EFFECTS OF PERFORMANCE-BASED FUNDING ON OHIO'S PUBLIC COMMUNITY COLLEGES

by

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ABSTRACT

With increased scrutiny on lackluster graduation rates and large debt-loads for students, state policymakers are searching for ways of improving the efficiency and effectiveness of higher education. Instead of traditional funding based solely on the total number of students enrolled in classes, states are shifting to a performance-based model that emphasizes student outcomes and prioritizes results. Performance-based funding is a system that allocates funds to higher education institutions based on their performance relative to pre-determined measures such as course completion, degree attainment, and credit accrual rather than a simple formula that relies only on enrollment. Some policymakers and state legislators suggest that performance-based funding (PBF) is an effective method that can hold institutions accountable for student success outcomes and demonstrate the positive influences they are having on students. However, there are concerns regarding whether PBF has the desired positive impact on improving student outcomes.

This quantitative research study utilizes an interrupted time series analysis (ITSA) to evaluate the impact of PBF on certificate and degree completion at Ohio's 23 public community colleges between the years 2004 and 2018. The study also seeks to identify whether differences exist among the different types of Ohio public community colleges (technical, state, community college) in these same student outcomes.

The results from this study suggest that public community colleges in the state of Ohio have significantly increased the volume of associate degrees over the amount of less than one-

year or one-year certificates as a result of the change to performance-based funding. The results of both research questions are consistent and add to the literature on this subject. This study supports the more recent results generally found in research and supports the value of PBF in the overall output of associate degrees.

KEY WORDS: Performance funding, public community colleges, associate degree and certificate completion, Interrupted Time Series Analysis (ITSA)

DEDICATION

This dissertation is dedicated to my loving husband, without whom this would not have been possible. For this, I am eternally grateful.

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CHAPTER 1: INTRODUCTION

INTRODUCTION

Institutions of higher education are an evolution of the Morrill Act of 1862, allowing for expanded access to public higher education to a more substantial portion of the public who had not previously been able to attend elite private institutions (Cohen & Brawer, 2003). Several social forces contributed to the development of the community college, the most prominent being the need for trained workers to operate the nation's expanding industries as well as the drive toward social equality, which was thought to result in economic growth as well as upward mobility (Cohen & Brawer, 2003). For nearly half of undergraduate students in the United States, it is the community college that affords them a chance to attain their goal.

Community colleges have been called the “people's college” due to their role in creating educational opportunities for the masses (Dowd, 2003, p. 95). However, the graduation rates of these institutions are mediocre, with only 4 out of 10 students graduating within 6 years, making this a loss to the overall economy and consequently the subject of increased scrutiny by legislators (Bailey et al., 2015). At the same time, the public has also become more concerned with student outcomes and the value of higher education (Moynihan, 2008). Both groups can derive the benefits of increasing graduation rates. The apparent reason for students includes increased job opportunities and improved lifelong earning potential, while the benefits for taxpayers include higher economic productivity as well as more significant technological advancement and furthering of the regional economy (Levin & Garcia, 2018).

As state budgets have become restricted, lawmakers are carefully considering how funds are allocated to higher education (Dougherty et al., 2011; Li, 2016; Miao, 2012; Tandberg, 2010). Also, public concerns are growing due to low graduation rates and large debt-loads. Legislators are looking for ways to improve higher education's efficiency and effectiveness (Dougherty et al., 2016; Hagood, 2019; Li, 2020). Simultaneously, the completion agenda has also been the subject of research and endorsed by educational nonprofits such as the Lumina and Gates Foundations and Complete College America (Dougherty et al., 2011). These organizations provide support and resources for practice in addition to funding for research advancement. The goal of the completion agenda is to substantially increase credentialed individuals' numbers to meet workforce demands and control costs of postsecondary education while increasing graduates (Blankenberger & Phillips, 2016; Rutherford & Rabovsky, 2014).

Accountability is not a new phenomenon in higher education (Cohen et al., 2014; Conner & Rabovsky, 2011). Federal, state, and local agencies have always held state-supported institutions accountable for their funding. However, this funding has been reduced over the past years, forcing higher education to compete against each other for the limited resources coming from state governments (Dougherty et al., 2011). The accountability movement was fueled by rising tuition costs, global competition, and issues with access (Li, 2016; Li & Zumeta, 2016). This led some legislators to investigate how to improve the performance of higher education by moving away from traditionally based funding mechanisms based on enrollment.

Taxpayers and policymakers alike are demanding that higher education demonstrates an increase in student success in areas such as retention, credit accrual, graduation, and job placement (Burke, 2002; Dougherty & Reddy, 2011, 2013; Li, 2016). One distinctive policy that

has emerged from the accountability movement is tying an institution's public funding to its overall performance or the use of performance-funding (Li, 2017; Zumeta & Li, 2016).

Instead of traditional funding based solely on the total number of students enrolled in classes, states are shifting to a performance-based model that emphasizes student outcomes and prioritizes results (Callahan et al., 2017a; Jones, 2014; Li, 2018). It is believed that performance-based funding (PBF) is an effective method that can hold these institutions accountable for student success outcomes and demonstrate the positive influences they are having on their students.

Performance-based funding is not a new concept, but it has recently gained renewed momentum with the completion agenda which identified it as one of the game-changer initiatives (Blankenberger & Phillips, 2016; Rutherford & Rabovsky, 2014; Tandberg & Hillman, 2014). PBF (also called outcome-based or performance funding) aims to increase transparency and accountability by allocating state support to public institutions based on how well they meet educational attainment and outcome goals such as course completion, degree attainment, credit accrual, and time to transition from developmental education (Blankenberger & Phillips, 2016; Li, 2018; Miao, 2012). Performance-based funding provides a financial and accountability mechanism for improvement in higher education by linking appropriations directly to institutional priority outcomes and is viewed as a policy solution (Alshehri, 2016; Hagood, 2019).

The change to this funding model is based on the idea that pay-for-performance increases educational outputs and results in colleges graduating a higher number of students (Burke, 2002; Hillman et al., 2014). Colleges that perform well earn funds at the expense of

those that are underperforming (Hillman et al., 2018). The primary goal of PBF is to better align the state's goals of increasing postsecondary educational attainment (Burke, 2002; Li, 2018). Performance funding is usually defined as tying state appropriations directly to institutional outputs (Hearn, 2015). This is the definition of performance-based funding that will be used in the rest of this study.

NATURE OF THE PROBLEM

According to Alshehri (2016), changing the fundamental way that colleges are funded increases accountability and ownership and positively affects student outcomes. However, there are concerns regarding whether PBF has the desired impact on improving student outcomes (Dougherty & Reddy, 2011). Moreover, there is some discussion regarding possible side-effects created by modifying the way funding is allocated (Dougherty et al., 2016). There is growing evidence that this type of funding model does not result in increased graduation rates and that the student outcomes are too complicated to quantify into a simple funding formula (Hillman, 2016).

Friedel et al. (2013) have indicated that performance-based funding has a more significant impact on higher education than ever before, as multiple state legislatures are turning to PBF as a solution to improve educational outcomes. Compared to 4-year university counterparts, community colleges receive a more substantial proportion of their total revenues via state funding, thereby making them more responsive to state-funded performance-based policies (Li, 2016; Mullin & Honeyman, 2008b). According to Boelscher and Snyder (2019), 33 states (64%) were either implementing (30 states) or developing (3 states) performance-based policies in FY 2019. One additional state is implementing and developing PBF, while five states

have developed PBF policies but are not currently utilizing this funding system (Boelscher & Snyder, 2019). It is important to note, performance-based funding is implemented differently across the U.S.; some states, such as Ohio, are allotting up to 100% of the funding allocation based on performance outcomes, while other states, such as Illinois, have as little as 1% tied to outcomes (Alshehri, 2016).

Furthermore, performance-based funding models can produce negative consequences for higher education institutions by eliminating equity in state funding (Mullin & Honeyman, 2008b). Since there is no guarantee of how the funds will be distributed each year, some colleges may not receive the necessary funding to support academic programming properly or sustain programs, which can create a vicious cycle of future reductions in allocations. Additionally, there are discrepancies in how different colleges receive financial resources, which can cause further inequality in funding. As an example, some public colleges in Ohio receive supplementary funding from property taxes via a levy (non- state community colleges). However, these schools are eligible to receive the same proportion of state funding dependent upon their success in the formula. In other words, all public community colleges are eligible for the same level of access to the state share of instruction regardless of whether they receive additional funding via a levy. Substantial redistributions could affect the responsiveness and equity of state community college systems (Hurtado, 2015). Concerns exist about colleges' ability to improve graduation rates and student outcomes in an environment of constrained resources (Melguizo & Witham, 2018).

This study seeks to determine if the change to a 100% performance-based funding model in the state of Ohio for public community colleges has led to an increase in student

outcomes measured by an increase in degree and certificate attainment. The study also seeks to identify if differences exist between the different types of community colleges (technical, state, community college) in these same student outcomes.

SIGNIFICANCE OF THE STUDY

Ohio lawmakers have embraced the publicized benefits of performance-based funding and allocate 100% of the state budget appropriations to public institutions based on performance of student outcomes. Ohio had previously been involved with PBF; in the 1980s, they participated in bonus funding called "Selective Excellence." These programs were designed to promote academic excellence and create change at Ohio's public institutions of higher education (Ohio Board of Regents, 1992). However, after the recession of the 1990s, the program was discontinued due to limited resources (Hurtado, 2015). In 2009, Ohio passed legislation that added a performance-funding component for 2-year colleges (Dougherty & Reddy, 2011). Ohio began the overhaul of its higher education funding system in 2010 with an initial transition to PBF in 2011 (Ohio Higher Education Funding Commission, 2012). As a result, Ohio has successfully implemented performance-based funding and remains one of the only states that allocate financial resources to public higher educational institutions at 100% based on performance rather than enrollment.

Ohio underwent a slow phase-in period to fully implement PBF. Funding changes began slowly in 2011, with only 5% of the funding tied to performance until 2015, when 100% of funding was linked to the performance metrics (Hurtado, 2015). This gradual phase-in makes Ohio an excellent case study to investigate the change to PBF before other states consider moving in the same direction or consider an increase to their current funding models closer to

100%. This 3-year phase-in period allows us to gain insight into whether the change of funding leads to an increase in degree and certificate production quickly or if the change was slower due to the gradual phase-in of the funding.

The latest version of the performance-based funding model for Ohio public community colleges allocates 50% of the state support for course completion, and 25% for success points for progression in developmental math and English and credit hour accrual milestones. The final 25% is awarded for students earning one-year certificates, associate degrees, or transferring to a 4-year institution with at least 12 credit hours (Ohio Department of Higher Education, 2019b). Performance-based funding in Ohio has been ongoing for several years. It provides enough data to evaluate if the policy change has positively affected degree and certificate production and a general increase in performance outcomes, which is believed to translate to an increase in student success. This study encompasses data for 7 years since the implementation of PBF. The state converted to performance-based funding in 2011, giving students ample time to accomplish their goals and graduate with associate degrees and certificates.

Most PBF studies utilized data from Integrated Postsecondary Education Data (IPEDS), limiting the population of study to first-time, full-time students, which is not representative of the demographics of most community colleges. On average, only 37% of the overall community college population are first-time, full-time students (Li, 2018), although that average can vary quite widely depending on the institution. Therefore, the studies that utilize IPEDS data are ignoring most of the population (part-time students) that attend community colleges. This study used data from the Ohio Department of Higher Education (ODHE) that includes all data reported from all 23 public community colleges in the state. Therefore, while scoped only to

Ohio, this study looked at the graduation data for all public community colleges in the state, making it much more focused and comprehensive. Consequently, the results of this study should add to the body of knowledge.

This study contributes to the available research on the effects of performance-based funding models and whether they improve institutional performance in higher education, specifically at community colleges. As more states move toward more significant investments in PBF, this research helps to inform state policy. The intent was to provide empirical data that can be evaluated by state policymakers and institutional administrators when making future decisions about the utilization of performance-based funding and its ability to increase student success.

PURPOSE OF THE STUDY

Historically, state legislatures have attempted to implement PBF models with limited success. However, this contemporary iteration of PBF is entirely different from prior versions (McKeown-Moak, 2013). Still today, little information exists on whether or not this new version of PBF (dubbed 2.0) will have significant results over the older versions of PBF (dubbed 1.0), which experienced less than impressive results and was abandoned in most states that had implemented these policies (Alshehri, 2016). PBF 1.0 programs were discontinued due to insufficient funds, changes in state leadership, not having buy-in from the higher education community, and a lack of quantifiable student outcomes (Dougherty et al., 2012; Hermes, 2012; Miao, 2012).

Further research is needed on how higher education institutions implement state performance policies that incorporate student outcomes on accountability. Further studies are

required to examine the effects of PBF in specific state contexts (Hu & Villarreal, 2019). This study examines performance-based funding in Ohio to determine if this method of funding has led to an increase in successful student completion at 2-year community colleges. It also investigates how Ohio's 23 community colleges have performed since the inception of PBF in 2011.

RESEARCH QUESTIONS

The following research questions will guide this study:

1. To what extent, if any, has the change to performance-based funding in Ohio increased credential attainment (less than one-year certificates, one-year certificates, and associate degrees) at 2-year community colleges? Is the obtainment of these credentials increasing, and if so, are associate degrees or are certificates increasing at a higher rate?

2. Are there any significant differences among the different types of institutions (state, community colleges, or technical schools) in response to performance-based funding in credential attainment (less than one-year certificates, one-year certificates, and associate degrees)?

Consequently, the alternative hypothesis for this study is the following: The change to performance-based funding has increased student success at Ohio community colleges. In the context of this research, student success measures include certificates and degree attainment.

THEORY OF ACTION RESPONSIBLE FOR PERFORMANCE-BASED FUNDING

It has been established that performance-based funding programs in higher education have been created as a way to improve the performance of institutions by rewarding colleges who successfully focus on student success outcomes (Snyder, 2015; Zumeta & Li, 2016). Advocates of performance-based funding believe that monetary incentives will improve

institutional performance (Burke, 2005). This type of funding can be explained by a variety of "theories of action," which include principal-agent theory, resource dependence theory, and neo-institutionalism theory (Dougherty & Reddy, 2013). With principal-agent theory, the principal (state) lays out a set of regulations and policies (goals or outcomes), and the agent (higher education) must follow these to achieve the results (Alshehri, 2016). Resource dependence theory incentivizes an institution, meaning that the better a school performs, the higher the funding it will receive, while neo-institutionalism theory states that the success or failure of PBF depends on the interaction of policy advocates with the institutions (Alshehri, 2016).

The Principal-Agent Theory (PAT) can best explain the concept of performance-based funding. The state (principal) uses rewards to ensure that higher education institutions (agent) are meeting its predetermined goals (student outcomes) (Shin & Milton, 2004; Tandberg et al., 2014). With principal-agent theory, the principal (the state) lays out a set of regulations and policies (goals or outcomes), and the agent (higher education institutions) must follow these to achieve the results (Alshehri, 2016; Sappington, 1991).

RESEARCH DESIGN

The study provides an analysis of how Ohio's 23 community colleges have performed based on the metrics of the funding model; the dependent variables include associate and certification completions. The independent variable in this study is performance-based funding. The design is a quasi-experimental, longitudinal study that examines the total number of certificates and associate degrees awarded both before and after the implementation of performance-based funding in Ohio. The study spans from 2004 to 2018, which created a 15-

year balanced panel data set. The data originated from the Ohio Department of Higher Education (ODHE) website from the Higher Education Information (HEI) system. The data are reported at the institution level as then aggregated to the state level. For this research project, all 23 Ohio community colleges were included.

The Ohio Revised Code (ORC), Section 3354, defines a community college as a public institution of education beyond high school, organized for the principal purpose of providing the people of the community college district. Each college is composed of programs that are defined as "arts and sciences" and "technical" and may also include the "adult education" program (ORC 3354). These colleges include technical colleges, community colleges, and state community colleges. *Technical colleges* offer career/technical education programs, adult continuing education programs, community service activities, workforce skills enhancement, and developmental education (Ohio Board of Regents, 2015) (ORC 3357). *State community colleges* and *community colleges* both offer general education in addition to career/technical education programs. These colleges derive funding primarily from a state subsidy as well as tuition and fees (Ohio Board of Regents, 2015) (ORC 3358). *Community college* differs from *state community colleges* as they can receive financial support through local tax levies and state subsidy and tuition and fees (Ohio Board of Regents, 2015) (ORC 3354).

An interrupted time series (ITS) analysis was conducted to estimate the effect of the treatment (performance-based funding) on the outcome variables (degree and certificate production) (Callahan et al., 2017a). This type of analysis is useful in the evaluation of the effect of a treatment (interrupts) time series data and is useful when natural experiments occur in the real world (Linden, 2017).

ASSUMPTIONS

This research study was based on several assumptions. The first assumption was that the data in the Ohio Department of Higher Education database are complete and accurate. The second assumption was that changes that are identified in associate and certificate completions are a direct result of the shift to the performance-based funding system. The third assumption is that an increase in certificate and degree production equals student success.

DELIMITATIONS

This research was restricted to all of Ohio's 23 public community colleges and did not include 4-year universities.

LIMITATIONS OF THE STUDY

This study is limited to the state of Ohio and may not be generalizable to other states. Second, this study did not consider the influence of external variables that may affect the funding results, such as college-readiness, unemployment, and economic conditions. This study uses data only from the 23 public community colleges in Ohio and no other institutions from other states or 4-year institutions, either public or private. Additionally, the results of the study will most likely be underestimated as a result of the slow phase from 2011-2015 for PBF in the state of Ohio. Any positive or negative effects would probably be more robust in this analysis if not for the presence of this limitation.

DEFINITIONS OF KEY TERMS

- *Accountability* refers to an obligation or willingness to accept responsibility for or account for one's actions (Merriam Webster, n.d.).

- *Associate degree* as defined by the Ohio Department of Higher Education (ODHE), who was formally called the Ohio Board of Regents (2015), refers to an award that requires the completion of a minimum of 60 semester hours and a maximum of 65 semester credit hours. There are five types of associate degrees recognized in Ohio:

    - *Associate of Arts (AA)* and *Associate of Science (AS)* degrees are designed for students to complete the first 2 years of a bachelor's degree or for students who desire 2 years of liberal arts education.

    - *Associate of Applied Business (AAB)* and *Associate of Applied Science (AAS)* degrees are awarded to students for the successful completion of career technical education programs and prepare students for employment after graduation.

    - *Associate of Technical Study (ATS)* degree is awarded for successful completion of a planned program of study designed to respond to the need for specialized technical education and must have an identifiable career objective.

- *Certificate* refers to a formal award that certifies the satisfactory completion of an organized program of study. Certificates are usually building blocks toward future degrees. Two types of certificates are defined (Ohio Board of Regents, 2015):

    - *Less than One-Year Technical Certificate* is a certificate awarded for the completion of an organized program of study that is less than 30 semester credit hours (or less than 900 clock hours) that is intended for a specific occupation or specific employment opportunity. These certificates prepare students for a valid occupational license or third-party industry certification, if available, related to the field of study (Ohio Board of Regents, 2015).

    - *One-Year Technical Certificate* is a certificate awarded for the completion of an organized program of study of at least 30 semester credit hours (900 clock hours) with most of the courses in a technical area. These certificates prepare students for a valid occupational license or third-party industry certification, if available, related to the field of study (Ohio Board of Regents, 2015).

- *Community, State, and Technical Colleges* refer to open access, public institutions that offer Associate of Arts, Associate of Science, Associate of Applied Science and Business, Associate of Technical Studies, as well as certificates (Ohio Board of Regents, 2015). The Ohio Revised Code, Section 3354 defines a community college as

    a public institution of education beyond the high school organized for the principal purpose of providing the people of the community college district wherein such college is situated the instructional programs defined in this section as 'arts and sciences' and 'technical,' or either, and may include the 'adult-education' program. (Lawriter, 2017)

- *Community College*. The community colleges bearing this designation are allowed to receive financial support through local tax levies and state subsidy and tuition and fees (Ohio Board of Regents, 2015).

- *State Community College* is a 2-year college established with the approval of the Ohio Department of Higher Education (ODHE) and derives funding primarily from state subsidy and tuition and fees and requires special ODHE permission before proposing local tax levies. A local board of trustees governs the college, all appointed by the governor (Ohio Board of Regents, 2015).

- *Technical Colleges* are established with the approval of ODHE upon the initiative of a city school district or a county, or by two or more contiguous city, county, local, or exempted village districts. Technical colleges offer career/technical education programs, adult continuing education programs, community service activities, workforce skills enhancement, and developmental education (Ohio Board of Regents, 2015).

- *Completion/Graduation Rates* refers to the percentage of associate degree-seeking students who complete their education programs.

- *Completion Milestones* are part of the funding formula and are designed to help ensure degree and certificate completion incentives within the funding formula. The milestones represent points at which students achieve a particular endpoint with a college and include associate degree completion, long-term certificate completion (30+ credit hours), and a transfer of 12 credit hours at a 4-year university (Ohio Association of Community Colleges, 2013).

- *Full-time Equivalent (FTE)* is a measurement equal to one student enrolled full time for one academic year (total semester hours enrolled divided by 30 hours). Total FTE enrollment includes full time plus the calculated equivalent of the part-time enrollment. It is a calculation showing how many students would be attending if all were enrolled full time.

- *Full-time Student* refers to a student who takes 12 credit hours or more each semester.

- *Part-time Student* refers to a student who is taking less than 12 credit hours per semester.

- *Performance-Based Funding* (also called outcome-based) funding aims to increase accountability by allocating state support to public institutions based on how well they are meeting broader educational goals such as course completion, degree attainment, credit accrual, and time to transition from developmental education (Miao, 2012).

- *Performance-Based Funding (PBF) 1.0* is an earlier performance-based funding model that took the form of a bonus in addition to regular state funding. The bonus amount is

relatively small, between 1% and 5% of the base funding for higher education (Snyder, 2015).

- *Performance-Based Funding 2.0* is the latest iteration of performance funding and is no longer a bonus but the base of the state support for higher education. It can range from 1% to 100% (Boelscher & Snyder, 2019).

- *Performance-Based Funding Typology* refers to a classification system that assigns different states to a type of performance-based funding category based on the criterion of the funding model.

- *Performance Indicators* are a type of performance measurement.

- *Progress Metrics* are the student's completion of developmental courses, the attainment of a set number of credit hours, the completion of a certificate or degree, or the successful transfer to a 4-year institution (Burke, 2002; Dougherty & Reddy, 2011).

- *Retention Rates* refer to the percentage of students who return to the same institution the following year.

- *State Share of Instruction (SSI)* is how the state of Ohio subsidizes the instructional costs of tuition for state-funded institutions of higher education. It is allocated each fiscal year based on a performance-based funding formula that incentivizes student and course completion (Ohio Department of Higher Education, 2020).

- *Stop-Loss Fund.* To avoid catastrophic changes in institutional funds allotted by state funding, stop loss was put in place to ensure that institutions would not lose more than a predetermined percentage of the prior year funding (Ohio Department of Higher Education, 2020).

- *Success Points* are part of the funding formula and are designed to help ensure degree and certificate completion incentives within the funding formula. The success points refer to one of the specific categories of student progress and completion where community colleges earn a point in the funding formula as students make progress toward completion (Ohio Department of Higher Education, 2019b).

    - Developmental Education Success:

        - Number of students completing developmental education math and enrolling in the first college-level math course.

        - Number of students completing developmental education English and enrolling in the first college-level English course.

    - Credit Hour Accrual

- Number of students earning first 12 college-level credits.
- Number of students earning first 24 college-level credits.
- Number of students earning first 36 college-level credits.

OVERVIEW OF ORGANIZATION OF THE STUDY

Chapter 1 is an introduction to the study, including background information on community colleges, accountability in community colleges, and the move toward performance-based funding. Chapter 2 presents a review of the relevant literature for the study, with an emphasis on performance-based funding in higher education. Chapter 3 presents the methodology for this study, including data collection and analysis. Chapter 4 presents the findings of the study, and, finally, chapter 5 presents a discussion of the findings as well as recommendations for future research.

SUMMARY

This chapter discussed the history of community colleges and the accountability movement in the United States. A distinct policy that emerged as the result of this movement is the shift to performance-based funding, which links public funding for higher education with an increase in student outcomes rather than funding schools based on enrollment (Li, 2017; Zumeta & Li, 2016). As of 2019, nearly 70% of the states have either implemented or are in the process of implementing performance-based funding to increase student outcomes (Boelscher & Snyder, 2019). However, research over the years has led to a myriad of differences from negative, neutral, and positive results from the change to PBF. This study utilizes an interrupted time series analysis to determine if the change to PBF for Ohio's 23 public community colleges has led to an increase in institutional effectiveness as measure by an increase in the award of

less than one-year certificates, one-year certificates, and associate degrees over the last 15 years (2004 to 2018). This study also seeks to examine if these results differ based on the type of community colleges (technical, state, and community college).

CHAPTER 2: LITERATURE REVIEW

INTRODUCTION

This chapter presents a summary of the literature relevant to performance-based funding. An overview of the different models of performance-based funding and a detailed look at PBF in Ohio are presented.

HISTORICAL BACKGROUND

Community colleges play an essential role in the higher education landscape by providing access to low-cost higher education to anyone interested in pursuing education to help better themselves and increase economic security and upward mobility. For nearly half of undergraduate students in the United States, it is the community college that affords them a chance to attain their goal. Joliet Junior College, the first community college, was founded in 1901 with the belief that a more skilled workforce would result in a more robust economy (Drury, 2003). In the decades after the Great Depression, the introduction of the G.I. bill, the Truman Commission Report, and the enrollment of baby boomers had the effect of intensifying enrollment in community colleges in the 1960s and had the consequence of creating one new college per week (Cohen et al., 2014). Several factors contributed to the development of community college, but the most prominent aspect was the need for a trained workforce for the nation's expanding industries (Cohen et al., 2014). By the end of the 20th century, there were over 1,100 community colleges that enroll over 10 million students annually (Drury,

2003). In 2018, two out of three community college students were working while attending; 37% of community college students were full-time, while 63% attended only part-time (American Association of Community Colleges, 2019). During this period, 75% of university students attended full-time, while the other 25% attended classes part-time (National Center for Education Statistics [NCES], 2019).

According to NCES (2018), 41% of all U.S. undergraduate students are attending a community college, and less than 40% of this group are entering as first-time freshmen. Studies indicate that over the next decade, the number of jobs requiring a postsecondary degree or credential will continue to climb, and community colleges will play an integral role in educating the population (Jobs for the Future, 2012). In considering this information, combined with low completion rates for community colleges (only 44% of students who enter a community college graduate 8 years later), most state policymakers have increasingly focused on accountability for higher education (Shapiro et al., 2017). Unlike their 4-year counterparts, community colleges are open-access institutions; therefore, not all students entering have the intent of graduating with a degree or transferring to a university. Some students are interested in taking courses for professional growth, some are looking to upgrade their current knowledge for more technical and complex jobs, and some are only wanting to gain a credential before entering the workforce. Community colleges offer flexible options that are not typically found at 4-year institutions, and this is reflected in their broad missions and often in the low graduation rates.

Community colleges were established to make higher education accessible to much of the local population in a geographic area. Therefore, the overall cost should be attainable for that population (Johnson, 2012). Funding for community colleges is generally derived from

three principal sources: state appropriations, local revenue (if available), as well as student tuition and fees (Mullin & Honeyman, 2008b). State appropriations are the financial resources given by the state directly to public higher education institutions. If allocated, local revenue is derived from local taxes or contributions calculated by property tax. Student tuition and fees often include per-credit-hour tuition, fees, books, and other costs associated with the education experience. Federal or local financial aid awarded to students, such as Pell Grants, is often used to offset these costs. The exact proportions of each of the primary funding sources vary significantly by state, reflecting the states' "differing expectations and goals for community colleges" (Phelan, 2014, p. 7). Wellman et al. (2009) identified nine sources of revenue, which include (1) net tuition revenue; (2) state and local appropriations; (3) private gifts; (4) investment returns; (5) endowment income; (6) state and local grants and contracts; (7) federal appropriations, grants, and contracts; (8) auxiliary enterprises; and (9) hospitals, independent operations, and other sources (p. 13).

Funding for public higher education in the United States is a discretionary expense (Pew Charitable Trusts, 2015). Historically, states provide a more significant share of assistance than the federal government, and that share has been declining since before the Great Recession (Pew Charitable Trusts, 2019). States have assumed a significant portion of funding community colleges, with a national average of 28% in 1942, a high of 60% in the 1980s, and leveling off to 45% in the 2000s (Cohen et al., 2014). State funding is an essential component of successful community colleges. Zumeta (1995) indicated that since it is not mandated, public funding for colleges often gets cut when state budgets become tight. Higher-education allocation is commonly used as a negotiation tactic in budget discussions and is aligned with political party

agendas. It remains easier for lawmakers to reduce funding for higher education rather than for health care and social services, which are mandated by law (Hovey, 1999; Okunade, 2004). Kane et al. (2003) found that growth in Medicaid expenditures came at the expense of higher education funding. Delaney and Doyle (2011) suggested that higher education budgets are targeted during difficult economic times, such as the Great Recession of 2007-2009. These institutions have other sources of income and can increase tuition to make up the difference in funding deficits. Unlike private institutions, community colleges rely on state and local appropriations (Mitchell et al., 2018). On average, states provide 53% of the costs for teaching and instruction, down from 64% in the early 2000s, which places a higher burden on the student through an increase in tuition combined with cuts to services, freezing of employment, and the use of part-time faculty (Kahlenberg et al., 2018; Phelan, 2014).

ACCOUNTABILITY IN HIGHER EDUCATION

Public higher education (both colleges and universities) has been under pressure for the past few decades to increase institutional performance and results (Burke, 2002, 2005). Concerns over higher education hit a peak in the late 1990s when the prosperous times ended, and the economy began to weaken (Hearn, 2015). Burke (2005) identified four phases in the accountability movement:

1. 1970s: focus on the economy and centralized state regulations;
2. 1980s: concern with outcomes in student learning, campus process, and institutional improvement;
3. 1990s: focus on state priorities, performance production, and results;
4. 2000s: greater reliance on private market forces with less emphasis on public priorities.

Increased scrutiny at the federal level occurred with U.S. Secretary of Education Margaret Spellings' Commission on the Future of Higher Education, which recommended a national strategy to reform postsecondary education (U.S. Department of Education, 2006). The commission mainly focused on how well higher education was preparing students for the 21st-century workforce and on improving the need of higher education institutions to efficiently graduate more students (U.S. Department of Education, 2006). The report helped bring educational shortcomings forward, and the results focused on five different areas: access, affordability, quality, accountability, and innovation (U.S. Department of Education, 2006). The United States is behind on educational attainment for 25 to 34 year olds, trailing 15 other countries, down from the rank of eighth in 2005 (Snyder, 2015). The change in rank is not due to a deterioration of performance, but rather the failure of the United States to improve and keep up with advances compared to other countries (Brooks, 2019). This growing gap became a significant concern for federal, state, and local lawmakers. Over the past three decades, policymakers have been searching for ways to make higher education more accountable for achieving better student outcomes (Dougherty et al., 2011). Burke (2005) found that "accountability programs for higher education have shifted over time from system efficiency to educational quality, to organizational productivity, and external responsiveness to public priorities or market demands" (p. 4). When compared to 4-year university counterparts, community colleges receive a more substantial proportion of their total revenues via state funding, making them more responsive to state-funded performance-based policies adopted by state policymakers (Li, 2016; Mullin & Honeyman, 2008b).

Legislators have become more interested in institutional reporting in areas of access, diversity, and effectiveness (Tandberg & Hillman, 2014). Organizations such as Complete College America and HCM Strategists not only advocate for PBF policies but also recommend "best practices" for implementing these policies (Miller & Morphew, 2017). This shift in accountability measurement led several states to adopt performance-based funding policies that linked funding to performance according to predetermined metrics (Tandberg & Hillman, 2014).

According to Serban and Burke (1998), the rationale for the use of performance-based funding can be divided into three components. First is to create a culture of accountability; second, to increase the performance of institutions on predetermined measures; and third, to provide educational opportunities targeted to state economic and workforce needs. The underlying theory is that paying for performance should provide an incentive to graduate more students rather than to enroll them without interest in their success (Heinrich, 2002; Hillman et al., 2014).

There is some disagreement on the real focus of higher education for PBF. While it is widely accepted that the primary intent is to increase student success, some authors have reported that PBF is motivated by a belief held by taxpayers and legislators that higher education should be run more like a business (Dougherty et al., 2014a; Lane, 2007; Li & Zumeta, 2016). They indicate that PBF incorporates private-sector logic to financially reward organizations for attaining the desired outcomes of increasing student success with the expectations that organizations will change their practices to receive additional funds (Dougherty et al., 2014a; Li & Zumeta, 2016; McLendon et al., 2006). Sexton et al. (2012) found

that while each state should fund higher education, it should not be responsible for subsidizing inefficient operations.

PERFORMANCE-BASED FUNDING 1.0 AND 2.0 DEFINED

There are two distinct models of PBF: PBF 1.0 and PBF 2.0 (Dougherty et al., 2014a). The first iteration of performance-based funding, called PBF 1.0, took place between 1979 and 2007 in the form of a bonus, typically between 1 and 5%. This bonus was allocated in addition to the regular state-based funding. It was designed as a reward for achieving prescribed outcomes (Dougherty et al., 2014b; Dougherty & Natow, 2009; Dougherty & Reid, 2007). Usually, the bonus was received because of the attainment of specific outcomes such as graduation rates, completion of courses, and achievement of credit hours (Alshehri, 2016; Dougherty & Reddy, 2013). Most of the PBF policies were introduced during an era of economic growth when states had sufficient resources at their disposal (Nisar, 2015). These early performance models were done quickly, designed poorly, lacked student-level data, and were missing a dedicated funding source (Conklin et al., 2016). While PBF 1.0 programs included state incentives toward goals such as the increase of enrollment in lower-income students, the models did not consistently recognize the difference that community colleges play in their missions (Hearn, 2015). Institutions also did not have the data required to make informed decisions (Hearn, 2015). In many cases, these policies were designed by legislators who had a limited understanding of institutional differences and did not understand the role, mission, and differences between community colleges and universities in higher education (Snyder, 2015). Tennessee was the first state to enact this form of funding in 1979 and continues to embrace this type of funding today (Dougherty et al., 2014a, 2016).

It is difficult to determine exactly how many states were utilizing PBF 1.0 due to differences in funding (Minnesota had a program with no funding attached to it). Approximately 26 states were using some form of this version of PBF (Hearn, 2015). However, this model was most popular in the 1990s during the economic upturn and declined in the first half of the 2000s at the beginning of the recession (Cohen et al., 2014; Harnisch, 2011). Nevertheless, many of these programs were discontinued due to insufficient funds, changes in state leadership, not having buy-in from the higher education community, rigid requirements that failed to reward intermediate progress, and a lack of quantifiable student outcomes (Dougherty et al., 2012; Hermes, 2012; Miao, 2012). Additionally, many programs did not allocate enough funding to create genuine incentives and help colleges improve their outcomes (Miao, 2012).

A renewed interest in performance funding occurred in the mid to late 2000s due in part to a tightening of state budgets, increasing costs of education, and the need to increase graduation rates (Dougherty & Natow, 2015; Jones et al., 2015). PBF 2.0 is the result of the Great Recession with decreasing state revenues, the need to use every state dollar efficiently, as well as the public perception of the inefficient allocation of resources and low graduation rates (Kelderman, 2019; Li & Zumeta, 2016). This new version of PBF, dubbed 2.0, is different from the first wave of funding in that it has increased accountability for the schools. The focus has changed from enrollment goals to student success outcomes such as completion and graduation, as well as helping to foster an increase in economic goals for the state (McKeown-Moak, 2013; Snyder, 2015). PBF 2.0 is fundamentally different from 1.0 models in that it ties a

much more significant portion of the state's share of institutional financial resources to performance.

In contrast to PBF 1.0, instead of a bonus on top of state funding, PBF 2.0 makes up the foundation of the funding formula and is not part of a separate program that can be dropped in times of constrained state budgets (Dougherty et al., 2014a; Dougherty & Natow, 2015; Dougherty & Reddy, 2013). Funding relies on the results of an institution's performance as determined by progress outcomes (credit accrual, graduation rates, and placement) rather than simple allocations based on overall outcomes (course completion and transfer rates to 4-year institutions) (Alshehri, 2016; Hearn, 2015). According to Boelscher and Snyder (2019), approximately 70% of states have implemented or are in the process of implementing PBF 2.0. However, performance-based funding is implemented differently across the United States. Some states, such as Ohio, are allocating up to 100% of the funding based on outcomes success. In contrast, other states, such as Illinois, have as little as 1% tied to outcomes (Alshehri, 2016).

Origins of Performance-Based Funding 2.0

The origin of PBF 2.0 is different from that of 1.0 in a few ways: the role of state governors, the influence of "outside actors" (such as policy and philanthropic organizations), and the motivation of higher education departments (Dougherty et al., 2014a). In 2009, Governor Ted Strickland ended Ohio's enrollment-based funding for both 2- and 4-year institutions and added a performance-funding element (Dougherty & Reddy, 2011). The continued role of the governor was crucial in Ohio's move to PBF 2.0. In 2012, Governor John Kasich met with the leaders of public colleges and universities in Ohio and asked them to continue to collaborate and change the state funding formula so that it funds based on student

success and student completion instead of enrollment (Ohio Higher Education Funding Commission, 2012). The same happened in Tennessee, where Governor Phil Bredesen called for education policy reform (Dougherty et al., 2014a).

It is also thought that, like PBF 1.0, political party alignment may have played a role in the adoption of 2.0 programs (Dougherty et al., 2014b). Philanthropic organizations such as the Lumina Foundation and Gates Foundation also played an essential part in the resurrection of PBF 2.0 by supporting the reform of the funding (Dougherty et al., 2014b). These foundations underwrite the advocacy organizations and consulting firms, such as HCM, that help states such as Ohio adopt and implement performance-funding models (Gandara et al., 2017; Hillman et al., 2018). The final factor that helped resurrect this type of funding is that state governments grew more concerned about increasing accountability from higher education institutions, specifically when looking at rising graduation rates and being more efficient with state funding (Dougherty et al., 2014a).

Discontinuation of Performance-Based Funding 1.0 and Adoption of 2.0

Despite the popularity of PBF 1.0, nearly two thirds of the states that used these models discontinued them (although some only temporarily). Dougherty et al. (2014b) found that the reasons were due to "opposition from higher education institutions, economic reasons, and loss of political champions" (p. 169). The opposition from higher education is a result of institutions that felt they did not get to provide feedback on the metrics, nor did they get buy-in to the initial funding (Dougherty et al., 2014b; Snyder, 2015). The economic downturn in the 2000s played a significant role in the downfall of PBF 1.0. State allocations for higher education declined, some close to 20%, and institutions called for PBF to be discontinued to allow for

continuous support from the state (Dougherty et al., 2014b). One of the first elements cut from challenging budget environments was performance funding since it was a bonus and not the base of funding (Snyder, 2015). Another factor that played into the discontinuation of PBF 1.0 was that there was no differentiation between institutional missions (Snyder, 2015). The final reason for the discontinuation of the funding lies with the change in the political party, due in part to the term limits of politicians who had acted as program champions (Dougherty et al., 2014b).

Over the past several years, the perceptions of politicians, legislators, students, as well as the public, are that higher education is not effective and not held accountable for low graduation rates (Dougherty et al., 2016; Kelderman, 2019). The United States is no longer a leader in higher education and is now behind 11 other countries in educational attainment for 25 to 34 year olds, with 46% of students not graduating within 6 years of starting postsecondary studies (Snyder, 2015). In some cases, state policymakers did not think that higher education budgets aligned with state priorities to produce graduates to bolster the local economy (McKeown-Moak, 2013). This focus on accountability led to the re-introduction of a redesigned performance-based model after 2007. Additionally, efforts from influential foundations such as Gates, Lumina, and Complete College America also contributed to influencing newly elected politicians (Kelchen, 2019). The new type of performance-based funding is evolved from PBF 1.0 in that while they still seek to incentivize and reward institutions, the new models are aligned to state workforce needs, focus on student completion, and address the issues identified with earlier models (Lumina Foundation, 2019; Snyder, 2015). PBF 2.0, while modeled on its predecessor, also includes the best portions of PBF

1.0, such as tying funding to the state's attainment needs and ensuring institutions are held accountable for student success, as well as incorporating lessons learned (Lumina Foundation, 2018; Snyder, 2015). Although implementation differs from state to state, the overall goal of PBF 2.0 is to improve college performance as it relates to student outcomes, such as course and degree completion, transfer, and developmental education completion (Dougherty et al., 2016). While some metrics remain the same between both models, most understand the community college mission, which attends to part-time students by allowing more time to count toward graduation (McKeown-Moak, 2013).

Objectives and Metrics of PBF 2.0

Each state is using different metrics to allocate funding, but the underlying purpose is the necessity to increase college graduation rates (Jones, 2013). Snyder (2015) believes that the overall objective of performance-based funding is as follows:

- Align state higher education funding method with the state's higher education attainment goals and student success priorities;
- Align institutional priorities with those of the state and support the scaling of proven student success practices;
- Hold institutions accountable for performance and their role in achieving state attainment goals. (p. 6)

While the metrics differ from state to state, all formulas include graduation rates (McKeown-Moak, 2013). Many also include priority categories (for the state), which include special student populations such as adults, underprepared academically, minority, low income, and STEM as a best practice (Snyder & Fox, 2016). Another set of performance metrics includes student progression and momentum points, primarily critical milestones, such as the number of credits earned and the successful passing of college-level math or English developmental

education courses (Snyder, 2015). Many formulas also include variations based on mission, meaning that there are different metrics for community colleges compared to 4-year universities (McKeown-Moak, 2013). Jones (2014) also cautions state legislators to ensure that parameters also include strategies for addressing racial and ethnic quality by adding special populations in the various categories mentioned above, such as in course completion, developmental education, and graduation rates.

Despite having student success as a basis for the funding formulas, PBF formulas can differ significantly between systems, making it difficult to compare and contrast from one state to another (Lumina Foundation, 2018). Differences include the percentage of state funding allocated (as an example, Ohio's percentage is 100%, while Illinois' is only 1%), the measures used to define the formula, and whether the formula applies to both 2- and 4-year institutions or only to one sector (Lumina Foundation, 2018). To understand the different performance-based systems in existence, HCM Strategists, a Washington D.C.-based advocacy group, attempted to create a classification system based on the complexity of funding policies (Snyder, 2015). This classification continues to be refined and has undergone three different iterations since the initial report (in 2016, 2018, and 2019). The different PBF 2.0 systems have been classified into four different general types based on the sophistication of the funding policies as well as an observance of promising practices (Table 1) (Conklin et al., 2016). Boelscher and Snyder (2019) have identified the critical areas included in the typology:

- Established completion or attainment goals are linked to the model;
- Recurring base funding is distributed;
- A significant level of funding is distributed;

- Total degree/credential completion is prioritized;
- Institution mission is reflected through varying weights, scales, or metrics;
- The funding structure is formula-driven to ensure incentives for continuous improvement;
- Success of underrepresented students is prioritized; and
- Funding is sustained over consecutive years. (p. 2)

Type I is simple. These states might be trying a pilot study before implementation. They do not include significant levels of funding, and likely it is similar to earlier versions of PBF 1.0 policies (Snyder & Boelscher, 2018). Typically, Type I do not reflect the need to increase the success of underserved populations and do not have a strong tie to the state fiscal policy (Snyder & Boelscher, 2018). Examples include Michigan, Florida, Kansas, and North Dakota. Type II and Type III systems, which include Colorado, California, and Wyoming, represent "increasing degrees of development and adhere to state practices" (Snyder & Boelscher, 2018, p. 3). Type IV is the most sophisticated model and has direct alignment with state policies for funding, reflects the institutional mission, prioritizes degree or credential completion, includes incentives for continuous improvement, and promotes the success of underserved populations (Snyder & Boelscher, 2018). Examples include Ohio, Wisconsin, Nevada, Louisiana, and Tennessee (Boelscher & Snyder, 2019).

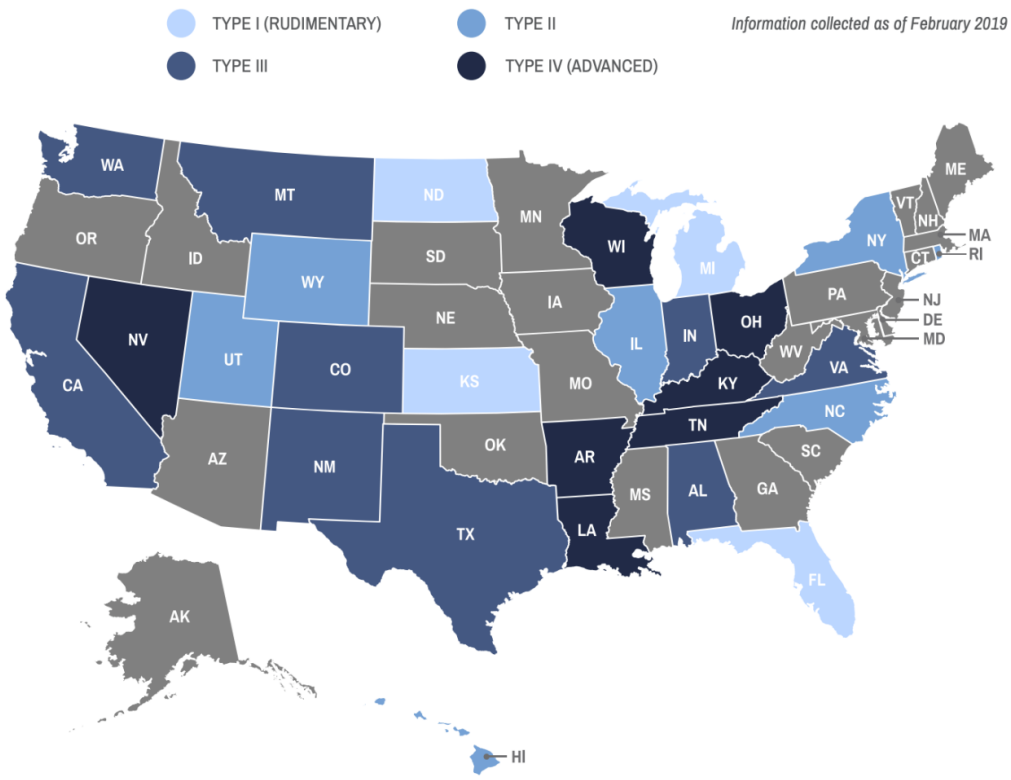
Table 1: *Performance-Based Funding Typical Characteristics for Each Type*

TYPE	TYPICAL CHARACTERISTICS
Type I	• State may have completion/attainment goals related to priorities • Model reliant on new funding • Low level funding (under 5%), based on sector analysis • Institutional mission not reflected through varied weights, scaling or metrics • Total, volume-based, degree/credential completion metric not included • Outcomes for underrepresented students not prioritized • Target/recapture approach likely • May not yet have been sustained for two or more consecutive fiscal years
Type II	• State may have completion/attainment goals related to priorities • ***Recurring dollars/base funding at least portion of funding source*** • Low level funding (under 5%), based on statewide analysis • Institutional mission not reflected through varied weights, scaling or metrics • ***Total, volume-based, degree/credential completion metric included*** • Outcomes for underrepresented students may be prioritized • Target/recapture approach likely • May not yet have been sustained for two or more consecutive fiscal years
Type III	• State has completion/attainment goals and related priorities • Recurring dollars/base funding at least portion of funding source • ***Moderate level of funding (5-24.9%), based on sector analysis*** • Institutions mission reflected through varied weights, scaling or metrics • Total, volume-based, degree/credential completion metric included • ***Outcomes for underrepresented students prioritized*** • May not be formula-driven • Not sustained for two or more consecutive fiscal years
Type IV	• State has completion/attainment goals and related priorities • Recurring dollars/base funding at least a portion of funding source • ***High level of state funding (above 25%) based on sector analysis*** • Institutional mission reflected through varied weights, scaling or metrics • Total, volume-based, degree/credential completion metric included • Outcomes for underrepresented students prioritized • ***Formula-driven/provides incentives for continuous improvement*** • ***Sustained for two or more consecutive fiscal years***

Note. Some states may meet most but not all criteria. States that do not meet all criteria for a type are assigned a lower type. ***Italicized and bold*** elements are primary differences from prior level.

(Boelscher & Snyder, 2019, pp. 3-4)

As of FY 2019, 33 states (or 64%) were either implementing (30 states) and/or developing (3 states) performance-based policies (Boelscher & Snyder, 2019). Pennsylvania is implementing and developing PBF policies, and an additional five states have developed PBF policies but have not yet implemented them in FY 2019 (Boelscher & Snyder, 2019). Only seven states (Arkansas, Kentucky, Louisiana, Nevada, Ohio, Tennessee, and Wisconsin) have implemented advanced Type IV models (Figure 1). While all seven states have advanced models, the percentage of funding tied to state institutional support differs significantly. Only Ohio is funded at 100%; Arkansas is funded at 98%, Nevada at 85%, Tennessee at 80%, and Kentucky at 65%, while Wisconsin and Louisiana have attached only 30% of funding to the state share of instruction (Boelscher & Snyder, 2019). This indicates a significant variance in funding, even within the Type IV states. However, a vast majority of the states' community colleges only have less than 25% (eight Type III, six Type II, and three Type I) of the funding tied to PBF, and only a few states have policies related to all public colleges and universities (Boelscher & Snyder, 2019).



(Boelscher & Snyder, 2019, p. 6)

Figure 1. States implementing performance-based funding: 2-year colleges

While the classification system devised by HCM Strategists provides a framework that helps classify the various forms of PBF in different states, it does not fully capture the complexities of policy implementation and state context (Callahan et al., 2017a).

Indiana

According to the Indiana Commission for Higher Education (ICHE, 2015), Indiana started utilizing PBF in 2003 by allocating 1 to 6% of state funding. However, it was not until 2007 that it began to implement a PBF 2.0 model with metrics related to on-time graduation, number of degrees awarded, and 2-year transfer rates (ICHE, 2015). As with most states, Indiana was previously awarding funding based on enrollments. To ensure stability, Indiana used a 3-year

average and awarded the first funds for PBF 2.0 in 2009, with 2.5% of the state's higher education budget, accounting for roughly $61 million (Umbricht et al., 2017). By 2011, several additional metrics were added to the funding formula, including incentives for low-income degree completion, workforce development, and successful credit completion (Umbricht et al., 2017). The overall percentage of performance-based funding grew to 7% of the total state budget by 2015 (Umbricht et al., 2017). The PBF indicators Indiana has used have changed every 2 years (Lahr et al., 2014). However, specific indicators have remained consistent (Indiana Commission for Higher Education, 2013; as cited in Lahr et al., 2014): change in the number of degrees awarded (2009–2011, 2011–2013, 2013–2015 biennia); change in quantity (or rate) of residents, undergraduate, first-time, full-time students graduating on time (2009–2011, 2011–2013, 2013–2015); change in degree completion by low-income students (2009–2011, 2011–2013, 2013–2015); and change in the number of successfully completed credit hours (2009–2011, 2011–2013) (Lahr et al., 2014).

Tennessee

Tennessee was the first state to implement performance-based funding in 1979 and is considered by many to be a pioneer in the development of PBF 1.0 (Dougherty et al., 2011; Dougherty & Reddy, 2013; McLendon & Hearn, 2013). According to McLendon and Hearn (2013), "the state's goal in establishing the first performance-funding system was to address widespread dissatisfaction with enrollment-based funding formulas and a growing public concern over performance assessment" (para. 7). Tennessee received support from several private foundations, including the Ford Foundation and W. K. Kellogg Foundation, which allowed the state to pilot several campus sites with close involvement of the Tennessee Higher

Education Commission (Dougherty & Reddy, 2011, 2013; McLendon & Hearn, 2013). Under this first system, institutions could earn a bonus of 2% over annual state appropriations for achieving specific goals based on five performance indicators (Dougherty & Reddy, 2013). The success of the pilot programs drove the legislative action to scale the programs across the state (Dougherty & Reddy, 2011, 2013; McLendon & Hearn, 2013).

In 2010, Tennessee passed the Complete College Tennessee Act (CCTA) that changed the way funding is allocated and is vastly different from the first iteration of PBF. This funding allocates 85% of the funding based on state priorities. The remaining 15% is awarded based on fixed costs and additional performance metrics that are not based on completion (Obergfell, 2018). Although Tennessee has only one formula, it is designed to recognize the variation in missions between 2- and 4-year institutions (Callahan et al., 2017a).

A variation in the Tennessee funding model is that institutions can choose how to weigh the formula for their institution, allowing for flexibility and choosing which metrics are more relevant (Callahan et al., 2017a; Obergfell, 2018). The formula was phased in over a 3-year period, which allowed institutions to adapt to the new model with the first full year in the 2013-2014 budget year, and the formula is re-evaluated every 5 years (Johnson & Yanagiura, 2016). However, the results of the change to this funding are finding both negative and positive impacts, making it difficult to determine if the change to PBF makes any significant difference in student success (Obergfell, 2018). According to a report prepared for Research for Action, positive changes were made on student success as a result of PBF; many positive effects for full-time students were also highlighted (Callahan et al., 2017a). Certificate production was found to increase (174% in short-term certificates and 27% in long-term certificates) (Johnson &

Yanagiura, 2016). However, results for part-time students were negative in terms of time to degree, credit accumulation, and transfer in 3 years (Callahan et al., 2017a).

IMPACTS

Many institutional changes have occurred in several states as a result of implementing PBF. Thornton and Friedel (2016) found that some community colleges subject to PBF did make organizational changes. They were more likely to make changes to developmental education, award credit for prior learning, and provide additional courses and programs in response to state-level PBF (Thornton & Friedel, 2016). The authors also found that other modifications, such as course scheduling, advising practices, supplemental instruction, first-year experience courses, and improved registration procedures, have occurred (Thornton & Friedel, 2016). Dougherty and Reddy (2013) also state that various studies in Tennessee, South Carolina, Florida, Missouri, Ohio, and Washington indicate that there are costs in funding (additional personnel) and time for complying with the PBF mandates (data collection). Another study by the Third Wave found that PBF policies have expanded institutional changes such as an increase in the number of advisors as well as additional student interventions (Li, 2018).

The literature is unclear if these changes are uniquely a result of PBF or other planned reforms, such as the Guided Pathway model. Several studies investigating the impact of PBF on college finances found that community colleges did spend more money on student services, instruction, and instructional programs (Dougherty et al., 2016; Kelchen & Stedrak, 2016; Rabovsky, 2012). This indicates that additional measures have been put in place as a result of new financing models (Dougherty et al., 2016; Kelchen & Stedrak, 2016; Rabovsky, 2012). Dougherty et al. (2016) also found that colleges are making changes due to legislative mandates

such as reducing credit hours to decrease time to graduation, expanding transfer opportunities, and initiating developmental education reform. There has also been mention of the influence of accreditors, non-profits, and philanthropic associations (such as the Gates Foundation and Complete College America) on the completion agenda with the Guided Pathway movement and others (Dougherty et al., 2016; Rabovsky, 2012). It is thought that there is a synergy between performance funding and other influencers to improve student outcomes (Dougherty et al., 2016).

Unintended Consequences of PBF

An unintended consequence of implementing the change to PBF is that since some community colleges are not receiving the same resources from state governments, they have had to raise tuition levels to statistically significant amounts (Hu & Villarreal, 2019; Lowry, 2000). This increase in tuition is negatively associated with student success and completion rates. This is especially true for underrepresented students, since many cannot afford to attend college, and raising tuition makes this even more unattainable (Deming & Walters, 2017; Heller, 1999). There is also concern that underresourced colleges will be caught in a vicious cycle. They do not perform well, which leads to a decline in funding, which in turn perpetuates poor results and weakens institutional capacity, making it more difficult to boost their performance (Dougherty & Reddy, 2013; Hillman & Corral, 2018). Also, in colleges with fewer resources and academic supports, it takes students longer to graduate; consequently, these colleges have lower graduation rates (Hillman, 2016).

Another unintended impact of complying with PBF mandates is an increase in costs as well as competition among institutions, which results in less cooperation (Alshehri, 2016; Lahr

et al., 2014). Examples of these additional costs include the additional data requirements to track student outcomes and the addition of a qualified person to collect and analyze them (Alshehri, 2016). Lahr et al. (2014) list the potential of narrowing institutional missions due to the metrics of the funding formula. Another possible impact is the faculty's perception concerning the lowering of academic standards with grade inflation, since funding is tied to course completion (Dougherty & Reddy, 2013; Lahr et al., 2014; McKeown-Moak, 2013). Lahr et al. (2014) and Dougherty and Reddy (2013) also list selective admission of students as a potential impact (both underprepared and an increase in minorities). A final concern is the shortening of time that students spend in developmental education and not providing them the time required to master the material before they move on (Dougherty et al., 2014b; Dougherty & Reddy, 2013; Lahr et al., 2014; Mullin & Honeyman, 2008a).

Results of Implementing Performance-Based Funding

Some researchers have stated that it is too early to quantify the effectiveness of performance-based funding, although some preliminary results have been determined (Thornton & Friedel, 2016). Several studies have found insignificant results in degrees awarded (Dougherty & Reddy, 2013; Hillman et al., 2014; Rutherford & Rabovsky, 2014; Sanford & Hunter, 2011; Shin, 2010; Shin & Milton, 2004; Tandberg & Hillman, 2014). Dougherty et al. (2016) indicate that additional multivariate studies need to be accomplished in states such as Ohio and Tennessee before more conclusive results can be made. Several studies have found that there is a lag between implementation and a positive impact on student outcomes (Callahan et al., 2017a; Hillman et al., 2018; Rutherford & Rabovsky, 2014). Where research does exist, the findings fluctuate between positive and negative results. Some research also

points to an increase in certificate completion at the expense of degree completion to increase completion rates, since certificates can be accomplished in a shorter period (Kelchen, 2020).

Negative or Neutral Results

Sanford and Hunter (2011) reveal that in Tennessee, where there is a long history of performance-based funding, public institutions have not seen a statistically significant increase in retention or 6-year graduation rates compared to other similar institutions. The authors believe that while this study was conducted for Tennessee, it can be extrapolated to other states. Li (2018) also found that most PBF policies have failed to improve degree completion and graduation rates in multi-state studies. In an analysis in Indiana, Umbricht et al. (2017) found no evidence that indicates graduation rates increased.

In another analysis, Tandberg et al. (2014) also found that performance-based funding for community colleges has not proven effective in raising associate degree completions. Further, they concluded that results of PBF were dissimilar across states, and, in the majority of states, the results were not statistically significant, and if they were, they had negative impacts (Hillman et al., 2015, 2018; Tandberg et al., 2014). This finding was validated by Rutherford and Rabovsky (2014), who determined that the number of graduates declined in states with performance funding. Hillman (2016) also found that states with PBF saw a decline of graduates in 2015; he explains this phenomenon as “triumph of hope over experience” (p. 7). A study by Callahan, Meehan, Shaw, et al. (2017a) indicate that PBF has a negative influence on part-time community college students in Tennessee on associate degree completion, credit accumulation, and articulation. However, Callahan et al. attribute that some of the negative results for part-

time students are the result of adult-learners who enrolled due to the recession but returned to the workforce before completing their credentials.

Some studies have also uncovered that some institutions, including community colleges, have restricted admission of underprepared students in a process known as creaming (Dougherty & Reddy, 2011). A few studies have found that some high schools are not being recruited due to low success rates of students, which are affected by the enrollment of minority and low-income students (Dougherty & Reddy, 2011; Smith, 2015; Tandberg & Hillman, 2014). Having higher education institutions be more selective is in direct conflict with the open door mission of community colleges (Cohen et al., 2014).

Positive Results

Organizations such as the Lumina Foundation and the Bill and Melinda Gates Foundation, which underwrite advocacy organizations (such as HCM Strategists), have produced numerous reports asserting the benefits of performance funding, as the implementation relates to an increase in student outcomes (Callahan et al., 2017a, 2017b; Conklin et al., 2016). In a study conducted by the Lumina Foundation, the authors found an increase of 6.3% of associate degrees awarded in Tennessee (Johnson & Yanagiura, 2016).

Nonetheless, other non-supported studies have found positive results. In her thesis findings for Ohio from 2011-2013, Hurtado (2015) did find that community colleges increased their associate degree awards by 27%. Additionally, Dougherty et al. (2016) stated that graduation numbers have increased in Indiana, Ohio, and Tennessee since the implementation of PBF 2.0. While results were negative for part-time students in Indiana and Tennessee, Callahan et al. (2017a) concluded that PBF had a positive impact on full-time students on

outcomes such as credit accumulation and degree completion and certificate completion. A study on Indiana found that more students were graduating on time; for bachelor's degrees, rates improved by 5%, and for associate degrees, rates improved by 4.4% (Conklin et al., 2016). Li's (2020) study showed an increase in the award of STEM bachelor's degrees in 13 states that prioritize and incentivize higher educational institutions with additional funding for these high-demand fields. In a study conducted on 4-year institutions, Hagood (2019) found that 4 years after the implementation of performance-funding 1.0, a 5% increase in bachelor's degree production occurred at institutions that awarded only bachelor's degrees (no graduate degrees). Li (2020) found that there was an increase of 21% for STEM bachelor's degrees in a multi-state analysis. Tandberg and Hillman (2014) concluded that it took 7 years to see a positive and significant impact. These studies all indicate that it can take time for higher education, which is large and decentralized, to respond to the financial incentives created by implementing performance-based policies (Callahan et al., 2017a). Li (2018) also determined that multi-state studies have found that models that use a series of statistical models have shown significant impacts in specific models that use lagged or delayed versions. Li and Kennedy (2018) did not find an increase in associate degrees and medium-to-long-length certificates but saw an increase in the award of short-term certificates in states with PBF policies in place for at least 6 years. Several studies have found an increase in short-term certificates at the expense of degrees or longer-term certificates (Hillman et al., 2015, 2018).

Dougherty and Reddy (2011) conducted a summary of research on several states, including Tennessee, Washington, Florida, Missouri, and both North and South Carolina. They found that, as a result of PBF, these states were making changes to their department's

structure, programs, curricula, advising, and tutoring, which have led to improved student performance and an increase in their performance metrics (Dougherty & Reddy, 2011; Tandberg et al., 2014). Additionally, there is evidence that performance funding prompts colleges to make substantial changes to their academic and student services policies, programs, and practices (Dougherty & Reddy, 2013). The addition of these academic supports for students increases student success.

Results Based on Mission or Size

Alshehri (2016) determined that larger universities and regional campuses already have the resources they need to quickly implement the policies of the state and are more likely going to do well fiscally as a result of PBF. Also, Alshehri warns that community colleges have fewer assets than their 4-year counterparts and are therefore more likely not to perform well. Tandberg et al. (2014) corroborated these results. In a study on small rural community colleges, Thornton and Friedel (2016) found that current research on PBF is based more on 1.0 models and that it is still too early to determine the effectiveness of PBF 2.0. While their study explored the impacts on PBF on small rural community colleges, they indicated that it would be essential to complete longitudinal studies and revisit the results in another 5 years and investigate all community colleges regardless of size (Thornton & Friedel, 2016). A study conducted by Hagood (2019) found that performance-based policies tend to favor highly resourced institutions (research universities) over low-resourced (state colleges and regional universities) 4-year institutions. Although the study was conducted on 4-year universities, the results can also be applied to community colleges that receive additional funding via local levies and do not rely solely on tuition. These institutions also have lower student enrollment, employ fewer faculty

and staff, and have lower salaries (Hagood, 2019). Callahan et al. (2017b) also determined that institutions with extensive financial resources do not need to make as many changes as under-resourced institutions, thereby rewarding these institutions by instituting performance-based funding policies. These institutions start in a better financial position to perform well on the metrics being measured for PBF programs. They also find that higher-resourced institutions have more considerable resources and higher quality staff and faculty, which can lead to more significant assessment and improvement of performance outcomes with their students.

Dougherty et al. (2016) conducted a study of 18 colleges and universities. They found that low-capacity institutions were more likely to report obstacles (student body makeup and institutional resources) to meeting the objectives of performance-based funding relative to high-capacity institutions. Finally, Birdsall (2018) found that institutions that rely less on state funding are more successful in attaining the metrics of the funding formula when compared to institutions that rely more on state funding. The author suggested that resource-dependent institutions are less able to change or identify solutions.

To date, there have been several quantitative studies that have utilized IPEDS data to examine the impacts of PBF on student success (Hillman et al., 2014, 2015; Rutherford & Rabovsky, 2014; Tandberg et al., 2014; Tandberg & Hillman, 2014). Boelscher and Snyder (2019) caution that IPEDS data may not correctly reflect nuances in PBF data (such as residency restrictions for some states and some metrics not previously reported) and may lead to "erroneous conclusions, positive or negative" (p. 35). These studies' results are mixed, and earlier reports indicate little effect on student outcomes (Hillman et al., 2014, 2015; Tandberg et al., 2014; Tandberg & Hillman, 2014). However, more recent IPEDS studies accomplished

several years after implementation indicate that PBF has had a positive effect on student outcomes (Hillman et al., 2015; Tandberg et al., 2014).

OHIO COMMUNITY COLLEGES

Community colleges in Ohio did not emerge until the 1960s, and bills that would have permitted their establishment failed to pass the Ohio General Assembly in 1929, 1931, 1949, 1951, and 1953 (Johnson, 2012). The first official community college in the state was Stark State College of Technology, founded in 1960 (Lerner, 1995). The remaining colleges in Ohio were established between 1960 and the end of 1976 (Johnson, 2012). However, there are a few institutions in the state that are much older, such as Sinclair Community College, which started as a private institution in 1887 but was converted into a public institution in 1965 (Sinclair, 2020). The community colleges in Ohio are defined by one of three different classification systems based on how they receive funding and what types of associate degrees they award. Out of the 23 community colleges in the state, 11 are classified as State Community Colleges, six as Technical Colleges, and six as Community Colleges that can receive funding from local taxpayers via property tax levies (Table 2).

Table 2: *Ohio Community Colleges by Type, Enrollment, and Classification*

Community College Name	Type (according to Ohio Revised Coded)	Local Levy Dollars Available	Enrollment (2018)	Carnegie Classification
Belmont Technical College	Technical College	No	986	Small
Central Ohio Technical College	Technical College	No	3,576	Medium
Cincinnati State Technical and	State Community College	No	9,459	Large

Community College Name	Type (according to Ohio Revised Coded)	Local Levy Dollars Available	Enrollment (2018)	Carnegie Classification
Community College				
Clark State Community College	State Community College	No	5,705	Large
Columbus State Community College	State Community College	No	27,675	Very Large
Cuyahoga Community College	Community College	Yes	26,408	Large
Eastern Gateway Community College	Community College	Yes	17,072	Large
Edison State Community College	State Community College	No	3,741	Medium
Hocking Technical College	Technical College	No	3,671	Medium
James A. Rhodes State College	State Community College	No	2,714	Medium
Lakeland Community College	Community College	Yes	6,920	Very Large
Lorain Community College	Community College	Yes	10,651	Very Large
Marion Technical College	Technical College	No	2,395	Medium
North Central State Community College	State Community College	No	2,965	Medium
Northwest State Community College	State Community College	No	4,552	Medium
Owens State Community College	State Community College	No	9,469	Very Large
Rio Grande Community College	Community College	Yes	1,336	Small
Sinclair Community College	Community College	Yes	18,575	Very Large
Southern State Community College	State Community College	No	2,457	Medium

Community College Name	Type (according to Ohio Revised Coded)	Local Levy Dollars Available	Enrollment (2018)	Carnegie Classification
Stark State Community College	State Community College	No	11,350	Medium
Terra State Community College	State Community College	No	2,263	Medium
Washington State Community College	State Community College	No	1,729	Small
Zane State Community College	State Community College	No	2,357	Medium

(Kahlenberg et al., 2018)

Consequently, most community colleges in the state receive and need state funds for support and operation. *Technical colleges* offer career/technical education programs, adult continuing education programs, community service activities, workforce skills enhancement, and developmental education (Ohio Board of Regents, 2015). *State community colleges* offer both general education and career/technical education programs. These colleges derive funding primarily from state subsidy and tuition and fees (Ohio Board of Regents, 2015). *Community colleges* differ from state community colleges as they are allowed to receive financial support through local tax levies in addition to state subsidy and tuition and fees (Ohio Board of Regents, 2015).

History of Performance-Based Funding in Ohio

Ohio began with PBF 1.0 in the 1980s as bonus funding called “Selective Excellence” programs designed to promote academic excellence in technology fields and adopt change in Ohio’s public institutions (Ohio Board of Regents, 1992). This program was competitively awarded as an addition to the base funding formula but was discontinued in the 1990s due to

limited resources (Hurtado, 2015). Between 1995 and 2009, the state instituted various performance challenges, which eventually failed since they did not sufficiently incentivize schools compared to enrollment-based funding (Hurtado, 2015). The "Performance Challenge" was adopted in 1995 and discontinued in 1999 (Balog, 2016). However, Ohio was not able to make a significant impact on increasing educational attainment, ranking 38th of 50 states in the U.S., with only 26% of the population holding a bachelor's degree compared to the national average of 31% (Ohio Board of Regents, 1992). Concerns that Ohio was falling behind in degree completion and not keeping pace with labor market changes led state policymakers to find a way for higher education to better align with state workforce goals.

Consequently, Ohio began the overhaul of its system in 2009 and adopted the new policy the same year (Ohio Higher Education Funding Commission, 2012; Snyder & Fox, 2016). Governor John Kasich asked the leaders of public colleges and universities to collaborate and not compete against each other. Instead, he challenged them to create a funding formula that rewards student success and completion and aligns with the state priority of future workforce development (Ohio Higher Education Funding Commission, 2012). Governor Kasich's charge demonstrated his support for higher education and put Ohio in a national leadership role for placing the state at the forefront of an increase in college attainment and global competitiveness (Ohio Higher Education Funding Commission, 2012).

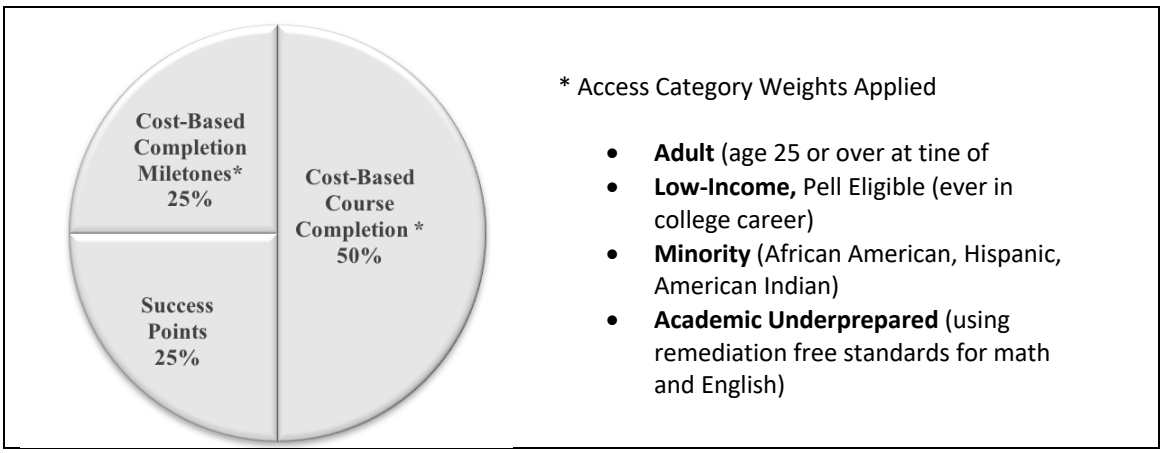
Ohio's Funding Formula

Ohio is considered a leader in PBF. It has created a state-level policy that includes all public institutions, and the state's share of instruction (funding) is based on performance metrics formulated by the institutions (Ohio Board of Regents, 2014). Ohio followed many of

the best practices in the design and implementation when forming its PBF policy. Legislators engaged institutions and created separate formulas for both 2- and 4-year institutions; they aligned the metrics to the state's higher education attainment and workforce needs. They made 100% of state funding outcomes based. Ohio also did a slow phase-in of the new funding model, tying a higher percentage of funding to performance each year, with 5% in 2011, 50% in 2014, and 100% in 2015 (Dougherty et al., 2011). Since Ohio's program was high stakes, the state began with a stop-loss provision from 2009-2014, which prevented institutions from dropping below the prior year's funding (Zumeta & Li, 2016). In Ohio, SSI (State Share of Instruction) is a zero-sum game, and institutions must perform by growing enrollment, increasing the number of course completions, and increasing degrees awarded faster than the others to increase funding to their institution (Cummins & Robinson, 2019).

The community college formula (Figure 2) is based on a 3-year average, which helps protect against massive funding changes. The formula also includes a bonus in the form of extra-weight for success from at-risk populations (called access categories) in recognition of community colleges (Ohio Board of Regents, 2014). The formula considers these additional costs and adds a cost-based model for these courses and degree completions (Ohio Association of Community Colleges, 2013). The funding formula is composed of three different categories:

1. Course completion (50%)
2. Student success points (25%)
3. Completion milestone (25%)



(Ohio Association of Community Colleges, 2013 p. 6)

Figure 2. Ohio performance-based community college SSI formula.

Boelscher and Snyder (2019) indicate that states with well-developed PBF models also include factors that promote the enrollment and success of underrepresented populations such as low-income, minority students, and academically underprepared students in their funding formula, thus acknowledging that nontraditional students are diverse, that these populations require additional resources, and that the state recognizes that these populations need to be prioritized to meet educational attainment goals (Boelscher & Snyder, 2019; Cielinski & Pham, 2017). Ohio has incorporated these populations in the funding formula by creating access weights applied to all aspects of the formula as bonus points.

Access category weights are calculated at a flat rate of 15% for course completions, and a tiered approach is taken for completion milestones (Ohio Association of Community Colleges, 2013). Students from one access group are calculated at 25% weight. Students from two or more categories are weighted at 66%, and students from three or more categories are weighted at 150% (Cielinski & Pham, 2017; Ohio Association of Community Colleges, 2013).

Ohio took great care in creating the funding formula by incorporating a component for course completion, while not directly related to enrollment. However, it helps provide stability to the formula and for institutions (Ohio Board of Regents, 2014). The course completion category accounts for 50% of the total funding formula (Ohio Association of Community Colleges, 2013). This category uses a cost-based model to help offset the higher cost of courses in science, technology, engineering, and mathematics (Ohio Association of Community Colleges, 2013). Additionally, course completions are also weighted for the access category weight with a flat weight of 15% added for any student who meets one or more of the risk factors or access categories (Ohio Association of Community Colleges, 2013).

Success points are used to allocate funding associated with student success as measured by credit accumulation and completion of developmental education (Ohio Department of Higher Education, 2019b). Success points for developmental math and English are awarded for students who complete a developmental class and enroll in a college-level class the same or next academic year in the same subject area (Ohio Association of Community Colleges, 2013). Points are also awarded for each student who reaches the attainment of their first 12, 24, or 36 credit hours, but this category is not weighted by access categories (Ohio Association of Community Colleges, 2013).

The completion milestones are intended to represent the point at which students achieve an endpoint at the community college. They include associate degree completion, long-term certificate completion (30+ credit hours), as well as a transfer with 12 credit hours at a 4-year university (Ohio Association of Community Colleges, 2013). The completion milestone is not equally distributed among the three categories. Long-term certificates are weighted at one-

half of the associate degree model cost, and transfers with at least 12 credit hours of college-level coursework are weighted at one-fourth of the associate degree model (Ohio Department of Higher Education, 2019b). For associate degree completion, institutions receive 100% of the cost model for students who complete their first degree in a given year (Ohio Department of Higher Education, 2019b). If students complete more than one associate degree, the subsequent award will be 50% of the cost model for that degree category (Ohio Department of Higher Education, 2019b). The completion milestones are weighted by access category and provide a 25% weight if the student meets one access category, 66% for two, and 150% for all three factors (Ohio Association of Community Colleges, 2013). At this time, short-term certificates (less than 30 credit hours) are not currently included, but this addition is being discussed for inclusion in the formula at a later date (Ohio Department of Higher Education, 2019b).

During budget talks for the 2020 year, Ohio community colleges rallied together to ensure that only residents of the state of Ohio were eligible to receive SSI from the state (Ohio Department of Higher Education, 2019b). Up until this point, SSI was awarded to any student registered at one of the state institutions. Starting FY 2020, the course completion portion of the formula will be awarded only to eligible subsidy students (students who live in the state of Ohio) (Ohio Department of Higher Education, 2019b). Starting in FY 2021, all three components of the funding formula (course completion, success points, and completion milestones) will be awarded only for eligible subsidy students for the 3 years included in the funding formula (Ohio Department of Higher Education, 2019b).

THEORETICAL FRAMEWORK

As previously indicated, performance-based funding programs in higher education seek to improve the performance of institutions by rewarding colleges that successfully focus on student success outcomes (Li & Zumeta, 2016; Snyder, 2015). These types of funding programs typify theories of action in moving colleges to produce desired results (Dougherty & Reddy, 2013). Argyris and Schon (1996) describe a theory of action:

> The general form of a theory of action is: If you intend to produce consequence C in situation S, then do A. Two further elements into the general schema of a theory of action: the values attributed to C that make it seem desirable as an end-in-view and they underlying assumptions, or model of the world, that make it plausible that action A will produce consequence C in situation S. (p. 13)

In theory, PBF rewards institutions that perform well and punishes low-performing institutions by providing them with fewer resources (Nedwek, 1996).

The principal-agent theory (PAT) can best explain the concept of performance-based funding. The state (principal) uses rewards to ensure that the higher education institution (agent) is meeting its predetermined goals (student outcomes) (Shin & Milton, 2004; Tandberg et al., 2014). With principal-agent theory, the principal (the state) lays out a set of regulations and policies (goals or outcomes), and the agent (higher education institutions) must follow these to achieve the results (Alshehri, 2016; Sappington, 1991).

PAT focuses on both the adoption and the implementation of PBF by establishing a system for monitoring performance and offers financial compensation for being successful (Gorbunov, 2013). The basis of PAT is that the principal (state) cannot control an action (student success) without the use of another entity (higher education) and contracts with them to accomplish the task (Ward, 2019). This contract is based on the idea that the agent (higher

education) has its self-interest and may not act how the principal would act (Ward, 2019). The central concern is how to motivate the agent to act as the principal desires by taking under advisement the issue with monitoring the agent's activities (Sappington, 1991).

Performance can be improved if incentive-based contracts between different parties are implemented. Since there are considerable costs associated with monitoring the agent's behavior, the states have to rely on a few simple indicators to assess if the institutions are producing the desired effects (Nisar, 2015). The outcomes must be easy to measure and quantify, which in higher education leads to degree and certificate completion taking precedence over harder-to-measure outcomes such as teaching quality (Kelchen, 2019). According to Heinrich and Marschke (2010), the agent can game the system and modify its behavior based on the changes in the principal's incentives. However, the principal relies on the assumption that if the policy is designed correctly, it will lead to the desired outcome (Nisar, 2015).

This theory is based on economic principles; the agent must be a willing participant so that both parties can benefit from the relationship (Stiglitz, 2008). The basic principal-agent theory explains how incentives can motivate the agent to act on behalf of the principal (Hillman et al., 2014). This relationship can be extended to public policy contexts (Bergmana & Lane, 1990) and serves as a guide, both conceptually and analytically (Hillman et al., 2014, 2015).

In theory, the principal-agent relationship helps explain why colleges may or may not improve performance goals. In this study, the performance-based funding policy is the contract that colleges must follow to be rewarded with additional money. The state uses this contract to monitor the performance of colleges (Hillman et al., 2014). However, there are several reasons

why colleges may not be able to fulfill their part. They may not have the financial resources to implement best practices, or they may not be able to implement all of the priorities from the state as there are several metrics to follow (Hillman et al., 2014). As a result, some colleges may not have the appropriate capacity to achieve policy goals (Dougherty et al., 2013).

Consequently, this framework can help identify whether the contract (performance-based funding) resulted in increased performance dependent upon each institution's financial capacity. If a relationship is found, then it suggests that the principal-agent theory was successful, and agents are performing according to the principal's request. However, if there is no increasing student success, there may be issues in having adequate resources (Hillman et al., 2014).

PERFORMANCE-BASED FUNDING 3.0

A new third wave of performance-based funding has been dubbed PBF 3.0 (Kelchen & Stedrak, 2016). This new designation is meant to highlight PBF 2.0 programs that tie a much higher percentage of allocation to performance metrics (Ward, 2018). Currently, only three states—Nevada, Ohio, and Tennessee—tie 80% or more of funding to these metrics (Boelscher & Snyder, 2019). This compares to the other states who utilize PBF 2.0 as a funding strategy but allocate 10% or less to fund higher education (Boelscher & Snyder, 2019). This new category is meant to help distinguish the different degrees of funding tied to performance, a classification that has not yet been studied (Ward, 2018). In this study, there is no distinction between PBF 2.0 and 3.0 programs, as most of the literature still refers to all these programs as PBF 2.0.

SUMMARY

Performance-based funding has recently resurfaced as a solution expected to help solve low graduation and retention rates as well as overall student success in institutions of higher education despite a lack of conclusive evidence on its effectiveness (Dougherty & Reddy, 2013; Hillman et al., 2014; Sanford & Hunter, 2011; Shin, 2010; Shin & Milton, 2004; Tandberg, 2010; Tandberg & Hillman, 2014). There is evidence that supports both positive and negative impacts of PBF (Callahan et al., 2017b; Conklin et al., 2016; Hillman, 2016; Tandberg & Hillman, 2014). Tandberg et al. (2014) found that there are "likely better and potentially more impactful ways" (p. 27) to increase college completion. Others indicate that performance-based funding serves a symbolic purpose of accountability without necessarily affecting the institution's resources (Hagood, 2019; Rabovsky, 2012; Tandberg & Hillman, 2014). This is not to say that performance-based funding will not result in the desired effect of increasing graduation rates; it may just be an indication that more time will need to elapse before any conclusive results can occur.

CHAPTER 3: METHODOLOGY

INTRODUCTION

The primary purpose of this study was to analyze whether the transition to performance-based funding in Ohio has resulted in increased institutional effectiveness (as measured by an increase of graduations from less than one-year certificates, one-year certificates, and associate degrees) over the last 15 years (2004-2018). The intent was to provide empirical data to be evaluated by state policymakers and other decision-makers to determine if the change to a PBF 2.0 model has the desired impact of increasing graduation rates and guiding future decisions concerning Ohio's PBF model. This study employed a quantitative analysis of 15 years of community college performance results to determine whether community college performance changed in response to the performance goals implemented by the Ohio Board of Regents in 2011. Data reports from the Higher Education Information System (HEI) were analyzed for the years 2004-2018. The data included the graduation numbers for associate degrees and certificates for the 7 years before the implementation of the performance-based funding (PBF) formula as well as the results for the first 7 years after the implementation.

RESEARCH QUESTIONS

1. To what extent, if any, has the change to performance-based funding in Ohio increased credential attainment (less than one-year certificates, one-year certificates, and associate degrees) at 2-year community colleges? Is the obtainment

of these credentials increasing, and if so, are associate degrees or are certificates increasing at a higher rate?

2. Are there any significant differences among the different types of institutions (state, community colleges, or technical schools) in response to performance-based funding in credential attainment (less than one-year certificates, one-year certificates, and associate degrees)?

The alternative hypothesis for this study is the following: The change to performance-based funding has increased student success at Ohio community colleges. In the context of this research, student success measures include certificate and degree attainment or graduation rates.

RESEARCH DESIGN

The independent variable in this study is performance-based funding. The dependent variables are certificates and associate degrees awarded per year. The design is a quasi-experimental, longitudinal study that examined the certificates and associate degrees awarded both before and after the implementation of performance-based funding 2.0 in Ohio in 2011.

All certificate and degree counts were converted to natural log values to help bring outliers closer to the average distribution and create a more symmetric distribution (Li & Kennedy, 2018). Autocorrelation analysis was also accomplished using Bartlett's 95% confidence interval estimates. This design is appropriate for this research since it intends to learn whether the treatment (change to performance-based funding) has had any significant influence on student success.

For the second research question, the study provided an analysis of Ohio's 23 community colleges based on the type of community college (technical, state, or community) to examine if the degree and certificate completion are significantly different at one kind of

institution relative to others. Since performance-based funding is not the only influence on student success metrics, this study will incorporate control variables to attempt to improve internal validity. Completions are affected by the enrollment type (full- and part-time) of the institution and the number of accessible resources; therefore, internal controls for enrollment status (full- and part-time status) were also included (Hillman et al., 2014). Since this study is a quasi-experimental regression-discontinuity design, it has a relatively high external validity (Trochim et al., 2016).

A possible threat to internal validity via a history effect is the change from quarters to semesters in the fall of 2012 in Ohio. As a result of the transition, most community colleges experienced an increase in graduates in the spring of 2012 since students were trying to graduate before the conversion (Pant, 2012). Also, the Great Recession (2007-2009) led to an increase in enrollment, which increased graduation counts, and the effects can be delayed in 2-year schools (United States Census Bureau, 2018).

STUDY POPULATION

The population for this study is Ohio public community colleges. The sample includes all 23 public community colleges in Ohio, representing just under 200,000 students per year. The unit of analysis is the public community colleges. The data in this study span from 2004 to 2018, which created a 15-year balanced panel data set. Ohio conducted a phased implementation for its PBF model; the funding changes began slowly in 2011, with only 5% of the funding tied to performance until 2015 when 100% of funding was linked to the performance metrics (Hurtado, 2015). This period starts 7 years before the implementation of PBF in Ohio in 2011 to provide a baseline of results before the treatment. It includes 7 years of results after the

application of PBF, giving the analysis equal representation before and after the execution of PBF. This sample represents a non-probability convenience sample.

Most of the research that exists on PBF is derived from the Integrated Postsecondary Education Data System (IPEDS) data (Hillman et al., 2014, 2015; Rutherford & Rabovsky, 2014; Tandberg & Hillman, 2014). However, there are limitations with this dataset as the "accessible population" for IPEDS data is available only for first-time, full-time degree-/certificate-seeking students who started and finished at the same institution (National Center for Education Statistics, 2017). Therefore, information derived from these studies is limited as they are not fully representative of the population at community college.

Instead, this study used data from the Ohio Department of Higher Education, which publishes funding and performance measures for all publicly funded institutions in Ohio in a system called the Higher Education Information System (HEI). These data are available for download on a public website in a variety of Excel spreadsheets and PDF documents containing datasets on student enrollment, distribution of state share of instruction (SSI) funds, as well as completion data for associate degrees, one-year certificates, and less than one-year certificates for the entire community college population (Ohio Department of Higher Education, 2018). The data are reported at the institution level as well as aggregated to the state level. The data are also freely available for download on the Ohio Department of Higher Education's HEI website.

INSTRUMENTATION

Data are self-reported to the HEI system and are subject to reporting inaccuracies. Since the data are self-reported to the HEI system similarly to how the data are reported to IPEDS, it is expected that the datasets are reliable and valid.

While the sample is not random, it does represent 100% of the Ohio HEI population data and should be comparable to all public institutions. However, since the study used only data from Ohio public community colleges, it does pose a threat to external validity. One should be careful in extrapolating the results to the entire higher education public community college population who are using performance-based funding.

DATA ANALYSIS: INTERRUPTED TIME-SERIES

This study used an interrupted time-series regression model that compares several outcomes before and after the implementation of performance-based funding in the state of Ohio. An interrupted time-series analysis (ITSA) is a rigorous quasi-experimental design used to evaluate the impact of policy change after the implementation (Callahan et al., 2017a; Penfold & Zhang, 2013). ITSA is the strongest and most commonly used quasi-experimental design to assess the impact of treatment when a randomized controlled population is not possible (Linden, 2017; Penfold & Zhang, 2013). ITSA has been used extensively in public health interventions and epidemiology studies, as well as other planned events such as financial crisis and policy implementations (Bernal, 2018; Bernal et al., 2017; Caswell, 2017).

In an ITSA design, data are collected at regular intervals both before and after an intervention. It is a regression analysis with an intervention at a given point in time, splitting the regression into a pre- and post-intervention linear regression model (Utz et al., 2013). ITSA estimates the effect of the treatment on the outcome variables (Callahan et al., 2017a). The main objective of an ITSA is to examine whether the data observed before and after an intervention are different from any underlying trend over time. It is more than a pre-post comparison since the analysis is looking at the analysis of the trend and not a single before-

after scenario (Bernal, 2018). This type of analysis is useful in the evaluation of the effect of a well-defined treatment (interrupts) in time-series datasets (Linden, 2017).

Further, Callahan et al. (2017b) found that "ITSA analysis is particularly relevant for evaluating programs and policies designed to produce statewide changes since such policies do not provide the opportunity to examine a comparison group within the same state during the time of policy implementation" (p. 18). With this analysis, data are collected at multiple time points before and after an intervention and then are evaluated to determine whether the intervention produced a change after the implementation (Callahan et al., 2017b; Fretheim et al., 2013). A minimum of three observations, as well as a defined intervention time point, are required for an ITSA analysis to be successful (Polus et al., 2017).

ITSA uses a counterfactual scenario (predicts what would have happened without the intervention) (Callahan et al., 2017b; Polus et al., 2017). This scenario provides a hypothetical expected trend comparison to evaluate the impact of the intervention by examining if any changes occurred had the intervention had not taken place (Bernal et al., 2017). This type of analysis identifies an immediate effect (level change), a sustained effect (slope change), or both (Figure 3). Essentially, if the treatment had an impact on the outcome, then a change in level and slope between pre- and post-interruption will be identified (Caswell, 2017). According to (Utz et al., 2013),

> ITSA compares the intercept and slope of the regression line before the intervention with the intercept and slope after intervention. A one-time baseline effect of the intervention without influencing the secular trend can be detected as an intercept change. If the intervention changed the secular trend, there will also be a significant difference in the slope between the two periods. (para. 3)

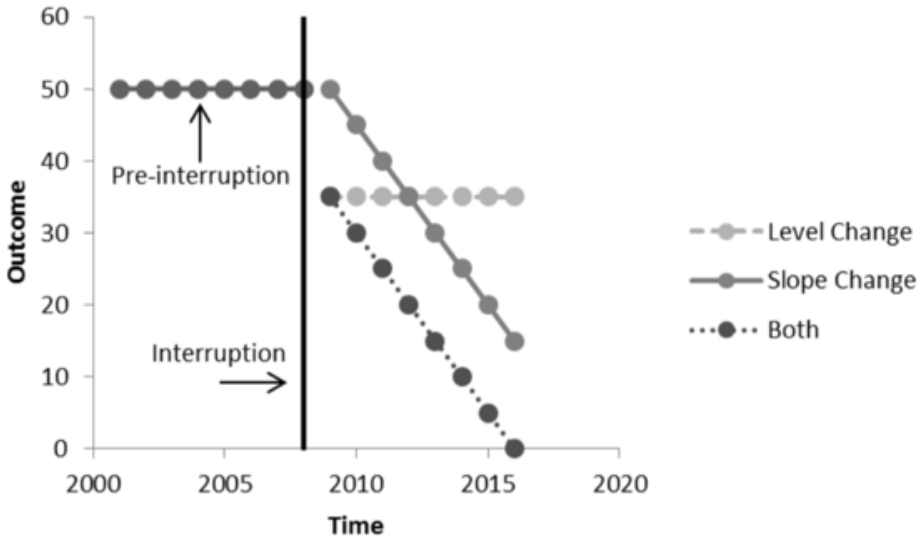


Figure 3. Different identification in ITSA analysis.

Bernal et al. (2017) also indicate that a minimum of three variables is required for an ITSA analysis:

1. T: the time elapsed since the start of the study
2. Xt: a dummy variable indicating the pre-intervention period (coded 0) and post-intervention (coded 1)
3. Yt: the outcome at time t

A standard ITSA regression model formula is:

$$Y_t = \beta_0 + \beta_1 T_t + \beta_2 X_t + \beta_3 X_t T_t + e_t$$

Where Y_t is the aggregated outcome variable measured at a regularly spaced time variable (t), T_t is the time since the start of the study, and X_t is a dummy variable that acts as the indicator representing the intervention (Caswell, 2017). β_0 represents the baseline level at T = 0 (or the starting time of the series), β_1 is the slope of the outcome variable until the introduction of the intervention being studied, β_2 estimates the change in the level immediately following the introduction of the intervention, β_3 indicates the slope change between the pre-

intervention and post-intervention slopes of the outcome (using the time and intervention: TXt), and e_t estimates the error (Bernal et al., 2017). Therefore, it is vital to look for significant *p*-values in β_2 as it indicates an immediate effect of the treatment, or alternatively, a significant *p*-value in β_3 indicates a treatment has had an effect over time (Linden & Adams, 2011). Through ITSA analysis, conclusions can be made based on statistical evidence rather than only a visual assessment of time series graphs (Caswell, 2017).

Model

ITSA allows for different types of regression-based models for time series data (linear, quantile, logistic, Poisson, multilevel) (Linden, 2015). It was determined that the ITSA with a Poisson regression model (also called log-linear) was the best model for this analysis. This type of regression is used only for numerical, continuous data (at regular intervals), making it the best solution for modeling an event with count data (Chesaniuk, n.d.). Poisson methods use a log conversion, which helps with skewed data (e.g., having zeros as an outcome).

ITSA has strong internal validity when multiple observations of pre- and post-intervention can be obtained and good external validity when the unit level is at the population level or when the results can be generalized to other settings (Campbell & Stanley, 1966; Shadish et al., 2002). ITSA regression also uses dummy variables that adjust for autocorrelation but do not control for trends that could exist before the policy change (Caswell, 2017). According to Bernal (2018) and Penfold and Zhang (2013), ITSA has numerous strengths, including:

- the ability to control for the effect of secular trends in a time-series of outcome measures;

- analysis can be conducted with respect to populations versus on the individual level;
- it lends itself to the analysis of unintended consequences of intervention and policy changes;
- stratified analysis can be conducted to evaluate the impact of a change on different sub-populations;
- ITSA provides easy-to-interpret graphical results.

The primary threat to internal validity is history bias, that some other event occurred around the same time as the treatment that could provide an alternative explanation of the estimated PBF effects (Callahan et al., 2017b). There are also threats to instrumentation and ensuring that the way the outcome is measured remains the same and is not changed throughout the study (Bernal, 2018). However, ITSA designs have strong external validity since they are undertaken in the real world with observational data (Bernal, 2018).

Other Measures

Additionally, descriptive statistics, including mean and standard deviation, was applied to the dependent variables to help identify patterns within the datasets. Using the HEI datasets from ODHE, visual time-series plots were utilized to show the changes that have occurred to each type of community college (technical, state, community) before and after the implementation of PBF. Descriptive statistics were used to evaluate and compare the effect of performance funding on the less than one-year certificates, one-year certificates, and associate degrees at Ohio's comprehensive public community colleges. The regression results for both studies represent all institutions as well as institution type with confidence levels. The analysis was accomplished in the statistical analysis tool Stata.

There is an assumption that no other policies that could affect the dependent variables (certificate and degree awards) were passed at the same time as performance-based funding in the state of Ohio (Umbricht et al., 2017). However, during the 2012 academic year, Ohio transitioned from quarters to semesters, which resulted in a large influx of students graduating in the spring of 2012. While not a policy change, another possible factor that can also affect the results of this study is that community colleges experienced an increase in enrollment from 2007 to 2011 as a result of the Great Recession (Chen, 2019).

Since only community colleges in the state of Ohio were included in this study, the results may not be able to be generalized to other states' funding models unless another state follows the same model as Ohio. Also, this study is limited to 2-year public community colleges and does not include 4-year institutions.

Finally, the results from 2011 to 2014 are likely underestimated as a result of the gradual phase-in of implementation to PBF. The inclusion of these 4 years of data post-implementation will lead us to minimize the effects of PBF. As a result, any negative or positive impact would likely be more substantial if the implementation occurred at 100% in 2011.

Other variables that were not accounted for include differences in demographic changes, the difference in the economy over the study period, mobility rates for high school students, and many other factors that can affect the result of this study. Many factors can affect the results of this study; however, what can be isolated has been identified. This study provides new insights derived from local data from the Ohio Department of Higher Education.

SUMMARY

As previously discussed, this study explored whether the introduction of performance-based funding in Ohio has led to an increase in student completions in certificates and associate degrees. The study set out to determine if smaller institutions have experienced the same amount of success as larger institutions or if they are disadvantage by their size. The alternate hypothesis for this study is the following: The change to performance-based funding has increased student success at Ohio community colleges. In the context of this research, student success measures include certificate and degree attainment or graduation rates.

This study should contribute to the available research on whether performance-based funding systems are improving institutional performance in higher education. As more states move toward more significant investments in PBF, this research can help shape policy at both the college and state level. The intent is to provide empirical data that could be evaluated by state policymakers and institutional administrators when making future decisions about the utilization of performance-based funding to increase student success.

CHAPTER 4: RESULTS AND FINDINGS

INTRODUCTION

Findings in this chapter are derived from the ODHE HEI System. Descriptive statistics are provided for the datasets. Statistical analysis results from the Interrupted Time Series Analysis (ITSA) results follow the descriptive statistics.

RESULTS – RESEARCH QUESTION 1

1. To what extent if any, has the change to performance-based funding in Ohio resulted in an increase in credential attainment (less than one-year certificates, one-year certificates, and associate degrees) at 2-year community colleges? Is the obtainment of these credentials increasing, and if so, are associate degrees or are certificates increasing at a higher rate?

Descriptive Statistics

Data were collected and analyzed for all 23 public community colleges (technical, state, and community) in Ohio. To get an overall overview of the data, they were plotted into a line graph to view the distribution and trend of the data (Figure 4).

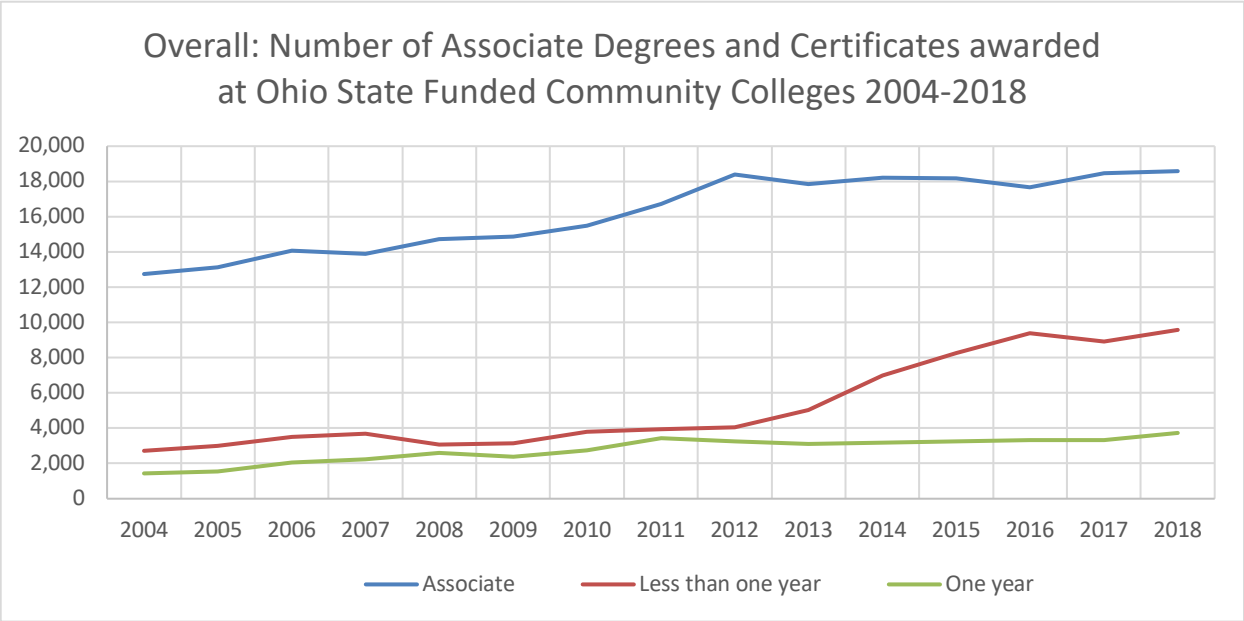


Figure 4. Number of associate degrees and certificates awarded at Ohio community colleges from 2004-2018.

A simple visual analysis displays that there has been an increase in the number of degrees and less than one-year certificates awarded. In contrast, the one-year certificate awards were relatively stable (Figure 4). Descriptive statistics were also generated (Table 3). These statistics are described in more detail below by each award category (less than one-year certificates, one-year certificates, and associate degrees).

Table 3: *Descriptive Statistics for All 23 Public Community Colleges in Ohio*

Overall: Less Than One-Year Certificates		Overall: One-Year Certificates		Overall: Associate Degrees	
Mean	5,274	Mean	2,774	Mean	16,199
Standard Error	665	Standard Error	182	Standard Error	553
Median	3,941	Median	3,109	Median	16,732
Standard Deviation	2,577	Standard Deviation	704	Standard Deviation	2,142
Sample Variance	6,641,650	Sample Variance	496,111	Sample Variance	4,588,448
Kurtosis	(1)	Kurtosis	(1)	Kurtosis	(2)
Skewness	1	Skewness	(1)	Skewness	(0)
Range	6,861	Range	2,297	Range	5,838
Minimum	2,717	Minimum	1,435	Minimum	12,746
Maximum	9,578	Maximum	3,732	Maximum	18,584
Sum	79,106	Sum	41,615	Sum	242,991
Count	15	Count	15	Count	15

Full-Time Equivalent

The full-time equivalent (FTE) for the study period is plotted below. Figure 5 shows the increase of FTE in the years leading up to the change from quarters to semesters in 2012. This increase was expected as numerous students wanted to graduate before the programs switched between systems. Research from the state of Ohio demonstrates that students who did not graduate under the quarter system but transitioned to semesters experienced a delay in graduation and were also subject to additional costs (Bostwick et al., 2019). The total number of students seeking less than one-year certificates is different in the pre-intervention and post-intervention periods. This could be a potential factor in determining the results.

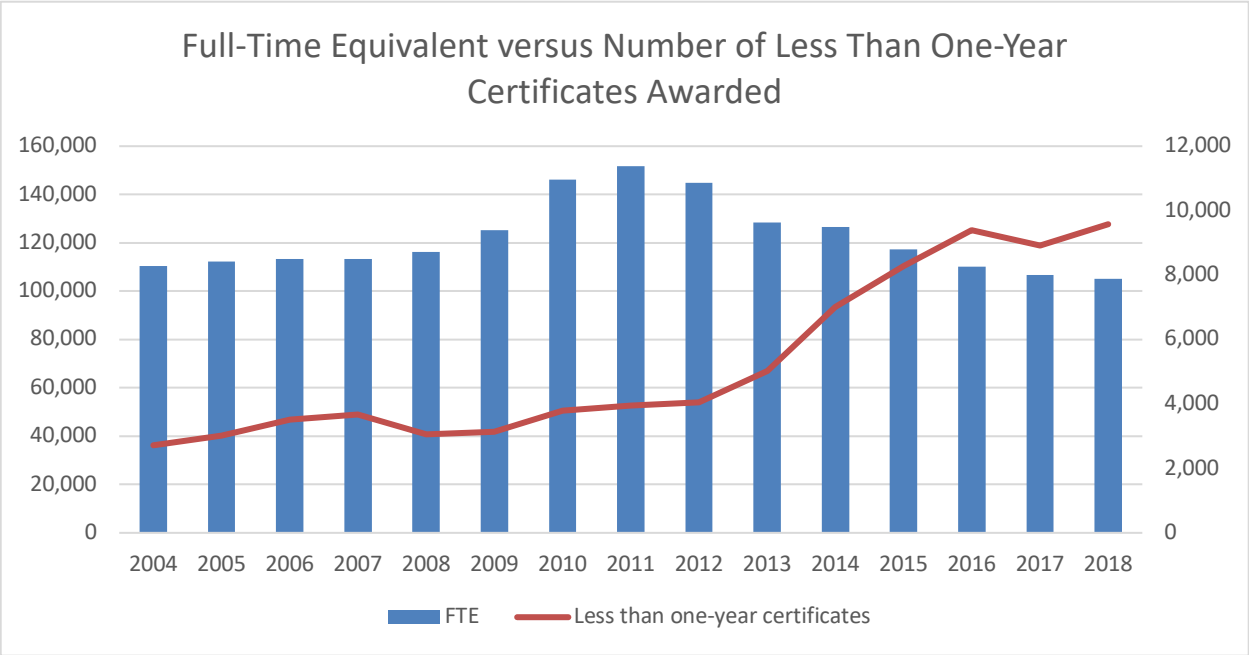


Figure 5. FTE chart for all 23 Ohio public community colleges and number of less than one-year certificates awarded.

Descriptive statistics were also generated (Table 4). A maximum number of FTE was experienced in 2011 with 149,884, and the minimum, 103,179, occurred in 2018.

Table 4: *Full-Time Equivalent (FTE) Descriptive Statistics*

DESCRIPTIVE STATISTICS	
Mean	119,829
Standard Error	3,884
Median	114,168
Standard Deviation	15,044
Sample Variance	226,316,273
Kurtosis	(0)
Skewness	1
Range	46,665
Minimum	103,179
Maximum	149,844
Sum	1,797,435
Count	15

Outcome: Number of Less Than One-Year Certificates

The number of certificates that were less than one year in length awarded in all 23 public community colleges is displayed in Figure 5. The mean number of less than one-year certificates awarded over the 15-year period is 5,274, with a minimum of 2,717 awarded in 2004 and a maximum of 9,578 awarded in 2018, indicating an upward trend while FTE was decreasing.

Interrupted time series analysis (ITSA) was performed on the log-transformed number of certificates for less than one-year certificates. Autocorrelation analysis using Bartlett's 95% confidence interval estimates was used to determine the lag of the autocorrelation structure.

Figure 6 is a correlogram of the autocorrelation of the log number of certificates. The correlogram shows a significant autocorrelation of the order one, as they follow a similar time collection cycle. This result is consistent with time-series data, which involve a sequence of measurements collected at evenly spaced time intervals of the same variable (PennState Eberly College of Science, 2018). The data from this analysis are managed and published by ODHE on a yearly schedule.

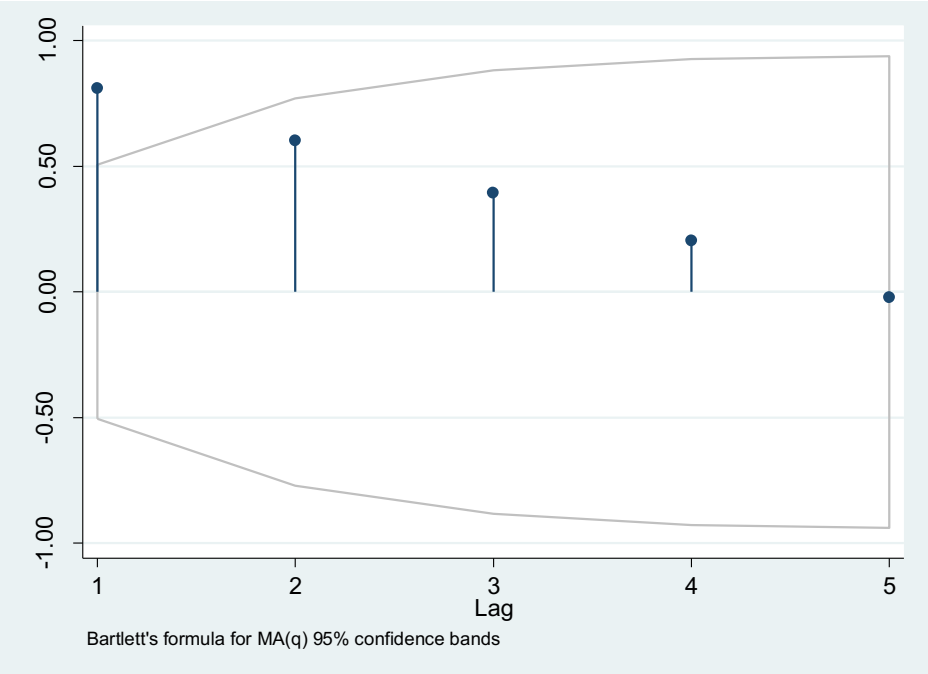


Figure 6. Correlogram for logarithm of number of certificates (less than one year).

To account for the effect of the number of full-time equivalent (FTE) students on the number of certificates, a time series regression model was used, taking the log of the number of certificates as the dependent variable and lagged log number of certificates and log of FTE as predictors. Table 5 presents a summary of the results of this regression model. The overall model was statistically significant (χ^2 (2) = 52.08, $p \leq .001$). The effect of log FTE adjusting for lagged log of number of certificates was not statistically significant (b = –0.371, Z = –0.57, p = .571). This indicates that adjusting for the lagged log of the number of certificates, the log FTE has no significant effect on the log number of certificates in an associative sense. Therefore, log FTE was excluded from the ITSA model. The significance of the effect of FTE in the presence or absence of other factors (covariates/control) is not discussed in this study.

Table 5: *Assessing the Effect of FTE on Number of Certificates (Less Than One-Year)*

PREDICTOR	(1) LOGLESSTHAN1	(2) ARMA	(3) SIGMA
Log FTE	–0.371 (0.655)		
L.log C		0.965*** (0.166)	
Intercept	12.82* (7.452)		0.148*** (0.0324)
Observations	15	15	15
Log L = 6.0611, Wald χ^2 (2) = 52.08, $p \leq .001$			

Note. Standard errors in parentheses.
*$p < 0.1$. **$p < 0.05$. ***$p < 0.01$.

Table 6 presents the results of ITSA for the log of the number of certificates for less than one-year certificates. There was a significant pre-intervention (before 2011) in the log of number of certificates (*b* = 0.0336, *t* = 2.21, *p* = .048, 95% CI: .0001 – .067). Specifically, there was an upward, significant 3.36% trend before the performance-based funding (PBF) policy was introduced in 2011. There was a significant post-intervention (after 2011) trend in log of number of certificates (*b* = 0.125, *t* = 7.191, *p* ≤ .001, 95% CI: .100 – .189). Specifically, there was an upward, significant 12.5% trend during the post-PBF policy introduction in 2011. The difference in slope (trend) in log number of certificates between pre-intervention and post-intervention periods was also significant (*b* = .112, *Z* = 4.44, *p* = .001). This implies that the positive trend in the number of less than one-year certificates after the PBF policy intervention in 2011 was 11.2% higher than the trend before 2011; the change (increase) in trend from pre-2011 to post-2011 periods was significant. However, the change in the mean level of log number of certificates between pre-intervention and post-intervention periods was not

significant (b = .069, Z = .66, p = .522). It is important to highlight that the change (the difference between pre- and post-intervention) was significant only for the slope (rate) and not the level. This indicates that, on average, there was no significant difference in the number of less than one-year certificates before and after the PBF policy introduction in 2011 (Figure 7).

Table 6: *Interrupted Time Series: Logarithm of Number of Certificates (Less Than One-Year Certificates)*

PARAMETER	LOG OF NUMBER OF CERTIFICATES	95% CI FOR β
Trend (Pre-intervention)	0.0336** (0.0152)	(0.0001, 0.0671)
Level change from pre-intervention to post-intervention	0.0694 (0.105)	(–0.1618, 0.3005)
Slope change from pre-intervention to post-intervention	0.112*** (0.0251)	(0.0562, 0.1669)
Constant	7.953*** (0.0758)	(7.7863, 8.1199)
Trend post intervention	0.125*** (0.0202)	(0.1007, 0.1896)
Observations	15	
$F(3, 11) = 45.02$, $p = < .001$)		

Note. Standard errors in parentheses.
*$p < 0.1$. **$p < 0.05$. ***$p < 0.01$.

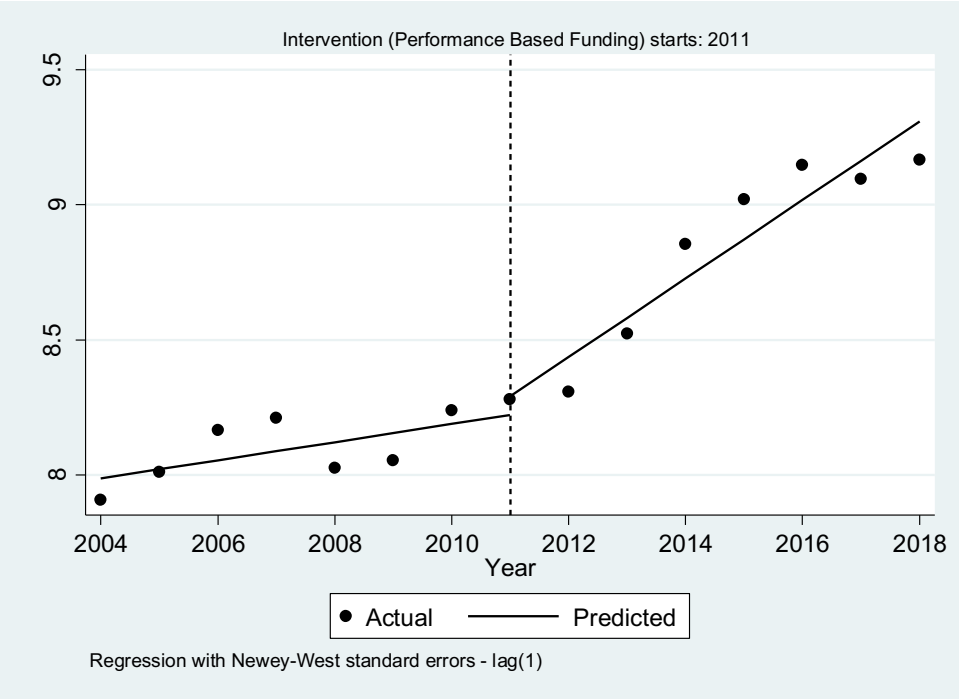


Figure 7. Interrupted time series analysis for log of number of certificates (less than one-year certificates).

Outcome: One-Year Certificates

The number of one-year certificates awarded in all 23 public community colleges is displayed in Figure 8. The mean number of one-year certificates awarded over the 15 years is 2,774, with a minimum of 1,435 awarded in 2004 and a maximum of 3,724 awarded in 2018, indicating an upward trend. Figure 8 shows the contrast between FTE and the number of one-year certificates awarded. The total number of students seeking one-year certificates is different in the pre-intervention and post-intervention periods. This could be a potential factor in determining the results.

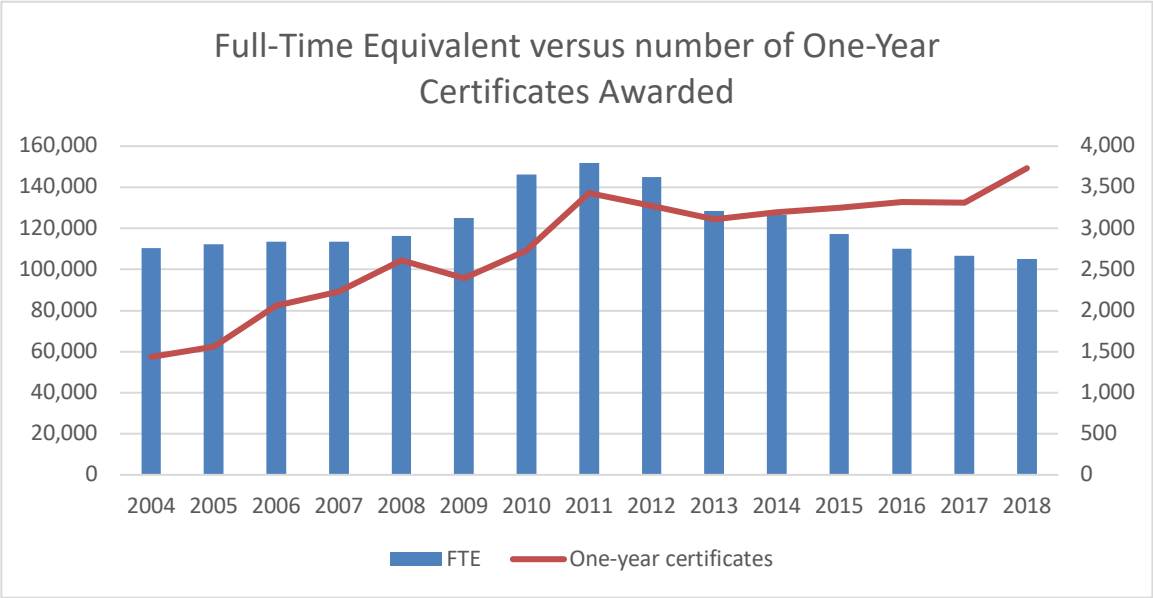


Figure 8. FTE chart for all 23 Ohio public community colleges and number of one-year certificates awarded.

Interrupted time series analysis (ITSA) was performed on the log-transformed number of one-year certificates. Autocorrelation analysis using Bartlett's 95% confidence interval estimates was used to determine the lag of the autocorrelation structure. Figure 9 is a correlogram of the autocorrelation of the log number of certificates for one-year programs. The correlogram indicates significant autocorrelation of order one. This result is consistent with time-series data, which involve a sequences of measurement collected at evenly spaced time intervals of the same variable (PennState Eberly College of Science, 2018). The data from this analysis are collected and published by ODHE on a yearly schedule.

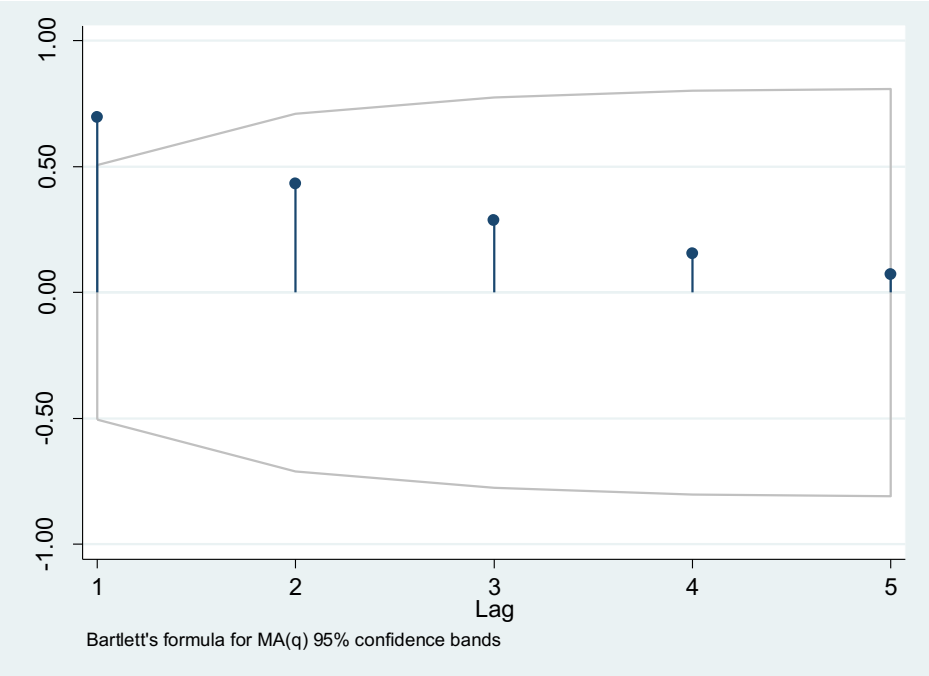


Figure 9. Correlogram for logarithm of number of certificates (one-year certificates).

To test the significance of the effect of the number of full-time equivalent (FTE) students on the number of certificates, time series regression model was used, taking the log of the number of certificates as the dependent variable and lagged log number of certificates and log of FTE as predictors. Table 7 presents the results of the regression model. The overall model was statistically significant (χ^2 (2) = 52.08, $p \leq .001$). The effect of log FTE adjusting for lagged log of number of certificates was not significant (b = 0.588, Z = 0.70, p = .49). This indicates that adjusting for the lagged log of the number of certificates, log FTE has no significant effect on the log number of one-year certificates. Therefore, the log FTE was excluded from the ITSA model. The significance of the effect of FTE in the presence or absence of other factors (covariates/control) is not discussed in this study.

Table 7: *Assessing the Effect of FTE on Number of One-Year Certificates*

PREDICTOR	(1) LOG CERTIFICATES	(2) ARMA	(3) SIGMA
Log FTE	0.588 (0.842)		
Lag.log Certificates		0.961*** (0.134)	
Intercept	0.930 (9.822)		0.120*** (0.0297)
n	15	15	15
Log L = 9.2528, Wald χ^2 (2) = 52.08, p = <.001.			

Note. Standard errors in parentheses.
*p < 0.1. **p < 0.05. ***p < 0.01.

Table 8 presents the results of ITSA for the log of the number of one-year certificates. There was a significant pre-intervention (before 2011) in log of number of certificates (b = 0.1085, t = 6.85, $p \leq .001$, 95% CI: .074 – .143). Specifically, there was a positive significant 10.85% upward trend before the performance-based funding (PBF) policy introduction in 2011. However, there was no significant post-intervention (after 2011) trend in log of number of certificates (b = 0.011, t = 0.905, p = .385, 95% CI: –.015 – .036). The difference in the slope (trend) in log number of certificates between pre-intervention and post-intervention periods was also significant (b = –.098, Z = –5.34, $p \leq .001$). This implies that the positive trend in the number of one-year certificates after the PBF policy intervention in 2011 was 9.8% lower compared with the trend before 2011, and the change (reduction) in trend from pre-2011 to post-2011 period was significant. The change in the mean level of log number of certificates between pre-intervention and post-intervention periods was not significant (b = –.0007,

$Z = -.01$, $p = .995$). It is important to highlight that the change (the difference between pre- and post-intervention) was significant only for the slope (rate) and not the level. This indicates that, on average, there was no significant difference in the number of one-year certificates before and after the PBF policy introduction in 2011 (Figure 10).

Table 8: *Interrupted Time Series: Logarithm of Number of Certificates (One-Year Certificates)*

PREDICTOR	LOG ONE-YEAR CERTIFICATES	95% CI FOR β
Trend (Pre-intervention)	0.1085*** (0.0159)	(0.0736, 0.1435)
Level change from pre-intervention to post-intervention	–0.0007 (0.0963)	(–0.2127, 0.2114)
Slope change from pre-intervention to post-intervention	–0.0980*** (0.0183)	(–0.1384, –0.0577)
Constant	7.1691*** (0.0711)	(7.0127, 7.3256)
Post intervention trend	0.011 (0.0116)	(–0.0150, 0.0360)
Observations	15	
$F(3, 11) = 59.28$, $p = <.001$.		

Note. Standard errors in parentheses.
*$p < 0.1$. **$p < 0.05$. ***$p < 0.01$.

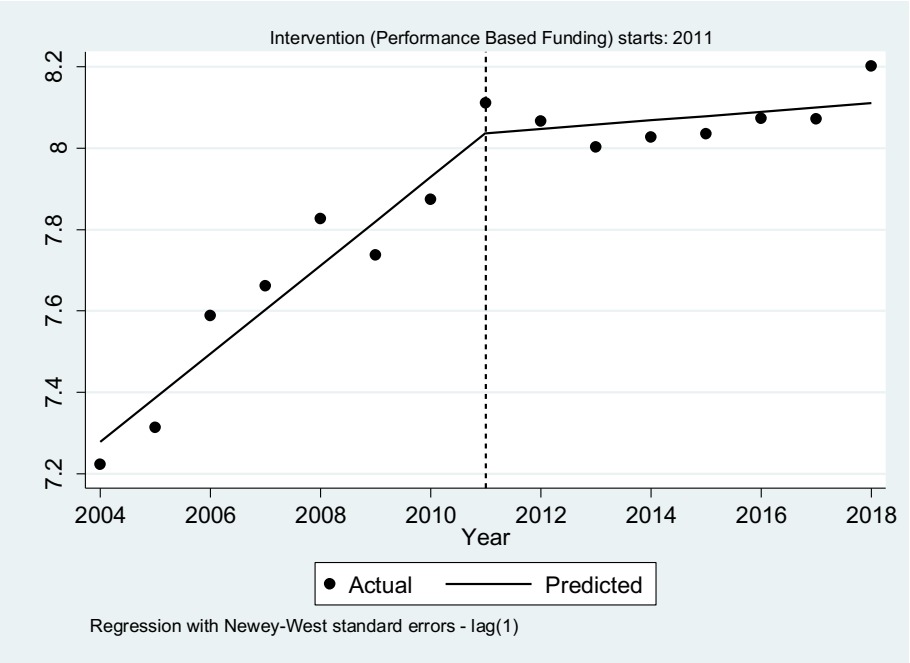


Figure 10. Interrupted time series analysis for log of number of certificates (one-year certificates).

Outcome: Associate Degrees

The number of associate degrees awarded to all Ohio community colleges is displayed in Figure 11. The mean number of associate degrees awarded between 2004 and 2018 is 16,199, with a total of 242,991—a minimum of 12,746 awarded in 2004 and a maximum of 18,584 awarded in 2018, indicating an upward trend throughout the study period. Figure 11 also shows the contrast between FTE and the number of one-year certificates awarded. The total number of students seeking associate degrees is different in the pre-intervention and post-intervention periods. This could be a potential factor in determining the results.

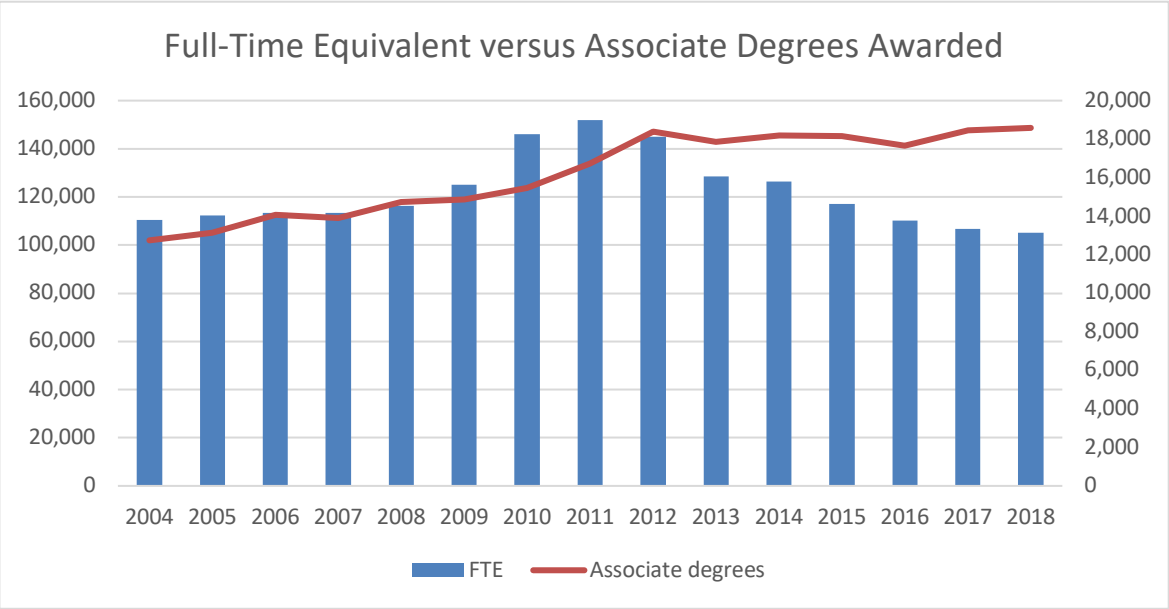


Figure 11. FTE chart for all 23 Ohio public community colleges and number of associate degrees awarded.

Interrupted time series analysis (ITSA) was performed on the log-transformed number of associate degrees. Autocorrelation analysis using Bartlett's 95% confidence interval estimates was used to determine the lag of the autocorrelation structure. Figure 12 is a correlogram of the autocorrelation of the log number of certificates for one-year programs. The correlogram indicates significant autocorrelation of order one. This result is consistent with time-series data, which involves a sequence of measurements collected at evenly spaced time intervals of the same variable (PennState Eberly College of Science, 2018). The data from this analysis are managed and published by ODHE on a yearly schedule.

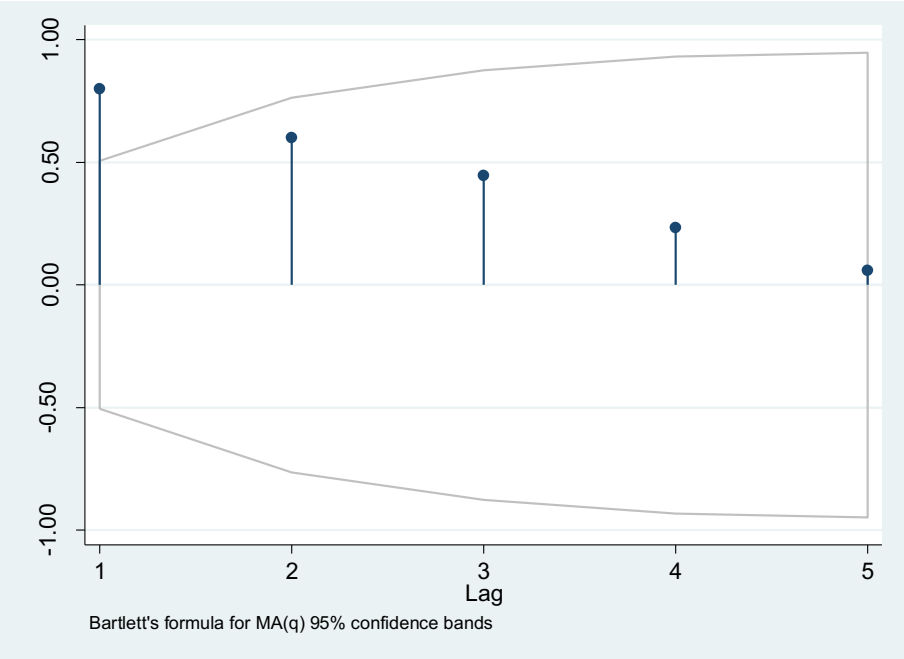


Figure 12. Correlogram for logarithm of number of associate degrees.

To test the significance of the effect of the number of full-time equivalent (FTE) students on the number of associate degrees, the time series regression model was used taking the log of the number of associate degrees as the dependent variable and lagged log number of associate degrees and log of FTE as predictors. Table 9 presents the results of the regression model. The overall model was statistically significant (χ^2 (2) = 49.41, $p \leq .001$). Effect of log FTE adjusting for lagged log of number of associate degrees was not significant (b = 0.197, Z = 0.43, p = .664). This indicates that, in adjusting for the lagged log of associate degrees, log FTE has no significant effect on the log of the associate degrees. Therefore, log FTE was excluded from the ITSA model. The significance of the effect of FTE in the presence or absence of other factors (covariates/control) is not discussed in this study.

Table 9: *Assessing the Effect of FTE on Number of Associate Degrees*

PREDICTOR	(1) LOG DEGREES	(2) ARMA	(3) SIGMA
Log FTE	0.197 (0.453)		
Lag.log degree		0.966*** (0.172)	
Intercept	7.357 (5.191)		0.0442*** (0.00914)
n	15	15	15
Log L = 22.1286, Wald χ^2 (2) = 49.41, p = <.001			

Note. Standard errors in parentheses.
*p < 0.1. **p < 0.05. ***p < 0.01.

Table 10 presents the results of ITSA for the log of the number of associate degrees. There was a significant pre-intervention (before 2011) in log of number of associate degrees (b = 0.0307, t = 18.35, $p \leq .001$, 95% CI: .027 – .034). Specifically, there was a positive, significant 3.07% increase in the number of associate degrees before the performance-based funding (PBF) policy introduction in 2011. However, there was no significant post-intervention (after 2011) trend in number of associate degrees (b = 0.008, t = 2.078, p = .062, 95% CI: –.005 – .017). The difference in the slope (trend) in log number of associate degrees between pre-intervention and post-intervention periods was significant (b = –.0224, Z = –5.27, $p \leq .001$). This implies that the positive trend in the number of associate degrees after the PBF policy intervention in 2011 was 2.24% less compared with the trend in the number of associate degrees before 2011, and the change (reduction) in trend from pre-2011 to post-2011 period was significant. However, the mean level change of log number of associate degrees between pre-intervention and post-intervention periods was significant (b = .0915, Z = 4.38, p = .001). It

is important to highlight that the change (the difference between pre- and post-intervention) was significant for the slope (rate) as well as for the level. This implies that the number of associate degrees completed after PBF policy introduction in 2011 was 9.15% higher than those completed before 2011 (Figure 13).

Table 10: *Interrupted Time Series: Logarithm of Associate Degrees*

PREDICTOR	LOG DEGREES	95% CI FOR β
Trend (Pre-intervention)	0.0307*** (0.00167)	(0.0269, 0.0343)
Level change from pre-intervention to post-intervention	0.0915*** (0.0209)	(0.0456, 0.1374)
Slope change from pre-intervention to post-intervention	–0.0224*** (0.00426)	(–0.0318, –0.0131)
Constant	9.420*** (0.0089)	(9.4009, 9.4400)
Post intervention trend	0.0082 (0.0040)	(–0.0005, 0.0169)
Observations	15	
$F(3, 11) = 433.85$, $p = <.001$		

Note. Standard errors in parentheses.
*$p < 0.1$. **$p < 0.05$. ***$p < 0.01$.

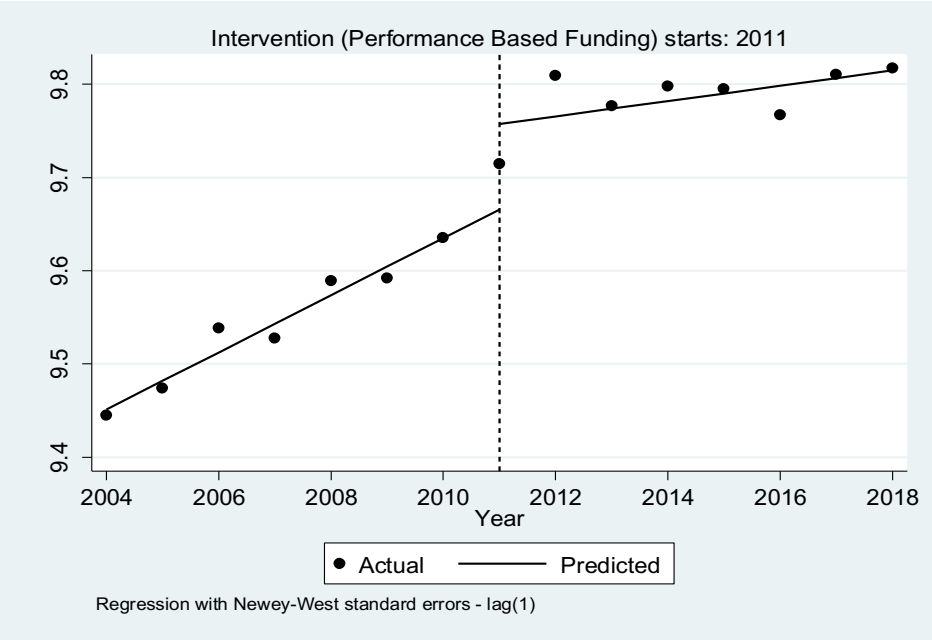


Figure 13. Interrupted time series analysis for log of number of associate degrees.

RESEARCH QUESTION 2

2. Are there any significant differences between the different types of institutions (state, community colleges, or technical schools) in response to performance-based funding in credential attainment (less than one-year certificates, one-year certificates, and associate degrees)?

The same analysis was accomplished based on the different types of institutions (technical, state, and community college) to determine if the various ways of funding colleges affect how they perform. In Ohio, community colleges are classified into three different classification systems based on how they receive funding and what types of associate degrees they award. Currently, out of the 23 community colleges in the state, 6 are classified as technical colleges, 11 are state community colleges, and 6 are classified as community colleges that can receive funding from local taxpayers via property tax levies.

Descriptive Statistics

Technical Community Colleges

Data were collected and analyzed for all six technical community colleges in Ohio. The data were plotted into a line graph to view the distribution and trend of the data and to get an overview of the data in question (Figure 14). A visual analysis confirms that associate degrees are increasing slightly over the study period while one-year certificates have remained stable. However, less than one-year certificates have dropped significantly over the study period.

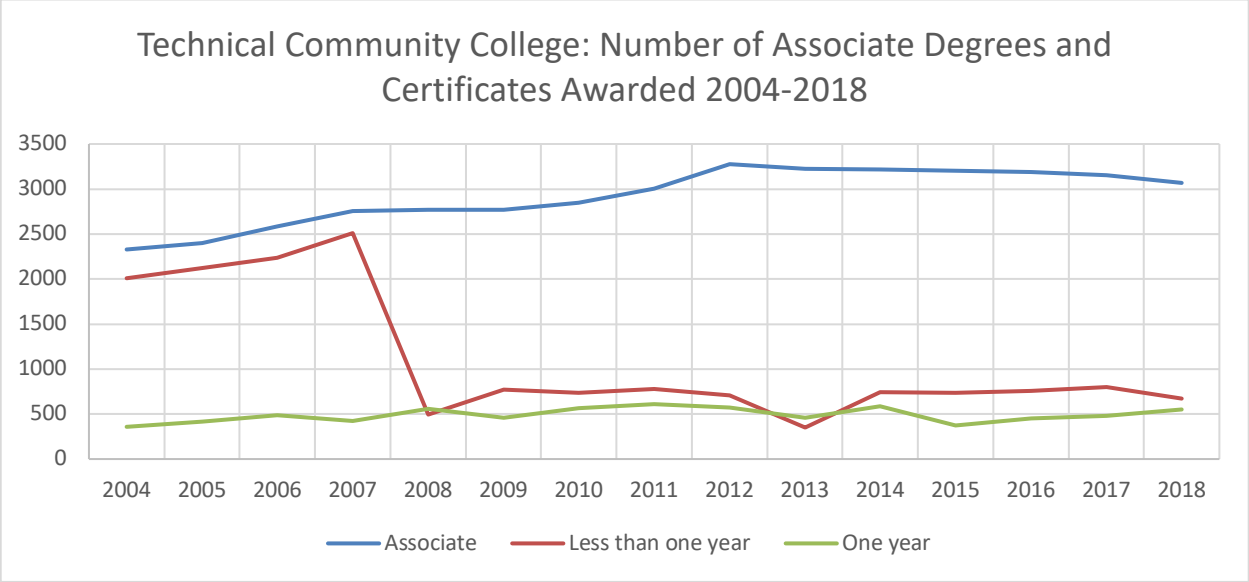


Figure 14: Number of certificates and associate degrees awarded at technical community colleges.

Descriptive statistics were also generated (Table 11). These statistics are described in more detail below by each award category (less than one-year, one-year, and associate degrees).

Table 11: *Technical Community Colleges Descriptive Statistics*

Less than One-Year Certificates		One-Year Certificates		Associate Degrees	
Mean	1,094	Mean	490	Mean	2,919
Standard Error	186	Standard Error	21	Standard Error	80
Median	754	Median	479	Median	3,004
Standard Deviation	719	Standard Deviation	80	Standard Deviation	310
Sample Variance	516,991	Sample Variance	6,465	Sample Variance	96,313
Kurtosis	(0)	Kurtosis	(1)	Kurtosis	(1)
Skewness	1	Skewness	(0)	Skewness	(1)
Range	2,160	Range	252	Range	948
Minimum	350	Minimum	358	Minimum	2,328
Maximum	2,510	Maximum	610	Maximum	3,276
Sum	16,414	Sum	7,347	Sum	43,792
Count	15	Count	15	Count	15

The descriptive statistics for full-time equivalent (FTE) for the study period are listed below in Table 12.

Table 12: *Descriptive Statistics for FTE – Technical Community Colleges*

Descriptive Statistics	
Mean	18,451
Standard Error	927
Median	16,926
Standard Deviation	3,591
Sample Variance	12,892,754
Kurtosis	(1)
Skewness	1
Range	10,634
Minimum	14,367
Maximum	25,001
Sum	276,772
Count	15

State Community Colleges

Data were collected and analyzed for all 11 state community colleges in Ohio. The data were plotted into a line graph to view the distribution and trend and to get an overview of the data in question (Figure 15). A visual analysis of this graph shows that associate degrees experienced a slight increase and that less than one-year certificates remained stable until 2012 and then experienced a drastic increase, while one-year certificates increased slightly over the study period.

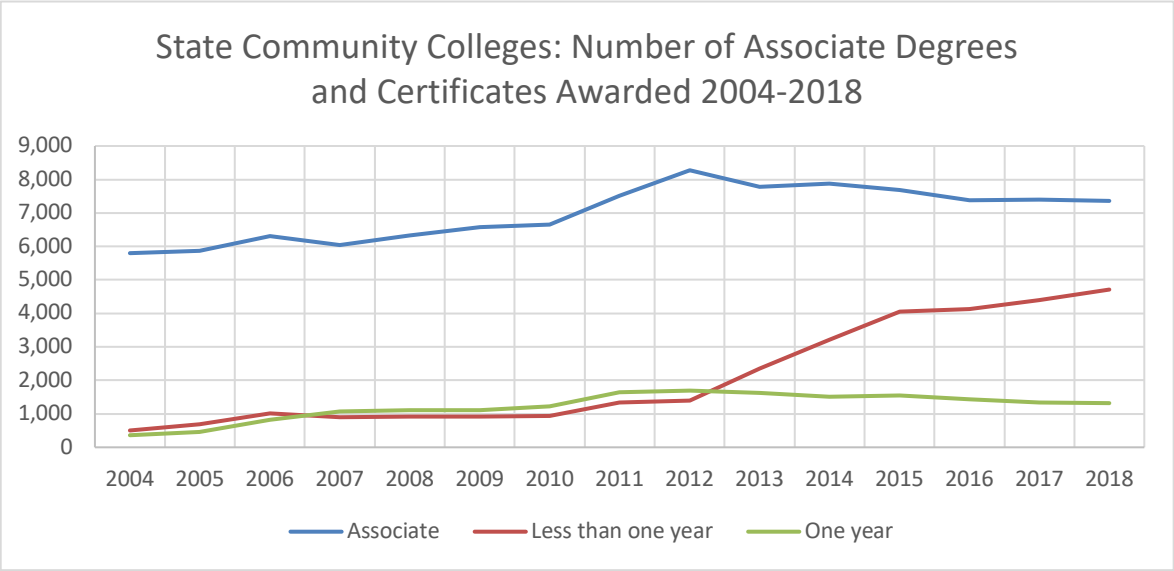


Figure 15. Number of certificates and associate degrees awarded at state community colleges.

Descriptive statistics were also generated (Table 13). These statistics are described in more detail below by each award category (less than one-year, one-year, and associate degrees).

Table 13: *State Community College Descriptive Statistics*

Less than One-Year Certificates		One-Year Certificates		Associate Degrees	
Mean	2,099	Mean	1,218	Mean	6,990
Standard Error	400	Standard Error	106	Standard Error	208
Median	1,344	Median	1,310	Median	7,356
Standard Deviation	1,551	Standard Deviation	410	Standard Deviation	804
Sample Variance	2,405,211	Sample Variance	168,389	Sample Variance	645,943
Kurtosis	(1)	Kurtosis	0	Kurtosis	(1)
Skewness	1	Skewness	(1)	Skewness	(0)
Range	4,209	Range	1,333	Range	2,476
Minimum	503	Minimum	361	Minimum	5,799
Maximum	4,712	Maximum	1,694	Maximum	8,275
Sum	31,490	Sum	18,275	Sum	104,850
Count	15	Count	15	Count	15

The descriptive statistics for full-time equivalent (FTE) for the study period are listed below in Table 14.

Table 14: *Descriptive Statistics for FTE – State Community Colleges*

Descriptive Statistics	
Mean	53,512
Standard Error	1,887
Median	50,917
Standard Deviation	7,309
Sample Variance	53,425,937
Kurtosis	0
Skewness	1
Range	23,663
Minimum	44,448
Maximum	68,111

Descriptive Statistics	
Sum	802,675
Count	15

Community Colleges

Data were collected and analyzed for all six community colleges in Ohio. The data were plotted into a line graph to view the distribution and trend and to get an overview of the data in question (Figure 16). A visual analysis of this graph shows that associate degrees and less than one-year certificates experienced an increase, while one-year certificates increased slightly over the study period.

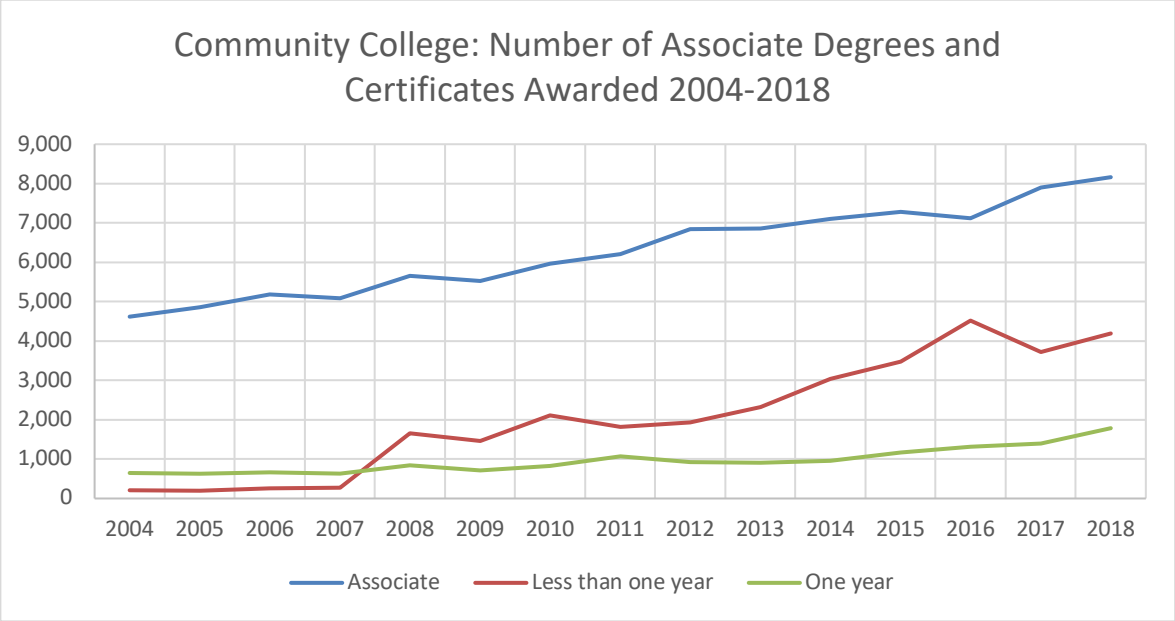


Figure 16: Number of certificates and associate degrees awarded at community colleges.

Descriptive statistics were also generated (Table 15). These statistics are described in more detail below by each award category (less than one-year, one-year, and associate degrees).

Table 15: *Community Colleges Descriptive Statistics*

Less than One-Year Certificates		One-Year Certificates		Associate Degrees	
Mean	2,080	Mean	966	Mean	6,290
Standard Error	380	Standard Error	86	Standard Error	290
Median	1,940	Median	914	Median	6,209
Standard Deviation	1,471	Standard Deviation	332	Standard Deviation	1,123
Sample Variance	2,165,253	Sample Variance	110,208	Sample Variance	1,260,103
Kurtosis	(1)	Kurtosis	1	Kurtosis	(1)
Skewness	0	Skewness	1	Skewness	0
Range	4,322	Range	1,157	Range	3,544
Minimum	197	Minimum	629	Minimum	4,619
Maximum	4,519	Maximum	1,786	Maximum	8,163
Sum	31,202	Sum	14,486	Sum	94,349
Count	15	Count	15	Count	15

The descriptive statistics for full-time equivalent (FTE) for the study period are listed below in Table 16.

Table 16: *Full-Time Equivalent Descriptive Statistics – Community Colleges*

Descriptive Statistics	
Mean	47,866
Standard Error	1,144
Median	45,378
Standard Deviation	4,432
Sample Variance	19,640,070
Kurtosis	(1)
Skewness	1
Range	13,106

DESCRIPTIVE STATISTICS	
Minimum	43,626
Maximum	56,732
Sum	717,988
Count	15

Outcome: Number of Certificates (Less Than One Year)

Technical Colleges

The number of certificates that were less than one-year in length awarded to technical community colleges is displayed in Figure 17. The mean number of less than one-year certificates awarded over the 15 years is 1,094, with a minimum of 350 awarded in 2013 and a maximum of 2,510 awarded in 2007, indicating that technical community colleges were previously awarded a higher number of less than one-year certificates before the beginning of performance-based funding. That number has decreased over the years (Table 11). The total number of students seeking less than one-year certificates is different in the pre-intervention and post-intervention periods. This could be a potential factor in determining the results.

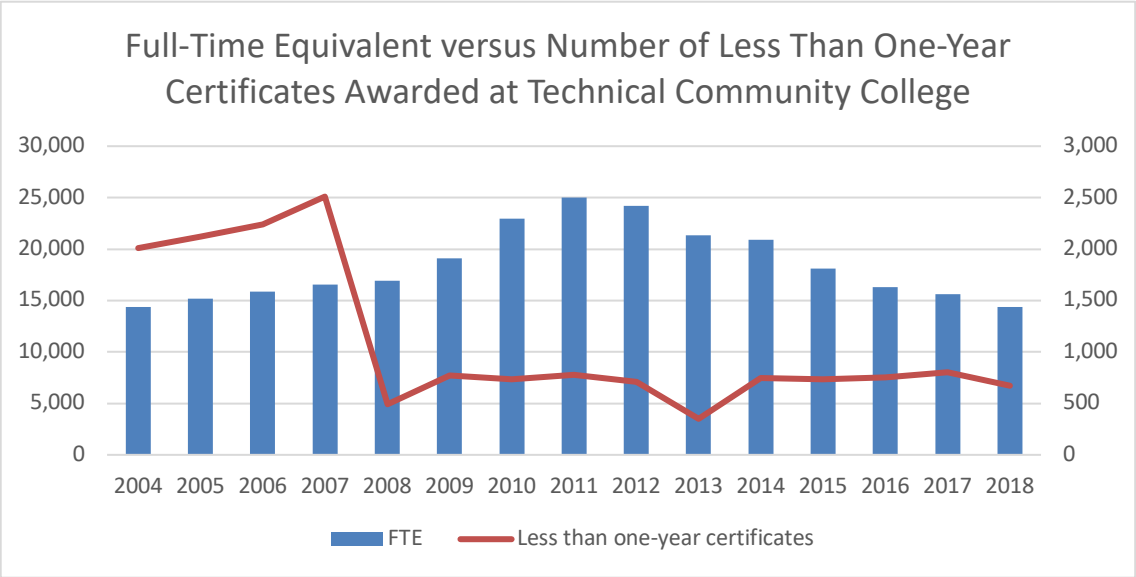


Figure 17. FTE versus number of less than one-year certificates awarded at technical community colleges.

For technical colleges, there was a significant downward pre-intervention trend (–23.4%) in the number of certificates (b = –0.234, Z = –4.55, p = .001). Furthermore, the slope change from pre- to post-intervention period was significant (b = 0.257, Z = 3.97, p = .002). Specifically, the trend reversed (became upward from –23.4% in the pre-intervention period to +2.25% in the post-intervention period); and the change in the trend was significant. However, the post-2011 trend, though positive, was small in magnitude (2.25%) and statistically not significant (b = 0.0225, t = 0.646, p = .531) (Table 17). It is important to highlight that the change (the difference between pre- and post-intervention) was significant only for the slope (rate) and not the level. This indicates that, on average, there was no significant difference in the number of less than one-year certificates before and after the PBF policy introduction in 2011.

State Community Colleges

The number of certificates that were less than one-year in length awarded to state community colleges is displayed in Figure 18. The mean number of less than one-year certificates awarded over the 15 years is 2,099, with a minimum of 503 awarded in 2004 and a maximum of 4,712 awarded in 2018, indicating an upward trend throughout the study period (Table 13). The total number of students seeking less than one-year certificates is different in the pre-intervention and post-intervention periods. This could be a potential factor in determining the results.

For state colleges, there was a significant upward pre-intervention trend (8.3%) in the number of certificates (b = 0.083, Z = 2.29, p = .043). The slope change from pre- to post-intervention period was significant (b = 0.112, Z = 2.29, p = .043). Specifically, the trend in the post-2011 period was 11.2% higher than the trend in the pre-2011 period, and this increase in the trend was significant. The post-2011 trend was positive (19.5%) and statistically significant (b = 0.195, t = 6.386, $p \leq 001$) (Table 17). It is important to highlight that the change (the difference between pre- and post-intervention) was significant only for the slope (rate) and not the level. This indicates that, on average, there was no significant difference in the number of less than one-year certificates before and after the PBF policy introduction in 2011.

Table 17: *Interrupted Time Series by College Type: Logarithm of Number of Less Than One-Year Certificates*

College	Parameter	β	95% CI for β
Technical	Trend (Pre-intervention)	–0.234** (0.051)	(–0.347, –0.121)
	Level change from pre- to post-intervention	0.194 (0.315)	(–0.499, 0.887)
	Slope change from pre- to post-intervention	0.257** (0.064)	(0.114, 0.399)
	Constant	8.116*** (0.259)	(7.543, 8.688)
	Trend post-intervention	0.0225 (0.035)	(–0.054, 0.099)
State	Trend (Pre-intervention)	0.083* (0.036)	(0.003, 0.164)
	Level change from pre- to post-intervention	0.244 (0.173)	(–0.138, 0.625)
	Slope change from pre- to post-intervention	0.112* (0.049)	(0.005, 0.219)
	Constant	6.377*** (0.196)	(5.945, 6.809)
	Trend post-intervention	0.195*** (0.031)	(0.128, 0.263)
Community	Trend (Pre-intervention)	0.458** (0.056)	(0.335, 0.582)
	Level change from pre- to post-intervention	–0.609* (0.246)	(–1.15, –0.069)
	Slope change from pre- to post-intervention	–0.325*** (0.059)	(–0.456, –0.194)
	Constant	4.475*** (0.306)	(3.801, 5.148)
	Trend post-intervention	0.136*** (0.020)	(0.089, 0.177)

Note. Standard errors in parentheses.
*$p < 0.1$. **$p < 0.05$. ***$p < 0.01$.

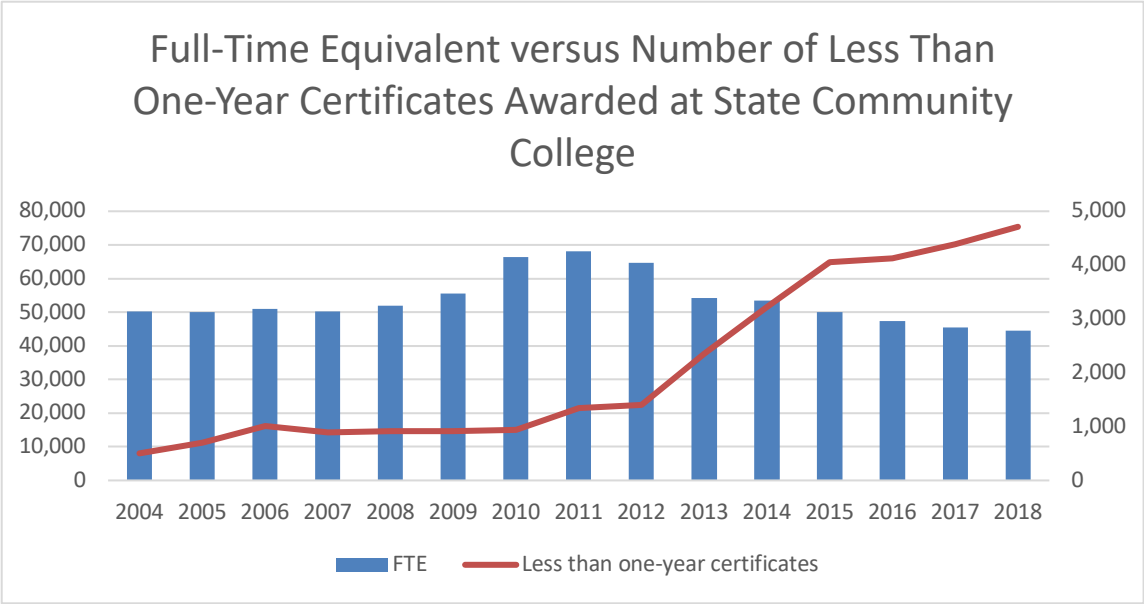


Figure 18. FTE versus the number of less than one-year certificates awarded at state community colleges.

Community Colleges

The number of certificates that were less than one-year in length awarded to community colleges is displayed in Figure 19. The mean number of less than one-year certificates awarded over the 15 years is 2,080, with a minimum of 197 awarded in 2005 and a maximum of 4,519 awarded in 2016, indicating an upward trend throughout the study (Table 15). The total number of students seeking less than one-year certificates is different in the pre-intervention and post-intervention periods. This could be a potential factor in determining the results.

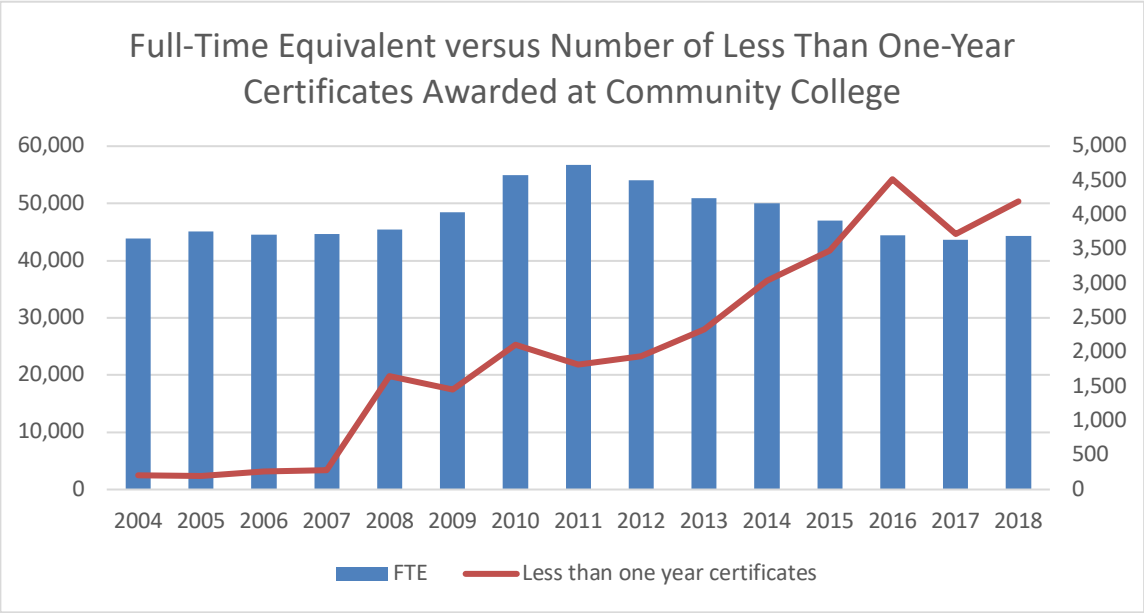


Figure 19. FTE versus the number of less than one-year certificates awarded at community colleges.

For community colleges, there was a significant upward pre-intervention trend (45.8%) in the number of certificates (b = 0.458, t = 8.18, $p \leq .001$). Additionally, the slope change from pre- to post-intervention period was significant (b = –0.325, t = –5.45, $p \leq .001$). Specifically, the trend in the post-2011 period was 32.5% lower than the trend in the pre-2011 period, and this change in the trend was significant. However, the post-2011 trend was positive (13.6%) and statistically significant (b = 0.136, t = 6.685, $p \leq .001$). This implies that though there was a significant positive trend in the post-2011 period (after PBF policy introduction), it was significantly lower than the positive trend observed before 2011. This was also complemented by the finding that there was a significant decrease in the mean level of the number of certificates post-2011 period compared with the pre-2011 period (b = –0.609, t = –2.48, p = .03). Overall, these results indicate that there was no significant increase in less than one-year certificates, but rather a significant decrease (Table 17).

Outcome: Number of Certificates (One-Year Certificates)

Technical Colleges

The number of certificates that were less than one-year in length awarded to technical community colleges is displayed in Figure 20. The mean number of one-year certificates awarded over the 15 years is 409, with a minimum of 358 awarded in 2004 and a maximum of 610 awarded in 2011, indicating no clear trend throughout the study (Table 11). The total number of students seeking one-year certificates is different in the pre-intervention and post-intervention periods. This could be a potential factor in determining the results.

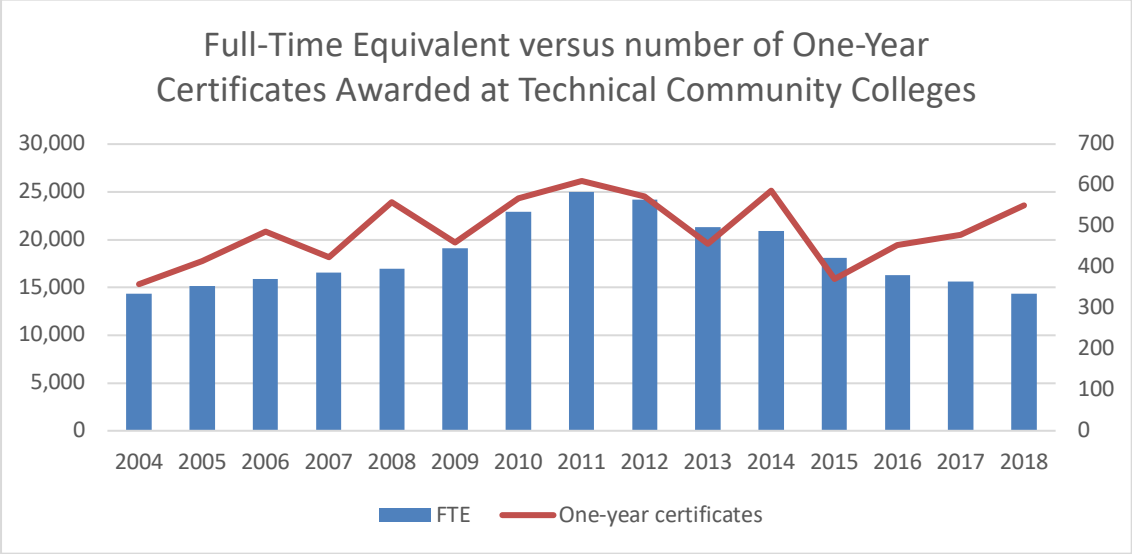


Figure 20. FTE versus the number of one-year certificates awarded at technical community colleges.

For technical colleges, there was a significant upward pre-intervention trend (6.2%) in number of certificates ($b = 0.062$, $t = 4.95$, $p \leq .001$). Furthermore, the slope (trend) change from pre- to post-intervention period was significant ($b = –0.087$, $t = –3.27$, $p = .007$). Specifically, the post-intervention period was 8.7% lower than the trend in the pre-2011 period, and this change in the trend was significant. The post-2011 trend was negative, small in

magnitude (–2.5%) and statistically not significant (*b* = –0.025, *t* = –1.096, *p* = .297) (Table 18). It is important to highlight that the change (the difference between pre- and post-intervention) was significant only for the slope (rate) and not the level. This indicates that, on average, there was no significant difference in the number of less than one-year certificates before and after the PBF policy introduction in 2011.

State Community Colleges

The number of certificates that were less than one-year in length awarded to State community colleges is displayed in Figure 21. The mean number of one-year certificates awarded over the 15 years is 1,218, with a minimum of 361 awarded in 2004 and a maximum of 1,694 awarded in 2012, indicating no clear trend throughout the study (Table 13). The total number of students seeking one-year certificates is different in the pre-intervention and post-intervention periods. This could be a potential factor in determining the results.

Table 18: *Interrupted Time Series by College Type: Logarithm of Number of One-Year Certificates*

COLLEGE	PARAMETER	LOG OF NUMBER OF CERTIFICATES	95% CI FOR β
Technical	Trend (Pre-intervention)	0.062** (0.012)	(0.034, 0.089)
	Level change from pre- to post-intervention	-0.073 (0.089)	(-0.267, 0.125)
	Slope change from pre- to post-intervention	-0.087** (0.027)	(-0.145, -0.028)
	Constant	5.887*** (0.059)	(5.756, 6.019)
	Trend post-intervention	-0.025 (0.023)	(-0.075, 0.025)
State	Trend (Pre-intervention)	0.206*** (0.042)	(0.112, 0.299)

	Level change from pre- to post-intervention	-0.066 (0.179)	(-0.461, 0.329)
	Slope change from pre- to post-intervention	-0.243*** (0.044)	(-0.339, -0.147)
	Constant	5.869*** (0.205)	(5.417, 6.321)
	Trend post-intervention	-0.037*** (0.005)	(-0.047, -0.027)
Community	Trend (Pre-intervention)	0.044** (0.008)	(0.027, 0.061)
	Level change from pre to post-intervention	0.036 (0.111)	(-0.208, 0.279)
	Slope change from pre to post-intervention	0.039 (0.027)	(-0.021, 0.099)
	Constant	6.383*** (0.039)	(6.297, 6.468)
	Trend post-intervention	0.083** (0.025)	(0.029, 0.137)

Note. Standard errors in parentheses.
*$p < 0.1$. **$p < 0.05$. ***$p < 0.01$.

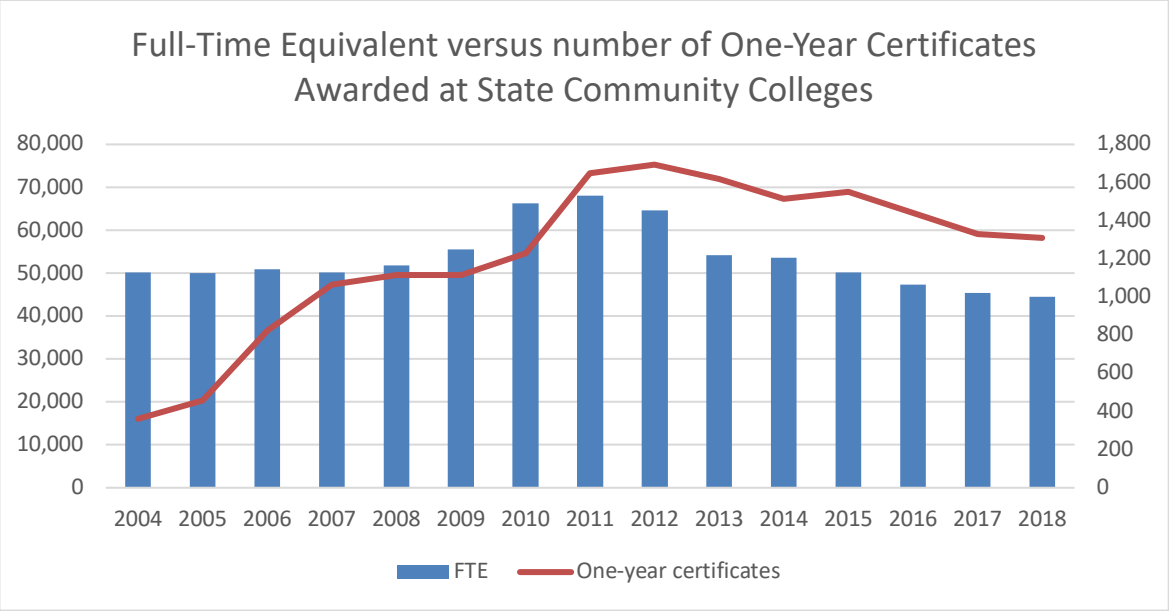


Figure 21. FTE versus the number of one-year certificates at state community colleges.

For state colleges, there was a significant upward pre-intervention trend (20.6%) in the number of certificates (b = 0.206, Z = 4.85, $p \leq .001$). Furthermore, the slope change from pre- to post-intervention period was significant (b = –0.243, t = –5.55, $p \leq .001$). Specifically, the trend in the post-2011 period was reversed to a negative trend, and it was 24.3% lower than the trend in the pre-2011 period, and this change in the trend was significant. The post-2011 trend was 3.7% lower and statistically significant (b = –0.037, t = –8.003, $p \leq .001$) (Table 18). It is important to highlight that the change (the difference between pre- and post-intervention) was significant only for the slope (rate) and not the level. This indicates that, on average, there was no significant difference in the number of less than one-year certificates before and after the PBF policy introduction in 2011.

Community Colleges

The number of certificates that were less than one-year in length awarded to community colleges is displayed in Figure 22. The mean number of one-year less than one-year certificates awarded over the 15 years is 966, with a minimum of 629 awarded in 2004 and a maximum of 1,786 awarded in 2018, indicating an upward trend throughout the study (Table 15). The total number of students seeking one-year certificates is different in the pre-intervention and post-intervention periods. This could be a potential factor in determining the results.

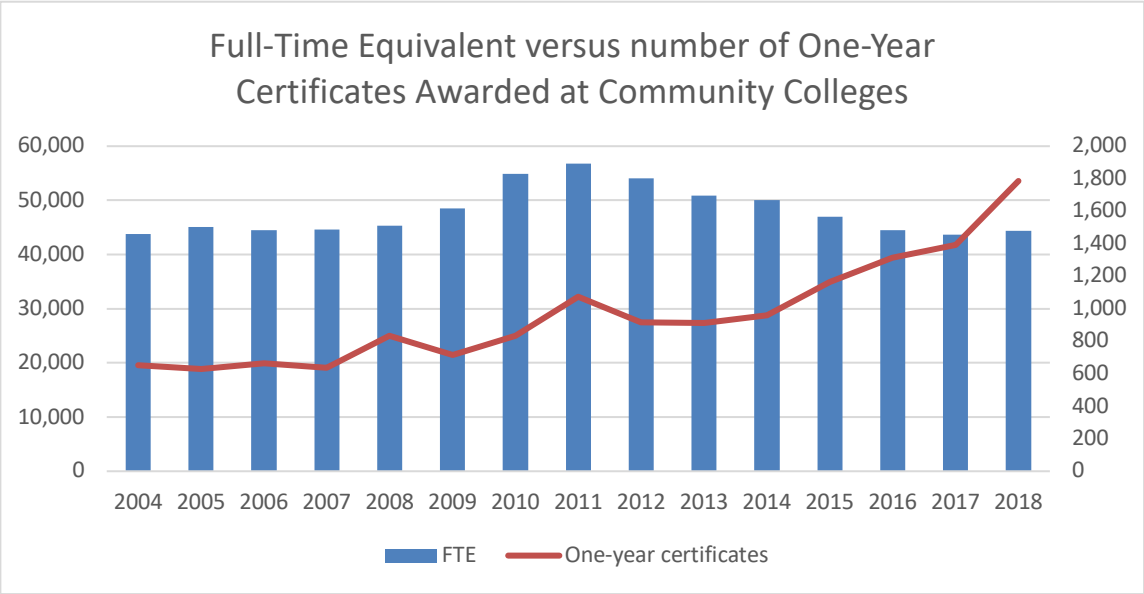


Figure 22. FTE versus the number of one-year certificates awarded at community colleges.

For community colleges, there was a significant upward pre-intervention trend (4.4%) in the number of certificates (b = 0.044, t = 5.63, $p \leq .001$). The slope (trend) change from pre- to post-intervention period was not significant (b = 0.039, t = 1.42, p = .183). This implies that the change in trend from the pre-2011 period to the post-2011 trend was not significant. The post-2011 trend was positive (8.3%) and statistically significant (b = 0.083, t = 3.368, p = .006). These results imply that there was a significant positive trend in the number of certificates before 2011 and after 2011, and there was no significant change in the trend in the number of certificates from pre- to post-PBF policy introduction in 2011 (Table 18). This indicates that, on average, there was no significant difference in the number of less than one-year certificates before and after the PBF policy introduction in 2011.

Outcome: Number of Associate Degrees

Technical Colleges

The number of associate degrees awarded to technical community colleges is displayed in Figure 23. The mean number of associate degrees awarded over the 15 years is 2,919, a minimum of 2,328 awarded in 2004 and a maximum of 3,276 awarded in 2012 (Table 11). The total number of students seeking associate degrees is different in the pre-intervention and post-intervention periods. This could be a potential factor in determining the results.

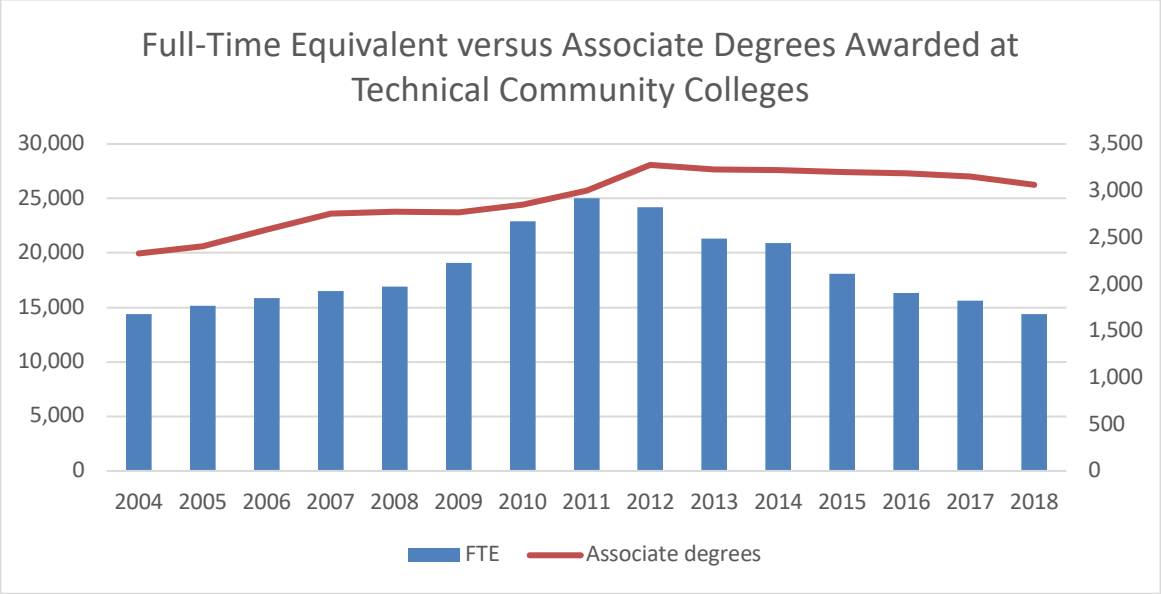


Figure 23. FTE versus the number of associate degrees awarded at technical community colleges.

For technical colleges, there was no significant pre-intervention trend in the number of associate degrees (b = 0.008, t = 1.31, p = .218). Furthermore, the post-2011 trend was also statistically not significant (b = –0.011, t = –1.695, p = .118). The slope (trend) change from pre- to post-intervention period was also not significant (b = –0.019, t = –1.96, p = .076). These results indicate that there was no significant trend in the number of associate degrees in the

pre-2011 or post-2011 period. However, there was a significant increase (8.3%) in the mean level of the number of associate degrees completed in the post-2011 period compared with the pre-2011 period (b = 0.083, t = 2.43, p = .034) (Table 19). It is important to highlight that the change (the difference between pre- and post-intervention) was significant for the slope (rate) as well as for the level. This implies that, on average, the number of associate degrees completed after PBF policy introduction in 2011 was 8.3% higher compared with those completed before the 2011 period.

State Community Colleges

The number of associate degrees awarded to state community colleges is displayed in Figure 24. The mean number of associate degrees awarded over the 15 years is 6,990, with a minimum of 5,799 awarded in 2004 and a maximum of 8,275 awarded in 2012, indicating there is no apparent increase throughout the study period (Table 13). The total number of students seeking associate degrees is different in the pre-intervention and post-intervention periods. This could be a potential factor in determining the results.

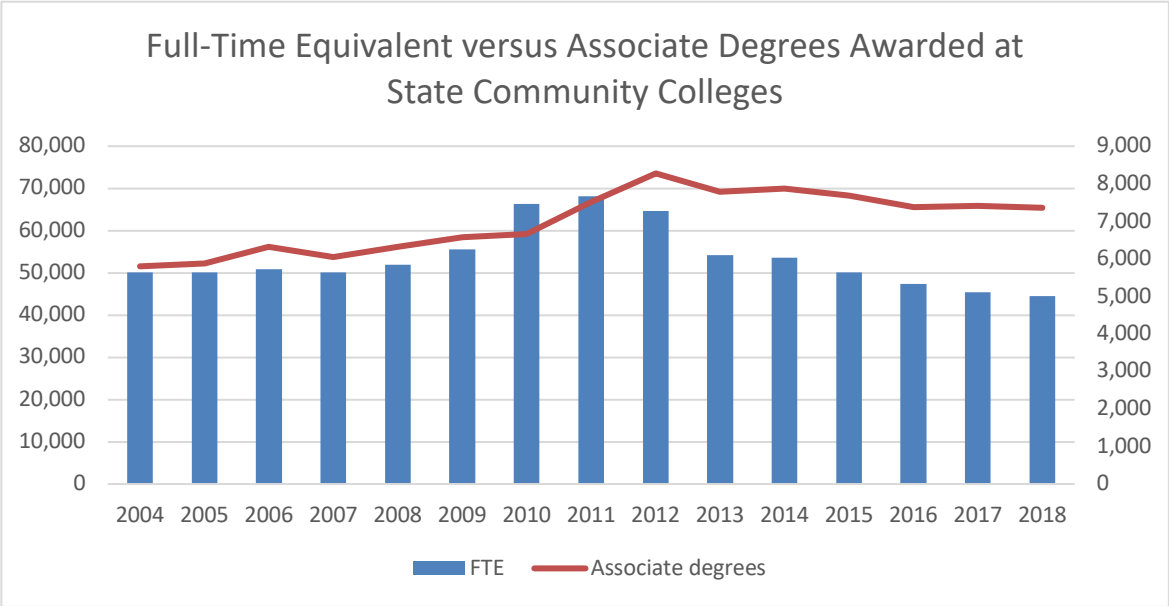


Figure 24. FTE versus the number of associate degrees awarded at state community colleges.

For state colleges, there was a significant upward pre-intervention trend (2.9%) in the number of associate degrees ($b = 0.029$, $t = 20.40$, $p \leq .001$). Furthermore, the slope change from pre- to post-intervention period was significant ($b = –0.034$, $t = –6.24$, $p \leq .001$). Specifically, the trend in the post-2011 period was 3.4% lower than the trend in the pre-2011 period, and this change in the trend was significant. The post-2011 trend was negative (–0.5%) and statistically not significant ($b = –0.005$, $t = –1.002$, $p = .338$). There was a significant increase (13.6%) in the mean level of the number of associate degrees completed in the post-2011 period compared with the pre-2011 period ($b = 0.136$, $t = 5.77$, $p \leq .011$) (Table 19). It is important to highlight that the change (the difference between pre- and post-intervention) was significant for the slope (rate) as well as for the level. This implies that on average, the number of associate degrees completed after PBF policy introduction in 2011 was 13.6% higher compared with those completed before the 2011 period.

Community Colleges

The number of associate degrees awarded to community colleges is displayed in Figure 25. The mean number of associate degrees awarded over the 15 years is 6,290, with a minimum of 4,619 awarded in 2004 and a maximum of 8,163 awarded in 2018, indicating an upward trend throughout the study period (Table 15). The total number of students seeking associate degrees is different in the pre-intervention and post-intervention periods. This could be a potential factor in determining the results.

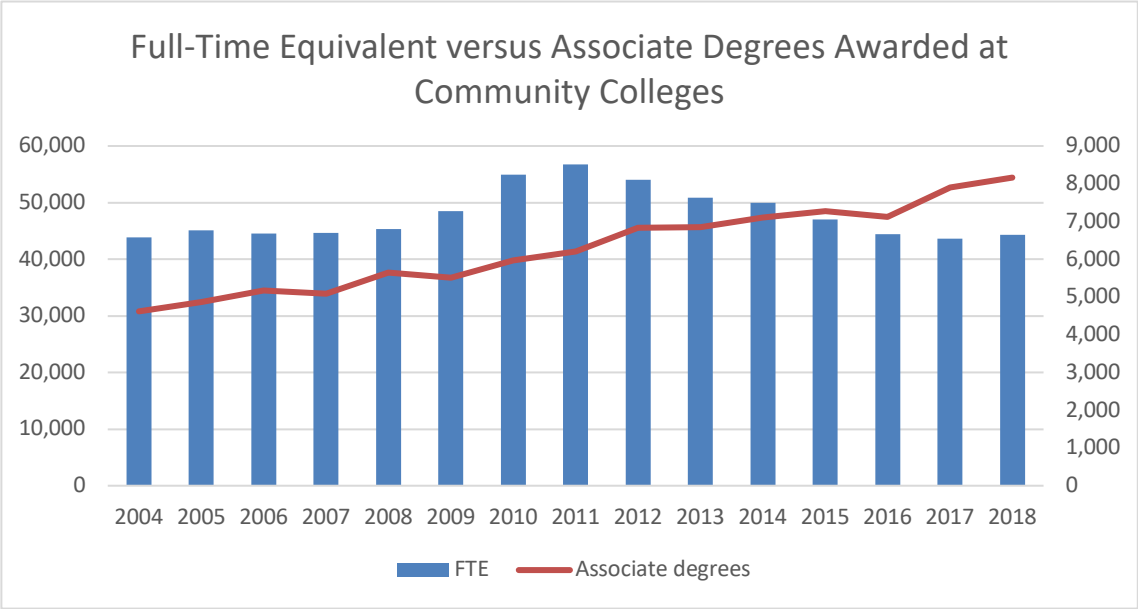


Figure 25. FTE versus the number of associate degrees awarded at community colleges.

For community colleges, there was a significant upward pre-intervention trend (3.9%) in the number of associate degrees ($b = 0.039$, $t = 16.57$, $p \leq .001$). The slope (trend) change from pre- to post-intervention period was significant ($b = –0.012$, $t = –2.59$, $p = .025$). This implies that the change in trend from the pre-2011 period to post-2011 trend was 1.2% lower than the trend in the pre-2011 period, and the change in the trend, though small, was statistically

significant. The post-2011 period trend was positive (2.8%) and statistically significant (b = 0.028, t = 6.604, $p \leq .001$) (Table 19). It is important to highlight that the change (the difference between pre and post-intervention) was significant for the slope (rate) as well as for the level. This implies that on average, the number of associate degrees completed after PBF policy introduction in 2011 was 4.2% higher compared with those completed before the 2011 period.

Table 19: *Interrupted Time Series by College Type: Logarithm of Number of Associate Degrees*

COLLEGE	PARAMETER	LOG OF NUMBER OF CERTIFICATES	95% CI FOR β
Technical	Trend (Pre-intervention)	0.008 (0.006)	(–0.005, 0.020)
	Level change from pre- to post-intervention	0.083** (0.034)	(–0.008, 0.157)
	Slope change from pre- to post-intervention	–0.019* (0.009)	(–0.040, 0.002)
	Constant	7.453*** (0.031)	(7.384, 7.522)
	Trend post-intervention	–0.011 (0.007)	(–0.026, 0.003)
State	Trend (Pre-intervention)	0.029** (0.001)	(0.026, 0.032)
	Level change from pre- to post-intervention	0.136*** (0.024)	(0.084, 0.187)
	Slope change from pre- to post-intervention	–0.034* (0.005)	(–0.046, 0.022)
	Constant	8.702*** (0.008)	(8.684, 8.720)
	Trend post-intervention	–0.005 (0.005)	(–0.016, 0.006)
Community	Trend (Pre-intervention)	0.039*** (0.002)	(0.035, 0.045)
	Level change from pre to post-intervention	0.042* (0.023)	(–0.008, 0.092)
	Slope change from pre to post-	–0.012**	(–0.021, –0.002)

College	Parameter	Log of number of certificates	95% CI for β
	intervention	(0.005)	
	Constant	8.435*** (0.009)	(8.416, 8.454)
	Trend post-intervention	0.028*** (0.004)	(0.019, 0.038)

Note. Standard errors in parentheses.
*$p < 0.1$. **$p < 0.05$. ***$p < 0.01$.

SUMMARY

Community colleges in Ohio are charged by the Ohio Department of Higher Education to prepare students for the workforce by offering a variety of credentials (less than one-year and one-year certificates) and associate degrees. The content of this chapter illustrates that the change to performance-based funding has not led to a statistically significant increase in the number of certificates, either less than one-year or one-year certificates. However, the ITSA showed that there was a 9.15% increase in the number of associate degrees awarded after the introduction of performance-based funding in 2011.

When looking at the effects of PBF based on the type of college (technical, state, community) for the second research question, the results for less than one-year certificates were similar for technical community college. However, there was a significant statistical increase in the award of less than one-year certificates for state and community colleges. The results for one-year certificates and associate degrees followed the same trend as the results from the first research question. There was no significant increase in the number of one-year certificates awarded, and all three categories exhibited an increase in the number of associate degrees awarded during the study.

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

INTRODUCTION

Over the last decade, there has been a renewed interest in performance-based funding (PBF) models to improve institutional performance throughout the United States (Tandberg & Hillman, 2014). Current research and literature suggested a lack of evidence indicating a definite relationship between PBF policies and desired outputs in institutional performance (Dougherty et al., 2014b; Dougherty & Reddy, 2013; Gandara, 2019; Hillman et al., 2014, 2015; Sanford & Hunter, 2011; Shin & Milton, 2004). Given this, legislators continue to move forward with PBF implementation. Approximately 70% of states have moved forward in some fashion with PBF policies (Boelscher & Snyder, 2019). Examining the results in states with a long history of PBF (such as Ohio) can help identify if the change has led to an increase in student success measures (Sanford & Hunter, 2011).

The primary purpose of this study was to analyze whether the transition to performance-based funding in Ohio increased the volume of community college credentials (short-term technical certificates, one-year certificates, and associate degrees) over the last 15 years (2004-2018). This research is intended to inform Ohio policymakers with current research to aid in decision-making surrounding the continuation of PBF. It also provides empirical evidence for all state legislators and policymakers to inform decisions within their own higher education systems. This chapter includes a discussion of the noteworthy findings related to the change to performance-based funding for community colleges in the state of Ohio. This chapter

concludes with a review of the limitations of the study, areas of future research, and a summary.

SUMMARY OF FINDINGS FOR RESEARCH QUESTIONS 1 & 2

1. To what extent, if any, has the change to performance-based funding in Ohio increased credential attainment (less than one-year certificates, one-year certificates, and associate degrees) at 2-year community colleges? Is the obtainment of these credentials increasing, and if so, are associate degrees or are certificates increasing at a higher rate?
2. Are there any significant differences between the different types of institutions (technical, state community colleges, or community colleges) in response to performance-based funding in credential attainment (less than one-year certificates, one-year certificates, and associate degrees?

The first research question considered all 23 community colleges in the state of Ohio. The second research question explored the data differently to determine whether changes exist in degree and certificate attainment among the different classifications of community colleges (technical, state, and community college). Community colleges in Ohio are defined by one of three different classification systems based on how they receive funding and what types of associate degrees they award. Currently, out of the 23 community colleges in the state, 11 are classified as state community colleges, 6 as technical colleges, and 6 hold the classification of community colleges. A college in Ohio classified as a community college, in this chapter referred to as Ohio college, is different in that it can receive funding from local taxpayers via property tax levies. Consequently, all three types of community colleges in the state are dependent on state funds for support and operation.

Less Than One-Year Certificates

Less than one-year certificates are awarded for the completion of an organized program of study that is less than 30 semester credit hours (or less than 900 clock hours) and is generally intended to prepare students for a specific occupation or employment opportunity. Less than one-year certificates prepare students for a valid occupational license or third-party industry certification, if available, related to the field of study (Ohio Board of Regents, 2015). Examples of this type of industry- (or workforce-) focused certificate might include American Welding Society (AWS) and Cybersecurity CompTIA A+, Security+, Network+ among numerous others.

Existing literature indicates that PBF policies have resulted in an increase in short-term certificates over the production of associate degrees (Hillman et al., 2015, 2018; Hu, 2019). However, there are documented concerns that the introduction of PBF drives institutions to focus on awarding short certificates over degrees because they take less time and college resources to produce (Dougherty et al., 2014a; Dougherty & Reddy, 2013; Gandara, 2019; Hillman et al., 2018; Hillman & Corral, 2018; Li & Kennedy, 2018). If colleges focus on increasing short-term certificates over associate degrees to gain more funding, there may be fewer resources available and potentially a reduced focus on other institutional priorities that could enhance overall student success.

Hillman et al. (2015) found that in the state of Washington there was no significant increase in the number of associate degrees produced, but instead determined that there was a dramatic increase in the number of short-term certificates awarded. These findings suggest that institutions may guide students toward an easier pathway to receive achievement points in the funding formula, thus increasing their financial resources. Research conducted by Johnson and

Yanagiura (2016) supported this in Tennessee, where they found that the production of short-term certificates increased by 174%, long-term certificates increased by 27%, and associate degrees by 6.3% since the implementation of PBF. These findings indicate that colleges in these studies may have an increased focus on the path of least resistance and could be "gaming the system" (p. 5). In another study, Li and Kennedy (2018) found an increase in short-term certificates in states that utilize high proportions of PBF. However, they acknowledged that, on average, most institutions award the same number of certificates and associate degrees regardless of the introduction of PBF. The research both supports and challenges the value of PBF in the overall output of these shorter certificates. For these reasons, investigating the impact of PBF on Ohio community college credential attainment has the potential to add substantively to the body of knowledge in this subject area.

When looking at the entire population of the 23 public community colleges in Ohio, there was an increase in the number of less than one-year certificates awarded over the 15-year study period (Figure 4). While there was an increase in less than one-year certificates after the implementation to PBF (Table 6), the results of the Interrupted Time Series Analysis (ITSA) revealed that the difference between the two periods is not statistically significant. However, since there is evidence of increased awards after 2011 (Table 6), results from this study suggest that colleges in the state of Ohio are working toward increasing the number of less than one-year certificates awarded. Nonetheless, overall, the result of the analysis determines that performance-based funding demonstrated no real impact on the total less than one-year certificate output. Interestingly, the findings in Ohio do not support some of the prior research in other states, which showed a strong correlation between PBF policies and an increase in less

than one-year certificates. Further discussion on this and the potential implications take place in the discussion section below.

At this time, less than one-year certificates are not included in Ohio's funding formula. Since 2016, however, there has been continued discussion lobbying for their inclusion in the formula. As a result, Ohio's community colleges have begun to increase their production, as shown by an increase in Table 4. This increase in credential volume has been a priority for Ohio's leaders who have been looking to increase postsecondary credential attainment by nearly one million by the year 2025 (Ohio Department of Higher Education, 2019a).

The results that are based on the type of community colleges for the second research question indicates the outcome of the analysis was similar for two of three different types of colleges. The analysis for technical and state community colleges showed no significant statistical difference in the award of less than one-year certificates as a result of the change to performance-based funding. However, the results were statistically significant but negative for Ohio colleges, indicating that Ohio colleges are producing fewer less than one-year certificates than they were before the implementation of PBF. The analysis indicates that there was a statistically significant decrease in the amount of less than one-year certificates awarded at Ohio colleges. The results for the second research question are consistent with the findings of the first; Ohio colleges do not appear to focus resources as a quick way to increase the award of an easier-to-obtain less than one-year certificate. The number of less than one-year certificates at Ohio colleges is substantially decreasing (Table 17).

In Ohio, there have been discussions for several years about allocating state funding or state share of instruction (SSI) for short-term technical certificates (which fall into the less than

one-year certificate category). This type of credential is currently not part of the funding formula; therefore, increases in this credential do not directly impact a college's state funding level. Colleges are presently not financially incentivized to increase the number of short-term technical certificates. This study confirms that they have not significantly increased in either research question as a result of performance-based funding (Table 17).

There is evidence that state community colleges in Ohio are preparing for the eventual inclusion of less than one-year certificates in the formula as the post-intervention trend for this category is increasing for this category of colleges (Table 17). In contrast to the results found in this study, other researchers have found an increase in the award of short-term technical certificates as a result of the change to PBF (Hillman et al., 2015; Hu, 2019; Li & Kennedy, 2018). It is plausible that these certificate numbers can increase regardless of whether institutions intend them to or not due to the shorter time required to complete them (Li & Kennedy, 2018). Furthermore, not all studies have described the amount of funding connected to this category. According to Li and Kennedy (2018), in all but three states (Michigan, Colorado, and Massachusetts), colleges receive the same amount of funding for a certificate (either short or one year to less than two years) as they receive for associate degrees. Therefore, the increase of less than one-year certificates could be influenced by the amount of funding the state receives for this category.

Overall, community colleges in the state of Ohio have not increased the volume of less than one-year certificates as a result of performance-based funding. The results of both research questions are consistent. The findings from this study add to the existing literature in establishing that the change to performance funding in Ohio has not resulted in an increase of

less than one-year certificates. Subsequently, this finding does not support the research suggesting that colleges may disproportionately focus on shorter credentials at the expense of degrees. However, this finding differs from results generally found and challenges the value of PBF in the overall output of these shorter certificates. Moreover, this result may demonstrate that research from state to state and with varying funding amounts may not always be comparable.

One-Year Certificates

One-year certificates are awarded for the completion of an organized program of study of at least 30 semester credit hours (900 clock hours) with most of the courses in a technical area. These certificates prepare students for a valid occupational license or third-party industry certification, if available, related to the field of study (Ohio Board of Regents, 2015). Examples of this type of industry- (or workforce-) focused certificate include Licensed Practical Nursing and Medical Assistant.

For the first research question, when looking at the entire population of the 23 public community colleges in Ohio, there was no visible increase in the number of one-year certificates awarded over the 15-year study period (Figure 8). This study confirms these results. From a purely quantitative standpoint, there was an increase in the quantity of one-year certificates awarded during the study period. While there was a positive statistically significant upward trend before 2011, there was no statistically significant post-intervention trend in the number of certificates. The results of the analysis confirm that this increase was not statistically significant. Overall, the result of the study determines that performance-based funding

demonstrated no substantive impact on the award of one-year certificate output when looking at all 23 community colleges in the state of Ohio.

For the second research question, which looks at the same information as the first question but grouped by the type of community college in the state, there also was no overall significant statistical increase in the number of one-year certificates awarded (Table 18). All three types of colleges (technical, state, and community) experienced a similar increase in the number of one-year certificates issued before 2011. Interestingly, numbers are trending downward for both technical and state community colleges since 2011, indicating that these colleges are awarding less one-year certificates since the change to performance-based funding. This decrease occurs when the state has expressed an interest in increasing postsecondary credentials attainment by one million by the year 2025 (Ohio Department of Higher Education, 2019a). The results are slightly different for Ohio colleges (those that receive a portion of their revenue from the local tax base) that also saw an increase after the implementation of PBF. However, the analysis determined that the change was not statistically significant, which indicates that there was no statistically significant change in the number of one-year certificates awarded as a result of PBF. The results from the three different community college classifications support the results from the first research question in that the change to PBF did not result in an increase of one-year certificates at any of the three different types of colleges.

Very little literature explicitly details the impact of PBF on medium- to long-length certificates, which are officially defined as a certificate that is one year in length but less than two years and are labeled as one-year certificates in this study. However, Li and Kennedy (2018)

found that there was no effect of PBF policies on the award of medium-length certificates. However, they did determine that in other states with Type IV funding (states that allocate more than 25% of funding via PBF), there was a slight increase in medium-length certificates at the beginning of PBF and a decrease in the fourth and fifth years (Li & Kennedy, 2018). In a study for Tennessee, Johnson and Yanagiura (2016) found a significant increase in short-term certificates as well as a 27% increase in the medium-length certificates for Tennessee.

This research does support the results found in this study. Right after the implementation of PBF, one-year certificates decreased for the next 6 years, only to experience an increase in 2018 (Figure 8). It is essential to highlight that Ohio continues to allocate SSI differently for the different completion milestones (transfer with 12 credit hours, one-year certificates, and associate degrees). For Ohio, one-year certificates are weighted at one-half that of an associate degree, thereby disincentivizing colleges from focusing solely on one-year certificates over associate degrees; however, these certificates are prioritized over less than one-year certificates as they are part of the funding formula and funding is allocated for the award of these degrees.

Overall, community colleges in the state of Ohio have not increased the award of one-year certificates as a result of performance-based funding. The results of both research questions are consistent. They add to the existing literature in finding that the change to performance funding in the state of Ohio has not augmented one-year certificates. This research supports the results generally found in the existing literature and challenges the value of PBF in the overall output of medium-length or one-year certificates.

Associate Degrees

Associate degrees refer to an award requiring completion of a minimum of 60 semester hours (maximum of 65 semester credit hours). There are four types of associate degrees recognized in Ohio. Associate of Arts and Associate of Science are transfer degrees, where many students are working on the first two years of a bachelor's degree. There are also applied degrees, which include Associate of Applied Business and Associate of Technical Studies (Ohio Board of Regents, 2015). These degrees are considered terminal and are aligned with local workforce needs and for people seeking technical skills to join the workforce (Batts & Pagliari, 2013). All four kinds of associate degrees awarded at Ohio public community colleges were included in this study.

For the first research question, when looking at all 23 public community colleges in the state of Ohio, there was a positive, statistically significant increase in the number of associate degrees awarded before the start of PBF. However, this trend was not statistically significant after the policy introduction. However, there was also a significant difference in the slope (trend) and level in the number of associate degrees awarded between pre-intervention and post-intervention periods. This result indicates that, on average, the number of associate degrees awarded after the PBF policy introduction was 9.15% higher than those awarded before the introduction of PBF and is statistically significant (Table 10). Therefore, the introduction of PBF did result in an increase of associate degrees awarded at the 23 Ohio public community colleges.

For the second research question, the results are similar for technical, state, and Ohio colleges. Technical community colleges demonstrated a statistically significant 8.3% increase in

the mean level of the number of associate degrees. State community colleges experienced a 13.6% increase in the number of associate degrees completed after the introduction to PBF. Ohio colleges experienced a 4.2% increase of associate degrees completed when compared with those completed before the implementation of PBF in 2011 (Table 19).

The results of both research questions are essential and add to the body of knowledge that associate degree awards have significantly increased in Ohio due to the change to PBF in 2011. Several studies have found insignificant or negative results in degrees awarded as a result of the shift to performance-based funding (Dougherty & Reddy, 2013; Hillman et al., 2014, 2018; Li & Kennedy, 2018; Rutherford & Rabovsky, 2014; Sanford & Hunter, 2011; Shin 2010; Shin & Milton, 2004; Tandberg & Hillman, 2014; Ward, 2018).

However, more recent studies found a correlation between PBF and increases in degrees awarded (Callahan et al., 2017b; Conklin et al., 2016; Hagood, 2019; Li, 2020). In a study conducted by the Lumina Foundation, the authors found that there was an increase of 6.3% of associate degrees awarded in Tennessee (Johnson & Yanagiura, 2016). Conklin et al. (2016) found an increase of 4.4% of associate degrees in Indiana. In her thesis findings for Ohio from 2011-2013, Hurtado (2015) found that Ohio colleges increased their associate degree awards by 27%. Additionally, Dougherty et al. (2016) found that graduation numbers have increased in Indiana, Ohio, and Tennessee.

Furthermore, many of the studies indicate that there is a delayed response to policy implementation. It could be that some of the earlier studies that did not find an increase, as a result, showed that there was not enough time for PBF to be fully realized when their studies were conducted. Studies, such as Tandberg and Hillman's (2014), concluded that it took 7 years

to see a positive and significant impact on bachelor's degree production. Hagood (2019) also reported a 5% increase for bachelor's degrees 4 years after implementation. Li's (2018) multi-state analysis determined that lagged models have demonstrated positive impacts. These results were echoed in a study by Li and Kennedy (2018), who found an increase in associate degrees after the PBF policies had been in place for at least 6 years. Since higher education is broad and decentralized, institutions may experience a delay in an increase in output (Callahan et al., 2017a). Possibly studies conducted too soon after the transition to PBF could have detected different and positive results in degree attainment had the treatment been given enough time to have an impact as well as provide enough time for students to matriculate through programs.

Overall, community colleges in the state of Ohio have significantly increased the volume of associate degrees as a result of performance-based funding. The results of both research questions are consistent and add to the literature by finding that the change to performance funding has resulted in an increase of associate degrees for the state of Ohio. This research from this study supports the more recent results generally found in research and promotes the value of PBF in the overall output of associate degrees.

The findings from this study support the design and intent of Ohio's performance-funding system and suggest that community colleges are responding favorably to the change to PBF by significantly increasing the number of associate degrees awarded. The formula was intentionally designed to be equitable, so that community colleges are focusing their attention on having more students graduate with associate degrees rather than have them leave after attaining a less than one-year or one-year certificate. As the state policymakers look to make

changes to the funding formula in upcoming years, they will need to continue this conservative approach to funding certificates.

DISCUSSION

Colleges continue to face pressure to increase student outcomes (Kelchen, 2019). Performance-based funding systems have grown in popularity, with nearly 70% of states either having implemented or planning to implement PBF (Boelscher & Snyder, 2019). This type of funding must be studied, explored, and thoroughly understood by policymakers responsible for driving policy and making changes in revenue allocations (Tandberg & Hillman, 2014).

The first research question demonstrated that in Ohio there was an increase of 9.15% in the number of associate degrees awarded. Associate degrees were awarded to a greater extent than less than one-year or one-year certificates due to the change to performance-based funding. There has been an increase in less than one-year certificates since the change to PBF. The overall number of certificates awarded was not statistically significant compared to the amount awarded before PBF implementation. The results for one-year certificates were not found to be statistically significant.

The second research question also revealed that associate degrees increased for all three types of community colleges in the state of Ohio. Technical community colleges increased by 8.3%, state community colleges increase their associate degree production by 13.6%, and Ohio colleges (institutions that receive additional levy funding) increased their output of associate degrees by 4.2% as a result of Ohio's resourcing institutions by performance instead of enrollment.

There was no significant difference in the number of less than one-year or one-year certificates for any of the different types of institutions. Several other studies have shown similar results with an increase of degrees awarded (Conklin et al., 2016; Dougherty et al., 2016; Hurtado, 2015; Johnson & Yanagiura, 2016), while numerous studies have shown an increase in the number of certificates awarded (Hillman et al., 2015, 2018; Hu, 2019; Li & Kennedy, 2018). Performance models can have a positive impact, but the way the funding models are designed and implemented can have effects (both positive and negative) on the results (Sanford & Hunter, 2011). Based on the results of this study, the funding formula for Ohio has been successful and well designed. Its impact thus far has been an increase of associate degrees as opposed to an increase in easier-to-produce lower awards in less than one-year and one-year certificates.

For performance-funding models to be effective, they need to be well designed and must consider the differences in mission between community colleges and 4-year institutions. Much can be learned from the development process taken and the components of Ohio's funding allocation formula. Ohio purposefully included representation from both groups when designing the formula and funding model components and created different formulas for community colleges and 4-year universities. The Ohio funding allocation, in general, aligns with the overall mission of community colleges by focusing on access. It includes extra funding weights for students that fall within one of four access categories—academic, financial, age, and race—since research shows students in these groups are less likely to succeed (Cummins & Robinson, 2019).

Ohio thoughtfully designed the metrics to be representational to the amount of effort for both the institution and the student in meeting the metrics (associate degrees receive one full point per award, while one-year certificates receive half of the allocation). In her study, Gandara (2019) determined that the inclusion or exclusion of metrics is critical for student groups. The design of the funding formula in Ohio recognizes these differences and, as determined by the study, has proven to be effective in stimulating increasing associate degree output.

In this study, I examined whether the change to performance-based funding in Ohio increased the production of less than one-year certificates, one-year certificates, and associate degrees. I had initially hypothesized that there would not be any significant increase in these measures. My analysis does not support this hypothesis as there has been a statistically significant increase in the number of associate degrees awarded since the inception of PBF in Ohio. This suggests that Ohio community colleges have risen to the challenge and have made substantive changes to increase student success in the form of a significant increase in the number of associate degrees awarded. As more time passes, more research from other states indicates that colleges are favorably responding to PBF (Hillman et al., 2015, 2018; Li, 2020; Li & Kennedy, 2018; Tandberg & Hillman, 2014).

IMPLICATIONS FOR THEORY

This study utilized the principal-agent theory (PAT) to evaluate the implementation of PBF in Ohio. PAT suggests that the principal uses rewards to meet a goal. In the case of PBF, the principal (the state) lays out a set of regulations and policies (goals or outcomes), and the agent (higher education institutions) must follow these to achieve the results (Alshehri, 2016;

Sappington, 1991). This theory assumes that the college was not previously working toward increasing student success and that the change to PBF will change how the agent performs. PAT's use is helpful in understanding the theoretical relationship between the state and colleges but is simplistic. Many different factors influence a community college student's ability to graduate or even complete a single college-level course successfully. Also, colleges are trying numerous tactics to help improve students' success, such as the whole college redesign movement that is occurring as a result of the Guided Pathway reform (Jenkins et al., 2019).

There is evidence that performance funding prompts colleges to make substantial changes to their academic and student services policies, programs, and practices (Dougherty & Reddy, 2013). The addition of these academic supports for students increases student success (Jenkins et al., 2019). The literature is unclear if these changes are uniquely a result of PBF or other planned reforms such as the Guided Pathway model. However, the results of this study indicate that the public community colleges in Ohio are increasing the number of associate degrees produced at their institutions. The state of Ohio went about the change to PBF strategically by involving the stakeholders to help develop the formula. The Ohio Department of Higher Education relied on the assumption that a well-designed policy will lead to the desired outcome (Nisar, 2015).

Applying this study's conceptual framework of principal-agent theory, it appears that the agendas of principals and agents agree, and the need to increase associate degrees is an equally important endeavor. The policy tool that was used as an incentive has been a catalyst to increase the number of associate degrees awarded.

RECOMMENDATIONS FOR FUTURE RESEARCH

There are several recommendations for further studies. This study explored data from 15 years, from 2004 to 2018, since this was the most recent data available at the time the study was conducted. There are clear benefits for continuing this research, as more data become available to explore trends in institutional effectiveness. Another research study could duplicate this study in another state with publicly funded community colleges to determine if results are similar between two or more geographic areas, especially in states that utilize Type IV funding, such as Ohio. It would also be of interest to replicate this study in a state that does not allocate as much state funding by performance to determine if the amount of the funding mechanism triggers a difference in results.

Based on the results from the study, further research into less than one-year certificate production would be beneficial. A potential study comparing states that fund these types of certificates with those that do not could help expand on the research found. Another potential study would be to compare the results in Ohio in the future after these types of certificates are incorporated into the funding formula to determine if there is a substantial increase based on that period.

To further the understanding of the Ohio model, it would be of interest to analyze the other components of the formula and determine if they have a similar relationship and have resulted in an increase since the change to performance-based funding. There are limitations in performing this type of analysis since the data on course completion and other components of success metrics were not actively collected before 2011. The study would be able to look at only differences since the change to PBF.

This study could be expanded to include an analysis of performance indicators beyond associate degree and certificate production and provide an analysis of the performance indicators since 2011 disaggregated by race and ethnicity. It is difficult to compare the results before the implementation of PBF since the state of Ohio and the various public institutions were not collecting metrics as they relate to the funding formula.

The state of Ohio is also considering making changes to the funding formula by incorporating metrics related to employment data. A future study should evaluate if the transition to PBF has led not only to an increase in students finding employment but specifically to an increase in employment in their field of study. Since August 2019, specific community colleges in the state have been able to offer a Bachelor of Applied Science at their institutions; currently, the legislature is uncertain of how to incorporate this new dimension into the funding formula. Graduates from the first programs should be beginning to graduate in the spring of 2021, and the state will need to incorporate this information into the formula.

FURTHER LIMITATIONS

It was previously discussed that the state of Ohio transitioned from quarters to semesters in the fall of 2012. This may have impacted the analysis; students may have attempted to graduate before the fall of 2012 to avoid being caught in the transition. Other factors that were not isolated in this study include the impact of the Great Recession on the results. Also, shortly after PBF was implemented, OACC began working with the Community College Research Center to help implement Guided Pathways to improve Ohio graduation rates. This could result in the overestimation of the PBF treatment in this study. Other factors that could influence this study include the various demographics and poverty levels in the state and

the performance of high school students as they moved over to college. Many other variables can have affected the results of PBF in Ohio over the study period. However, it was impossible to isolate them and determine their contribution.

CONCLUSION

In conclusion, this study advances the literature on performance-based funding by examining the volume of credential attainment of Ohio's public community colleges, where 100% of the state funding allocation for higher education is based on performance. This study provides empirical evidence that PBF can be useful in raising the state's community college attainment rate for associate degrees. For policymakers outside of Ohio, this type of analysis allows policymakers to assess the suitability of implementing performance-based funding in their own state's context, assist them in how to design their PBF formula, and provide insight into the successes of Ohio's implementation.

This study demonstrates that careful consideration of how to proceed with PBF includes having the key stakeholders identify the essential elements of the funding formula that can lead to successful outputs. For states that are currently allocating only less than 50% of the funding, this study demonstrates that allocating a higher percentage can lead to increased performance if their current formula is not already demonstrating this result. For policymakers in Ohio, this study reveals that the change to performance-based funding for the state of Ohio has been a positive change by increasing associate degrees and that more time should pass before making any major changes to the formula.

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APPENDIX A: IRB APPROVAL LETTER

FERRIS STATE UNIVERSITY
INSTITUTIONAL REVIEW BOARD FOR HUMAN SUBJECT RESEARCH
1010 Campus Drive FLITE 410 Big Rapids, MI 49307 | (231) 591-2553 | www.ferris.edu/irb

Date: June 2, 2020

To: Susan DeCamillis and Aimee Belanger-Haas
From: Gregory Wellman, PhD, RPh, IRB Chair
Re: Revised IRB Determination Letter, Project #19-20-119

The Ferris State University Institutional Review Board (IRB) reviewed your application for using human subjects in the study, "*PBF-Ohio*" and determined on December 5, 2019 that it did not meet the Federal Definition of research on human subjects, as defined by the Department of Health and Human Services or the Food and Drug Administration. This project did not meet the federal definition of research on human subjects because the unit of analysis were the institutions and not the human subjects. As such, approval by the Ferris IRB was not required for the proposed project.

The determination applied only to the activities described in the submission; it did not apply should changes be made. If changes are made and there are questions about whether the activities are research involving human subjects, submit a new request to the IRB for determination. Note that quality improvement project findings may be published, but any findings presented or published should be clearly identified as part of a quality improvement initiative and not as research.

Your project remains on file with the Ferris IRB for purposes of tracking research efforts at Ferris. Should you have any questions regarding this letter, please contact the IRB.

Regards,

Gregory Wellman, R. Ph, Ph. D, IRB Chair
Ferris State University Institutional Review Board