p. 771). Higher education administrators have also expressed concerns over the types of the measures used and the impact of these policies on their institutions (Fryar, Rabovsky, & Moynihan, 2012; Huisman & Currie, 2004), and leaders doubted the link between state performance measures and the instructional mission (Harbour & Nagy, 2006). Additional research found that opposition within the ranks of higher education institutions was instrumental in the discontinuation of PBF in some states (Burke & Modarresi, 2001; Dougherty et al., 2012).

The research presented by Fryar et al. (2012) revealed a wide variety of opinions about the value of PBF among leaders at four-year universities in Texas. While some presidents and chancellors interviewed for the study appreciated the role of the state legislatures in determining the metrics of the PBF formula, they did not believe the policy would lead to improved graduation rates. Further, administrators expected little or no improvement in their institution's finances as a result of PBF. To improve the likelihood of successfully implementing performance funding, the authors asserted that legislatures should support a diversity of measures and sustain a long-term commitment to gain administrators' buy-in (p. 27). Nisar (2015) used the term "neo-institutionalism" (p. 295) to describe the interaction of individuals and organizations in response to proposed institutional change, and he posited that internal organizational contexts, such as a college culture or faculty perspectives, play a significant role in the adoption of PBF as public policy. In order to implement organizational changes intended to change institutional behaviors, such as performance funding, Nisar (2015) stated these policies "must be devised in consultation with such institutions" (p. 295).

Burke and Minassians (2004) collected information on the types of performance metrics used by legislatures and agencies to review institutional performance. Community colleges under PBF were most often required to report on enrollment, retention, transfer, and graduation rates, indicating, according to the research methodology, an emphasis on efficiency over quality. More importantly, researchers found that campus leaders primarily responsible for those performance metrics were unaware or uniformed about the reporting, and they proposed this lack of information may result in lack of improvement on the designated metrics (Burke & Minassians, 2004).

Some states have reversed course and abandoned PBF in part or totally. Dougherty, Natow, and Vega (2012) found half of the states that adopted performance funding policies between 1979 and 2010 "later dropped or suspended their performance funding systems" (p. 3). Researchers have examined the causes of the failure of PBF in those states and identified several factors. Burke and Modarresi (2001), studied Florida, Ohio, and South Carolina, and they observed that opposition from campus administrators, lack of interest from business leaders, and insufficient time for planning and implementation of PBF doomed the policies in those states. Dougherty, Natow, and Vega (2012) followed this study, confirming Burke and Modarresi's

(2001) report, and added state budget shortages and political turnover as key factors in states' decisions to abandon PBF. Additional subsequent studies in Illinois, Indiana, Missouri, and Washington confirmed these findings (Dougherty et al., 2011; Lahr et al., 2014). Sanford and Hunter (2011) suggested that the low percentage of higher education funding coming from states that were committed to PBF contributed to the policy's failure in those states. In a recent investigation of institutional responses to PBF, researchers found that college leaders were reactive to changes that may impact funding, and faculty and other managers understood how their work influenced the budget through PBF (Dougherty, Jones, Lahr, Natow, Pheatt, & Reddy, 2016a). However, administrators also reported that their strategic goals are driven by other stakeholders and initiatives, not just PBF.

PBF policies that target outcome measures without consideration for at-risk populations may adversely impact minority students, and this population was more likely to attend community colleges than other public higher education institutions (Baime & Baum, 2016; Jones, 2014). Researchers identified this risk early in PBF 1.0, and some states addressed it by including minority or at-risk metrics in their policies (Dougherty et al., 2010; Miao, 2012; Rabovsky, 2012). However, Texas, among other states, did not apply a factor or measurement for at-risk students, and researchers found this population generated the least amount of funding from the community college PBF model, possibly reducing the incentive for colleges to serve at-risk students (McKinney & Hagedorn, 2015). Jones (2014) urged caution for lawmakers seeking to implement PBF at minority-serving institutions, noting that these colleges may need different metrics than other public colleges and improvements in data collection tools in order to perform comparably to predominately white institutions.

Researchers also examined the role of state politics in PBF implementation. During the development period of many PBF 1.0 policies, Republican-led state governments were more likely to cut or restrict the growth of higher education funding (Delaney & Doyle, 2011), and researchers found that the probability of a state's adoption of PBF was positively correlated to the proportion of Republicans in its legislature (Kelchen & Stedrak, 2016; Li, 2017; McLendon et al., 2006). For example, the Republican majority in the state legislature was responsible for establishing PBF in Washington State in 1997, but the formula was abandoned after Democrats gained seats in the legislature the following year (Dougherty et al., 2010; Dougherty et al., 2012). Li (2017) examined the adoption of PBF by state legislatures and reported a positive correlation between PBF policies and rapid growth in unemployment. Further, non-PBF states adjacent to states with performance funding delayed adoption of PBF until the policy effects could be determined, a phenomenon Li (2017) referred to as "reverse policy diffusion" (p. 1).

Blankenberger and Phillips (2016) examined the development of PBF in Illinois, which implemented the policy as part of the state's higher education completion agenda. Illinois used a PBF 1.0 model from 1999 through 2002, but it allocated less than 0.5% of community colleges' budgets and was abandoned due to the state's fiscal crisis (Dougherty et al., 2011). Studying the process through the lens of politics and the public budgeting process, the researchers found the movement back to outcomes-based budgeting was influenced by the state's ongoing financial deficits. However, Illinois was successful in implementing PBF 2.0 by including a broad range of stakeholders in the development process, including elected officials, business leaders, higher education board members, faculty, and college administrators (Blankenberger & Phillips, 2016).

In a review of PBF research, Friedel et al. (2013) did identify some positive outcomes from the policy implementation. Within the institutions studied, there was greater awareness of the connections among goals, the states' agendas, and the colleges' outcomes, and they observed that administrators and leaders used organizational data more frequently for planning and making decisions (p. 9). Mullin (2014) noted the highest value of PBF was the input the policies gave to external stakeholders over institutional operations. To improve the implementation of PBF among colleges, researchers recommended that states should invest in the technology and research capacities of community colleges to more effectively monitor institutional performance on the target metrics (Jones, Dougherty, Lahr, Natow, Pheatt, & Reddy, 2015). Further, they suggested that college leaders should collaborate in "communities of practice" (p. 32) to identify and discuss best practices among similar institutions adopting PBF. Jenkins, Ellwein, and Boswell (2009) recommended that states adopt a "learning year" (p. 7) or progressively adopted to help institutions adapt operations to the new policies.

Research on Impact of Performance-Based Funding

While researchers have explored the development and implementation of PBF, few studies have examined the impact of PBF on institutions and students. States do not use a single formula or common metric, making comparison among PBF states difficult and imprecise (Ewell & Jones, 2006; Hillman, Tandberg, & Fryar, 2015; Tandberg, 2008; Thornton & Friedel, 2016). In their study of performance funding on Pennsylvania colleges and universities, Hillman, Tandberg, and Gross (2014) acknowledged the limitations of evaluating student success data among PBF states. In one of the early studies focused on PBF, Shin and Milton (2004) examined graduation rates for First Time in College (FTIC) students in Tennessee, a performance metric tied to funding of the state's universities. Their study found the same rate of increase in graduation among FTIC students in non-PBF states as occurred in Tennessee. A second study by Shin in 2010 found that regardless of the higher education governance system, or the length of time the policy had been in place, PBF "did not bring changes in institutional performance" (Shin, 2010, p. 63). Additional study of Tennessee's funding model concluded the system did not improve retention or graduation rates, and performance still did not improve when the funding allocation affected by PBF was raised from 2% to 5% (Sanford & Hunter, 2011).

Measuring Up was a self-described "report card" of states' education performance by the National Center for Public Policy and Higher Education, and it was supported by grants from two PBF advocacy groups, the Bill and Melinda Gates Foundation and the Lumina Foundation for Education (McKeown-Moak, 2013; Measuring Up, 2008). Based on data in these reports, McLendon, Tuchmayer, and Park (2009) analyzed retention and completion rates of eight states, including Pennsylvania and Arkansas, which used PBF. Though Pennsylvania used performance-based funding during each year studied, the researchers found little difference in retention and completion among the states in the study, regardless of PBF.

In the first study of Indiana's PBF system, Umbricht, Fernandez, and Ortagus (2015) evaluated the performance of the state's public four-year institutions with three comparison peer groups that included public universities in Kentucky, Illinois, Iowa, Missouri, Minnesota, and Wisconsin. The study also included private four-year institutions in Indiana. The researchers "found no evidence to suggest that performance funding is increasing the number of graduates in Indiana in comparison with other institutions" (p. 24). Further, the results of the study indicated PBF institutions became more selective, reducing the overall admissions rates, and fewer low-income and minority students were admitted (Umbricht et al., 2015).

Pennsylvania's performance funding was aimed at improving the completion rates among the state's universities, and graduation rates were a specific measurement in its allocation formula. Hillman et al. (2014) examined the undergraduate completion rates in the state and compared them to nearby states and similar institutions. They reviewed the 10 years of data prior to policy implementation and the 10 years that immediately followed. The study showed "weak evidence" (p. 847) of an increase in completions in Pennsylvania, and "limited evidence" (p. 850) of outpacing nearby states. Overall, the state's PBF formula did not positively impact the stated goal of improving the graduation rates of Pennsylvania colleges and universities (Hillman et al., 2014).

Dougherty, Jones, Lahr, Natow, Pheatt, and Reddy (2016b) focused their study on three states and their public higher education institutions. Specifically, they selected Indiana, Ohio, and Tennessee because of their early adoption of PBF 2.0 (Chapter 9, para. 2), and they examined the institutional responses to PBF, state support for the transition to PBF, and the impacts on student achievement. Through their mixed methods study, the researchers found that colleges did make organizational changes as a result of PBF, most notably in developmental education, counseling, and advising (Chapter 9, Section 5, para. 1). However, Dougherty et al. (2016) concluded that there was not "a significant positive impact of performance funding in higher education" (Chapter 9, Section 6, para. 6) on student outcomes in states with PBF compared to states without PBF.

Two-year colleges meet a critical need of affordability and transferability for students pursuing higher education, and they serve a strategic economic purpose in workforce development for their regions. Baime and Baum (2016) observed that the national emphasis on college completion and economic growth have increased the focus of federal and state policy on community colleges. Twenty-seven states use some form of PBF for their two-year colleges, and only seven states that use performance funding for higher education do not include these institutions (NCSL, 2015). However, few studies have examined the impact of PBF on the two-year college sector exclusively. Due to focus on the local area and an open access mission, community colleges may be especially harmed by state policies that focus on statewide metrics or university standards that are misaligned with the institution's operations (Dougherty et al., 2013; Tandberg et al., 2014). Mullin and Honeyman (2008) examined Florida's PBF model from 2005-2008, which increased performance funding from 2% of its allocation to 5% for community colleges to create incentive for improved performance. Institutional budgets grew as colleges focused on the measurement criteria, but the study noted that these gains came from increasing academic offerings and decreasing remedial and adult programs. The researchers concluded their study by questioning if Florida's PBF formula caused its colleges to prioritize financial returns above institutional mission.

North Carolina and Texas are among the states using PBF 2.0 formulas, and Thornton and Friedel (2016) conducted a qualitative study of the impact of the policies administered by rural college leaders in both states. Noting the small percentages of the colleges' budgets allocated by PBF, the researchers reported that administrators did not make programmatic decision or organizational changes based on the funding formula. However, the administrators in the study disclosed that public and board members' perceptions were impacted by the scores of the colleges on the performance metrics, especially in comparison to peer institutions (Thornton & Friedel, 2016).

Hillman et al. (2015) studied the impact of the model adopted by Washington when PBF was re-introduced in 2007. The state's board approved a formula that included intermediate and completion measures, and the researchers specifically sought to determine if the institutional changes in response to PBF improved graduation rates. The study included Washington's community and technical colleges, as well as comparative institutions in the region that do not use a performance funding system. Studying a six-year timeframe after the implementation of PBF, the researchers found little effect on the colleges' retention rates or associated degree production (Hillman et al., 2015), but they did observe an increase in short-term certificates.

In the largest study to date of PBF's impact on community college performance, Tandberg, Hillman, and Barakat (2014) examined completion rates among two-year colleges in 19 states, reviewing data from 1990 through 2010. Findings revealed little evidence that PBF improved completion rates, and the researchers proposed two possible reasons. First, most of the performance funding formulas favored full-time students, and only 40% of the community college students in this study were full-time. Secondly, Tandberg et al. (2014) noted that though PBF was focused on degree completion: "community colleges serve multiple missions, only one of which is the delivery of associate's degree programs" (p. 22). The study by McKinney and Hagedorn (2015) of Texas community colleges underscored the concern of misalignment of metrics with the college's missions, noting that the unique work of community colleges "make developing PBF policies for this sector especially challenging" (p. 19). Burke and Minassians (2003) found that state reporting on colleges and universities to higher education agencies and legislatures for funding did not account for the student demographics, operations, or the mission of the community college. Since the study by Burke and Minassians (2003), some states, such as Connecticut and Illinois, have revised their PBF formulas to include those factors (NCSL, 2015).

Research for Action, a non-profit education research group, sponsored reviews of the PBF models in Indiana, Ohio, and Tennessee in their 2009, 2010, and 2011 versions respectively. All three states used PBF for two- and four-year institutions, and the researchers found mixed results among student outcomes (Callahan, Meehan, & Shaw, 2017). In addition to strategic and operations changes to accommodate PBF at the institutions, the authors reported higher credit hour and degree attainment rates among full-time students in Indiana and Tennessee. However, graduation rates and credit accumulation did not improve for part-time students in both states, and the results were mixed for students of color and economically disadvantaged students (Callahan et al., 2017).

Advocacy for Performance-Based Funding

Despite the challenges and results of PBF to date, calls for accountability and performance improvement in higher education have not lessened. Nonprofit policy groups such as Jobs for the Future and Complete College America are actively working with states to implement and refine performance models that focus on outcomes rather than inputs (Altstadt, 2012; Jones, 2012). In his report, Jones (2012) included the following recommendations that concur with suggestions in prior research: consideration for underserved populations, increased PBF-based allocation to promote institutional behavior change, and formula differentiation for respective institutional missions. Policy briefs for Achieving the Dream and Complete College America promoted similar strategies and provided guidance for PBF proponents to engage higher education leaders and the community in crafting effective performance funding policies (Altstadt, 2012; Jaquette, 2006). In their examination of the strategies used by PBF advocates in three states, Dougherty et al. (2016) found evidence of support for institutions to develop capacity for PBF, but this support was usually sponsored or provided by policy groups such as Complete College American and the result of comprehensive plans by states to help colleges implement PBF. State legislatures did, however, design the PBF formulas with “phased in” approaches and funding loss prevention measures to give institutions fiscal stability as they transitioned to the new models (Dougherty et al., 2016, Shulock, 2011).

Public Two-Year Colleges in Texas

Texas' public two-year colleges include two specific types of institutions: standard community colleges and Texas State Technical College (TSTC). They are frequently linked by legislation, policy, and are coordinated by the state's governing agency for colleges and universities, the Texas Higher Education Coordinating Board (THECB). Collectively, these institutions enrolled 712,468 students and awarded more than 99,000 degrees in 2014 (THECB, 2016c). The state's 50 community colleges are established by the legislature and assigned specific service areas by the THECB. Voters within the service areas determine the taxing district for each community college and elect a governing board, which establishes local district tuition rates, local policy, and provides institutional oversight.

Texas State Technical College was established by Governor John Connally in 1965 as the two-year branch of Texas A&M, and it became a separate state agency with its own appointed governing board in 1969 (TSTC, 2016). In 2016, the system of four independent colleges merged into a single college with ten campuses. TSTC has a statewide mission rather than specific service areas, and because the college receives no local taxes, state appropriations and student tuition comprises the majority of its budget.

Funding Methodology and Trends

State funding for public higher education in Texas is determined during each legislative session, and most of the funds are allocated by various funding formulas, depending on the type of institution and the use of funds (THECB, 2016a). State law requires the biennial appropriation to "supplement local funds for the proper support, maintenance, operation, and improvement" of public community colleges (Texas Education Code, 2017, § 130.003a). From 1973 to 2013, state funding for community colleges and TSTC was determined by contact hours, an enrollment-based methodology using factors of cost of delivery, number of students enrolled, and number of class hours per student in courses. Institutions reported all expenses of instruction by course types, excluding facilities, to the THECB. The Coordinating Board organized the expenditure data into 26 program areas in accordance with the Department of Education's Classification of Instructional Programs to determine the average cost for each course type, also known as the contact hour funding rate (Legislative Budget Board [LBB], 2013). The THECB then recommended an allocation amount for each institution, based on a percentage of the funding rates for its contact hour types, to the state legislature. Because the expenditure data included costs that colleges recovered through other means, such as tax revenue and student tuition, the contact hour funding rate recommended by the THECB did not equal 100% of the reported expenses (LBB, 2016). State lawmakers considered the THECB recommendation in light of available state revenue and competing governmental priorities, and the legislature determined the final appropriation for each institution. Contact hour-based funding for community colleges and TSTC grew from $784.4 million in 2001 to $929.9 million in 2013, an increase of 18.4%, but the number of contact hours taught by public two-year colleges grew by more than 60% during the same time (THECB, 2016b).

Performance-Based Funding Formulas in Texas Two-Year Colleges

In their June, 2010 funding formula report to the legislature, the THECB rejected the suggestion of a PBF model that included incentives and included a recommendation to delay the start of funding based on performance metrics until the 2013 academic year, noting "This will allow institutions an opportunity to adjust their policies and practices accordingly" (THECB, 2011, p. 11). Lawmakers followed this recommendation, and subsequently passed H.B. 9 (2011) which amended earlier legislation to include consideration for "critical fields" (p. 3), such as engineering, computer science, and nursing, and for at-risk populations. In 2013, the 83rd Texas Legislature formally adopted two performance-based funding models, one for the state's 50 community colleges and a distinct formula for TSTC. The Texas community college PBF formula, also referred to as the Success Points model, incorporated intermediate and completion metrics to calculate institutional performance. Colleges earn points for students' achievements of developmental coursework, first-level college courses, and semester credit hour (SCH) milestones, as well as other metrics such as graduation or transfer to a four-year university. Table 1 presents a list of completion metrics and their respective point values.

Table 1

Texas Community College Success Points Model Student Completion Metrics and Point Values

Metric	Points
Developmental education in mathematics	1.0
Developmental education in reading	0.5
Developmental education in writing	0.5
First college-level mathematics course with grade of C or better	1.0
First college-level course designated as reading-intensive with grade of C or better	0.5
First college-level course designated as writing-intensive with grade of C or better	0.5
First 15 SCH at the institution	1.0
First 30 SCH at the institution	1.0
Transfer to general academic institution after completing at least 15 SCH at the institution	2.0
Associate's degree, bachelor's degree, or certificate recognized for this purpose by the THECB in a field other than science, technology, engineering, or mathematics (STEM) or allied health	2.0
Associate's degree, bachelor's degree, or certificate recognized for this purpose by the THECB in a STEM or allied health field	2.25

Legislative Budget Board. (2016). *Financing public higher education in Texas.* Legislative Primer Report – ID: 3148. Austin, TX: Legislative Budget Board Staff.

The model, which began in 2014 fiscal year, accounts for 10% of the state funding given to community colleges, and it is calculated each fiscal year, with the results factored into the biennial legislative appropriations bill. The balance of community college funding is the combination of the contact hour formula and $1 million for "core operations to help cover basic operating costs, regardless of the district's geographic location or institutional size" (LBB, 2016). The Texas Higher Education Coordinating Board developed the model in partnership with community college leaders from around the state and worked with the Texas Association of

Community Colleges to make minor revisions for the 2016-2017 biennium (D. Hudson, personal communication, June 9, 2014).

One advantage was the Texas Higher Education Coordinating Board's (THECB) inclusion of multiple measures, noting "educational achievement includes more than just traditional, terminal accomplishments" (THECB, 2015b, p. 1). Further, the information used to calculate the formula is among the data already compiled and submitted by institutions, and no additional reporting is necessary (THECB, 2015b).

The Success Points model does not include any factors for at-risk populations, and McKinney and Hagedorn (2015) calculated that colleges benefit most from the formula with high performing students and least from older students and GED completers. They noted that the current Success Points model may incentivize institutions to target the students most likely to succeed because those students generate more funding for the colleges. Therefore, an unintended consequence of PBF may be fewer services and less recruiting for lower performing students, harming Texas' diverse community college students (McKinney & Hagedorn, 2015).

Performance-Based Funding at Texas State Technical College

In cooperation with TSTC, the THECB and the Comptroller's Office, the 81st Texas Legislature instructed the THECB in 2009 to evaluate the merits of a PBF formula specifically for the technical college system, with special consideration of the institution's unique mission in Texas (S.B. 1, 2009, p. III-62). From the outset, the PBF model for TSTC addressed key recommendations made by researchers and policy advocates: collaborative design by college leaders and policy makers, sufficient time for planning and implementation, significant funding, and alignment with the institutional mission (Burke & Modarresi, 2000; Kadlec & Shelton, 2015; Miao, 2012; Shin, 2010; Tandberg et al., 2014). TSTC is charged specifically with contributing "to the educational and economic development of the State of Texas by offering occupationally oriented programs with supporting academic course work, emphasizing highly specialized advanced and emerging technical and vocational areas for certificates or associate degrees" (Texas Education Code, 2017, §135.01b). Following a favorable report from the THECB, the 82nd Texas Legislature instructed the THECB to develop a "value-added" formula that, in direct contrast to the prior, enrollment-based formula, "shall reward job placement and graduate earnings projections, not time in training or contact hours" (H.B. 1, 2011, p. III-54).

The THECB collaborated with TSTC staff, the LBB, and the Ray Marshall Center for the Study of Human Resources at the University of Texas to develop a performance-based funding formula for TSTC (THECB, 2013). The 83rd Texas Legislature established the Returned Value Funding Model for TSTC, basing its allocation on the "direct and indirect state tax revenues generated because of the education provided to students by the TSTCs" (S.B. 1, 2013, p. III-216). The bill further detailed the model as follows:

1. Cohorts comprised of graduates, transfers, and leavers who did not enroll at another Texas higher education institution after two years, earning at least nine SCH from 2006 and 2007.
2. Cohorts were matched with Unemployment Insurance wage data to determine students' wages for five years after leaving TSTC.
3. Direct value-add is "the incremental state tax revenue attributable to former TSTC students' jobs, based on the difference between former TSTC students' annual wages and a base wage representing a full-time employee earning minimum wage (7 percent of the wage delta)" (p. III-216).

4. Indirect value-add is "the direct value-added multiplied by 1.5, an economic multiplier derived from a U.S. Bureau of Economic Analysis study" (p. III-216).
5. The direct and indirect value-adds of a five-year period were combined, then reduced by a given percentage to establish TSTC's PBF formula.

In its report to the 84th Texas Legislature, TSTC (2015, p. 2) presented a simplified version of the PBF formula in the following way:

1. [Average salaries earned by TSTC students] less [minimum wage earnings] = average value added by TSTC
2. [Average value added by TSTC] times [number of students placed in jobs] = economic benefit to Texas
3. [Economic benefit to Texas] less [the legislative discount] = TSTC's formula funding.

Though early designs of the formula proposed that TSTC receive 50% of the direct and indirect value-adds, the Returned Value Funding Model was initially capped to match what the prior, contact-hour-based formula would have recommended for TSTC, ensuring the formula would demonstrate consistency with previous funding levels (G. Hendricks, personal communication, October 16, 2016). The legislature appropriated $90 million to TSTC for 2014-2015, 32.6% of the sum of the direct and indirect value-adds (S.B. 1, 2013), and for the 2016-2017 biennium, the 84th Texas Legislature appropriated 35.5% of the value added to TSTC, a total of $94 million (H.B. 1, 2015).

Summary

PBF policies will continue to evolve as stakeholders seek more transparency in the use of public funds for higher education, and the current trends of PBF place greater emphasis on student success. Legislatures have moved away from providing bonus or extra money to public institutions to incentivize student achievement, and PBF 2.0 formulas are placing greater burden on institutions to demonstrate attainment of success measures to receive full funding. Though the measures were not consistent from state to state, 95% of states using or considering PBF included retention, graduation, or placement/transfer as performance metrics tied to public funding (NCSL, 2015). In contrast to this trend and its underlying theoretical perspectives, there is little evidence that PBF states improve student outcomes at a greater rate than non-PBF states. Hillman (2016), reviewing a dozen quantitative studies on PBF, observed, “the weight of evidence suggests states using performance-based funding do not out-perform other states” (p. 6).

The Returned Value PBF model at TSTC incorporated many of the recommendations from previous research on performance funding, and the current study fills the gap in existing literature by examining the impact of PBF at the institution and program level. The results from the study may be used to further refine TSTC’s funding design, and they establish a baseline of performance among TSTC’s academic divisions and a methodology for future measurement. Chapter Three presents the methodology used in this study to assess the impact of the Returned Value Funding model on TSTC graduation rates.

Chapter 3

Methodology

The prior research on the impact of PBF on two-year college student graduation rates compared states with performance-based funding policies to states without PBF (Tandberg et al., 2014). In his review of applicable studies, Hillman (2016) reported no research that evaluated the impact on graduation rates at specific institutions, and no empirical research on PBF at individual colleges. Thus, the current study addressed a gap in the existing literature by examining the change in graduation rate at a single institution before and after the PBF formula was implemented. This study further evaluated the impact at the program level by comparing completion rates among academic divisions. This chapter reviews the research purpose and questions, describes the context and participants, explains the process for preparing the sample, and provides an overview of the statistical methods to be used. The chapter concludes with information on the proposed data analysis and limitations.

The research methodology for this study was based on the following research questions:

1. To what extent is there a statistically significant difference in the overall graduation rate at Texas State Technical College after the implementation of the Returned Value Fund Model when compared to the graduation rate prior to the implementation of the performance-based funding?
2. To what extent is there a statistically significantly difference in graduation rate by academic divisions after the implementation of the Returned Value Funding Model when compared to the graduation rate prior to performance-based funding?

The null hypothesis for this study proposed no statistically significant difference between graduation rates before the implementation of PBF compared to the graduation rates after 2013 when PBF was implemented. Where the proportion of pre-PBF graduates is represented by p_1 and the proportion of post-PBF graduates is represented by p_2, the null hypothesis is stated as $H_o : p_1 = p_2$. The study evaluated any statistical difference between the rates, not only any increase; therefore, the alternative hypothesis is expressed as $H_A : p_1 \neq p_2$.

To answer the research questions, the study employed two research designs: a *z* test for the difference between proportions and an interrupted time series analysis. The Returned Value Funding Model applied to all TSTC students in this study's population since its implementation in 2013; therefore, random assignment to treatment and control groups was not possible. However, the matching process used for the *z* test mimicked random assignment, and the pre-PBF and post-PBF cohorts formed comparison groups appropriate for the quasi-experimental design. The quantitative design of the analysis was appropriate to evaluate the statistical significance of any difference between the pre-PBF and post-PBF samples.

Context

TSTC is a multi-campus institution in Texas, with ten permanent locations across the state. Prior to the implementation of the Returned Value Funding Model, TSTC's legislative appropriation was based on contact hours, an enrollment-based calculation of student participation where one student in one class for one hour equals one contact hour. The contact hours were then multiplied by average costs of delivery for each type of course provided by all two-year colleges in Texas to calculate the recommended appropriation. The contact hour formula effectively funded TSTC for the amount of time students spent in its courses, not on the economic impact of its graduates. Upon its approval of the Returned Value Funding Model, the 83rd Texas Legislature separated TSTC's PBF formula from the state's community colleges and established a unique public funding mechanism for higher education. TSTC presented an opportunity to study the impact of PBF on graduation rates because the formula addressed key recommendations of previous PBF research: collaboration with the college's leadership, focus on the institutional mission, and a high percentage of its budget determined by performance funding. The Texas legislature approved the formula with the intent of improving TSTC's completion rates (THECB, 2013).

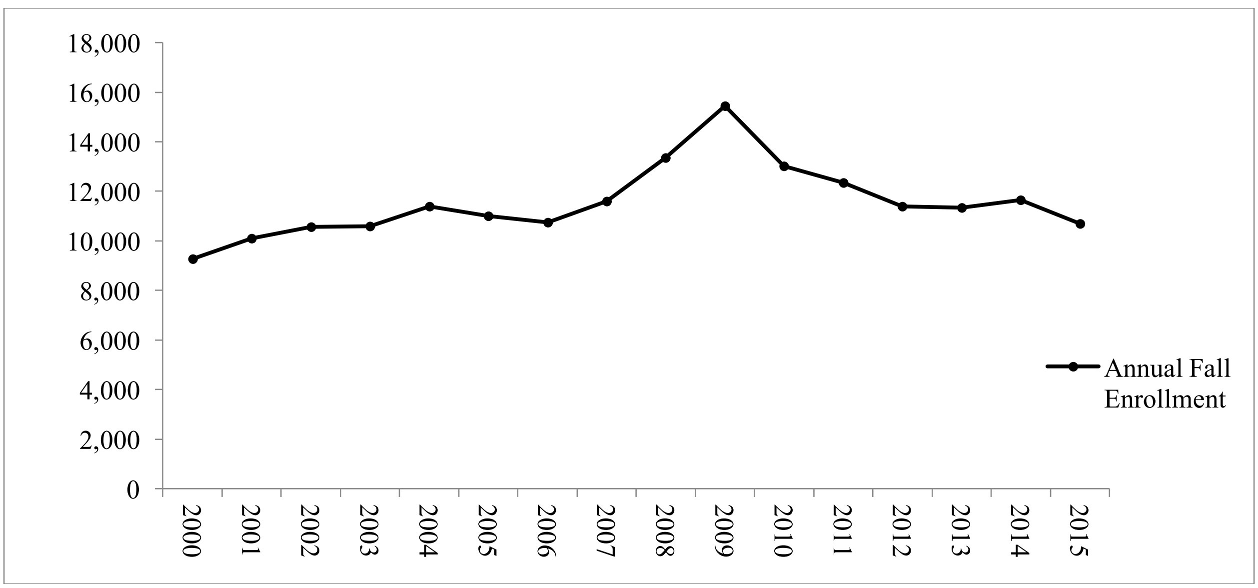
Research Design

To calculate the statistical significance of the Returned Value Funding Model's impact on TSTC graduation rates, the independent variable in this study was the PBF formula for TSTC as enacted by the state legislature in 2013 and implemented by the THECB. The dependent variable was the student completion rates, a stated goal in the legislation that recommended the formula change (THECB, 2013). Previous research on PBF at two-year institutions focused on academic instead of workforce programs and did not include certificate programs (Tandberg et al., 2014). However, in this study, THECB-recognized workforce Level 1 (CERT1) and Level 2 (CERT2) certificates were included in the dependent variable calculations, as they were defined educational objectives focused on a single technical specialty (THECB, 2016d), and the certificates were complementary to the college's AAS degrees. Because the Returned Value Funding Model measured the economic impact of the college's graduates in the Texas workforce, TSTC's CERT1, CERT2, and AAS programs were collectively considered when calculating the dependent variable of graduation rates in this study. TSTC collects and retains enrollment and completion data for all students, as well as key demographic information, and the institution's data were used in this study.

As a comparison between graduation rates before the implementation of PBF and after PBF, the broadest population from which the sample was drawn includes all students enrolled at

TSTC since it began in 1965. However, this population was first narrowed by the exclusion of students before 2000, when TSTC moved from a quarter system to a traditional collegiate semester. Though the demographic characteristics of pre-2000 students were consistent with later students, individuals enrolled prior to 2000 followed a significantly different academic calendar and did not begin their programs in the same cohort structure as post-2000 students. Therefore, they were excluded from this study.

The data used in the first research design focused on three semester periods: two before implementation and one following the authorization of PBF by the state legislature. As illustrated in Figure 2, the enrollment at TSTC remained relatively steady between 2000 and 2015, except for a sharp increase from 2008 through 2011.



Source: THECB, 2017

Figure 2. Annual fall enrollment headcount at TSTC from 2000-2015.

To evaluate the difference in graduation rates before the implementation of PBF, a sample of students was taken before the temporary increase and during the increase. The sample for this design only included individuals at TSTC who enrolled as fully matriculated students for the first time in the Fall 2005 semester, the Fall 2009 semester, and the Fall 2013 semester.

Students from 2005 were selected because the 150% completion date for this cohort, a standard metric used by the NCES (2016), ended prior to the expansion of year-round Pell Grant authorized by the Higher Education Opportunity Act of 2008 (2008). Students enrolled for the first time in the Fall 2009 semester had the benefit of access to a larger Pell Grant and additional funds through the American Recovery and Reinvestment Act (2009). To be included as graduates in the calculation of the graduation rate, the sampled students who enrolled in the Fall semesters of 2005, 2009, or 2013 must have completed their degree or certificate in 150% of the published (TSTC Catalog) expected time to graduation for an AAS degree.

Dual credit students were not included in the Returned Value Funding Model during the time of this study, and TSTC received no state funding for their outcomes. Because the institution had no financial incentive to improve the graduation rates for this group of students, no high school students who received dual credit from TSTC were included in the population of this study.

To evaluate the impact of PBF on student graduation rates at TSTC, the first statistical design used a paired, or matched, sampling method to determine the final samples that were statistically evaluated. Matched sample research designs pair samples from one population with corresponding samples from a different population based on one or more variables to create a direct counterpart (Fraenkel, Wallen, & Hyun, 1993). By matching covariates between the selected samples, the method allows researchers to examine the dependent variable under investigation and compare the effects of an intervention in cases when random assignment to control and treatment groups is not possible (Stuart, 2010). Stuart and Rubin (2008) observed that matching methods "attempt to replicate, as closely as possible, the ideal of randomized experiments when using observational data" (p. 155). Matched sample designs are used frequently in medical and social science research to evaluate causal inference in observational data (Ho, Imai, King, & Stuart, 2007; King & Nielsen, 2016; Morgan & Harding, 2005).

To enhance the accuracy of the matching process, the design employed a full or exact matching process that directly linked the pre- and post-sample groups in a one-to-one comparison. In the exact matching method, the researcher pairs each treatment sample with a corresponding control sample with the same values on the selected covariates (Randolph, Falbe, Manuel, & Balloun, 2014). This full matching minimizes variance as effectively as alternative control and treatment group designs for observational studies, and it is an improvement over propensity scoring matching methods (Godfrey, 2016; Hansen, 2004; King & Nielsen, 2016).

To determine the selected covariates, this first design of this study drew upon prior research on TSTC students. Hendricks (2000) conducted a longitudinal, statewide study of TSTC students to determine variables most related to student graduation and found the following factors were most significant:

1. full- or part-time student status,
2. gender,
3. academically disadvantaged,
4. economically disadvantaged, and
5. program major.

Items one through four are binary data collected by TSTC for each student upon enrollment in the institution, and academic division was determined by the student's choice of program major. The programs were aligned into academic divisions of similar disciplines and presented in Appendix A.

The second statistical test in this study was an interrupted time series design. Frequently used in research on the impact of public policy, interrupted time series (ITS) designs compare changes in the baseline trend of pre-intervention groups with post-intervention groups over a period of time when random, controlled experiments are not possible or feasible (Biglan, Ary, & Wagenaar, 2000; Glass, 1997). This method does not require matching cohorts, but rather it examines statistical changes in level and trends of longitudinal data (Bloom, 2016; McDowall, 1980), and the interrupted time series method has been used to study the impact of PBF in Indiana and Tennessee (Callahan, Meehan, Shaw, Slaughter, Kim, Hunter, Lin, & Wainstein, 2017a; Callahan et al., 2017b). Therefore, the data sample for this design was TSTC students who enrolled in the Fall 2005 semester through the Summer 2017 semester graduates. Consistent with the current study's delimitations, this sample included only CERT1, CERT2, and AAS graduates; dual credit students were excluded.

Data Collection

Following approval by the Human Subjects Review Committee of the Darden College of Education at Old Dominion University and the Institutional Review Board at TSTC, the request for data was submitted to the TSTC Business Analytics and Reporting department. This study examined existing data and records that are publicly available as directory information or were recorded in such a manner that the subjects cannot be identified directly or indirectly. The data request included information on new student cohorts from the Fall semesters of 2005, 2009, and 2013, excluding individuals enrolled as dual credit students, and including student graduation date. These data were used for the first statistical design. Additionally, data were collected on CERT1, CERT2, and AAS graduates by program from the Fall 2005 through the Summer 2017 semester for use in the second statistical test. The requested data were exported from TSTC's student information system, also known as "'Colleague", in comma-separated values formats, such as Microsoft Excel. For all data, personally identifiable information, such as name, address, and student identification number, were removed, and where necessary, a sequential, anonymous record numbers was assigned to each student record. No identifiable information will be published as a part of this study.

The data of each year's cohort were sorted by enrollment status, gender, academic, and economic disadvantage, and the students were categorized by academic division based on the student's last declared major. Students in the Fall 2005 cohort were then matched by the predetermined demographic categories with students in the Fall 2013 cohort, and the Fall 2009 students were matched to corresponding Fall 2013 students. The pairings were made without consideration of the student's graduation status, and the two matched sets were the final samples used for statistical evaluation in the first statistical test in the current study. For the interrupted time series, the graduation rates from the Fall 2005 through Summer 2017 semesters were calculated separately for each term for the entire institution and for each academic division.

Statistical Tests

The first evaluation of the data sets examined the statistical difference between the proportions of sample students who graduated before PBF and the matched students who started after PBF in 2013. The null hypothesis stated there is no statistically significant difference between the samples, or H_0: $p_1 - p_2 = 0$, and a two-tailed *z* test for proportions was used to calculate the test statistic. Where n_1 and n_2 are the number of matched students in the sample before and after PBF, and G_1 and G_2 were the graduates in the samples, the overall sample proportion was:

$$\hat{p} = \frac{G_1}{n_1} + \frac{G_2}{n_2}$$

Assuming a normal distribution, the test statistic was calculated using the standard formula as follows:

$$z = \frac{(\hat{p}_1 - \hat{p}_2) - 0}{\sqrt{\hat{p}\,(1 - \hat{p})\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

The second statistical evaluation was an interrupted time series analysis. Sommers, Zhu, Jacob, and Bloom (2013) observed the ITS method was more rigorous than other comparative analysis methods because “it implicitly controls for the differences between the treatment and comparison group with respect to their baseline outcome levels and growth” (p. 3). Furthermore, ITS was an appropriate method for the data in the current study because of the long baseline period of TSTC graduation rates evaluated, and the implementation of PBF in 2013 provided a clear point in time from which to evaluate pre- and post-intervention.

The ITS design in this study examined the broad impact of PBF on the TSTC student population from the Fall 2005 semester through the Summer 2017 term. Rather than using the matched samples employed in the *z* test, the ITS used a broader sample of all TSTC students during that time. It also benefitted this study by providing a visual display of changes, if any, in the level or trends of graduation rates for the institution and each academic division. The null hypothesis for this study states that there is no difference in the graduation rates at TSTC overall and by academic divisions. Therefore, the factors considered by the ITS analysis were the slope or trend of graduation rates, and the ITS also identified any changes in the levels of graduation rates after the implementation of PBF.

To conduct the ITS, the data were separated by semester, beginning with students who started at TSTC in Fall 2005 and continuing through Summer 2017 graduates, and all CERT1, CERT2, and AAS graduates were included in the analysis. The data were compiled in a comma-separated values spreadsheet with columns for semester, graduation rate, time increment, PBF implementation, and trend post-implementation. Using RStudio version 1.0.143 and R version 3.4.0 for Mac OS X, the statistical tests were run for a preliminary ordinary least squares regression model to assess for autocorrelation, and appropriate statistical tests were conducted to evaluate positive or negative correlation. The RStudio code is shown in Appendix B. The following segmented regression model was used:

$$Y_t = \beta_0 + \beta_1 \times time_t + \beta_2 \times level_t + \beta_3 \times trend_t + \varepsilon_t$$

where Y represented the outcome, β_0 represented the baseline level at the beginning of the study, β_1 was pre-intervention trend, β_2 was the level change following PBF, β_3 represented the post-intervention trend, and ε_t estimated the error over time (Bloom, 1999; Somers et al., 2013; Wagner, Soumerai, Zhang, Ross-Degnan, 2002).

The final regression analysis results were plotted to show the trend and levels of TSTC graduation rates prior to the implementation of PBF, the level immediately afterward, and the trend after 2013. In addition to the statistical tables for each coefficient, a graph of the ITS analyses were prepared for TSTC as a whole and for each academic division, and an extension of the pre-intervention trend line beyond the implementation of PBF was included in each graph for comparison.

Data Analysis

The data from the two statistical tests provided a broad view of the impact of TSTC's PBF model. The *z* test for proportions examined graduation rates for specific matched sample cohorts at TSTC in 2005, 2009, and 2013. For this test, the significance level (α) was set at 0.05; therefore, a *z* statistic greater than 1.96 or less than -1.96 was considered statistically significant. The *z* statistic was computed for the entire 2005 to 2013 and 2009 to 2013 comparison samples, as well as for each academic division in the sample sets. The ITS analysis was used to calculate the statistical significance of changes in graduation trends after PBF for all students who began at TSTC from Fall 2005 through Summer 2017 graduates, with $\alpha = 0.05$. The ITS analyses were also conducted for each academic division.

Limitations

The current study does have limitations. First, it is limited by generalizability. Because each state was using a different PBF formula at the time of this research, the study has limited applicability outside of Texas. Further, the funding formula for TSTC was distinct from the other two-year colleges in the state. The proposed study did not have a control group within the same population or a comparison group for evaluation. While the matched sample design may improve internal validity, the study was not a true, randomized experiment. Graduation rates are also affected by multiple factors of institutional quality, such as faculty, facilities, and curricula, and the current study did not evaluate these topics. Similarly, TSTC's total budget is affected by numerous elements, including tuition rates, enrollment, and special line-item funding through legislation. This study only considered the Returned Value Funding model as the independent variable. Finally, public policy implementation is an ongoing process that may take several years to realize, and this study did not consider any ongoing institutional changes motivated by the PBF formula that may impact graduation rates.

Summary

The implementation of the Returned Value Funding model at TSTC provided an opportunity to study the impact of PBF on graduation rates, and the current study adds to the existing literature by examining a single institution and its academic programs rather than an entire state. The methodology employed two statistical tests to provide a more comprehensive analysis of graduation rates before and after PBF, and to improve the validity of the study overall. The *z* test for proportions used matched sample data from the Fall 2005, 2009, and 2013 semesters, and the interrupted time series design included all CERT1, CERT2, and AAS graduates from 2005 to 2017. These two complimentary methods allowed the researcher to examine the statistical significance of the impact of TSTC's PBF model on student graduation rates.

Chapter 4

Results

As policymakers seek to improve accountability among colleges and universities, performance-based funding (PBF) may be used to link fiscal appropriations for public institutions to intermediate or outcome measures such as retention or graduation rates. Early studies proposed improvements to states' PBF formulas (Cavanaugh & Garland, 2012; Shin, 2010), and the purpose of this study was to examine the impact of a funding methodology that included some of the recommended changes on graduation rates at Texas State Technical College (TSTC). The study incorporated two statistical tests to evaluate changes in graduation rates after the implementation of PBF at TSTC in 2013. The first test used a matching method to compare students who began at TSTC in the Fall semesters of 2005 and 2009 to students with similar demographic characteristics who began in Fall 2013. The second test was an interrupted time series (ITS) analysis of the graduation rates and trends for all students from Fall 2005 through Summer 2017 graduates. These methods provided snapshot and longitudinal views of the impact of PBF on the graduation rates at TSTC. The study was guided by the following research questions:

1. To what extent is there a statistically significant difference in the overall graduation rate at Texas State Technical College after the implementation of the Returned Value Fund Model when compared to the graduation rate prior to the implementation of the performance-based funding?
2. To what extent is there a statistically significant difference in graduation rate by academic divisions after the implementation of the Returned Value Funding Model when compared to the graduation rate prior to performance-based funding?

The null hypothesis for this study proposed that there was no statistically significant difference between graduation rates before and after the implementation of the funding formula change.

Graduation Rates of Matched Samples Before and After PBF

To prepare the data for the *z* test for proportions, students from each semester were matched by the following five demographic factors identified by Hendricks (2000) and categorized by academic division as listed in Appendix A:

1. full- or part-time student status,
2. gender,
3. academically disadvantaged,
4. economically disadvantaged, and
5. program major.

For the comparison group of Fall 2005 to Fall 2013, a total population of 6,275 students pursued CERT1, CERT2, or AAS awards, and 1,379 final matches were made based on the five demographic factors. The largest number of matches was in the Computer and Information Systems division (346), followed by Transportation (316), Engineering and Electronics (239), and Industrial and Manufacturing (191). Allied Health and Business and Professions had 129 and 123 matches respectively, and Environmental, Safety, and Natural Resources had 35 set of matched students. Table 2 presents the number of matches for each division and the final sample, as well as the number and percentage of graduates in each year. To determine significance between the samples, the *z* statistic for proportions was calculated for each rate set, and the corresponding *p* value was determined. Table 3 repeats the graduation rates for each division in the comparison semesters and displays the results of the *z* test and each *p* value for each comparison.

Of the 1,379 matched students who started in Fall 2005, 457 students graduated, a completion rate of 33.14%. The number of graduates for the 2013 students matched to the 2005 cohort dropped by 40 to 417, a decrease of 2.90%. This change was not statistically significant at the $p < 0.05$ level.

Only two divisions from the Fall 2005 to Fall 2013 comparison increased graduation rates: Allied Health and Environmental, Safety, and Natural Resources. The Allied Health division increased graduation rates from 2005 to 2013, improving by 8.53%, a difference of 11 graduates, and Environmental, Safety, and Natural Resources had one more graduate among the 2013 matches than the 2005 sample. The Business and Professions, Engineering and Electronics, Industrial and Manufacturing, and Transportation divisions all decreased in graduation rates of matched students from 2005 to 2013, but the declines in these areas were not statistically significant. The Computer and Information Systems division sample, which contained that largest number of matched students (346), did have a statistically significant drop in graduation rates from 25.43% in Fall 2005 to 17.05% in Fall 2013, a decrease of 8.38%. This change in graduation rate after the implementation rate supported the alternative hypothesis for research question 2.

Table 2

Student Matches From 2005 to 2013 for Each Academic Division

Division	Total Matches	2005 Matched Graduates	2005 Matched Graduation Rate	2013 Matched Graduates	2013 Matched Graduation Rate	Net Change
Allied Health	129	37	28.68%	48	37.21%	8.53%
Business and Professions	123	32	26.02%	28	22.76%	-3.26%
Computer and Information Systems	346	88	25.43%	59	17.05%	-8.38%
Engineering and Electronics	239	85	35.56%	83	34.73%	-0.83%
Environmental, Safety, and Natural Resources	35	11	31.43%	12	34.29%	2.86%
Industrial and Manufacturing	191	83	43.46%	72	37.70%	-5.76%
Transportation	316	121	38.29%	115	36.39%	-1.90%
Total	1,379	457	33.14%	417	30.24%	-2.90%

Table 3

Graduation Percentages, z Statistic, and p Value for 2005 to 2013 for Each Academic Division

Division	2005 Matched Graduation Rate	2013 Matched Graduation Rate	*z* Statistic	*p* Value
Allied Health	28.68%	37.21%	1.457	0.1443
Business and Professions	26.02%	22.76%	-0.5939	0.5552
Computer and Information Systems	25.43%	17.05%	-2.6852	0.0069
Engineering and Electronics	35.56%	34.73%	-0.1916	0.8493
Environmental, Safety, and Natural Resources	31.43%	34.29%	0.2545	0.8026
Industrial and Manufacturing	43.46%	37.70%	-1.1462	0.2501
Transportation	38.29%	36.39%	-0.4934	0.6241
Total	33.14%	30.24%	-1.6370	0.1010

From a population of 8,252 students in Fall 2009 and Fall 2013, a total of 1,548 matched sets were established using the demographic factors identified by Hendricks (2000). Of these pairs, 475 of the 2009 cohort graduated, and 461 of the 2013 cohort completed, a decrease of 0.90% after the implementation of PBF. This change in graduation rate from pre-PBF to post-PBF for all students in the matched sample was not significant at the $p < 0.05$ level and supported the null hypothesis for research question 1.

Table 4 presents the number of matches for each division and the total sample, as well as the number and percentage of graduates in each year. Table 5 repeats the graduation rates for each division in the Fall 2009 and Fall 2013 matched sets and displays the results of the *z* test and each *p* value for each comparison. In this series, the Engineering and Electronics division had the most matched pairs (378), followed by Computer and Information Systems (339), Transportation (268), and Industrial and Manufacturing (229). Business and Professions had 153 sets, Allied Health had 140, and Environmental, Safety, and Natural Resources had just 41. Environmental, Safety, and Natural Resources had the largest percentage change in graduation rates from 2009 to 2013 (7.32%), but because of the low number of matches, this was achieved with only three additional graduates. The number of matched graduates per division fluctuated slightly between comparison years, and no division increased or decreased more than 10 matched graduates after the implementation of PBF in 2013. None of the changes in graduation rates of the matched students between Fall 2009 and Fall 2013 were statistically significant at the institution level or the division level, supporting the null hypotheses for research questions 1 and 2.

Table 4

Student Matches From 2009 to 2013 for Each Academic Division

Division	Total Matches	2009 Matched Graduates	2009 Matched Graduation Rate	2013 Matched Graduates	2013 Matched Graduation Rate	Net Change
Allied Health	140	53	37.86%	47	33.57%	-4.29%
Business and Professions	153	24	15.69%	27	17.65%	1.69%
Computer and Information Systems	339	59	17.40%	50	14.75%	-2.65%
Engineering and Electronics	378	148	39.15%	143	37.83%	-1.32%
Environmental, Safety, and Natural Resources	41	12	29.27%	15	36.59%	7.32%
Industrial and Manufacturing	229	100	43.67%	90	39.30%	-4.37%
Transportation	268	79	29.48%	89	33.21%	3.73%
Total	1,548	475	30.68%	461	29.78%	-0.90%

Table 5

Graduation Percentages, z Statistic, and p Value for 2005 to 2013 for Each Academic Division

Division	2009 Matched Graduation Rate	2013 Matched Graduation Rate	*z* Statistic	*p* Value
Allied Health	37.86%	33.57%	-0.7483	0.4533
Business and Professions	15.69%	17.65%	0.4602	0.6455
Computer and Information Systems	17.40%	14.75%	-0.9410	0.3472
Engineering and Electronics	39.15%	37.83%	-0.3737	0.7114
Environmental, Safety, and Natural Resources	29.27%	36.59%	0.7050	0.4839
Industrial and Manufacturing	43.67%	39.30%	-0.9484	0.3421
Transportation	29.48%	33.21%	0.9311	0.3524
Total	30.68%	29.78%	-0.5479	0.5823

The matched samples from Fall 2005 to Fall 2013 and Fall 2009 to Fall 2013 provided comparison points before and after the implementation of PBF for students with similar demographic characteristics. While some academic divisions improved graduation rates and others decreased, both institutional samples showed declines in overall completion. Only the Fall 2005 to Fall 2013 comparison of matched students in the Computer and Information Systems indicated a statistically significant change in graduation rates, with a decrease of 8.38%.

Graduation Rates of All Students Before and After PBF

The second analysis of graduation rates at TSTC was an interrupted time series (ITS), which included students who started at TSTC from the Fall 2005 semester through the Spring 2016 semester, a total of 44,567 individuals. This population included students pursuing

Associate of Applied Science degrees, Level 1 Certificates, or Level 2 Certificates, but the study excluded high school students enrolled for dual credit. Figures 3 through 10 illustrate the graduation rates for cohorts from each semester in the study for the institution as a whole and by academic division, and a dashed, vertical line before Fall 2013 indicates the implementation of PBF at TSTC. As presented in Figure 3, the institutional graduation rates at TSTC during the time studied stayed relatively steady, with a noticeable drop in Summer 2011 and slight increase thereafter.

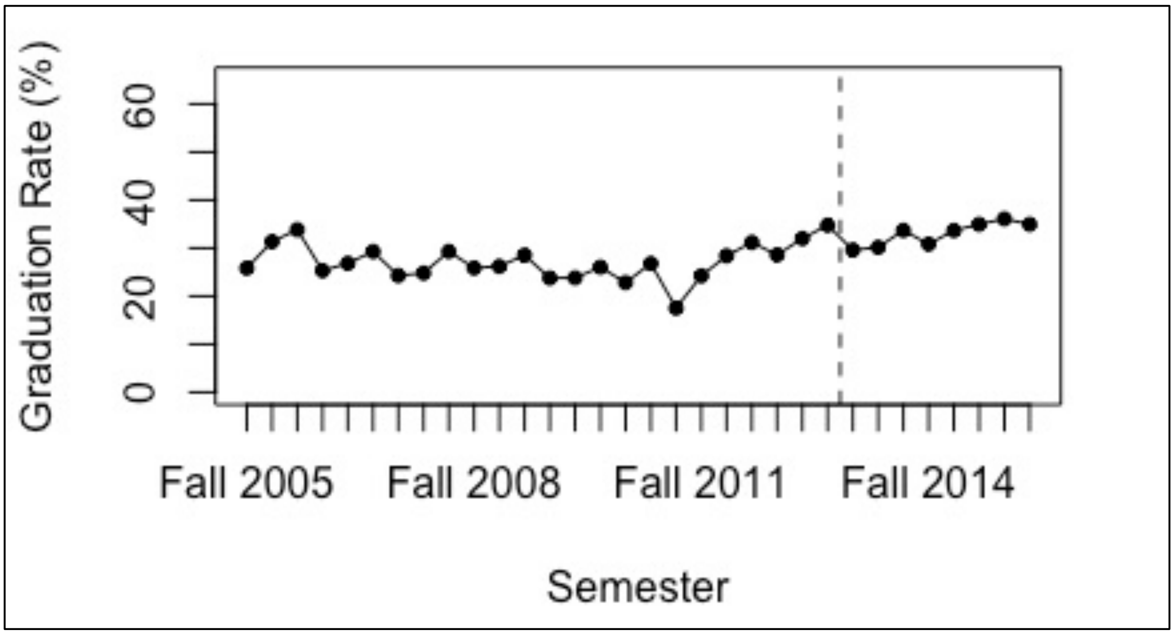


Figure 3. Graduation rates by semester for all divisions at TSTC.

The Allied Health division graduation rates declined from a peak of 56.30% for students who began in Summer 2006 to a low of 18.18% for Summer 2011 students. The graduation rate improved for the Fall 2011 cohort and averaged about 40% thereafter. The division's cohort with the highest graduation rate in this study was Summer 2015 students, when 50 of 84 students who began that term completed (59.52%). There were 7,207 Allied Health students in the sample from Fall 2005 through Spring 2016, or 16.17% of the total, and the graduation rates for the division is shown in Figure 4.

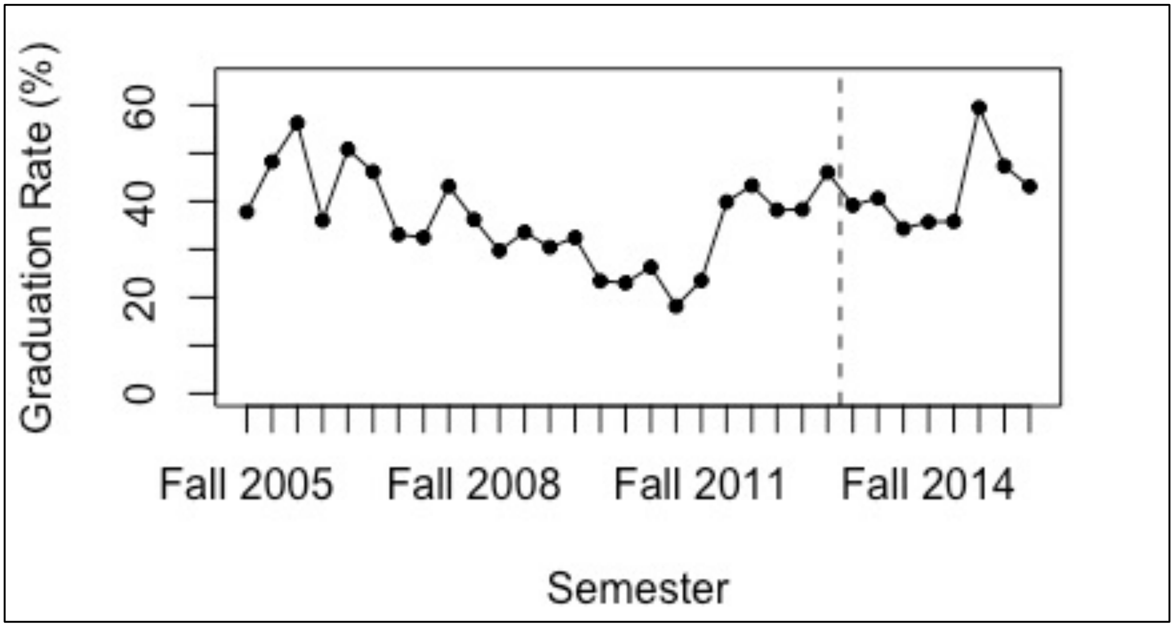


Figure 4. Graduation rates by semester for Allied Health.

The Business and Professions division had 3,654 students in the sample, and the graduation rates in the division declined steadily from Fall 2005 to less than 10% for students who began in Fall 2008. From 2009 through end of this study, the rates fluctuated between 1.92% for the Summer 2011 cohort, when only one of 52 students graduated, to a high of 38.71% of the 78 students in the Spring 2012 cohort. Figure 5 presents the graduation rates for the Business and Professions division.

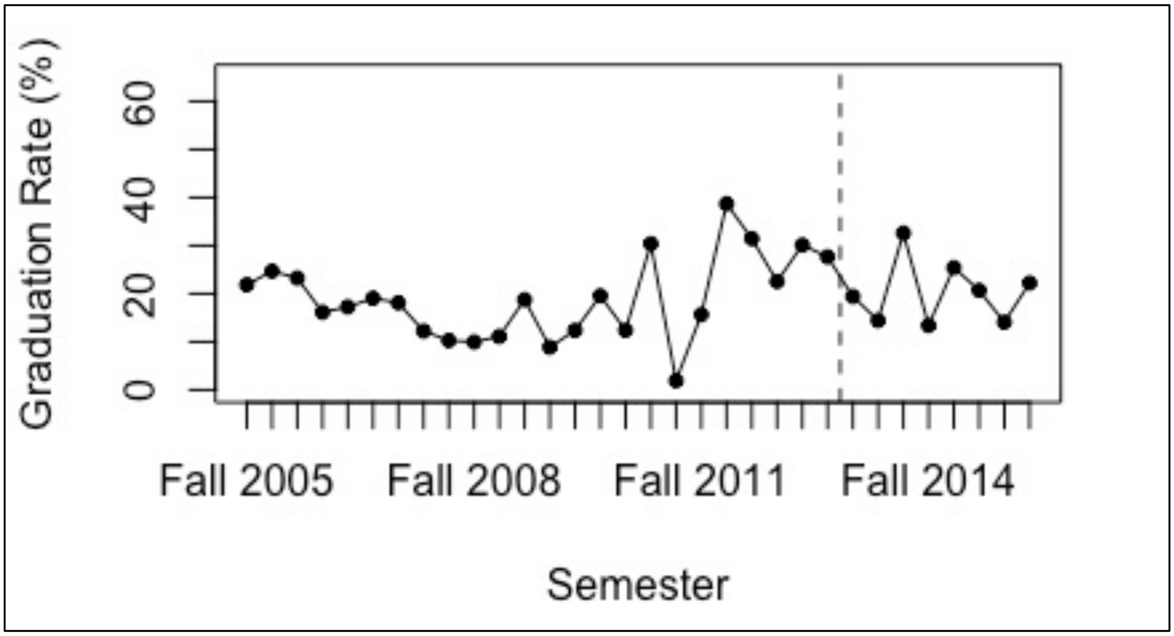


Figure 5. Graduation rates by semester for Business and Professions.

The average graduation rate for the Computer and Information Systems division remained steady at approximately 15% through the current study, with variations from 8.30% for the Fall 2011 cohort to 21.70% for students who began in Spring 2013. The rates are displayed in Figure 6. Like other divisions in this study, Computer and Information Systems students who started in Summer 2011 were least likely to graduate among the division's cohorts from Fall 2005 through Spring 2016, completing at a rate of only 5.61%. The Computer and Information System division had 9,262 individuals in the sample, the most of any division in this study.

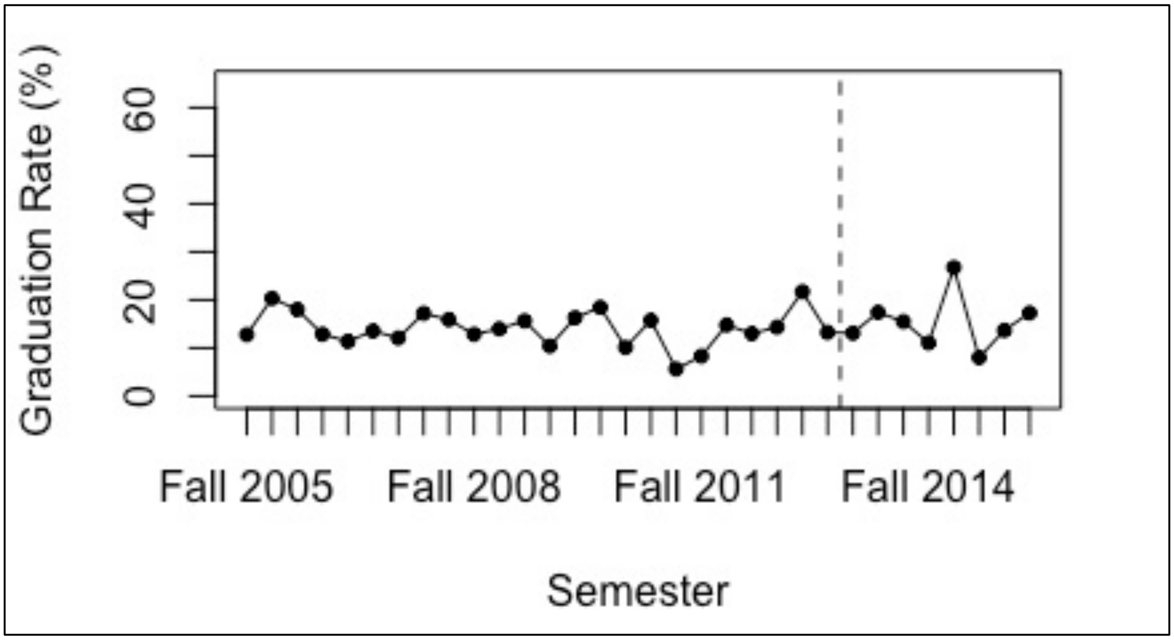


Figure 6. Graduation rates by semester for Computer and Information Systems.

The Engineering and Electronics division included 7,763 students in the sample, and its graduation rates, presented in Figure 7, generally increased over the span of the current study. Students in this division who began from Fall 2005 through Fall 2007 completed at an average rate of 24%. The average improved to at least 32% for cohorts from Fall 2010 through Fall 2012 and remained at that level after the implementation of PBF, with the exception of a drop to 24.58% for the Spring 2015 cohort.

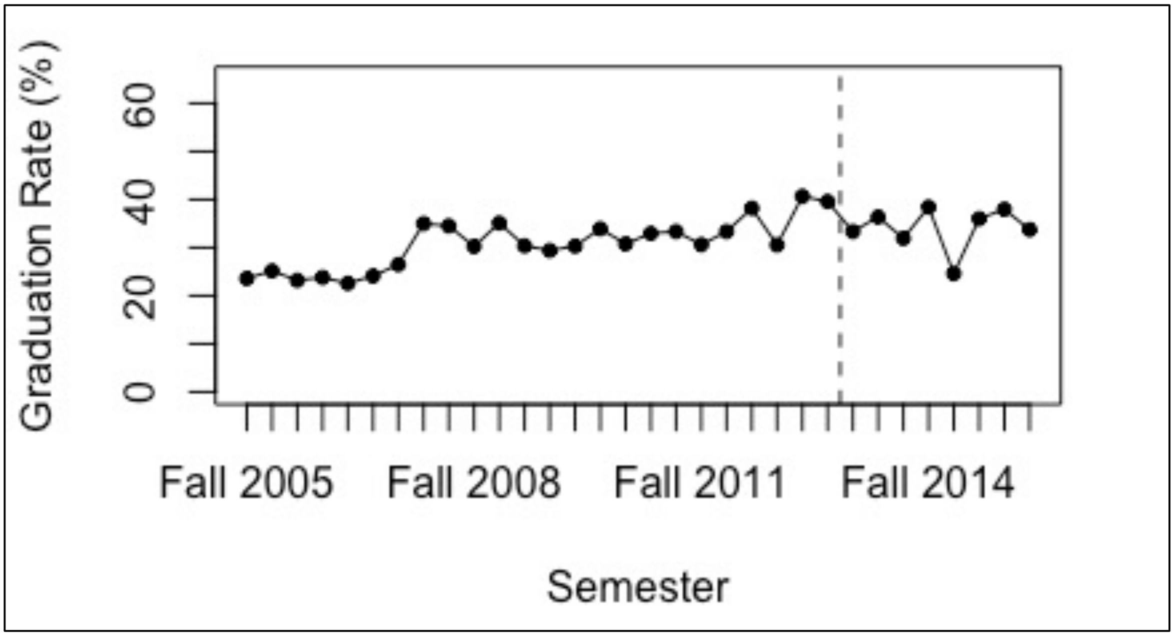


Figure 7. Graduation rates by semester for Engineering and Electronics.

The Environmental, Safety, and Natural Resources division was the smallest group in the sample with 1,618 students or 3.6% of the total. The graduation rates for the division were stable for students who began in Fall 2005 through Fall 2007, averaging 22%, but the rates varied through the balance of the study, ranging from a peak of 50% for the Summer 2012 cohort to no graduates from the Summer 2015 cohort. The graduation rates for the Environmental, Safety, and Natural Resources are presented in Figure 8.

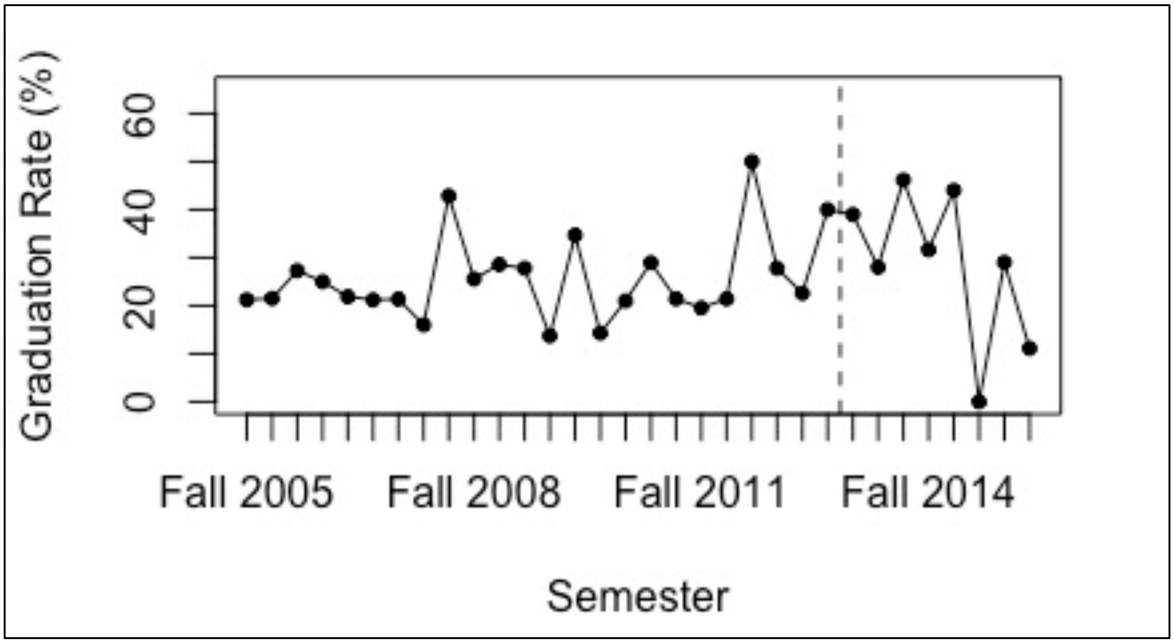


Figure 8. Graduation rates by semester for Environmental, Safety, and Natural Resources.

The Industrial and Manufacturing division had 6,839 students in the sample, which was 15.3% of the total sample, and the graduation rates are shown in Figure 9. Students who began in Summer 2006 completed at a rate of 54.39%, but the average rate declined over time, with the graduation rates below 30% for each of the five cohorts from Spring 2011 through Summer 2012. The graduation rates improved for students who began in the three semesters prior to the implementation of PBF, and remained above 35% following the Fall 2013, with the exception of a drop to 30.16% for the Summer 2015 cohort.

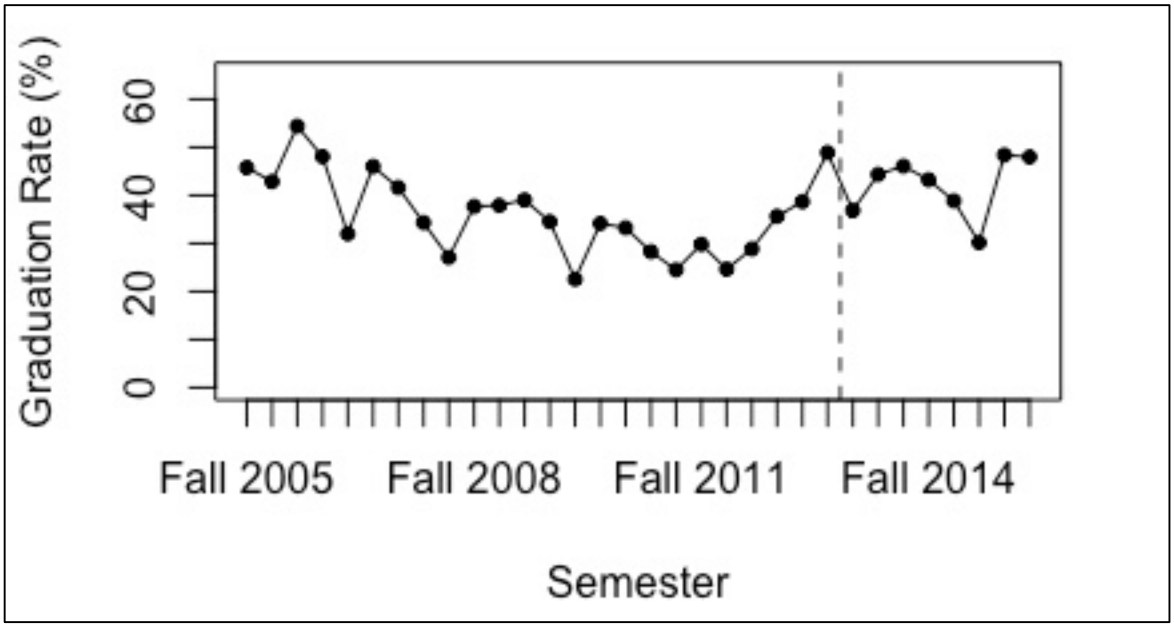


Figure 9. Graduation rates by semester for Industrial and Manufacturing.

The graduation rates for the Transportation division increased steadily in the sample, with small variations between semesters. Students who began in Fall 2005 through Spring 2008 completed at an average of 21.98%, and by the Summer 2013 cohort, the graduation rate exceeded 38%. The improvement in graduation rates continued after the implementation of the Returned Value Funding model, and all three cohorts that began in 2015 had completion rates of at least 40%. The sample of Transportation division students in this study included 8,217 students, and it was the second largest division in the study, representing more than 18% of the total. The graph of the graduation rates is presented in Figure 10.

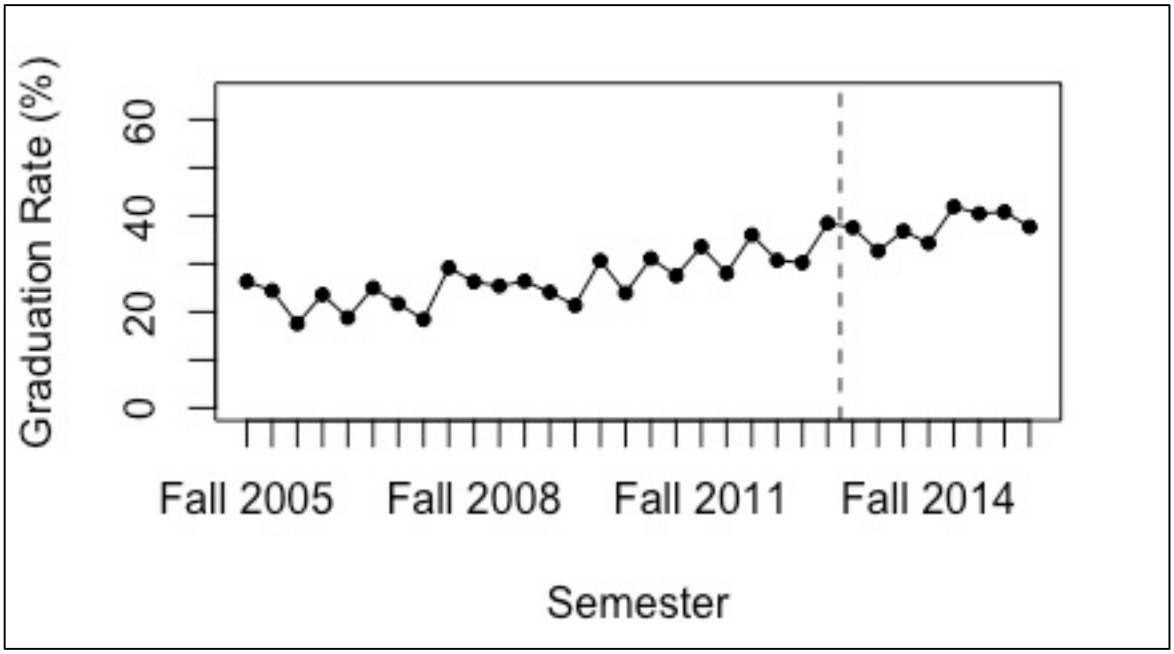


Figure 10. Graduation rates by semester for Transportation.

The longitudinal evaluation of these 32 cohorts established a level and a trend of graduation rates before and after the implementation of PBF at TSTC. ITS analyses were conducted for each academic division as well as the institution as a whole, and the results are presented in Tables 6 through 13. In each table, the Intercept value represents the level at the beginning of the study, Semester denotes the slope over time prior to the funding formula change, PBF represents the level after the policy implementation, and Trend is the trend of graduation rates after PBF. To visualize the levels and trends of graduation rates from the Fall 2005 through Spring 2016 semesters, the final regression analysis results for the institution as a whole and for each academic division were plotted in Figures 11 through 18 and are presented with the related table. Figures 11 through 18 also include a vertical dashed line to identify the implementation of PBF at TSTC. Extensions of the pre-intervention trend lines are included in each graph to compare with the actual levels and trends realized in each division and the entire institution.

For TSTC as a whole, the graduation rate level at the beginning of the study was 26.78%, and the rate remained flat for cohorts through Summer 2013, increasing 0.02% per semester. The graduation rate level increased by 1.59% after the implementation of PBF in Fall 2013, and the slope increased to 0.85% per semester. Though the level and trend improved after PBF was introduced, the changes were not statistically significant at $p < 0.05$ level. Table 6 presents the results of the regression model, and Figure 11 illustrates the level and trends of the graduation rates for the entire institution before and after PBF began in Fall 2013.

Table 6

Regression Model Summary for All Divisions at TSTC

	Value	Standard Error	*t* Value	*p* Value
Intercept	26.782	1.488	17.993	0.000
Semester	0.028	0.104	0.268	0.790
PBF	1.585	3.087	0.513	0.612
Trend	0.849	0.555	1.529	0.138

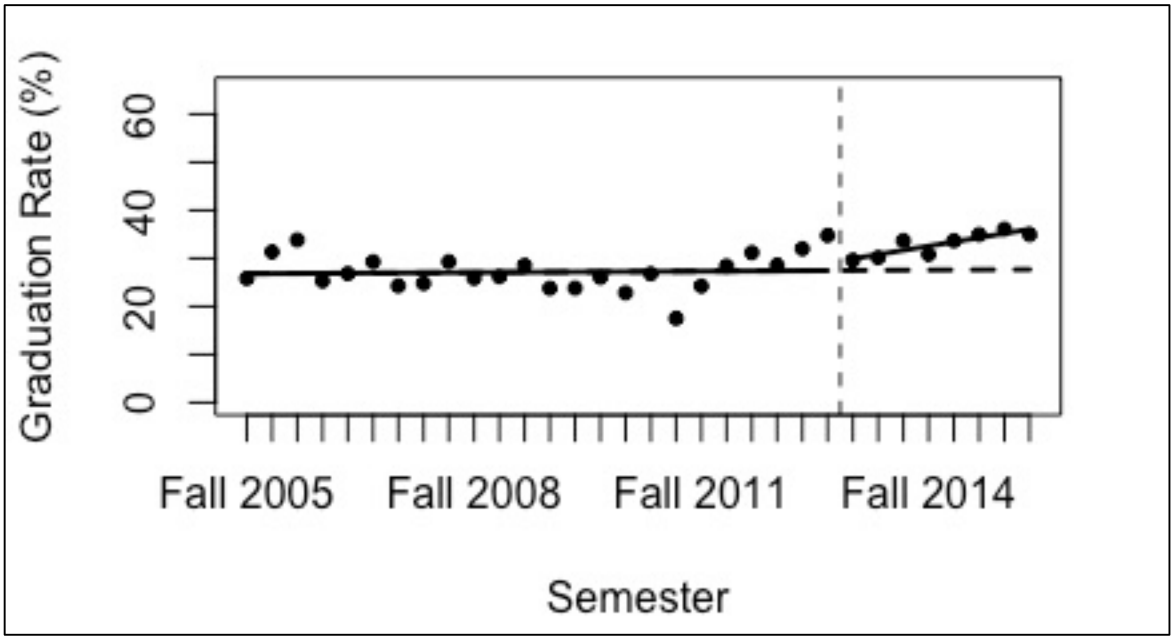


Figure 11. Level and trend of graduation rates for all divisions at TSTC from Fall 2005 to Spring 2016.

The graduation rate level for the Allied Health division at the beginning of the study was 42.18%, with a downward trend of -0.49% per semester before PBF began in Fall 2013. After the initiation of the Returned Value Funding model, the trend reversed, and the graduation rate increased by 2.11% each semester. Similarly, the level increased by 4.11% after PBF was implemented in Fall 2013. However, the improvements in the graduation rate level and trend were not statistically significant. The results of the regression model are listed in Table 7 and illustrated in Figure 12.

Table 7

Regression Model Summary for Allied Health

	Value	Standard Error	*t* Value	*p* Value
Intercept	42.181	3.753	11.240	0.000
Semester	-0.486	0.263	-1.850	0.075
PBF	4.111	7.784	0.528	0.602
Trend	2.111	1.399	1.509	0.143

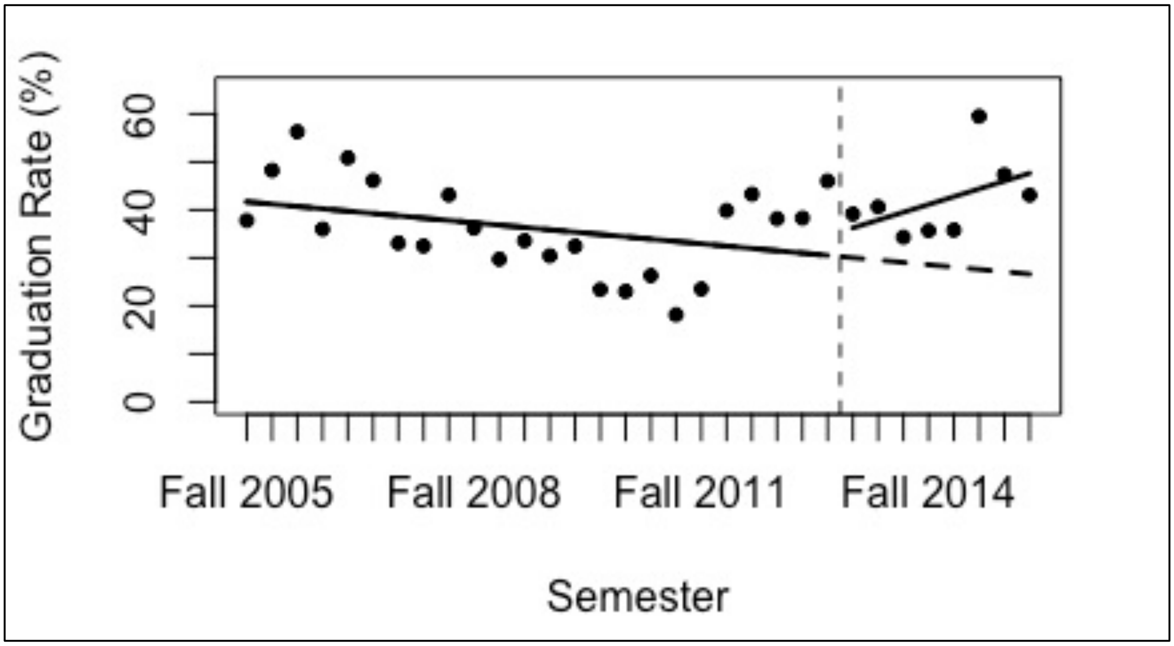


Figure 12. Level and trend of graduation rates for Allied Health from Fall 2005 to Spring 2016.

Table 8 and Figure 13 present the results of the regression model for the Business and Professions division. The initial level of the graduation rate in the current study was 14.5% for the division, and the trend was positive prior to the change to the Returned Value Funding model, increasing at 0.35% each term. The graduation rate level dropped after PBF by 2.4%, and the trend was a downward slope of -0.42% after Fall 2013. Neither the change in graduation rate level nor the change in the trend was statistically significant.

Table 8

Regression Model Summary for Business and Professions

	Value	Standard Error	*t* Value	*p* Value
Intercept	14.498	3.447	4.206	0.000
Semester	0.354	0.241	1.468	0.153
PBF	-2.401	7.149	-0.336	0.740
Trend	-0.424	1.285	-0.330	0.744

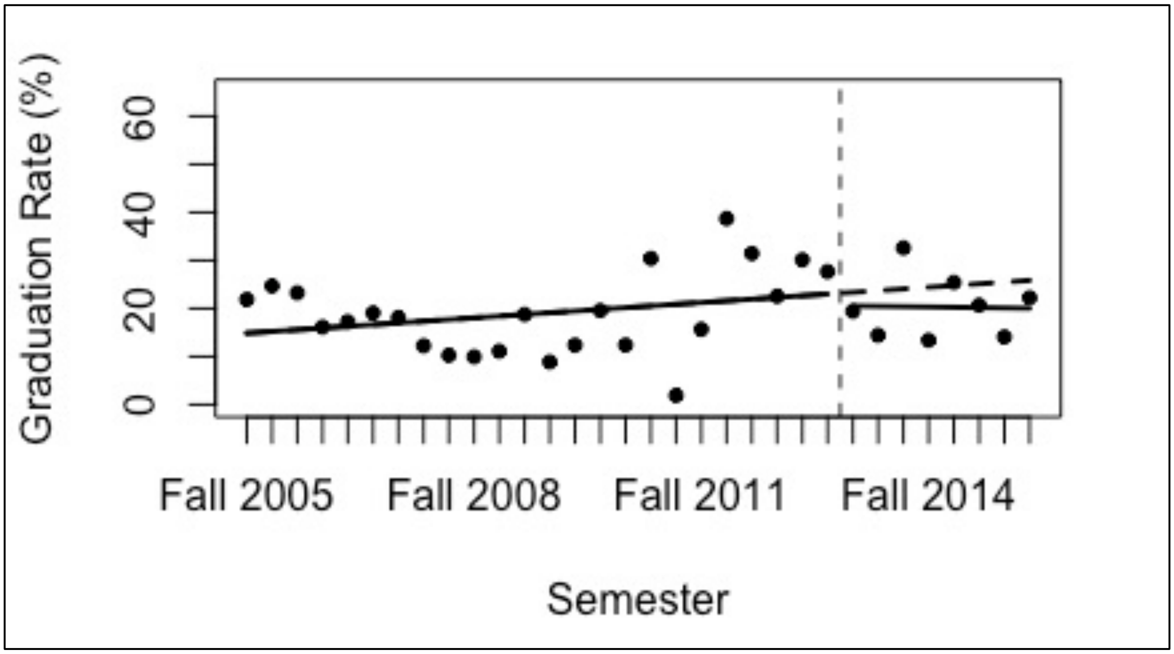


Figure 13. Level and trend of graduation rates for Business and Professions from Fall 2005 to Spring 2016.

The Computer and Information Systems division's initial graduation rate level was 14.85%, and the trend for the graduation rate before PBF was slightly downward at -0.06%. After the implementation of PBF in Fall 2013, the level improved by 1.72%, and the trend went up slightly, increasing by 0.11% per semester. The increases in the graduation rate level and trend after the change to the Returned Value Funding model were not statistically significant. Table 9 lists the results of the regression model for the Computer and Information Systems division, and Figure 14 displays the levels and trends before and after the implementation of the funding model.

Table 9

Regression Model Summary for Computer and Information Systems

	Value	Standard Error	*t* Value	*p* Value
Intercept	14.854	1.819	8.167	0.000
Semester	-0.060	0.127	-0.475	0.639
PBF	1.724	3.772	0.457	0.651
Trend	0.108	0.678	0.159	0.875

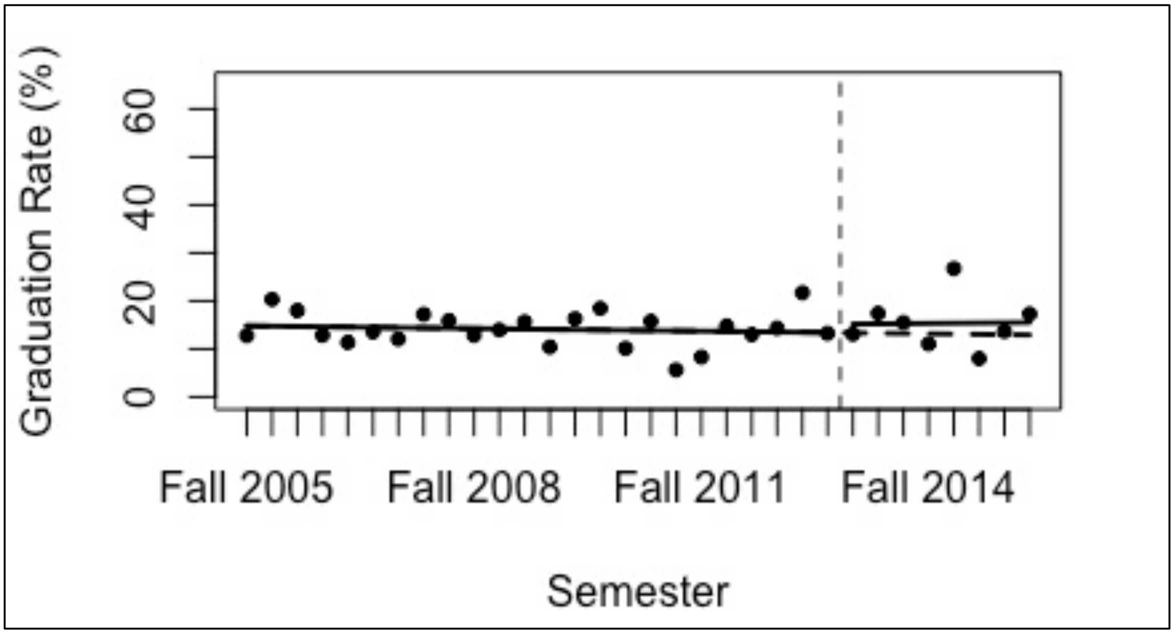


Figure 14. Level and trend of graduation rates for Computer and Information Systems from Fall 2005 to Spring 2016.

The Engineering and Electronics division had a positive graduation rate trend at the beginning of this study, with an increase of 0.59% per semester, and the initial level was 23.35%. However, the trend shifted to a decrease of -0.48% per term after the implementation of the Returned Value Funding model in Fall 2013, and after the beginning of PBF, the graduation rate level dropped 3.9%. The changes in the trend and level of graduation rates for the Engineering and Electronics division were not statistically significant. The output of the regression model is presented in Table 10, and Figure 15 displays the graph of the results.

Table 10

Regression Model Summary for Engineering and Electronics

	Value	Standard Error	*t* Value	*p* Value
Intercept	23.349	1.527	15.290	0.000
Semester	0.591	0.107	5.526	0.000
PBF	-3.974	3.168	-1.255	0.220
Trend	-0.482	0.569	-0.847	0.404

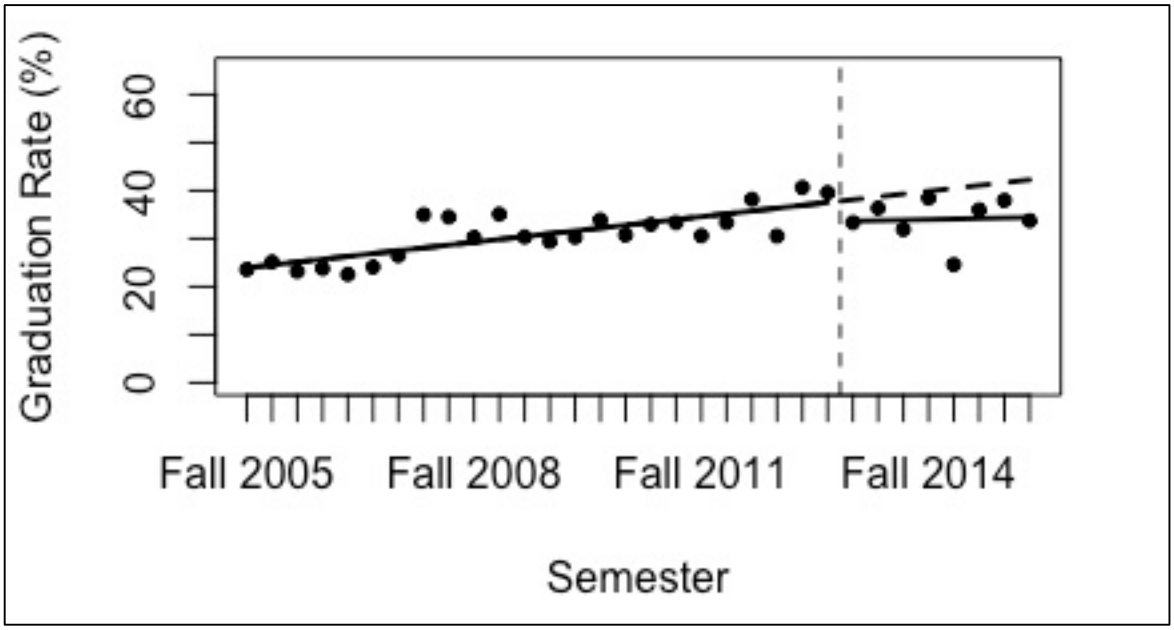


Figure 15. Level and trend of graduation rates for Engineering and Electronics from Fall 2005 to Spring 2016.

Table 11 lists the results of the regression model for the Environmental, Safety, and Natural Resources division, and the ITS plot for the division is shown in Figure 16. The graduation rate level for the division at the beginning of the study was 21.44%, and trend was positive, improving 0.34% per term. After the Returned Value Funding model was implemented, the graduation rate level went up by 16.04%, the largest post-PBF change of any division in this study. However, the increase was not sustained, and the graduation rate trend following PBF decreased by 4.10% per semester. The change in level was not statistically significant with a p value of 0.079, but the decline in the trend in graduation rates for the Environmental, Safety, and Natural Resource division was statistically significant. This result supported the alternative hypothesis for research question 2.

Table 11

Regression Model Summary for Environmental, Safety, and Natural Resources

	Value	Standard Error	*t* Value	*p* Value
Intercept	21.445	4.23	5.065	0.000
Semester	0.336	0.296	1.135	0.266
PBF	16.035	8.783	1.826	0.079
Trend	-4.101	1.579	-2.598	0.015

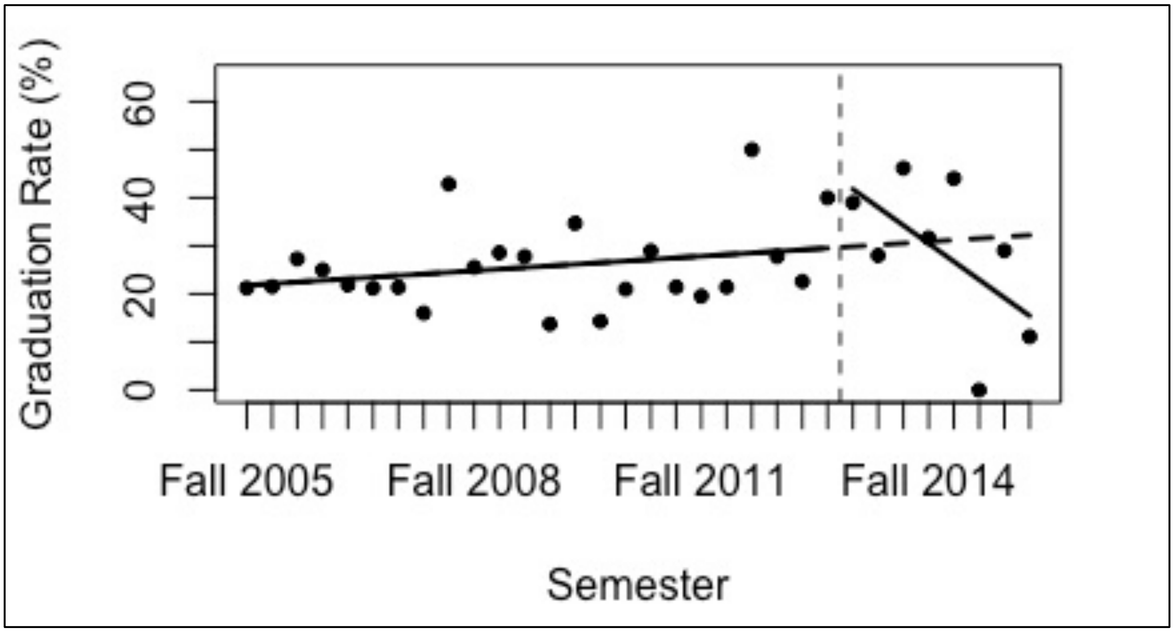


Figure 16. Level and trend of graduation rates for Environmental, Safety, and Natural Resources from Fall 2005 to Spring 2016.

The Industrial and Manufacturing division had the highest initial graduation rate level in the current study at 43.27%. The trend for the division decreased by 0.56% per term prior to the Returned Value Funding model. After PBF began in Fall 2013, the graduation rate level increased by 9.68%, and the graduation rate trend reversed, increasing by 1.11% each semester. Though the ITS analysis shows improvement in the graduation rate level and trend, the changes were not statistically significant. The regression model summary for the Industrial and Manufacturing division is listed in Table 12, and the graduation rate levels and trends for pre- and post-PBF are displayed in Figure 17.

Table 12

Regression Model Summary for Industrial and Manufacturing

	Value	Standard Error	*t* Value	*p* Value
Intercept	43.267	3.137	13.792	0.000
Semester	-0.560	0.220	-2.550	0.017
PBF	9.679	6.507	1.488	0.148
Trend	1.109	1.170	0.948	0.351

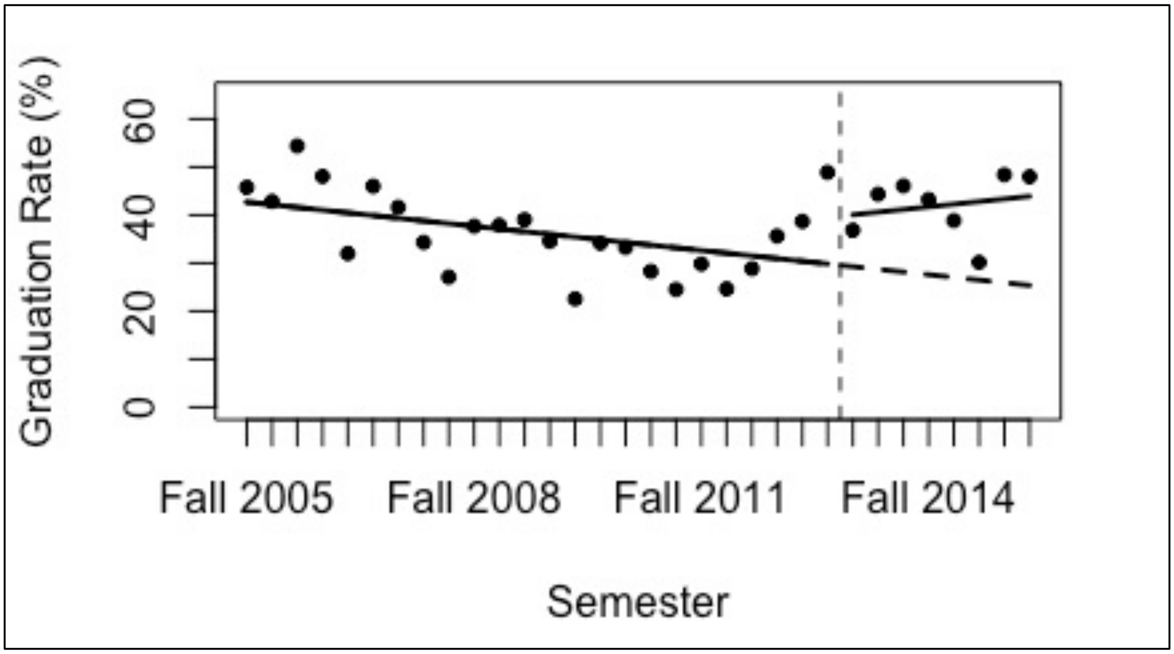


Figure 17. Level and trend of graduation rates for Industrial and Manufacturing from Fall 2005 to Spring 2016.

In the current study, the Transportation division had an initial graduation rate level of 19.76%, and the trend increased by 0.55% per term before Fall 2013. The level increased by 1.61% after the funding formula changes, the smallest change among the divisions in this study. Similarly, the graduation rate trend remained relatively consistent, increasing by only 0.17%. The changes in the graduation rate level and trend after the implementation of the Returned Value Funding model were not statistically significant, and the regression model summary and graph of the results are presented in Table 13 and Figure 18.

Table 13

Regression Model Summary for Transportation

	Value	Standard Error	*t* Value	*p* Value
Intercept	19.759	1.494	13.223	0.000
Semester	0.549	0.105	5.245	0.000
PBF	1.611	3.100	0.520	0.607
Trend	0.169	0.557	0.304	0.763

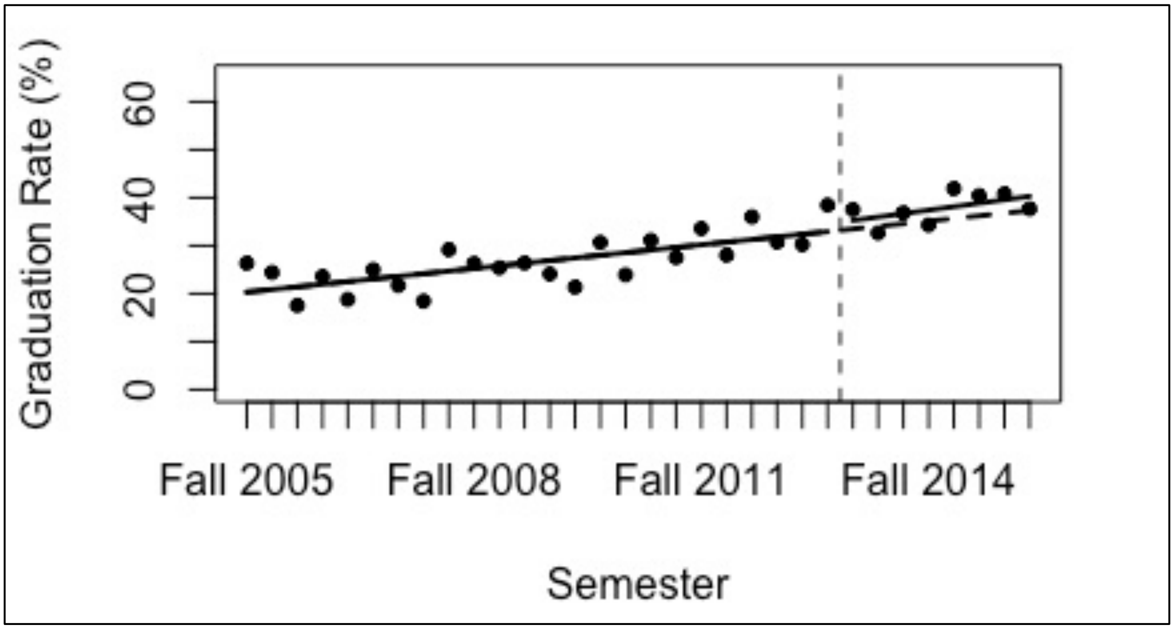


Figure 18. Level and Trend of Graduation Rates for Transportation from Fall 2005 to Spring 2016.

Summary

The current study evaluated the impact of PBF on the graduation rates at TSTC as a whole and by academic division, and the two statistical tests provided point-in-time and longitudinal evaluation of the samples studies. The first research question was focused on the effects of PBF on the entire institution. The two-tailed *z* test for proportions of the Fall 2005 to Fall 2013 and the Fall 2009 to Fall 2013 cohorts indicated that the changes in graduation rates for TSTC as whole after the implementation of Returned Value Funding model were not statistically significant. The ITS analysis for students who began in Fall 2005 through the Spring

2016 cohort also revealed no statistically significant changes in the graduation rate for the entire institution after the implementation of PBF before the Fall 2013 term. Therefore, the null hypothesis cannot be rejected for the first research question.

The second research question explored the impact of the implementation of the Returned Value Funding model in each academic division, repeating the statistical analyses for each academic division. The two-tailed *z* test for proportions identified a statistically significant decrease in the graduation rate in the Fall 2013 cohort of the Computer and Information Systems division when compared with a matched population of students from Fall 2005. None of the changes in graduation rates in the other academic divisions were statistically significant. The ITS analyses for each division indicated a statistically significant decrease in the graduation rate trend after the implementation of PBF in the Environmental, Safety, and Natural Resources division. None of the other changes in graduation rate levels or trends after the implementation of PBF were statistically significant. Because of the significant findings in the Computer and Information Systems and the Environmental, Safety, and Natural Resources divisions, the null hypothesis can be rejected for the second research question.

Chapter 5

Discussion

Since the implementation of performance-based funding (PBF) for higher education in the late 1970s, lawmakers and policy analysts have advocated for its use as a superior appropriation method over enrollment or activity-based formulas (Dougherty et al., 2011). PBF models link an institution's public funding, usually by the state legislature, to its attainment of predetermined metrics, usually student outcomes. Twenty-six states were using PBF by 2007, and most of these versions included additional appropriations for institutions that exceeded targets (Hermes, 2012). Researchers referred to these early models as PBF 1.0, and through these formulas, legislatures provided incentive funding without risking baseline funding (Doughtery et al., 2016; Lahr et al., 2014). Many states discontinued the use of PBF during the 2000s, but lawmakers began implementing a second generation of performance-based funding formulas, called PBF 2.0, in response to the economic downtown in the late 2000s (Dougherty et al., 2012). PBF 2.0 eliminated the bonus funding of PBF 1.0, broadened the number of metrics to include more intermediate measures, and placed more emphasis on degree productions (Friedel et al., 2013; McLendon & Hearn, 2013; Reddy, 2011). Many PBF 2.0 formulas also increased the percentage of institutions' budgets determined by performance metrics (Mullin et al., 2015).

Context for Study

In 2013, the 83rd Texas Legislature approved two performance-based funding formulas for its two-year colleges: the Success Points model for the community colleges, and the Returned Value Funding model for Texas State Technical College (TSTC). TSTC is a single institution with 10 campuses located throughout the state, enrolling approximately 14,000 students, and primarily offering Associate of Applied Science degrees and certificates to meet statewide workforce needs. The Returned Value Funding formula was developed in conjunction with college leadership, the Texas Workforce Commission, and the Texas Higher Education Coordinating Board. Referring to TSTC's mission of economic development and workforce development, the model uses the workplace earnings of TSTC students as its outcome, and the formula accounts for 100% of the recommended state appropriation. Thus, the Returned Value Funding model incorporated recommendations from prior research, including broader collaboration among stakeholders, alignment with institutional mission, and a high percentage of funding determined by the formula.

Methodology and Results

To determine if the Returned Value Funding model impacted completion rates at TSTC, the study incorporated two statistical tests to provide point-in-time and longitudinal views of graduation rates at the institution. Specifically, the study sought to answer the following research questions:

1. To what extent is there a statistically significant difference in the overall graduation rate at Texas State Technical College after the implementation of the Returned Value Fund Model when compared to the graduation rate prior to the implementation of the performance-based funding?
2. To what extent is there a statistically significant difference in graduation rate by academic divisions after the implementation of the Returned Value Funding Model when compared to the graduation rate prior to performance-based funding?

The two-tailed *z* test for proportions compared cohorts from Fall 2005 to Fall 2013 and Fall 2009 to Fall 2013. The 2005 and 2009 groups were selected as examples of graduation rates before the implementation of PBF, and Fall 2013 was the first cohort of students after the Returned Value Funding model. Using a matched sample method, students from Fall 2005 and Fall 2009 were matched to students from Fall 2013 based on demographic markers found by Hendricks (2000) to be the best predictors of graduation at TSTC. Only non-dual credit students who declared an Associate of Applied Science, Level 1 Certificate, or Level 2 Certificate were included in the sample, and each academic division listed in Appendix A was independently evaluated, as well as the institution as a whole. In all, 16 statistical analyses were conducted, eight for each matched set, to determine if any changes in graduation rates observed between the sets were statistically significant. For the 2005 to 2013 and 2009 to 2013 matched sets for the entire institution, the graduation rates decreased, but this difference was not statistically significant. The change in graduation rate in the Computer Information Systems division between Fall 2005 and Fall 2013 was the only statistically significant result, a decrease of 8.38%.

An interrupted time series (ITS) analysis was used to determine the statistical significance of any changes in the level or trend of graduation rates after the implementation of PBF at TSTC. As with the *z* test, the population included only non-dual credit students who declared an Associate of Applied Science, Level 1 Certificate, or Level 2 Certificate. The timeframe of the ITS tests extended from the Fall 2005 semester through students who graduated by the Summer 2017 semester. In addition to the statistical tables for each coefficient, the regression analyses were plotted for the institution as a whole and each academic division, with extensions of the pre-PBF trend lines included for comparison. The ITS tests revealed the levels and trends of graduations rates changed for the institution as a whole and for the academic divisions, but most of the impacts were not statistically significant. The only statistically significant change after the implementation of PBF was a decrease in the trend of the graduation rates for the Environmental, Safety, and Natural Resources division.

Findings Related to Prior Research

By 2015, 32 states were using PBF to fund public higher education, but the metrics and allocation percentages varied by state and, in some cases, by type of institution. Researchers studying PBF implementation found many college leaders opposed PBF because of their belief the formulas were ineffective and misaligned with institutional mission (Fryar et al., 2012; Huisman & Curry, 2004; Rabovsky, 2014). Studies also showed the opposition of educational administrators, political turnover, and budget shortfalls influenced legislatures in some states to discontinue PBF (Burke & Modarresi, 2001; Dougherty et al., 2012; Dougherty et al., 2016a). Researchers studying the impact of PBF models observed that because the models vary, comparison of outcomes among states was difficult and imprecise (Ewell & Jones, 2006; Hillman, Tandberg, & Fryar, 2015; Tandberg, 2008; Thornton & Friedel, 2016). Nonetheless, studies of PBF in Indiana, Ohio, Pennsylvania, and Tennessee found no evidence of improvement in graduation or retention rates (Dougherty et al., 2016b); Hillman et al., 2014; Shin, 2010; Umbricht et al., 2015). Mullin and Honeyman (2008) studied the PBF model used in Florida community colleges from 2005 to 2008 and found while institutional budgets increased, remedial and adult education programs decreased as colleges appeared to shift operations to activities with higher fiscal returns. A study of Washington's PBF formula for community and technical colleges revealed little impact on retention rates or associate degrees, but Hillman et al. (2015) did observe an increase in short-term certificates. Tandberg et al. (2014) examined the impact of PBF among 19 states from 1990 through 2010 and found little evidence of increased completion by community college students, and they noted that most formulas were designed to provide higher levels of funding for full-time students, though these students were the minority of the total enrollment. This finding was consistent with reports by Burke and Minassians (2003) and McKinney and Hagedorn (2015) which questioned the alignment of PBF with the demographics, operations, or missions of community colleges.

Discussion

The study of TSTC's Returned Value Funding model built upon the existing literature on the impact of PBF at the state level by examining a single institution within Texas, and further exploring the effect of PBF on individual academic divisions. The results of the two statistical tests addressed the research questions regarding graduation rates at TSTC as a whole and by academic division.

PBF Impact on Entire Institution. The first research question in this study focused on the impact of PBF on graduation rates at TSTC overall. Prior research found that PBF had little or no effect on graduation rates at a state level, but the literature review for this study did not reveal any studies on single institutions within a state using performance funding. In the current study, the matched samples of TSTC students from Fall 2005 and Fall 2009 graduated at a higher percentage than the corresponding matched samples from Fall 2013. These differences, 2.90% and 0.90% respectively, were not statistically significant, and they provided only a point-in-time examination of the impact of the Returned Value Funding model. The lower graduation rate in the Fall 2013 may be indicative of the TSTC's adjustment to PBF. This possibility is strengthened by the longitudinal results of the ITS study. Spanning 32 semesters, the analysis of the ITS for TSTC as a whole showed a level increase and positive trend in graduation rates after the implementation of PBF. The ITS analysis concurred with the z test finding that the Returned Value Funding model did not have a statistically significant impact on overall graduation rates at

TSTC. However, the graduation rate increased at a higher rate than the extension of the pre-implementation trend line, suggesting that the institution was improving in achieving the outcome goal of higher graduation rates. Nonetheless, growth in graduation rates at TSTC overall during the time period of the study was not statistically significant nor can it be attributed to the introduction of PBF.

PBF Impact on Academic Divisions. The second research question investigated the impact of PBF on related program groups. A review of the literature for this study did not find any research on individual institutions, and dialogue with other researchers indicated there were no studies of performance funding at the program level as well (M. D'Amico, personal communication, April 7, 2017; N. Hillman, personal communication, May 5, 2017). The two-tailed *z* test on the sets of 2005 to 2013 and 2009 to 2013 matched students in each academic division found mixed results, with most divisions decreasing in graduation rates. Similar to the institution as a whole, this drop in the graduation rate immediately after the implementation of PBF in 2013 may be indicative of the institution adapting to the new funding formula. The only statistically significant change was a decrease in the graduation rate from Fall 2005 to Fall 2013 for the Computer and Information Systems division. This division represented the largest number of matched sets (346) in the sample, and its 2013 graduation rate (17.05%) was the lowest among all divisions in the set. If the Computer and Information System division matches were removed from the Fall 2005 to Fall 2013 comparison, the graduation rate still decreased, but by 1.1% instead of 2.9%. Despite the division's large contribution to the total sample, it is noteworthy that difference in graduation rates for the 2005 to 2013 Computer and Information Systems matches would not have been statistical significant at the $p < 0.05$ level if only eight additional students had completed in the 2013 sample. Indeed, a long-term view of the graduation rates in the Computer and Information Systems (Figure 13) indicates little variation in graduation rates when compared to the point-in-time analysis of the *z* test.

When examining the ITS results and regression plots for each division, the changes in graduation rates after Fall 2013 become more apparent. While not statistically significant, the increases in the levels and reversal in trends of graduation rates for the Allied Health (Figure 11) and Industrial and Manufacturing (Figure 16) divisions suggest other factors affected graduation rates in those divisions. Those changes cannot be attributed to the implementation of the Returned Value Funding model, but they do indicate the institutional capacity to improve completion rates.

The ITS analysis for the Environmental, Safety, and Natural Resources division (Table 11) revealed an increase in the graduation rate level with a p value of 0.079. While not significant at the $p < 0.05$ level, this result is important when coupled with the impact of PBF on the division's graduation rate trend. The trend decreased at a statistically significant rate of greater than 4% per term for the seven semesters following the implementation of PBF in Fall 2013. This included zero graduates in the division from the Summer 2015 cohort, but even if the graduation rate that term had been equal to the intercept (21.45%), the trend would have remained significantly negative. This finding suggests the programs in the Environmental, Safety, and Natural Resources division were poorly suited to sustain higher graduation rates under the Returned Value Funding model or the division was operationally unable to fully adapt to PBF. In either case, the negative trend in this division is an example of the potential negative impact of PBF at the program level.

Overall, the impacts of the Returned Value Funding model on TSTC were mixed, but mostly null, not significantly impacting graduation rates at TSTC. These results are consistent with previous quantitative examinations of the impact of PBF on graduation rates. From early studies on the Tennessee model (Shin & Milton, 2004; Shin, 2010) to long-term studies of community colleges in multiple states (Tandberg et al., 2015), researchers have found that performance funding does not consistently improve graduation rates, and this study extends similar conclusions to the institutional and program levels. Researchers in previous studies made recommendations to improve outcomes of subsequent PBF formulas, and some of these suggestions were addressed in the Returned Value Funding model (Dougherty et al., 2011; Rabovsky, 2014). The current study found, however, the modifications also did not achieve the intended results at TSTC.

Recommendations

The Returned Value Funding model was implemented by the 83rd Texas Legislature in 2013, and this study established a baseline of results for TSTC. Though the results indicated limited impact, the institution should regularly update the regression analysis of graduation rates and conduct ongoing review of the outcomes. Continued examination at the division level will also help identify program areas with decreasing graduation rates before significant state funding is affected.

McKinney and Hagedorn (2015) identified the risk of using metrics in PBF formulas that do not account for at-risk populations, and unlike the Texas community college model, the Returned Value Funding design for TSTC includes no weight for different populations. Consistent with the resource dependency theory, the institution may begin to shift instructional and student services to favor students more likely to result in larger state appropriations. Policy makers and college leaders should incorporate revisions to the Returned Value Funding model to include incentives for TSTC to fully serve all eligible students in Texas based on their needs and contributions to the state economy.

Finally, there are two areas recommended for further research. First, the statistical analyses of this study examined TSTC as a single institution, and it did not differentiate among the campuses around the state or student demographics. Given the diverse geography and population of Texas, researchers should conduct a similar study at each TSTC location separately or by key student demographics, such as gender, ethnicity, or academic and economic disadvantage. Secondly, further study should inquire about the organizational changes at TSTC as a result of PBF. Researchers should consider a qualitative study to examine unintended consequences or employee perceptions, and would include TSTC faculty, staff, and administrators. The research by Thornton and Friedel (2016) provides an applicable framework for such a study.

Conclusion

Performance-based funding continues to evolve as policy advocates and lawmakers seek greater accountability for public investments in higher education. Early models that offered incentive funds for achieving goals have been replaced by formulas that require meeting targets for baseline funding. Some of the problems with PBF identified by prior research, such as lack of collaboration, inadequate funding, and alignment with mission, were addressed in the design of Returned Value Funding model implemented at TSTC in Fall 2013. Despite these improvements to the formula, this study showed PBF did not significantly impact graduation rates at the institution. While the goal of improved completions may be appropriate for TSTC, sustained and meaningful changes to two-year college graduation rates are more complex than a shift to an exclusive focus on outcomes. Ongoing research should inform future revisions to performance-based funding formulas to ensure that institutions are appropriately supported to fulfill their mission, creating opportunities for students to enroll, persist, advance, and complete a quality postsecondary education.

References

Alexander, F. A. (2000). The changing face of accountability: monitoring and assessing institutional performance in higher education. *Journal of Higher Education, 71*(4), 411-431.

Altstadt, D. (Ed.). (2012). *Tying funding to community college outcomes: Models, tools, and recommendations for states*. Boston, MA: Jobs for the Future.

American Association of Community Colleges. (2016). Fast facts from our fact sheet. Retrieved from http://www.aacc.nche.edu/AboutCC/Pages/fastfactsfactsheet.aspx

American Recovery and Reinvestment Act, 26 U.S.C. §§ 1-3 (2009).

Baime, D., & Baum, S. (2016, August). *Community colleges: Multiple missions, diverse student bodies, and a range of policy solutions.* Washington, DC: Urban Institute.

Biglan, A., Ary, D., & Wagenaar, A. C. (2000). The value of time-series experiments for community intervention research. *Prevention Science: The Official Journal of the Society for Prevention Research, 1*(1), 31-49.

Bailey, T. R., Jaggars, S. S., & Jenkins, D. (2015). *Redesigning America's community colleges: A clearer path to student success*. Cambridge: Harvard University Press.

Blankenberger, B., & Phillips, A. (2016). Performance funding in Illinois higher education: The roles of politics, budget environment, and individual actors in the process. *Educational Policy, 30*(6), 884-915.

Bloom, H. S. (1999). Estimating program impacts on student achievement using short interrupted time series. *MRDC*, 1-29. Retrieved from http://mdrc.org/sites/default/files/full_92.pdf

Bloom, H. S. (2016). *A short comparative interrupted time-series analysis of the impacts of jobs-plus* [PDF document]. Retrieved from http://www.opremethodsmeeting.org/docs/2016/Bloom_AShortComparative.pdf

Burke, J. C., Minassians, H. P., & Nelson, A. (2003). *Performance reporting: "Real" accountability or accountability "lite". Seventh annual survey 2003.* Albany, NY: Nelson A. Rockefeller Institute of Government.

Burke, J. C., & Minassians, H. P. (2004). Implications of state performance indicators for community college assessment. *New Directions for Community Colleges,* 126, 53-64.

Burke, J. C., & Modarresi, S. (2000). To keep or not to keep performance funding: Signals from stakeholders. *Journal of Higher Education, 71*(4), 432-453.

Burke, J. C., & Modarresi, S. (2001). Performance funding programs: assessing their stability. *Research in Higher Education, 42*(1), 51-70.

Callahan, K., Meehan, K., & Shaw, K. M. (2017, February). *Implementation and impact of outcomes-based funding in three states: High-level findings.* Philadelphia: Research for Action.

Callahan, M. K., Meehan, K., Shaw, K. M., Slaughter, A., Kim, D. Y., Hunter, V. R., Lin, J., Wainstein, L. (2017a, July). *Implementation and impact of outcomes-based funding in Indiana.* Philadelphia: Research for Action.

Callahan, M. K., Meehan, K., Shaw, K. M., Slaughter, A., Kim, D. Y., Hunter, V. R., Lin, J., Wainstein, L. (2017b, July). *Implementation and impact of outcomes-based funding in Tennessee.* Philadelphia: Research for Action.

Cavanaugh, J. C., & Garland, P. (2012, May/June). Performance funding in Pennsylvania. *Change*, 34-39.

D'Amico, M. M., Friedel, J. N., Katsinas, S. G., & Thornton, Z. M. (2014). Current developments in community college performance funding. *Community College Journal of Research and Practice*, *38*(2-3), 231–241. doi:10.1080/10668926.2014.851971

Delaney, J. A., & Doyle, W. R. (2011). State spending on higher education: Testing the balance wheel over time. *Journal of Education Finance, 36*(4), 343-368.

Dougherty, K. J., Jones, S. M., Lahr, H., Natow, R. S., Pheatt, L., Reddy, V. (2016a). Looking inside the black box of performance funding for higher education: Policy instruments, organizational obstacles, and intended and unintended impacts. *The Russell Sage Foundation Journal of the Social Sciences, 2*(1), 146-173.

Dougherty, K. J., Jones, S. M., Lahr, H., Natow, R. S., Pheatt, L., Reddy, V. (2016b). *Performance funding for higher education* [Kindle version]. Baltimore: Johns Hopkins Press.

Dougherty, K., Jones, S., & Natow, R. (2014). *Envisioning performance funding impacts: The espoused theories of action for state higher education performance funding in three states. Working paper 63*. New York: Community College Research Center.

Dougherty, K., Natow, R., Hare, R., & Jones, S. (2011, February). *The politics of performance funding in eight states: Origins, demise, and change*. *Final report to the Lumina Foundation for Education*. New York: Community College Research Center.

Dougherty, K. J., Natow, R. S., Bork, R. H., Jones, S. M., & Vega, B. E. (2013). Accounting for higher education accountability: political origins of state performance funding for higher education. *Teachers College Record*, *115*(010305), 1–50.

Dougherty, K. J., Natow, R., & Vega, B. (2012). Popular but unstable: Explaining why state performance funding systems in the United States often do not persist. *Teachers College Record*, *114*(030301), 1–41.

Dougherty, K., & Reddy, V. (2011). *The impacts of state performance funding systems on higher education institutions: Research literature review and policy recommendations. Working paper 37*. New York: Community College Research Center.

Dougherty, K., & Reddy, V. (2013). Performance funding: Nature and forms. *ASHE Higher Education Report, 39*(2), 1-134.

Ewell, P. T., & Jones, D. P. (2006). State-level accountability for higher education: On the edge of transformation. *New Directions for Community Colleges, 135*, 9-17.

Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (1993). *How to design and evaluate research in education* (Vol. 7). New York: McGraw-Hill.

Friedel, J. N., Thornton, Z. M., D'Amico, M. M., & Katsinas, S. G. (2013, September). Performance-based funding: The national landscape. *Education Policy Center*, 1-20.

Fryar, A. H., Rabovsky, T., & Moynihan, D. P. (2012). Examining perceptions of accountability policies. Paper presented at the Annual Political Science Association Conference, New Orleans, LA.

Gilbert, C. K., & Heller, D. E. (2013). Access, equity, and community colleges: The Truman Commission and federal higher education policy from 1947 to 2011. *The Journal of Higher Education, 84*(3), 417-443.

Glass, G. V. (1997). Interrupted time series quasi-experiments. In R. M. Jaeger (Ed.), *Complementary methods for research in higher education, 2,* 589-608. Washington, DC: American Educational Research Association.

Godfrey, K. E. (2016). *Creating matched samples using exact matching.* New York: The College Board.

Hansen, B. B. (2004). Full matching in an observational study of coaching for the SAT. *Journal of the American Statistical Association, 99*(467), 609-618.

Harbour, C. P., & Nagy, P. (2006). Assessing a state-mandated institutional accountability program: The perceptions of selected community college leaders. *Community College Journal of Research and Practice, 29*(6), 445-461.

H.B. 1. (2011). General Appropriations Act by the 82nd Texas Legislature, Regular Session.

H.B. 1. (2015). General Appropriations Act by the 84th Texas Legislature, Regular Session.

H.B. 9. (2011). An Act by the 82nd Texas Legislature, Regular Session.

Hendricks, J. G. (2000). *An analysis of student graduation trends in Texas State Technical Colleges utilizing data mining and other statistical techniques.* (Doctoral dissertation). Retrieved from ProQuest Dissertations & Theses Global. (304584411)

Hermes, J. (2012). States trend toward performance funding. *Community College Journal, February/March,* 26-29.

Higher Education Opportunity Act of 2008, 20 U.S.C. §§ 1001-1125 (2008).

Hillman, A. J., Withers, M. C., & Collins, B. J. (2009). Resource dependence theory: A review. *Journal of Management, 35*(6), 1404-1427.

Hillman, N. (2016, May 25). *Why performance-based college funding doesn't work.* The Century Foundation. Retrieved from https://tcf.org/content/report/why-performance-based-college-funding-doesnt-work/

Hillman, N. W., Tandberg, D. A., & Fryar, A. H. (2015). Evaluating impacts of "new" performance funding in higher education. *Educational Evaluation and Policy Analysis, 37*(4), 501-519.

Hillman, N., Tandberg, D., & Gross, J. (2014). Performance funding in higher education: Do financial incentives impact college completions? *Journal of Higher Education*, *85*(6), 826–857. doi:10.1353/jhe.2014.0031

Ho, D. E., Imai, K., King, G., & Stuart, E. A. (2007). Matching as nonparametric preprocessing for reducing model dependence in parametric causal inference. *Political Analysis, 15*, 199-236.

Huisman, J., & Currie, J. (2004). Accountability in higher education: Bridge over troubled water? *Higher Education, 48*(4), 529-551.

Illinois State. (2015). Fiscal support for higher education, by state, fiscal years 2009-10, 2012-13, 2013-14, and 2014-15. Retrieved from education.illinoisstate.edu/grapevine/tables/

Jaquette, O. (2006). *Making performance accountability work: English lessons for U.S. community colleges. An achieving the dream policy brief.* Boston, MA: Jobs for the Future.

Jenkins, D., Ellwein, T., & Boswell, K. (2009). *Formative evaluation of the student achievement initiative "learning year": Report to the Washington State Board of Community and Technical Colleges and College Spark Washington.* New York: Community College Research Center.

Jones, D. (2012). *Performance funding: From idea to action.* Washington, DC: Complete College America.

Jones, S. M., Dougherty, K. J., Lahr, H., Natow, R. S., Pheatt, L, & Reddy, V. (2015). *Organizational learning by colleges responding to performance funding: Deliberative structures and their challenges.* New York: Community College Research Center.

Jones, T. (2014). *Performance funding at MSIs: Considerations and possible measures for public minority serving institutions.* Atlanta: Southern Education Foundation.

Juszkiewicz, J. (2014, April). *Community college students and federal student financial aid: A primer.* Washington, DC: American Association of Community Colleges.

Kadlec, A., & Shelton, S. (2015, November). Outcomes-based funding and stakeholder engagement. *Lumina Foundation for Education.* Retrieved from https://eric.ed.gov/?id=ED561303

Kelchen, R. K., & Stedrak, L. J. (2016). Does performance-based funding affect college's financial priorities? *Journal of Education Finance, 41*(3), 302-321.

King, G. & Nielsen, R. (2016). Why propensity scores should not be used for matching. *Harvard Institute for Quantitative Science, Paper 481.* Retrieved from https://gking.harvard.edu/files/gking/files/psnot.pdf

Lahr, H., Dougherty, K. J., & Natow, R. S. (2014). *Unintended impacts of performance funding on community colleges and universities in three states. Working paper 78*. New York: Community College Research Center.

Legislative Budget Board. (2016). *Financing public higher education in Texas.* Legislative Primer Report – ID: 3148. Austin, TX: Legislative Budget Board Staff.

Lewis, J. M. (2015). The politics and consequences of performance measurement. *Policy and Society, 34*, 1-2.

Li, A. Y. (2017). Covet thy neighbor or “reverse policy diffusion”? State adoption of performance funding 2.0. *Research in Higher Education,* 1-26.

McDowall, D. (1980). *Interrupted time series analysis (vol. 21).* Thousand Oaks, CA: Sage.

McKeown-Moak, M. P. (2013). The “new” performance funding in higher education. *Educational Considerations*, *40*(2), 3–12.

McKinley, W., & Mone, M. A. (2003). Micro and macro perspectives. In H. Tsoukas & C. Knudsen (Eds.), *The Oxford Handbook of Organizational Theory* (pp. 345-372). New York: Oxford University Press.

McKinney, L., & Hagedorn, L. S. (2015). *Performance-based funding for community colleges in Texas: Are colleges disadvantaged by serving the most disadvantaged students?* Bryan, TX: Greater Texas Foundation.

McLendon, M. K., & Hearn, J. C. (2013). The resurgent interest in performance-based funding for higher education. *Academe, 99*(6), 6-9.

McLendon, M. K., Hearn, J. C., & Deaton, R. (2006). Called to account: Analyzing the origins and spread of state performance-accountability policies for higher education. *Educational Evaluation and Policy Analysis*, *28*(1), 1–24.

McLendon, M. K., Tuchmayer, J. B., & Park, T. J. (2009). State policy climates for college student success: An analysis of state policy documents pertaining to college persistence and completion. *Journal of College Student Retention, 11*(1), 33-56.

Measuring Up. (2008). *About measuring up.* Retrieved from http://measuringup2008.highereducation.org/about/index.php

Miao, K. (2012). Performance-based funding of higher education: A detailed look at best practices in 6 states. *Center for American Progress*. Retrieved from http://cdn.americanprogress.org/wp-content/uploads/issues/2012/08/pdf/performance_funding.pdf

Morgan, S. L., & Harding, D. J. (2005). Matching estimators of causal effects: From stratification and weighting to practical data analysis routines. *Unpublished manuscript, Department of Sociology, Cornell University*. Retrieved from https://www.researchgate.net/profile/David_Harding6/publication/228655677_Matching_estimators_of_causal_effects_From_stratification_and_weighting_to_practical_data_analysis_routines/links/55d369d708ae0a341722676a.pdf

Mullin, C. M. (2010, September). *Doing more with less: The inequitable funding of community colleges: Policy brief 2010-03PBL*. Washington, DC: American Association of Community Colleges.

Mullin, C. M., Baime, D. S., & Honeyman, D. S. (2015). *Community college finance*. San Francisco: John Wiley & Sons, Inc.

Mullin, C. M., & Honeyman, D. S. (2008). *The funding of community colleges: Formulas and governance, 32*(7), 512-524.

National Association of State Budget Officers. (2014). *Fiscal survey of states, fall 2014.*

National Association of State Budget Officers. (2017). *State expenditure report.* Retrieved from https://www.nasbo.org/mainsite/reports-data/state-expenditure-report

National Center for Education Statistics. (2016, December). *Graduation Rates*. Retrieved from https://nces.ed.gov/pubs2017/2017046.pdf

National Center for Education Statistics. (2017). Classification of instructional programs. Retrieved from https://nces.ed.gov/ipeds/cipcode/Default.aspx?y=55

National Conference of State Legislatures. (2015). *Performance-based funding for higher education.* Retrieved from http://www.ncsl.org/research/education/performance-funding.aspx

Nisar, M. A. (2015). Higher education governance and performance-based funding as an ecology of games. *Higher Education, 69*(2), 289-302.

Pfeffer, J., & Salancik, G. R. (2003). *The external control of organizations: A resource dependence perspective.* Stanford, CA: Stanford University Press.

Rabovsky, T. (2012). Accountability in higher education: Exploring impacts on state budgets and institutional spending patterns. *Journal of Public Administration Research and Theory, 22*(4), 675-700.

Rabovsky, T. (2014). Support for performance-based funding: The role of political ideology, performance, and dysfunctional information environments. *Public Administration Review, 74*(6), 761-774.

Randolph, J. J., Falbe, K., Manuel, A. K., Balloun, J. L. (2014). A step-by-step guide to propensity matching in R. *Practical Assessment, Research & Evaluation, 19*(18), 1-6.

Rutherford, A., & Rabovsky, T. (2014). Impacts of performance funding policies on student outcomes in higher education. *The Annals of the American Academy, 655*(1), 185-208.

Sanford, T., & Hunter, J. M. (2011). Impact of performance-funding on retention and graduation rates. *Education Policy Analysis Archives*, *19*(33), 1-30.

S.B. 1. (2009). General Appropriations Act by the 81st Texas Legislature, Regular Session.

Shin, J. C. (2010). Impacts of performance-based accountability on institutional performance in the U.S. *Higher Education, 60*(1), 47-68.

Shin, J., & Milton, S. (2004). The effects of performance budgeting and funding programs on graduation rate in public four-year colleges and universities. *Educational Policy Analysis Archives, 12*(22), 1-26.

Shulock, N. (2011). *Concerns about performance-based funding and ways that states are addressing the concerns*. Institute for Higher Education Leadership & Policy IHELP Brief. Sacramento: California State University. Retrieved from http://archive.sheeo.org/annualmeeting/Concerns%20About%20Performance-based%20Funding.pdf

Somers, M., Zhu, P., Jacob, R., & Bloom, H. (2013). The validity and precision of the comparative interrupted time series design and the difference-in-difference design in educational evaluation. *MRDC,* 1-140.

Stauffer, A., & Oliff, P. (2015, June). Federal and state funding of higher education. *Pew Charitable Trusts.* Retrieved from http://www.pewtrusts.org/en/research-and-analysis/issue-briefs/2015/06/federal-and-state-funding-of-higher-education

Steiner, P. M., & Cook, D. (2013). Matching and propensity scores. In T. D. Little (Ed.), *Volume 1 of the Oxford handbook of quantitative methods in psychology* (pp. 237-259). New York: Oxford University Press.

Stuart, E. A. (2010). Matching methods for causal inference: A review and look forward. *Statistical Science, 25*(1), 1-21.

Stuart, E. A., & Rubin, D. B. (2008). Best practices in quasi-experimental designs. In J. W. Osborne (Ed.), *Best practices in quantitative methods* (pp. 155-176). Thousand Oaks, CA: Sage.

Student Right to Know Act, 20 U.S.C. § 1092 (1990).

Tandberg, D., Hillman, N., & Barakat, M. (2014). State higher education performance funding for community colleges: diverse effects and policy implications. *Teacher's College Record*, *116*, 1–31.

Texas Education Code §130 (2017).

Texas Education Code §135, Texas State Technical College System (2017).

Texas Higher Education Coordinating Board (2010). *Formula funding recommendations 2012-2013 biennium*. Retrieved from http://www.thecb.state.tx.us/reports/pdf/2020.PDF

Texas Higher Education Coordinating Board (2013). *Texas State Technical College system returned value funding model methodology*. Retrieved from http://www.thecb.state.tx.us/reports/pdf/3207.pdf

Texas Higher Education Coordinating Board. (2015a). *Guidelines for instructional programs in workforce education*. Retrieved from http://www.thecb.state.tx.us/reports/DocFetch.cfm?DocID=3378&format=pdf

Texas Higher Education Coordinating Board. (2015b). *Success points data flow.* Retrieved from http://www.txhighereddata.org/interactive/accountability/ SuccessPoints.pdf

Texas Higher Education Coordinating Board (2016a). *Formula funding*. Retrieved from http://www.thecb.state.tx.us/index.cfm?objectid=4EA741D3-C76D-FBC5-04F664C233E8802B

Texas Higher Education Coordinating Board. (2016b). *An overview of formula funding*. Retrieved from http://www.thecb.state.tx.us/reports/xls/3582.xlsx

Texas Higher Education Coordinating Board. (2016c). *Texas higher education data*. Retrieved from http://www.txhighereddata.org/

Texas Higher Education Coordinating Board. (2016d). *Reporting and procedures manual for Texas community, technical, and state colleges.* Retrieved from http://www.thecb.state.tx.us/reports/DocFetch.cfm?DocID=8572&Format=PDF&Confirmed=1

Texas Higher Education Coordinating Board. (2017). *Higher education accountability system*. Retrieved from http://www.txhighereddata.org/Interactive/Accountability/InteractiveMain.cfm

Texas State Technical College. (2015, January). *Report to the 84th Texas legislature: Returned-value funding formula.* Waco: Texas State Technical College

Texas State Technical College. (2016). *Texas State Technical College history.* Retrieved from http://tstc.edu/about/history

The White House. (2013, February 12). President Barak Obama's State of the Union address as prepared for delivery. Retrieved from https://obamawhitehouse.archives.gov/the-press-office/2013/02/12/president-barack-obamas-state-union-address-prepared-delivery

Thornton, Z. M., & Friedel, J. N. (2016). Performance-based funding: State policy influences on small rural community colleges. *Community College Journal of Research and Practice, 40*(3), 188-203.

U.S. Department of Education. (2011). *College completion tool kit*. Retrieved from https://www.ed.gov/sites/default/files/cc-toolkit-accessible.doc

U.S. Office of the President. (2013). *Fact sheet on the President's plan to make college more affordable: A better bargain for the middle class.* Retrieved from https://obamawhitehouse.archives.gov/the-press-office/2013/08/22/fact-sheet-president-s-plan-make-college-more-affordable-better-bargain-

Umbricht, M. R., Fernandez, F., & Ortagus, J. C. (2015). An examination of the (un)intended consequences of performance funding in higher education. *Educational Policy,* 1-31.

Volkwein, J. F., & Tandberg, D. A. (2007). Measuring up: Examining connections among state structural characteristics, regulatory practices, and performance. *Research in Higher Education, 49*(2), 180-197.

Wagner, A. K., Soumerai, S. B., Zhang, F., Ross-Degnan, D. (2002). Segmented regression analysis of interrupted time series studies in medication use research. *Journal of Clinical Pharmacy and Therapeutics,* 27, 299-309.

Zumeta, W. (1995). State policy and budget developments: Small gains on the fiscal front but clouds continue to build. In H. Wechsler (Ed.), *The NEA 1995 Almanac of Higher Education* (pp. 73-96). Washington, DC: National Education Association.

APPENDICES

Appendix A: Academic Divisions and Related Programs

Academic Divisions	Related Program
Allied Health	Certified Nurse Assistant
	Chemical Dependency Counseling
	Dental Assistant
	Dental Laboratory Technology
	Dental Hygiene
	Emergency Medical Technology
	Health Information Technology
	Licensed Vocational Nurse
	Massage Therapy
	Medical Assistant
	Medical Insurance Coding
	Pharmacy Technician
	Registered Nurse
	Surgical Technology
Business and Professions	Accounting Technician
	Administrative Assistant and Secretarial
	Business Management Technology
	Culinary Arts
	Data Entry
	Education and Training
	Legal Secretary
	Logistics Technology
	Office Supervision and Management
	Professional Office Technology
	Software and Business Management Accounting
	Technical/Business Writing
Computer and Information Systems	Animation, Graphics, and Special Effects Technology
	Cloud and Data Center Computing Technology
	Commercial Advertising and Arts Technology
	Computer and Information Systems Security Technology
	Computer Installation Technology
	Computer Maintenance Technology
	Computer Networking and Systems Administration
	Computer Programming Technology

	Computer Science Technology
	Computer Support Technology
	Cyber Security Technology
	Database and Web Programming Technology
	Digital Media Technology
	E-commerce Technology
	Gaming and Simulation Programming
	Graphic Design Technology
	Information Science and Systems Technology
	Instructional Media Design Technology
	Network Information Management Technology
	Software Development Technology
	System, Networking, and LAN/WAN Management Technology
	Web Design and Development Technology
	Visual Communications Technology
Engineering and Electronics	Architectural Drafting and Design Technology
	Biomedical Equipment Technology
	Cartography Drafting Technology
	Drafting and Design Technology
	Electrical Power and Controls Technology
	Electromechanical Technology
	Electronic Communications Technology
	Electronics Technology
	Energy Management Technology
	Engineering Analysis and Design Technology
	Industrial Controls Technology
	Instrumentation Technology
	Laser Electro-Optics Technology
	Mechanical Engineering Technology
	Mechatronics Technology
	Process Operations Technology
	Robotics Technology
	Surveying Technology
	Telecommunications Technology
Environmental, Safety, and Natural Resources	Agriculture Technology
	Chemical Technology
	Environmental Technology
	Horticulture Service Technology
	Nuclear Power Technology
	Occupational Safety Compliance
	Radiation Protection Technology
	Solar Energy Technology

	Turfgrass and Landscape Management
Industrial and Manufacturing	Construction Electrician Technology
	Construction Technology
	Electrical Lineworker Technology
	HVAC Technology
	Industrial Maintenance Technology
	Industrial Systems Technology
	Plumbing Technology
	Precision Machining Technology
	Tool and Die Technology
	Welding Technology
Transportation	Air Traffic Controller
	Aircraft Airframe Technology
	Aircraft Dispatch Technology
	Aircraft Pilot Training
	Aircraft Powerplant Technology
	Auto Collision Technology
	Automotive Technology
	Aviation Management Technology
	Avionics Technology
	Diesel Equipment Technology

Appendix B: RStudio Code for Interrupted Time Series

```
#ITS Dissertation Code

# Convert rate decimal to percentage
data$rate <- data$rate * 100

# Plot outcome variable versus time
plot(data$semester,data$rate,
    ylab="Graduation Rate (%)",
    ylim=c(0,65),
    xlab="Semester",
    type="l",
    col="black",
    xaxt="n")

# Add x-axis year labels
axis(1, at=1:32, labels=data$term)

# Add in the points for the figure
points(data$semester,data$rate,
     col="black",
     pch=20)

# Label the time of change to PBF
abline(v=24.5,lty=2)

# Preliminary OLS regression
model_ols <- lm(rate ~ semester + PBF + trend, data=data)
summary(model_ols)
confint (model_ols)

# Durbin-watson test
dwt(model_ols,max.lag=3,alternative="two.sided")

# Graph the residuals from the OLS regression to check for serially correlated errors
plot
(data$semester,
    residuals(model_ols),
    type='o',
    pch=16,
    xlab='Semester',
    ylab='OLS Residuals',
    col="red")
abline(h=0,lty=2)
```

```
# Plot ACF and PACF
# Set plotting to two records on one page
par(mfrow=c(1,2))

# Produce plots
acf(residuals(model_ols))
acf(residuals(model_ols),type='partial')

########################
# Plot results
#########################

# First plot the raw data points for the Graduation Rate
plot(data$semester[1:32],data$rate[1:32],
     ylim=c(0,65),
     ylab="Graduation Rate (%)",
     xlab="Semester",
     pch=20,
     col="black",
     xaxt="n")

# Add x-axis year labels
axis(1, at=1:32, labels=data$term[1:32])
# Label the policy change Fall 2013
abline(v=24.5,lty=2)

# Plot the first line segment for the intervention group
lines(data$semester[1:24], fitted(model_ols)[1:24], col="black",lwd=2)

# Add the second line segment for the intervention group
lines(data$semester[25:32], fitted(model_ols)[25:32], col="black",lwd=2)

# Add the counterfactual for the intervention group
segments(1,
         (model_ols$coefficients[1] + model_ols$coefficients[2]),32,
         (model_ols$coefficients[1] +model_ols$coefficients[2]*32),
         lty=2,
         lwd=2,
         col="black")
```

VITA

Adam C. Hutchison

Education

- Ph.D., Community College Leadership, Old Dominion University, 2018
- M.A., Management and Leadership, Liberty University, 2012
- B.S., Missionary Aviation, Bob Jones University, 1996
- A.A.S., Aviation Maintenance, Bob Jones University, 1995

Professional Experience

- Provost, Texas State Technical College, April 2016-present
- Associate Vice Chancellor & Executive Academic Officer, Texas State Technical College, 2014-2016
- Provost & Vice President for Student Learning, Texas State Technical College, 2011-2014
- Adjunct Faculty, University of Houston, 2012-2013
- Chief of Staff, Texas State Technical College, 2008-2011
- Vice President for Workforce Development, Texas State Technical College, 2006-2008
- Department Chair, Aviation Maintenance Technology, Texas State Technical College, 2002-2006
- Senior Instructor, Aviation Maintenance Technology, Texas State Technical College, 2000-2002

Professional Service

- On-Site Committee Chair, Southern Association of Colleges and Schools Commission on Colleges (SACSCOC), 2017
- Academic Peer Evaluator, On-Site Committee, SACSCOC, 2013-2016
- Institutional SACSCOC Liaison, Texas State Technical College, 2016-2017
- Institutional Liaison, Texas Higher Education Coordinating Board, 2015-present
- Quality Enhancement Plan Evaluator, On-Site Committee, SACSCOC, 2014-2015
- Heart of Texas Council of Governments Economic Development District Committee Member, 2016-present
- Greater Waco Chamber of Commerce Education Sub-Committee Co-Chair, 2016-present
- Advisory Member, Waco Business League
- Treasurer, Tropical Texas Regional Center for Innovation and Commercialization, Texas Emerging Technology Fund, 2013

- Executive Board Member, Tech Prep of the Rio Grande Valley, 2012-2013
- Co-Chair, Lower Rio Grande Valley P-16 Council, 2012-2013
- Member, Texas Higher Education Coordinating Board Perkins Program of Study Strategic Planning Committee

Professional Presentations and Publications

- Hutchison, A. (February, 2016). Block scheduling for technical education. Presented at the Texas Higher Education Coordinating Board quarterly meeting, Austin, TX.
- Hutchison, A., & Massey, K. (April, 2015). The perks and perils of system-wide curriculum alignment. Presented at the 2015 Texas Association of College Technical Educators, Austin, TX.
- Hutchison, A. (March, 2013). Legislative testimony, select committee on health care education and training. Texas House of Representatives, Austin, TX.
- Bettersworth, M., Hutchison, A., & Reeser, M. (December, 2013). Competency, credit, and careers: Aligning curricula with employer needs. Presented at the Texas Workforce Commission annual conference, Dallas, TX.
- Hutchison, A., & Maldonado, C. (May, 2010). Strategic alignment for organizational leadership. Presented at National Institute for Staff and Organizational Development, Austin, TX.