ABSTRACT

KING, GREGORY. A Path to Completion? The Impacts of Statewide Articulation Agreements on Enrollment and Attainment. (Under the direction of Dr. Paul Umbach and Dr. A. Brooks Bowden).

The United States (US) is faced with a crisis in college completion as states are increasingly depending on a highly skilled and educated workforce (Falconetti, 2009; Long, 2005; Perna & Finney, 2014). This crisis is not solely the result of too few students enrolling in college, but also that students who enroll do not complete their educational journey. It is estimated that over 31 million students over the last 20 years have enrolled in but not completed post-secondary education (Shapiro, Dunbar, Yuan, Harrell, Will, & Ziskin, 2014). As a result, states are exploring policy options to increase the number of graduates through increasing enrollments and reducing the number of students who leave school prior to earning a degree.

One way that states are addressing the need to increase the number of graduates is to create streamlined pathways through the post-secondary landscape. These pathways create policies around the transfer of credits and credentials between institutions. These sets of policies that tie public two-year and public four-year institutions together are known as articulation agreements. This study measures the effect of adopting statewide articulation agreement policies on college enrollment, associate degree attainment, and bachelor's degree attainment using data from the Integrated Postsecondary Educational Data Systems (IPEDS). The effects of articulation agreements on the specified student outcomes are estimated using a Difference-in-Difference (DiD) approach.

The findings show that the adoption of a statewide articulation agreement did not have an effect on first-time, full-time general enrollment at two-year or four-year institutions. However, there is evidence that the adoption of statewide articulation agreements did influence more

students receiving federal grant aid to attend two-year institutions in the first year after policy-adoption. This effect seems to diminish after the first two years of the policy. The adoption of statewide articulation agreements positively influences the number of low-income students enrolling at two-year institutions regardless of whether these policies originate from a governing board or state legislature.

Articulation agreements have a significant impact on the number of students graduating at two-year institutions by the third year of the policy. These policies increase the overall number of two-year associate degree earners by as much as 1,100 students in the third-year post policy. When focusing the analysis only on states with legislated statewide policies, the difference in the number of two-year graduates increases to over 1,300 graduates. States that adopt articulation agreements also produce a difference of 1,600 additional four-year graduates. These findings demonstrate that statewide policies can improve educational outcomes within a state and provide evidence of the efficacy of mandated articulation agreement policies to increase the numbers of graduates beyond what would have otherwise been expected.

A Path Toward Completion? The Impact of Statewide Articulation Agreements on Enrollment and Attainment.

by
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A dissertation submitted to the Graduate Faculty of
North Carolina State University
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

Education Research and Policy Analysis

Raleigh, North Carolina
2019

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DEDICATION

Dedicated to my spouse, Anne, and daughter, Rosalie.

Additionally, dedicated to the many in foster care who never imagine achieving a college education. To those who have found themselves homeless, hungry, and lost: never give up, never stop moving forward.

BIOGRAPHY

Gregory (Greg) King has worked in higher education since 2007. He spent seven years working professionally in various student affairs settings before pursuing his doctorate. He has worked in housing, advising, student activities, student leadership, and assessment throughout his time in higher education. Through each of his experiences, he found a passion for creating better systems which hold the potential to increase higher education access and degree attainment for all students. He remains humbled and influenced by the many mentors and friends he has, and continues to, work alongside. Greg is a proud husband and father. He started at McHenry County College, while working full-time at Marriott. He received a scholarship and Pell grant to attend Western Illinois University, where he graduated with a Bachelors in English. He then went on to receive his master's from Colorado State University, and his doctorate from North Carolina State University. He looks forward to continuing his work in education policy.

ACKNOWLEDGMENTS

This dissertation, and entire Ph.D. process would not have happened or be completed without the wonderful and amazing support of my partner, spouse, and friend: Anne. My name may be listed as the author, but the completion of this process is also her accomplishment. Throughout the past four-years, Anne has sacrificed so much. She left her job in Portland, Oregon to move across the country, giving up significant amounts of time together to make this happen. Often this process has caused her sacrifice and accomplishments to be overshadowed; she deserves as much recognition as I do. She may not have been in classes, but she has supported, encouraged, and ultimately, is what has allowed me to do good work throughout this chapter of our lives. I'm thankful to have her by my side. She inspires and grounds me. She helps me to be a better person and scholar. I recognize how lucky I am to have such an amazing spouse. She is intelligent, witty, uplifting, and a wonderful mother to our daughter.

I also want to acknowledge my brother, Jeff. Jeff and I have seen the worst and best in people, but through everything we stuck by each other. Jeff, rather unknowingly, provided me with the example that it was okay to take a risk and change the course of one's life. Jeff enlisted in the military at 17. He has traveled the world, raising to the current rank of a Lieutenant Commander in the Unites States Navy. He taught me that we can be successful with hard work and perseverance. He has been a constant source of encouragement. I would not be the person I am today without his guidance and example. I am humbled to have him as a consistent part of my life. I am proud of the distance we've journeyed from our beginnings.

Beyond my spouse and brother, there are countless others who have invested in me. These people encouraged me to pursue bigger things than I ever thought possible. Some of these people never knew the impact they had. There is the social worker who worked tirelessly to find

No acknowledgement would be remotely close to complete without recognition of the inimitable Vicki Wise. Vicki has been a wonderful mentor for the past several years. I had not truly thought about conducting a national search for a Ph.D. program until Vicki encourage me to do so. Vicki has taught me how to use data and assessment to demonstrate how institutions can put their limited resources toward helping as many students be successful as possible. She taught me much about understanding systemic thinking at both the micro and macro levels. I am grateful for her push to expand my Ph.D. search and patience with all my questions. I'm lucky to have her as a mentor and support throughout this process.

There are several folks at NC State who have been a part of this process. I want to thank Paul Umbach and Audrey Jaeger. Paul has been an incredible advisor. He has consistently encouraged me and pushed me to apply myself beyond what I thought I could do. Paul has invited me to be a part of several research projects, helped me improve my writing, and been patient with me throughout this dissertation process. Audrey Jaeger provided me with an amazing opportunity to be a part of NILIE. I am incredibly grateful to the work she put in to bring me to NC State, as well as her mentorship and guidance as a supervisor and scholar.

My journey through NC State would not have been successful had in not been for many of the faculty. I especially want to thank Brooks Bowden for serving as a Co-Chair on my committee and allowing me to TA her Quantitative Methods section. Her encouragement, patience, and edits have been helpful beyond belief throughout this process. I am thankful for her consistent encouragement, positivity, and guidance. Alyssa Rockenbach also deserves special recognition for not only serving on my committee, but for her constant encouragement. Alyssa allowed me to TA her Quantitative Methods course which provided me with the confidence that I could do a quantitative dissertation. Alyssa taught me a great deal on how to teach statistics as a

language and how to remove the fear of quantitative methods that so many students experience. Last, but not least, I want to thank my fellow NC State students for their support, specifically Matt Starke, Mihaela Henderson, Katie Smith, Katie Johnson, Nicole Ditillo, Alessandra Dinin, Jemilia Davis, Chelsea Doub, and Andrea DeSantis.

Finally, I want to thank those in the Portland, Oregon area. Specifically, John Cronin, as well as the many individuals on the NWEA research team who have encouraged me, provided feedback, and helped me along. In alphabetical order, I'd like to specifically thank: Mike Dahlin, Abby Javurek, Nate Jensen, Megan Kuhfeld, Jim Soland, and Beth Tarasawa, to name a few. There are also several close families who have provided support and encouragement for my entire family prior to the Ph.D. process, during the coursework, and throughout the dissertation process. Specifically, I'd like to acknowledge the Taylor, Erickson, and Sengdeng families.

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CHAPTER 1: INTRODUCTION

The United States (US) must boost both associate degree and baccalaureate attainment to keep pace with the share of professional careers requiring postsecondary education (Falconetti, 2009; Long, 2005; Perna & Finney, 2014). Despite the need to boost education attainment, the percentage of the population with postsecondary credentials remains consistent. The US has not substantively increased the proportion of adults with a college degree above 41% in the past 30 years (Hossler, 2013). During this period, the US has gone from first to 16th among developed nations in the proportion of the 25-34 year-olds with a college degree.

Increasing enrollments at four- and two-year institutions do not address the stagnation in completion percentages (Hossler, 2013). Though enrollments have continued to increase, over 31 million students over the past 20 years have left higher education before completing a degree (Shapiro, Dunbar, Yuan, Harrell, Wild, & Ziskin, 2014). The failure to complete disproportionally impacts those who stand to benefit the most from a college degree and widens the educational attainment gap by race and socioeconomic status (Page & Scott-Clayton, 2016). To address this issue, policymakers have focused on increasing access and attainment among state populations (ECS, 2017). Most states have established strategic directions dedicated to increasing overall college achievement to 55% of their population.

A key feature of state strategic directions is to better utilize community colleges, where nearly half of the total US undergraduate population attend educational programs (Jenkins & Fink, 2015; Roksa & Keith, 2008; Snyder et al., 2016; ECS 2017). Community colleges provide an avenue to reduce the education attainment gaps existing among populations usually underrepresented in higher education. Community colleges provide this avenue because they are more diverse than four-year institutions among a variety of characteristics (Cohen, Brawer, &

Kisker, 2014; Jaeger, Dunstan, & Dixon, 2015). Community college students tend to have lower incomes (e.g. Dougherty & Kienzl, 2006; Wang, Wickersham, & Sun, 2016), are more racially and ethnically diverse (e.g. Wellman, 2002), have lower levels of academic preparedness (e.g. Adelman, 1999), and are older (e.g. Long & Kurlaender, 2009).

In many cases, community colleges provide a flexible outlet to increase education levels in their local area, whether in an urban environment, a rural county, or a tribal region within a state (Jenkins & Fink, 2015; Long, 2005; Rouse, 1995). Community colleges seek to grow and develop local economies. Community colleges decrease poverty by providing additional skills to residents that meet local workforce needs (Dougherty, 1994; Jaeger et al., 2015). Community colleges provide a higher education avenue for rural and underrepresented students who cannot leave communities to travel to four-year universities (Jaeger et al, 2015, Page & Scott-Clayton, 2016; Ma, Baum, Pender, Welch, 2017; Perna & Jones, 2013; Roksa & Keith, 2008; Scott-Clayton, 2011). In addition, by existing in the geographic location of the populations they serve, community college students often represent the demographics of residents residing in the community college district.

Community colleges are also less expensive options for students than four-year institutions, where costs of been increasing, in some cases faster than inflation. By offering postsecondary education at low tuition rates, community colleges largely address the cost constraint among low-income students who are otherwise qualified for baccalaureate programs. When higher university prices shift more costs to students these students are subsequently driven to less expensive options (Page & Scott-Clayton, 2016; Epple, Romano, Sarpca, Sieg; 2017). Community colleges offer a lower-cost opportunity for students who cannot afford to start at four-year institutions. The location, diverse student population, and cost at community colleges

make them an ideal arena for many students, especially underrepresented student populations, to begin their college career (Dougherty & Kienzl, 2006; Ampaw, Partlo, Hullender, & Wagner, 2015; Jaeger et al., 2015).

Beyond the several advantages community colleges provide to students and communities, states also invest in community colleges to improve the overall number of graduates in the state. There is a fiscal incentive to states boosting the number of students who successfully complete at two-year institutions and then move to four-year institutions. States save three percent more on higher education expenditures when students complete an associate degree and then a bachelor's degree compared to students who start and finish at baccalaureate institutions (Belfield, 2013). College graduates also increase the tax base for states by producing higher earnings among state populations (Baum, Ma, & Payea, 2013), are less likely to rely on state welfare programs, and tend to contribute more to the local economy (Rothwell, 2015). The focus on helping students complete also aligns with students' stated goals.

Among first-year community college students, 80% enroll in post-secondary education with the goal of completing a four-year degree (Jenkins & Fink, 2015). However, there is a clear disconnect between the number of students desiring a four-year degree at the onset of their higher education journey and those who reach their goal (Alfonso, 2006; Long & Kurlaender, 2009). While those students who transfer with an associate degree to a four-year institution graduate with bachelor's degrees at high rates (Kopko & Crosta, 2016), only 25% of all first-time, first-year community college students transfer (Baker, 2016; Jenkins & Fink, 2015; Shapiro et al., 2014; Shapiro et al., 2015). Of all enrolled students, only 17% of first-time, first-year students go on to meet their baccalaureate degree aspirations (Jenkins & Fink, 2015; Shapiro et al., 2014; Shapiro et al., 2015). If states are seeking to increase degree attainment, while also

reducing attainment gaps between socioeconomic and racial groups, then policies focusing on the flow of students between community college and four-year institutions are a good place to start.

Transferring between institutions can be a complicated process for students to navigate. Without a guide, students are left confused about what courses transfer, the appropriate degree to transfer with, and the most efficient pathway through the collegiate system (Scott-Clayton, 2011; Belfield, 2013). Any pathway designed to encourage college completion must be constructed with the flow of students in mind. Pathways must encourage students who start at community colleges to progress towards degree attainment. The same pathways must also promote attainment for students who begin at four-year institutions and transfer into community colleges. Regardless of the manner or direction of transfer, all transfer pathways must continue to improve avenues for students to complete (Dougherty & Kienzl, 2006; Dougherty, 1994; Doyle, 2009; Long & Kurlaender, 2009).

One tool institutions and states heavily rely on to provide a seamless path to completion for students who utilize multiple institutions are articulation agreements. Articulation agreements are defined transfer policies at state or institutional levels stipulating common courses or degrees which are interchangeable between them (Anderson, Sun, & Alfonso, 2006; Bers, 2013). Statewide articulation agreements are designed with the intention of simplifying the transfer process between approved institutions (Jaeger et al., 2015; Roksa & Keith, 2008).

However, the effect agreements have on the actions of student outcomes is unclear. There are a few studies that measure the effect articulation agreements have on the probability of students in states with these agreements to enroll at community colleges (LaSota & Zumeta, 2016) or probability of students to graduate from either a two-year or four-year institution (Bers,

2013; Stern, 2016). These studies do not focus on state-level specifics, or the origination of policies. Without state level samples, current research cannot determine whether articulation agreements are having an impact on increasing enrollment and attainment for the states adopting the policies. The lack of evidence supporting the impact of articulation agreements on higher education outcomes represents a critical gap in the research on the effectiveness of articulation agreements as a policy.

Despite the lack of evidence on the efficacy of articulation agreements, 41 states have a mandatory articulation agreement policy governing all public universities in the state. As of 2018, only Connecticut, Delaware, Michigan, Nebraska, New Hampshire, Vermont, and Wisconsin, do not have a statewide articulation agreement policy, as represented in Figure 1. Comparing states that do not have articulation agreements with those who have recently adopted articulation agreements provides an opportunity to fill existing gaps in the research to address questions around effects of articulation agreements on student attainment. Appendix A provides a detailed description of each state policy and the date of policy adoption, as well as the bill or governing policy stipulating the articulation agreement.

Figure 1.

States with and without articulation agreements as of 2018
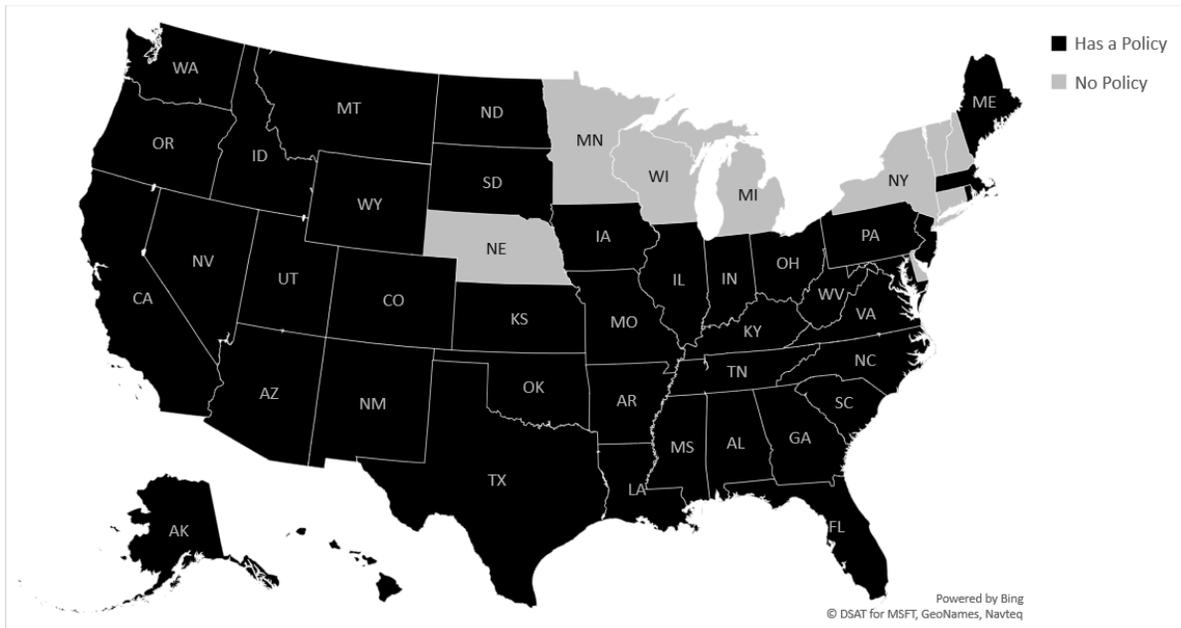
Note: New York and Minnesota do not have statewide articulation agreements but have policies which govern most of the public institutions within the state.

Purpose of Study

The purpose of this study is to examine the effect articulation agreements have on community college enrollment, associate degree attainment, and bachelor's degree attainment, using state-level panel data between the years of 2000 and 2015. Changes in policies over time allows for this research to analyze the effects of articulation agreements on enrollment and attainment with a Difference-in-Difference (DiD) statistical model. A DiD model allows this study compare changes prior to and post-policy adoption between the states with mandatory articulation agreements and those without a mandated policy.

Past studies use national datasets to measure articulation policy impacts at the individual level, but none have examined how these policies affect statewide enrollments and degree attainment. Recent studies have not looked at whether these policies are increasing the overall number of graduates in a given state. Further, current studies do not address whether articulation

agreements increase graduates at all levels, or if students are transferring from four-year institutions at higher rates. This study addresses the first issue by analyzing enrollment at two-year and four-year institutions pre- and post-policy adoption. The study then addresses overall trends in the number of students who graduate. Results are analyzed to see if the statewide adoption of articulation agreements lead to more students enrolling in a higher education institution and attaining a post-secondary degree.

Research Questions

The present study will seek to answer the following research questions:

1. Is there an increase in enrollment at either two-year or four-year institutions after the enactment of statewide articulation agreements? Is there evidence of an increase in enrollment for federal financial aid recipients post policy adoption at either two-year or four-year institutions?

2. To what extent do statewide articulation agreements affect bachelor's degree attainment? To what extent do statewide articulation agreements affect associate degree attainment?

This research will add to the overall body of data on the effects of articulation agreements. Specifically, it will address the lack of research on the effect articulation agreements have on community college enrollment and degree attainment on a state level.

Overview of Research

Only a few recent studies address questions related to the effect articulation agreements have on state-level trends of enrollment and attainment. Baker's (2016) Difference-in-Difference-in-Difference (DDD) study on a California policy change provides the most direct evidence on the effect of state-mandated articulation agreements and serves as a foundation for

this study. Baker's analysis measures the impact of The Student Transfer Achievement Reform Act (STAR Act) of California which mandated the creation of mutually agreed upon transfer degrees between the California Community College and the California State University systems. Baker (2016) found the policy did increase the number of transfer associate degrees completed, and in the third-year post policy adoption, begin to increase the number of transfer students (Baker, 2016). This study picks up where Baker left off by expanding the analysis to look at enrollment and attainment across multiple states.

The remaining state-level analysis, using a chi-square technique, provides suggestive evidence from Florida that those who benefited from Florida's articulation agreement attained bachelor's degrees with fewer first- and second-year credit hours than students who had started at three of Florida's four-year public institutions (Falconetti, 2009). However, results from Falconetti's (2009) study should be taken with caution as the study provides only limited correlational observations. Falconetti (2009) does not measure the impact articulation agreements have on her findings, only that there appears to be a difference.

Additional research. Overall, evidence of the effects of statewide articulation agreements is sparse. Few studies find statewide articulation agreements do not significantly increase the number of students who transfer (Anderson et al, 2006; Goldhaber, Gross, & DeBurgomaster, 2008; Gross & Goldhaber, 2009). However, one study provides nuance to overall research finding that articulation agreements may only increase transfer to four-year institutions among students who did not originally intend to pursue bachelor degrees (Goldhaber et al., 2008). Though not increasing the rates of transfer overall, articulation agreements may increase rates of baccalaureate completion for students who start at community colleges (LaSota & Zumeta, 2016; Stern, 2016). Using a national dataset, Stern (2016) found articulation

agreements did not influence the propensity of students to transfer but did have a strong positive effect on the probability of students who transferred to graduate with bachelor's degrees. These studies provide inconsistent evidence on the effect articulation agreements have on students' probability of transfer, but find that they do increase rates of graduation.

Limitations of current research. Current studies do not measure the effect articulation agreements have on enrollment and attainment at the state-level (Roksa & Keith, 2008; Roksa, 2009). This is because current research focuses on the probability of individuals to transfer or graduate based on the presence of articulation agreements in their state. The focus on the probability to transfer or graduate provides limited utility in determining whether states that adopted statewide policies are increasing the number of graduates beyond their expected trend because of adopting a policy. These studies are also limited by using individual-level national surveys. The national data-sets used in prior research preclude state-level analyses because the surveys are not representative of states. This study seeks to address the lack of existing research on the effects of articulation agreements on state-level enrollment, degree attainment at two-year and four-year institutions.

Brief Introduction of Theoretical Framework

Measuring the impact of transfer pathways is a complicated problem (Cohen et al., 2014; Dougherty, 1994). Transfer pathways make up for a failure in the higher education market (Perna & Finney, 2014). A market failure occurs when an otherwise desirable outcome cannot be met by natural market forces (Page & Scott-Clayton, 2016). In this case a market failure is producing an inadequate number of graduates to meet the needs of the states, as well as failing to increasing college attainment for all sectors of society.

State or federal government often adjust for market failure in education through funding measures (Perna & Titus, 2004; Toutkoushian & Shafiq, 2010) in the form of federal aid, usually Pell Grant or loans, and state aid which can take on several forms. States can provide aid to institutions and lower individual costs through direct appropriations (Toutkoushian & Shafiq, 2010). They can also provide aid in the form of grants directly to individuals paying for their education. Forms of aid, either directly to individuals or to states are ways to reduce the overall cost of education, thereby reducing barriers to enrolling and completing degrees for disadvantaged individuals. Policies, such as articulation agreements, adjust for this market failure by focusing resources and streamlining the collegiate pathways for students in several ways. Articulation agreements can encourage students to use two-year institutions as a means of lowering the cost of education, shortening the time to completion by encouraging transfer between two and four-year institutions, and encouraging some sort of credentialing by guaranteeing associate degrees transfer. Articulation agreements provide a non-monetary policy format from which states can address market failures in higher education (Perna & Jones, 2013; Perna & Finney, 2014), resulting in an increase in state-level education outcomes in a manner consistent with state goals.

States are relying on a key component of human capital theory to entice potential students to pursue degrees. Human capital theory holds that students will make the most rational choices for their individual situation based on available information (Desjardins & Toutkoushian, 2006; Perna, 2006). As described, articulation agreements provide clear choices for students which allow students to make the most use out of their time at various institutional types prior to transferring or graduating. Helping students find easier choices could help yield better potential outcomes. Following human capital theory, individual investment in one's self will be beneficial

only when the benefits of the venture exceed the cost of the investment. Articulation agreements reduce the cost burden of education on students, on the education system, as well as on society. Reducing the cost on students makes education more attractive than other possible avenues, potentially increasing the number of students who attend and complete college. By reducing the overall cost of college, articulation agreements also make higher education more accessible to a wider range of students who might not otherwise continue their education. In short, these agreements aim increase the number of students who enroll in college and completed by providing a mechanism for students to easily progress toward a degree by moving between institution types (Baker, 2016; Stern, 2016).

However, striking an equilibrium on cost and providing enough information to students must be addressed for articulation agreements to influence enrollment and graduation. On the one hand, the cost of education must be low enough that it will draw students away from the workforce for an extended time or be beneficial enough that students will attend while working, thereby, sacrificing other areas of life. On the other hand, students need to have access to quality information upon which to make decisions. A lack of access to quality information, known as information asymmetry, hinders students' ability to make the best choice. Information asymmetry is an especially important key to articulation agreements considering its prevalence among students from lower incomes or lesser performing schools (Bettinger, Long, Oreopoulos, Sanbonmatsu, 2012).

Higher education is an avenue by which states can provide opportunities to improve the social mobility of low-income populations. Moving low-income populations into higher income brackets increase the competitive nature of the state and broaden a state's tax base, thereby increasing the state's human capital. Since states need to continually develop human capital, they

have a clear need to help students make higher education choices (Hanushek, Ruhose, & Woessmann, 2017). State policies need to balance decreasing information asymmetry with finding a low-cost option to draw students into higher education. By finding the right balance, states can provide a clear set of opportunities for students to make the best choice on where to start and finish their postsecondary education. Articulation agreements are aimed at providing a policy avenue to encourage the development of human capital. If articulation agreements work correctly, states benefit from a highly educated and productive workforce. Individuals benefit from articulation agreements by gaining the ability to attain postsecondary education at a low cost. However, there is simply no research on whether articulation agreements as a policy mechanism are living up to their potential to broaden college enrollment while improving overall degree attainment.

Study Overview

The purpose of this study is to examine the effects of articulation agreements on community college enrollment, associate degree attainment, and bachelor's degree achievement. This uses the number of first-time, first-year students beginning at public community colleges and four-year universities, as well as the number of associate and bachelor's degree graduates, by collecting and aggregating data from IPEDS. One limitation of this study is that it does not incorporate individual-level statistics. This study also does not look at whether a specific type of institution performs better or whether a precise type of individual is more likely to transfer and succeed. Instead, this study focuses on aggregate data to better understand whether articulation agreement policies affect state college enrollments and state degree production. Limitations are further discussed in Chapter 3.

Articulation agreements range in their breadth and depth (Roksa & Keith, 2008; Roksa, 2009). For instance, the Education Commission of the States (ECS) (2010) found seven different specific policy components can make up any one statewide articulation agreement. The combination of policy specifications can vary from adopting state to adopting state, making the specifics of each articulation agreement different. For the purposes of this study the definition of a statewide articulation policy has two components. As guided by the ECS (2010), a state with an articulation agreement codified in state law is considered to have a statewide articulation policy. Articulation agreements are also considered to be statewide if they are ratified by a Board of Governors or a higher education oversight committee that has been granted full statutory powers by the state legislature. A secondary analysis will look at whether articulation agreements have a different effect on enrollment and attainment when only including states with policies mandated by state legislatures.

This research will consider states without a statewide articulation agreement policy between 2004 and 2010 as counterfactuals. States without a policy during the same time-frame will be exposed to similar national trends. Statistical controls can help highlight how states without policies have similar trends as states which adopt policies prior to the adoption of the policy. Figure 2 shows the nine states that adopted new statewide articulation agreements between the years of 2004 and 2010 and the seven states with no statewide articulation agreement policy in place.

Figure 2.

States with policies prior to 2000, changed policies between 2000 - 2010, and without policies from 2000 - 2010
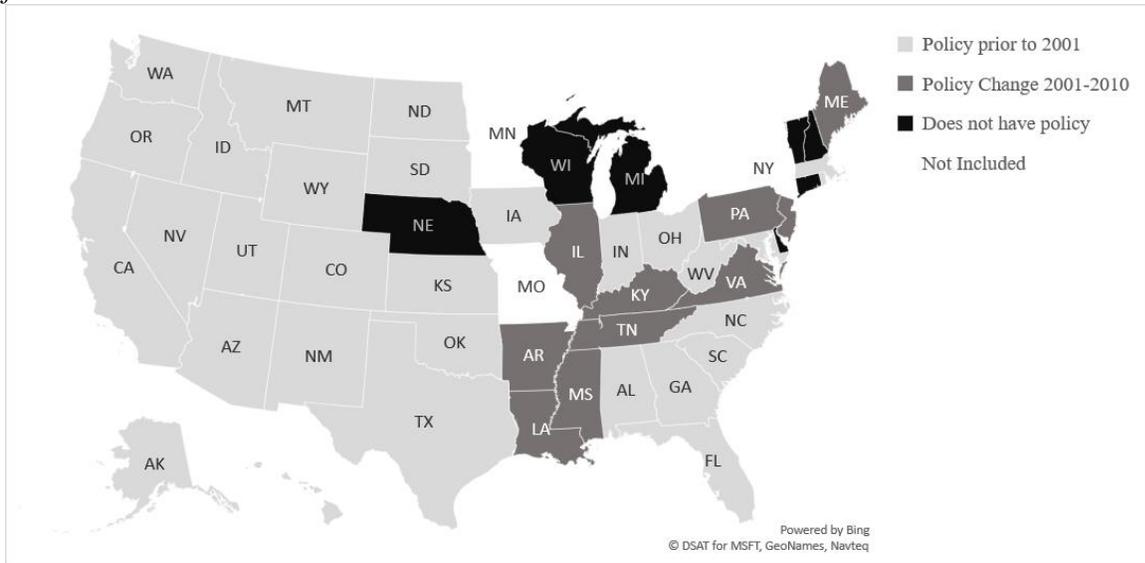
Table 1.

States adopting policies and without policies

List of states treated and non-treated states included in the analysis		
Changed	**Policy Implementation**	**No Policy Every Adopted**
Arkansas	Fall 2005	Connecticut
Kentucky	Fall 2004	Delaware
Louisiana	Fall 2009	Michigan
Maine*	Fall 2005	Nebraska
Mississippi*	Fall 2010	New Hampshire
New Jersey	Fall 2008	Vermont
Pennsylvania	Fall 2008	Wisconsin
Tennessee	Fall 2010	
Virginia	Fall 2005	
Notes: Missouri is not included in the analysis because they changed their policy in 2012. There are not enough years of data with a current policy in place to use this state as a comparison group. Indiana is not included because they introduced their policy in 2002. There are not enough prior years of data available to assess this policy. New York and Minnesota are not included in the analysis because they do not have a statewide policy, but have system wide policies which cover large swaths of students. *Maine and Mississippi have policies which are directed by the boards governing public two-year and public four-year institutions. They are statewide policies but are not enacted by the state legislature.		

Understandably, a complex problem in measuring the effect of a policy on community college enrollment, associate degree attainment, and bachelor's degree achievement is controlling for the heterogeneity within the selection of the states. Any state has a confluence of social, demographic, and economic factors influencing student actions. States are constantly adopting policies which may influence other policies affecting the outcome of interest. The constant changes obfuscate the impact of a single policy's effect on a solitary outcome. A Difference-in-Difference model (DiD) can help isolate the impact of the policy adoption holding other state and time covariates equal.

The DiD with fixed-effects model will be used to measure the local average treatment effects. This limits the discussion of the results to states which have added articulation agreements during the study's time frame. The model allows the researcher to control for variables that are constant over time and state to isolate the policy change using state and year fixed effects, meaning the model adopts controls for changes within and between states occurring year after year. Associate degree and baccalaureate attainment are the main dependent variables. Other state factors that vary across time, such as measures of the state's economy, will be used as control variables.

From a policy angle this research highlights the impacts state policies may or may not have on their intended population. This study will add to the overall research on how articulation agreements may shift where students attend college, and whether policies influence the number of students who graduate. This research may lend itself as evidence that state policies can help improve educational outcomes. This work may provide policymakers with additional information on the impacts of creating unified higher education systems that allow students to flow between multiple types of institutions in more seamless ways.

The remainder of the dissertation will be as follows: Chapter 2 will review literature and history of articulation agreements. Chapter 3 will fully describe the methods, model, and limitations of this study. Chapter 4 will provide results and analysis. Chapter 5 will provide a discussion of the results and a guide to future studies of articulation agreements.

CHAPTER 2: LITERATURE REVIEW

In the years after the Great Recession, employment experienced a U-shaped recovery, where the largest wage increases went to high skill, high wage jobs held by college graduates (Autor, 2010). While the recession exasperated this trend, it's something that has been building for quite some time. Figure 3 highlights how the weekly wage ratio between a high school diploma earner and individual with a college degree has been increasing consistently since 1980. Figure 3.

Graph of college degree vs. high school diploma weekly wage ratio, 1963-2008.
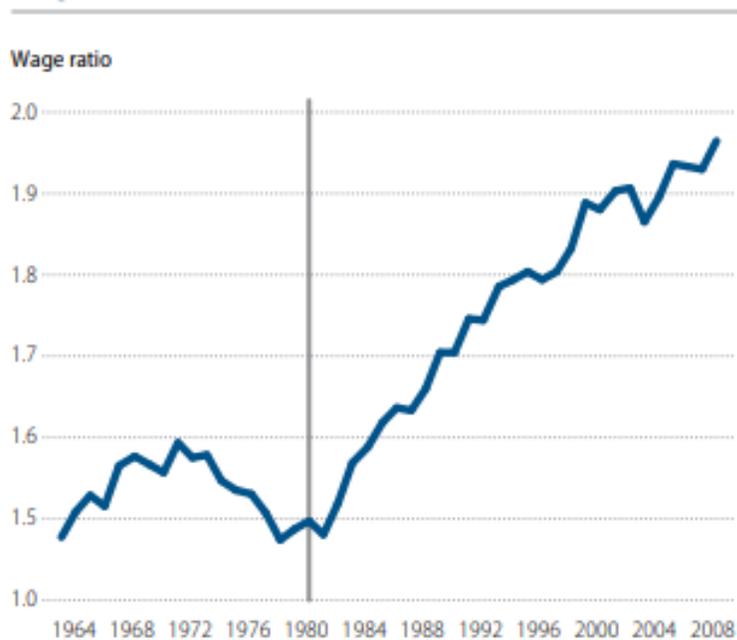
Source: March CPS data for earnings years 1963-2008. Log weekly wages for full-time, full-year workers are regressed in each year on four education dummies (high school dropout, some college, college graduate, greater than college), a quartic in experience, interactions of the education dummies and experience quartic, and two race categories (black, nonwhite other). The composition-adjusted mean log wage is the predicted log wage evaluated for whites at the relevant experience level (5, 15, 25, 35, 45 years) and relevant education level (high school dropout, high school graduate, some college, college graduate, greater than college). The mean log wage for college and high school is the weighted average of the relevant composition adjusted cells using a fixed set of weights equal to the average employment share of each group. The exponentiated ratio of mean log wages for college and high school graduates for each year is plotted.

See Data Appendix for more details on treatment of March CPS data.

Figure 3. Adapted from 'The Polarization of Job Opportunities in the U.S. Labor Market,' By D. Autor, 2010, Brookings Institute, p. 23.

The wage gains experienced by college graduates is not isolated to only those with four-year degrees. Associate degree earners experience a significant return on investment for degree completion. For instance, it is estimated the yearly wage returns to associate degrees average $10,000 (Kreisman, Jacob, & Dynarski, 2017), and others find the wage premium of associate degrees is between $4,640 and $7,160 (Belfield & Bailey, 2017). Investing in a two- or four-year degree returns an average yield of 15% on the initial investment (J. Abel & Deitz, 2014; Greenstone & Looney, 2012).

In addition to increased earnings, degree holders are likely to have improved long-term outcomes in health and to be more active as citizens (Baum, Ma, & Payea, 2013). The benefits of higher education completion spread to society as well. College degree holders are more likely to pay higher taxes and less likely to depend on state-run anti-poverty programs. Local economies see beneficial returns to investments in education as the average bachelor's degree holder may spend over $250,000 more locally (excluding items such as housing) than the average high school graduate (Rothwell, 2015).

States and individuals experience benefits when students begin postsecondary education at community colleges. Community college students who transfer to four-year institutions and completed baccalaureate degrees upon the completion of associate degrees realize higher net benefits than students who did not finish associate degrees while still completing a four-year degree (Belfield, 2013). Higher net benefits mean these students realized the highest overall value at the lowest total cost (benefits of degree completion minus the costs of degree completion). States, benefit from students starting at community college by saving three percent on higher education expenditures when students receive a two-year associate degree and then a baccalaureate degree (Belfield, 2013).

The benefits yielded from starting at community college are only realized when students complete their higher education journey by attaining a degree either prior to transferring or from their post-transfer institutions. The process by which students flow through the higher education system deserves additional scrutiny when considering all that is at stake for states and students in failing to attain a post-secondary credential after starting. Policies which place an emphasis on the transfer process and community college enrollment may be setting the stage for fewer students to complete because of the difficulties involved in the transferring.

Research on Transfer Students

For policies to have an impact on enrollment and graduation trajectories, they must address specific problems restricting students from transferring between institutions. Community college attendees tend to be more diverse and economically disadvantaged (Anderson et al., 2006; Dougherty & Kienzl, 2006; Jepsen, 2008) and their attainment rates lag compared to more economically advantaged peers attending four-year schools (Dougherty & Kienzl, 2006; Jepsen, 2008; Roksa, 2006; Roksa & Keith, 2008). Community colleges have long been seen as an avenue to reduce the opportunity gap between those with means and those without. Research has confirmed that those who complete a baccalaureate program after transferring do not face any wage penalty upon entry into the labor market (Ampaw et al., 2015; Belfield & Bailey, 2017; Liu & Belfield, 2014). Meaning that students who transfer and complete earn the same as those who never transferred and completed similar academic programs.

It may be that previous studies undervalue the long-term returns to associate degrees by as much as 25% (Kreisman et al., 2017). In fact, for a large subset of students, entry into the community college, then transferring, is the most advantageous route in terms of price if those

who transfer graduate with a bachelor's degree (Belfield, 2013). Using data from North Carolina, Clive Belfield (2013) found the most cost-effective route is to spend a minimum of one year at a community college before transferring and completing a baccalaureate program. However, the efficiency is lost if a degree is not earned.

Most, nearly 80%, of all incoming first-time, first-year students who enroll in community colleges state an intent on transferring to a four-year institution (Baker, 2016; Doyle, 2009; Shapiro et al, 2015). Yet, only approximately 30% of all students complete the transfer process and, while the number completing that step has been increasing, only between 40% and 60% of transfers go on to obtain the degree (Baker, 2016; Jenkins & Fink, 2015; Shapiro et al., 2014; Shapiro et al., 2015). Students who start at community colleges are 14.5% less likely to obtain bachelor's degrees according to one study using data from Ohio (Bettinger, 2015). Another study, using the National Education Longitudinal Study from 1988-2000, puts the probability of attaining a bachelor's degree at 21-33% less when starting at a community college (Alfonso, 2006). Disaggregating these students even further, found only 12% of first-time, first-generation freshman will persist to their third year of college (Ampaw et al., 2015). Community college students also face significant challenges in maintaining enrollment and completing degree requirements due to the likelihood that they are working full-time and have family responsibilities (Adelman, 1999a; Goldrick-Rab & Pfeffer, 2009).

Additionally, community college students tend to be older and have more children (Calcagno, Crosta, Bailey, Thomas, & Jenkins, 2007). Full-time work and having children could impact the number of credit hours one can take, which can lead to a longer trajectory toward completion. The longer it takes students to complete classes and the fewer classes one takes each term are both negatively associated with completion rates (Calcagno et al., 2007; Doyle, 2009;

Kopko & Crosta, 2016). Transfer students may also carry only a fraction of the credits earned at their starting institution with them when they transfer (Smith, 2015). Credit loss can hinder transfer completion rates and further reduce the likelihood of completion (Alfonso, 2006; Doyle, 2009).

Full-time and continuous enrollment are among some of the strongest predictors of community college student success (Wang, 2012). Conversely, first generation, low socioeconomic status, and underrepresented racial and ethnic students are less likely to transfer or complete their degree. First-generation, low-income students are also likely to under-invest in their education due to high sticker prices (J. R. Abel & Deitz, 2014; Bettinger, 2015; Bettinger, 2004; N. W. Hillman, 2016) or a lack of understanding about financial aid (Bettinger, Long, Oreopoulos, & Sanbonmatsu, 2012). Community college students may also face structural issues in transferring and completing a baccalaureate program.

Academic preparedness at the high school level may have a role in decreasing students' ability to place into college-level classes. Students who place into remedial or developmental education courses upon entry into community college may end up spending the same amount of time at the college but have fewer credits (Scott-Clayton, 2011). This may divert students from degree programs or transfer opportunities. Students starting at a community college who take similar amounts of credits as those at four-year institutions have comparable success rates. However, even students who stay on track may be stymied by the transfer process due to credit loss. One study shows that only 58% of students who transferred carried all of their credits with them upon transferring (Monaghan & Attewell, 2015). Overall, students from community colleges take fewer credits, resulting in divergent paths toward degree completion.

There are also issues of student and college locations, community college funding, and faculty to student ratios that serve as a detriment to baccalaureate attainment for those who start at community colleges. Students from rural backgrounds may not have the luxury of having any postsecondary education resources near their home (Hillman, 2016). These same students may not have access to high-speed internet to apply for college or study for required college admission tests (Dettling, Goodman, & Smith, 2015). At the same time, it appears taking online courses may have an additional negative impact on student persistence and attainment (Huntington-Klein, Cowan, & Goldhaber, 2017).

Community college funding models have also been repeatedly studied. Increases in student spending have shown to increase the probability of upward transfer (Gross & Goldhaber, 2009). Here again, expenditures on faculty do seem to matter. Part-time faculty is associated with a decrease in the probability of transfer (Eagan Jr. & Jaeger, 2009; Gross & Berry, 2016) due to less interaction time with students, as well as less time to prepare for class (Umbach, 2006). Increased Faculty interaction is shown to help increase student grade point average and course completion (Umbach, 2006). Other factors of institutional commitment, such as intrusive advising, where advisors reach out to students instead of students reaching out to advisors, can help students maintain credits and increase retention rates (Donaldson, P., McKinney, L., Lee, M., & Pino, D., 2016; Smith, J. S., 2007). Volumes (see How College Affects Students) have been written on the environmental, academic, and social influences which contribute to the degree completion of students who begin at community colleges (Mayhew, M. J., Rockenbach, A. N., Bowman, N. A., Seifert, T. A. D., Wolniak, G. C., Pascarella, E. T., Terenzini, P. T., 2016).

In short, while a myriad of struggles exists for community college students who wish to transfer, community colleges remain a low-cost option for students, and an instrumental workforce development tool for local economies. The ability for students to transfer between two-year and four-year institutions is and has been a vital linkage to increasing post-secondary outcomes.

Theory of Change

There is open debate on whether policies which seek to encourage students to attend community colleges prior to transferring help or hurt disadvantaged students, especially considering the challenges students have in transferring between two-year and four-year institutions (Dougherty & Kienzl, 2006; Dougherty, 1994; Rouse, 1995). The debate centers around whether policies governing the flow of students between two-year and four-year institutions have a democratizing or diverting effect on student behavior (Dougherty & Kienzl, 2006; Dougherty, 1994; Rouse, 1995). While articulation agreement policies may seek to make transferring between institutions easier, they may inadvertently move low-income students to two-year colleges where they have fewer opportunities to transfer and complete (Dougherty & Kienzl, 2006 Dougherty, 1994; Rouse, 1995). Thereby, diverting students from four-year institutions.

A democratizing policy is a policy that allows social mobility to occur (Gross & Berry, 2016). Democratizing refers to mobility: that students will have the ability to achieve higher incomes or obtain economic stability which otherwise would not be available to them (Goldhaber et al., 2008; Gross & Berry, 2016). Relating this to community colleges, is the idea that community colleges enhance educational opportunities. This can be seen in students' ability to learn skills, transfer to new institutions, and obtain a degree in a low cost, but high value

manner (Leigh & Gill, 2003; Rouse, 1995). Democratizing policies that help students transfer and complete their higher education journey can serve a distinct function in helping underrepresented students achieve more economic opportunities (Leigh & Gill, 2003; Rouse, 1995) regardless of whether they stay or transfer.

Once in a two-year or four-year institution, a clear pathway toward degree completion can provide the information necessary to help students complete their education (Goldhaber et al., 2008). Students may continue their education either by transferring between institutions multiple times or by transferring from a two-year to a four-year. Policies can also encourage students who start at two-year colleges to complete an associate degree prior to transferring to a four-year institution. Transferring after completing a two-year degree provides students with a credential should they not attain a four-year degree. The opportunities to take credits that can pass between institutions can also reduce the time it takes to complete a degree program by eliminating wasted credits (Umbach, Tuchmayer, Clayton, Smith, 2018; Falconetti, 2009). The ability to ensure students leave college with a degree, while reducing the time to achieve a four-year degree increase the odds of successful student outcomes.

Arguments also exist that community colleges are not democratizing. These scholars claim that policies pushing students to begin at community colleges draw qualified individuals away from opportunities which would promote social mobility (Dougherty, 1994; Rouse, 1995). In this manner policies are diverting qualified students away from four-year institutions, placing those students into environments where they would be less likely to transfer and complete. These policies, such as articulation agreements, would serve as a diversionary policy.

Theories about the potential effects of articulation agreements are the foundation for some of the research questions addressed in this dissertation. A post-policy drop in enrollment at

four-year institutions and subsequent increase in two-year enrollment, holding all else equal, could provide evidence that articulation agreements are diverting students away from four-year institutions. The opposite could also be true. An increase in four-year enrollment, with a subsequent decrease in two-year enrollment could provide evidence of a democratizing effect of articulation agreements. No change in four-year enrollment and an increase in two-year enrollment provides evidence that articulation agreements could be encouraging new students to enter college, further highlighting the democratizing nature of articulation agreements.

One possible result may be that articulation agreements do not have an impact on overall enrollment, but instead only factor into the number of graduates. Increases to baccalaureate degrees only serve as evidence that articulation agreements do not provide additional pathways for more individuals to transfer. In this case articulation agreements simply serve to provide guidelines which allow those already intent on transferring to transfer between institutions without penalty and eventually graduate (Roksa, 2009). This study could provide evidence that articulation agreements help increase the number of graduates at four-year and two-year institutions, thereby providing additional opportunities for any student, regardless of the student transferring. Increasing graduation rates across two-year and four-year institutions could provide evidence that articulation agreements have a democratizing effect by encouraging more students to complete than otherwise would have.

Based on previous studies, this research would expect that articulation agreements may not shift enrollment trends at four-year institutions but may encourage more students to start at two-year institutions. Baker (2016) and Stern (2016) provide evidence that articulation agreements may encourage more students to graduate at four-year and two-year colleges. However, these studies provide incomplete information on the overall effect adopting statewide

articulation agreements have on enrollment and graduation trends. This study could provide evidence that statewide articulation agreements have a democratizing effect by encouraging more students to enroll and receive degrees than otherwise would have without the policy. Such a result would demonstrate the democratizing nature of articulation agreements which is aligned with the spirit originally intended by the creation of community colleges.

The Growth of the Community College and Articulation Agreements

When Joliet Junior College, the first public community college in the US, was established in 1901, its very existence mirrored that of a university (Kintzer, 1996; Stern, 2016; Townsend, 2000). William Rainey Harper, as president of the University of Chicago, divided the University into upper- and lower-level courses. Harper partnered with a high school principal in Joliet, Illinois with the intention of creating a junior college. The college, Joliet Junior College, allowed students to attend university courses without having to leave their communities (Stern, 2016). In 1907, this idea extended to California when the University of California-Berkeley created a program where students could take up to two years of university courses in high school (Kintzer, 1996; Mosholder & Zirkle, 2007). By 1921, the state of California codified the policy into law as the first legislated articulation agreement (Kintzer, 1996; Mosholder & Zirkle, 2007).

The role of community colleges expanded with the establishment of national organizations, research, and individuals' increased desire to attend college (Kintzer, 1996). Driven by financial aid programs such as the GI Bill, community colleges began to serve varying purposes. Economic strain, as well as state and federal involvement drove increases in enrollment and growth of vocational programs intended to increase local employment. The number of community colleges operating nearly doubled between the mid-1960s and the mid-1970s. In the mid-1960s, there were 719 community or junior colleges which increased to 1,233

by 1977 (Mosholder & Zirkle, 2007). Along with the growth of community colleges came an increase in articulation agreements legislated by various states (Kintzer & Wattenbarger, 1985; Kintzer, 1996). What William Harper Rainey saw as the need to create local areas of high quality of education which could serve as the equivalent of the first two-years of college was now fully realized in articulation agreements.

Early Research on transfer students, which grew with the enactment of articulation agreements, found that students who started at community colleges and transferred to four-year universities had similar outcomes as students who initially started at those universities (Koos, 1924; Bird, 1956). Further, Bird (1956) found that many of the students starting at community colleges would not have been able to start at four-year universities (Mosholder & Zirkle, 2007). Bird's finding prompted him to push for the continued development of community colleges as access institutions. Harper-Rainey's vision of providing education to those who could not travel to it, begin to take a life of its own in the form of community colleges.

Research interest in transfer students declined between the 1960s and the mid-1980s (Dougherty & Kienzl, 2006). During this time, studies with a sole focus on the state's role in policy creation and higher education management began to gain traction (Kintzer, 1996). Research on articulation agreements, coupled with transfer rates, began appearing throughout the 1990s (Dougherty & Kienzl, 2006). This renewed focus, driven in part by the rise of technology, new unified data systems, and relevant ease in reporting data, helped inform newly created state policies revolving around transfer. Articulation agreements and their complexity increased as access to more and more individual level information became available. Between 1985 and 1995, 23 states adopted some sort of articulation agreement policy (Mosholder & Zirkle, 2007). Beyond policy adoption, states enacted policy updates to account for changes in technology

which increased the ability of institutions to report accurate data (Knoell, 1990). One study concluded in part,

> the development of state-level policies and regulations relating to course equivalencies, general education requirements, and recognition of the associate in arts degree for transfer is judged to be laudable, necessary, and effective in simplifying the transfer and articulation processes and in making transfer more equitable for community college students (Knoell, 1990, p. 72).

Differing Perspectives on the Purpose of Articulation Agreements

While Knoell (1990) may have lauded the creation of articulation agreements to create a more equitable transfer system, debate has consistently centered on the purpose of articulation agreements and the student populations community colleges are intended to serve (Gross & Berry, 2016; Gross & Goldhaber, 2009; Roksa, 2009). William Rainey Harper initially intended community colleges to facilitate the transfer of students between lower and upper courses of college (Kintzer, 1996). Through Harper's vision, community colleges would increase the number of students who participated in an upward transfer. Upward transfer refers to students who start at two-year institutions and proceed to transfer to four-year universities. Individuals who did not want to leave their community but desired to complete degrees could more easily start at community colleges prior to transferring (Mosholder & Zirkle, 2007; Townsend, 2000). As time went on, community colleges became comprehensive, meaning they served a variety of functions for a variety of people (Kintzer & Wattenbarger, 1985; Knoell, 1990; Townsend, 2000).

By becoming comprehensive two-year institutions, the mission of community colleges began to change, as did the demographics and services provided (Knoell, 1990; Townsend,

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2000). Researchers observed that community colleges had more low-income students, immigrants, older students, and students who were less academically prepared (Adelman, 1999b; Dougherty & Kienzl, 2006). By the mid-1980s and early 1990s, community colleges began to suffer from having so many missions that they seemed destined to fail at all of them (Clowes & Levin, 1989; Dougherty, 1994; Karabel, 1986). Students were no longer using community colleges as a starting place, but for lifelong learning, to transfer from a four-year university, to earn a vocational degree, and for various other reasons (Clowes & Levin, 1989; Lovell, 1971).

Researchers hypothesized that mission "creep" at community colleges threatened to make it difficult for the diverse student populations attending the college to transfer to four-year universities (Bender, 1990; Roksa, 2009). Being embedded in local communities, community college provided a unique and affordable entry point for any student (Doughtery, 1994). However, students starting at community colleges, specifically students of color and low income, faced greater risks of dropping out or never transferring beyond the community college. As budget crunches occurred in the 1980s, concerns about the rising costs of colleges led to policymaking around articulation agreements as a mechanism to encourage upward transfer for students who could not afford to start at four-year universities. Articulation agreements provided a non-monetary solution which could ease the transfer process while reducing costs for students and states. Further, articulation agreements could increase the numbers of transfers and help reduce the enrollment and completion gaps between social classes and racial identities (Clowes & Levin, 1989; Karabel, 1986).

Concerned about the declining transfer rates, Kintzer and Wattenbarger (1985) developed guidelines for articulation agreements to improve the process of upward transfer. Their structure helped lead a push to create wide and structured pathways through community colleges (Roksa,

2009). While these structured pathways became known as articulation agreements, there can be wide variation in what is considered an articulation agreement and what specific components make up such a policy.

Definitions and Policy Variations

For this research, the term articulation agreement is defined by Kintzer and Wattenbarger's (1985) definition of "the generic term referring to the entire range of processes and relationships involved in the systematic movement of students interinstitutionally and intersegmentally throughout postsecondary education" (p. iii). Further, Kintzer and Wattenbarger categorized policies by formal and legal frameworks, state system policies, and voluntary policies between institutions. Accordingly, a state system policy is codified into law or governing policy and is focused on the process of transferring, including ensuring that completed credits at one institution can transfer to other similar institutions governed by the stated policy.

One issue with current articulation agreement studies is that using different policy definitions could yield diverse results. For instance, Education Commission of the States (ECS) expanded Kintzer and Wattenbarger's initial definitions regarding the type of articulation agreements and re-categorized them by new definitions through an analysis of state legislation policies to provide a nuanced lens to look at policies (Roksa, 2009). ECS's broad definition of a statewide policy is congruent with Kintzer and Wattenbarger's statewide policy, holding those policies simply pertain to articulation agreements adopted at the state level. By ECS's definition, 36 states have a statewide policy. Since the two definitions are similar, this study focuses on using the higher-level standards for what constitutes a statewide articulation agreement. Studies focusing on a more nuanced definition of a policy may run into issues on how the overall component is managed by different states and are left out of this analysis.

The variation between definitions and datasets is further complicated by differences in the object of study. Throughout the past two decades, several studies have researched the effects of starting at community colleges (Alfonso, 2006; Doyle, 2009; Melguizo, Kienzl, & Alfonso, 2011), the effects of transferring on degree attainment (Alfonso, 2006; Ampaw, Partlo, Hullender, & Wagner, 2015; Dougherty & Kienzl, 2006; Monaghan & Attewell, 2015), and even when it is best to transfer (Crook, Chellman, & Holod, 2012), or if it is best to receive an associate's degree before transferring (Belfield, 2013b; Ehrenberg & Smith, 2004; Kopko & Crosta, 2016). Many of these studies do not measure the effect of an articulation agreement on the actions of students. There are two main categories in studies that do include articulation agreements: whether articulation agreements affect transfer (Anderson, Sun, & Alfonso, 2006; Goldhaber, Gross, & DeBurgomaster, 2008; B. Gross & Goldhaber, 2009; LaSota & Zumeta, 2016), and the effect of articulation agreements on degree attainment for transfer students (Baker, 2016; Roksa & Keith, 2008; Stern, 2016). Current studies on the effect of transferring and completing may ignore articulation agreements altogether, focus on different elements impacted by articulation agreements, and tend to view articulation policies in the context of the individual student's probability of transferring and graduating. Current research tends to leave alone the impact articulations agreements have at the state level.

State Policy Context

As laid out previously, what is more widely debated, less researched, and not as clearly defined are the effects of state policy on enrollment trends and completion. States tend to adopt similar policies to other states (Hillman, Tandberg, & Sponsler, 2015, p. 12). Researchers refer to this process as "policy diffusion". State lawmakers face a limit in the amount of time,

information, and choices they can process in a single legislative session, so they follow what other states have already passed (McLendon, Heller, Young, 2005).

Lawmakers also pass similar policies to deal with competition between states. Adopting similar policies that are comparable to a neighboring state can prevent other states from having a competitive advantage over one another (McLendon, Heller, Young, 2005). Policies with the potential to boost college graduation present a unique way for states to boost the number of college graduates within their state without competing with other states for that talent, while simultaneously saving legislative time through policy diffusion.

Even though states may adopt policies from other states, the specific components states choose to insert into adopted policies look different. Studies on articulation agreements have highlighted policy variance as a difficulty in analyses, finding that having a policy in place might matter more than the specific components of the policy (LaSota & Zumeta, 2014; LaSota, 2013). Any positive effects of policy specifics, such as having a common course numbering system between two-year and four-year institutions, go away when controlling for state level covariates (LaSota, 2013).

The larger effect of articulation agreements on students transferring may also be a matter of how the policy is studied. Studies using national data-sets without state weighted samples have found that state-level articulation agreements do not have any impact on the probability of students to transfer to four-year institutions (Roksa & Keith, 2008; Stern, 2016). However, looking specifically at state-level data Baker (2016) provides evidence that a change in state policy encouraging transfer degrees boosted transfer degree attainment. Baker (2016) found the effect of the policy lagged by as much as two years, and by the third year, transfer degree programs had become more popular. Few other previous studies provide more historical support

of Baker's (2016) work, finding states with articulation agreements show an increase in the transfer rates of community college students to four-year institutions (Higgins & Katsinas, 1999).

The probability of upward transfer is only one part of the equation. Stern (2016) uses Beginning Postsecondary Study 1996-2000 and IPEDS institutional-level data to research the effect of articulation agreements on the probability of students to transfer and graduate post-transfer. Like Roksa & Keith (2008), Stern (2016) did not find that articulation agreements impacted the probability of students to transfer. However, Stern (2016) found an increase in the probability of students graduating after upward transfer in states with articulation agreements.

Considering states rely on creating similar policies and that specific policy components do not seem to be impactful (Hillman, Tandberg, & Sponsler, 2015; LaSota & Zumeta, 2016), the act of having or not having a policy may play a larger role than the specific policy components. Aside from policy components, it may matter on who is directing the policy, whether that be the state legislature, the board of governors, the system, or simply institutional agreements. Further, it may be simply having a clearly defined policy with the purpose of creating and legally mandated pathway between public institutions may improve desired student outcomes. The latter option is supported by theory.

Human Capital Theory and Structured Pathways

The concern of declining transfer rates and recommendation for policies to make it easier for students to transfer and successfully complete their degrees is aimed at encouraging students to finish college. Creating a policy to encourage upward transfer and degree completion needed to be easy enough for students to understand, as well as affordable enough for tax payers to support, while providing enough incentives for students to do. Human capital theory provides an

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underlying theory as to why using a statewide policy for articulation agreements could, in this case, lead to beneficial outcomes (Bender, 1990; Clowes & Levin, 1989).

Bender (1990) argued for greater involvement by state policymakers to provide avenues for students to move forward in their college careers. Greater involvement at the state level would provide greater structure and allow for a more seamless transfer between institutions. The argument follows that the creation of standardized structured pathways across universities and community colleges could allow students to make better decisions on how to spend their time and money (Baker, 2016; Scott-Clayton, 2011). Better pathways would make higher education a more attractive option when compared to other opportunities which lie outside education. The logic policymakers responsible for articulation agreements use is supported by economic principles, mainly, human capital theory.

Human capital theory views students as rational decision makers (Desjardins & Toutkoushian, 2006). DesJardins and Toutkoushian (2006) explain that in a human capital model, students make a cost-benefit analysis in education decisions and choose where to attend based on the greatest potential benefit at the lowest potential cost. Students revisit this investment over time. For instance, every year students must make decisions on whether to continue their education (thereby increasing their investment in education) or stop (thereby reducing their investment in education) (Chen, 2008; Desjardins & Toutkoushian, 2006; Goldrick-Rab, Harris, & Trostel, 2009).

It is important to remember that cost is not always monetary (DesJardins & Toutkoushian, 2006; Chen, 2008). Costs could be time spent doing other things or the foregone opportunities to do something other than education. If transfer pathways are not clear and efficient, then students may decide the cost of learning the pathway may not be worth the

investment. In other words, students may find other avenues, such as full-time work, more advantageous than transferring. Students may also find that confusing pathways incur additional costs due to increasing the time it takes to transfer between institutions. As costs increase, students will demand less, unless the students view the investment is worth the cost of time, energy, lost wages, and the actual price of education.

The concept of creating enough choices to allow students self-determination in making choices, but not being overwhelmed, is supported by earlier research in behavioral economics. Behavioral economic research hold that students do not behave as fully rational individuals (Scott-Clayton, 2011). Instead, students have bounded rationality (Baker, 2016). Bounded rationality points out that people make rational choices based on the limited amount of information guiding a decision that an individual can hold at one time (Bender, 1990). Individual decisions are based on a rational choice using the information at hand. It is important to note that a rational choice does not mean an individual will make a choice that makes sense to other individuals, it means they will make decisions based on their own rationale (Paulson, 2000).

The key in any policy decision is to help provide information by which individuals can make rational choices based on as much information as possible. This means creating a balance between streamlined processes and limited choices which do not overwhelm individuals, but also gives ample freedom for individuals to choose a pathway best suited to their needs. Applying the idea of rational choice to transfer policy means that an articulation agreement should provide a clear, efficient pathway to transfer and obtain a degree (Baker, 2016; Scott-Clayton, 2011). However, little research has been conducted on whether articulation agreements have met the promise placed on them by policymakers.

Conclusion

Historically, community colleges have provided a pathway to help students who otherwise would be unable to attend four-year institutions start their post-secondary journey (Kintzer, 1996; Mosholder & Zirkle, 2007). The colleges present opportunities for students to attend college at a lower-cost (Epple et al, 2017; Page & Scott-Clayton, 2016). Students who graduate with associate degrees from community colleges see significant wage increases and returns on their degrees compared to non-degree earners (Kreisman, Jacob, & Dynarski, 2017). Similarly, students who start at community colleges and go on to complete bachelor's degrees see no discernable difference in salaries post-graduation compared to those who never transferred (Ampaw et al., 2015; Belfield & Bailey, 2017; Liu & Belfield, 2014). While starting at community colleges provides many benefits, they also present unique challenges which can prohibit students from transferring and completing their education.

In part these difficulties were due to the growth of community colleges. The proximity of community colleges to local communities, and flexibility of community colleges to meet local economic needs led to an increased focus on vocational and workforce development. As community colleges grew, and their use changed, the process of transferring became more convoluted and complicated. The complications in the transferring process led institutions and states to create more systemic guidelines, known as articulation agreements, to better facilitate the movement of students between institutions.

Articulation agreements may not increase transfer rates because that is not their intention (Roksa, 2009). Instead statewide articulation agreements seek to increase the number of students who enter higher education and exit higher education with a degree (Anderson et al, 2006; Roksa, 2009). Specifically, articulation agreements may serve to address the state's need to

increase the number of individuals with degrees necessary to meet the state's workforce demands (Bender, 1990; Doughtery, 1994; Mosholder & Zirkle, 2007; Roksa, 2009). By increasing the human capital available in the state, states may be enacting democratizing policies that encourage more students to enter at lower cost institutions and then transfer to four-year universities post two-year degree completion.

At the same time, articulation agreements may provide clearer pathways within which students can make more well-informed educational choices, thereby improving outcomes for more students (Baker, 2016; Bender, 1990; Scott-Clayton, 2011). Creating a system which allows for more well-informed educational choices, with the potential of reducing the overall cost of education may also help shrink attainment gaps between students with economic advantages and those without. In increasing the number of individuals who graduate with associate or baccalaureate degrees, articulation agreements may help those who would stand to benefit the most from college completion.

Studying the effect of adopting a statewide articulation agreement policy has on the enrollment and graduation trends within the adopting states provides insight to the effectiveness of the policy. Comparing adopting states to non-adopting states during similar time periods allows researchers to see if articulation agreements are indeed democratizing higher education. Few studies examine whether the adoption of a statewide articulation agreement policy increases the number of students who enroll and graduate beyond expected trends. Most research on articulation agreements only involves upward transfer (Roksa & Keith, 2008; Stern, 2016). Several studies stop at whether or not students transfer (Anderson et al., 2006; Goldhaber et al., 2008; Gross & Goldhaber, 2009; LaSota & Zumeta, 2016). Few studies view articulation agreements as an impact on the entire public college eco-system and seek to measure how the

policy may influence enrollment and degree attainment across the state. Only Baker (2016) looks

at the effect of policy change on the degree patterns of students. There are no studies which

measure the effects of articulation agreements on state-level community college enrollment,

associate degree attainment, and bachelor's degree achievement. This study seeks to fill the gap

in research on articulation agreements by measuring if the adoption of a statewide articulation

agreement has an overall impact on each of these outcomes.

CHAPTER 3: METHODS

Measuring the effect of an adopted policy across multiple states means teasing out the trends naturally occurring over time from any new trend resulting from the adoption of a specific policy. This study seeks to determine if articulation agreements increased the number of students who enrolled and graduated one, two, and three-years post-policy adoption. Ideally this question would be addressed with a randomized research design. This would allow the policy adoption to be exogenous (Zhang, 2010). The term exogenous is a way of saying any changes in the variable of interest, enrollment and attainment, occur outside of the model or, not because of internal changes in the state. Ensuring changes occur exogenously allows researchers to isolate and measure the effect of a specific policy on each state throughout the nation. In lieu of the ideal scenario, researchers must evaluate the effects of state-level policy using quasi-experimental approaches. One method that is commonly used for state-level analyses is a Difference-in-Difference (DiD) approach.

Issues in Measurement of Policy Adoption

A DiD model can help contend with issues of heterogeneity at the state level and control for a variety of disparate policies enacted during a study's timeframe. Heterogeneity refers to the reality that any state has a confluence of social, demographic, and economic factors influencing the movements of students within and between higher education institutions. The confluence of variables interplaying with each other subsequently impact community college enrollment and degree attainment within the state. Each state regularly adopts additional policies that may affect these outcomes of interest. Without proper modeling and controls, the implementation of multiple policies obfuscates the effect of any one policy on a single outcome.

For non-federal policies, states self-select into policy adoption. Self-selecting into a mandatory articulation agreement may have different populations supporting such legislation. For instance, states adopting articulation agreements may have populations with higher incomes and pay higher taxes which could already influence the proportion of students enrolling and completing higher education. In short, the differences between adopting and non-adopting states could influence the success of policies leading to bias results. These results could limit the understanding of any findings.

Restatement of the Research Questions

Using a DiD regression method allows this study to address limitations of policy related research to find whether the adoption of a policy leads to specific outcomes. This study seeks to answer:

1. Is there an increase in enrollment at either two-year or four-year institutions after the enactment of statewide articulation agreements? Is there evidence of an increase in enrollment for federal financial aid recipients post policy adoption at either two-year or four-year institutions?

2. To what extent do statewide articulation agreements affect bachelor's degree attainment? To what extent do statewide articulation agreements affect associate degree attainment?

Addressing Issues of Measuring Policy Adoption

Specifically, the DiD model can control for heterogeneity and selection bias by including additional state-level controls. Variables such as employment levels, the gross per capita product of a state, and migration into and out of the state can help control for variance due to self-selection into an articulation agreement. A DiD model also helps to provide guidelines to ensure

that adopting and non-adopting states behave similarly prior to policy adoption, in order to prevent selection bias. To differentiate between states which have adopted a policy, or treated states, are coded as "1". States with no statewide mandatory policy related to articulation agreements, or comparison states, are identified as "0". The states that have already created a policy prior to this study are not included. The aggregate number of students enrolling at community colleges, as well as attaining bachelor's and associate degrees, are the dependent measures of interest.

Using the definition of a statewide articulation policy as guided by Kintzer and Wattenbarger (1985), only states with specific statutes laid out by the state legislature or higher education governing body, in the state directing the establishment of articulation agreements between all public institutions within that state, are included in this study. Statewide articulation agreement policies are dummy coded. Only measuring whether a state has or has not accepted a policy leaves out the measurement of policy nuances. LaSota & Zumeta (2016) find that policy differences had little effect on the overall impact of policies. This study focuses on whether the act of implementing an overall statewide policy has an effect, as opposed to whether specific components of the policy impact students.

Description of The Method

DiD is a common method to measure the effect of policy change on the populations (Athey & Imbeds, 2017). It is a quasi-experimental approach, useful for identifying policy impacts by examining outcomes post-policy. For instance, Dynarski (2003) uses a DiD approach to study the impact of Congress eliminating a social security benefit which paid for students' tuition if their father had passed away. Dynarski's (2003) work demonstrates how measuring the trend pre- and post-policy change can help estimate the impact of the change.

DiD allows researchers to measure the effects of a policy through a simple pre- and post-measurement (Dynarski, 2003; Angrist & Pischke, 2009). Since this study uses state-level policy, the DiD explanation will only focus on states, although DiD can be used to study other unrelated data. DiD needs four points in time: two time points for each state in the study and treated as well as untreated cases (Angrist & Pischke, 2009; Angrist & Pischke, 2015). To conduct a rudimentary DiD, one needs data prior to the policy and post policy for the two states. One entity changes policy, while the other does not. Using four time points, the model differentiates the trend of the adopting state with what would have happened had the state not adopted. Taking post-policy for state one minus pre-policy for state one (our treatment group) and subtracting it from the result of post-policy for state two minus pre-policy in state two, provides a straightforward difference in the two states pre- and post-policy. The resulting difference can be interpreted as the impact of the policy. This basic form of DiD is demonstrated visually in Figure 3 and mathematically in Equation 1. For Equation 1, let *S*=State, with *Pre* being pre-policy for *S* state, and *Post* being post-policy for *S* state.

Equation 1.

$$\delta_{Dif} = \left(\gamma_{S1,Post} - \gamma_{S1,Pre}\right) - \left(\gamma_{S2,Post} - \gamma_{S2,Pre}\right)$$

Figure 4 demonstrates how the slopes of the lines for those in the treatment and comparison group differ over the same time-period. The dotted line represents the trend the treatment group would have followed had the states not adopted articulation agreements. The difference between the trend the state would have followed and the actual outcome, or the trend the state did follow, represents the effect of policy adoption.

Figure 4.

Visual representation of a simple DiD model
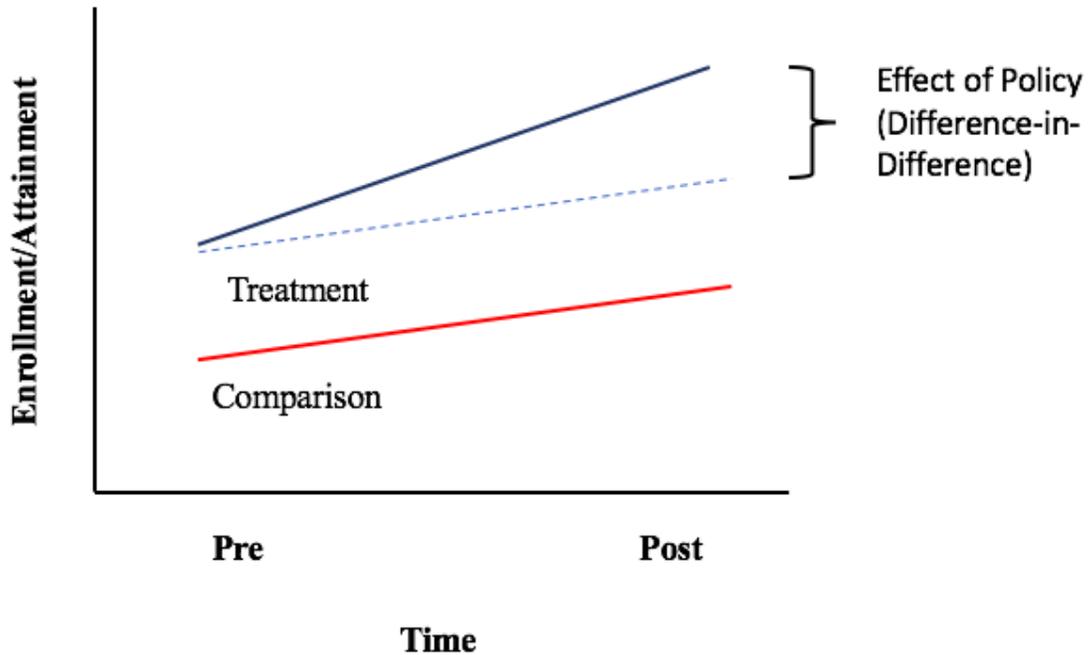
A basic DiD allows this study to take each state's overall community college enrollment, as well as associate and bachelor's degree attainment populations, post-adoption of an articulation policy and subtract it from the state's overall community college enrollment, associate and bachelor's degree attainment prior to the policy. The subtraction pre- and post-policy occurs while also accounting for the trends between the time points. In the same manner, the difference is estimated between overall enrollment and attainment at the same time points in another state without an articulation agreement policy. This allows us to see how the trend changes over time pre and post policy change between a state adopting a policy and not adopting a policy. This comparison between treatment and control provide the counterfactual needed to compare the policy impact (Angrist & Pischke, 2009).

Equation 2 presents the scenario of using only two states in the DiD model. As highlighted in Angrist & Pischke (2015), γ_{st} is the number of bachelor's degrees awarded in the state. $TREATMENT_s$ is the state adopting an articulation agreement, and $POST_t$ is the time of policy adoption through the post-study data. $TREATMENT_s \ X \ POST_t$ are the interaction terms identifying the number of states adopting an articulation agreement and the number of years post articulation agreement policy adoption.

Equation 2.

$$\gamma_{st} = \propto \ + \ \beta TREATMENT_s + \ \gamma POST_t + \ \delta_{DID}(TREATMENT_s \ X \ POST_t) + \ \epsilon_{st}$$

It is easy to find several situations where the straightforward function of DiD would not paint an accurate picture of policy change (Angrist & Pischke, 2015). For instance, the result of a DiD could be picking up trends that were already changing between states prior to the policy change. The change may have been implemented at a particular time making it look as though the policy had an impact. To limit the chance of Type 1 error, that is to limit the chance of incorrectly finding a policy impacts a state when it does not, is important to demonstrate the common trends assumption.

The common trends assumption holds that states follow similar trends over time (Angrist & Pischke, 2009; Angrist & Pischke, 2015) and that two states are moving in comparable directions with common measures prior to the policy change. If the assumption holds, the policy change in one state would have pushed that state off the current trend previously demonstrated by both states. In the case of articulation agreements, adoption of state articulation policies could result in a state seeing an increase in student enrollment and graduation above the anticipated trend, while states resisting the adoption of an agreement continue on their trend line.

To establish a common trend, multiple time points for each state adopting or not adopting a policy are included in this study. The dataset for this study includes a total of 16 states (nine

states adopting new policies and seven states not adopting any policy) between 2000-01 (four

years prior to the first policy added) and 2014-15 (four years after the last policy added) for a

total of 15 years. This means the dataset has 240 observations (16 states x 15 years).

By including multiple years of data, thus creating a panel dataset, this model must

address another issue. Panel data provides information on a single unit across dimensions and

time (Woolridge, 2009; Zhang, 2010). This is desirable because it allows researchers to control

for endogenous changes within the state over time, which are not related to policy, but may

influence the outcome (Jaquette, 2013). Absent a national policy implementation, each state

adopted an articulation agreement on an individual timeline. While the states included as

counterfactuals do not ever add a policy, states which have added policies do so at different time

points. Therefore, the DiD model must account for states adopting policies at various periods.

At this point, the DiD model is clearly no longer the summation of two time points for

two states or a straightforward Ordinary Least Squares regression. The DiD model is now a

regression, incorporating time and state-level fixed effects within the state-level panel dataset for

multiple states adopting the policy at different time points. Equation 3 accounts for adding many

states and various time points as a regression model.

Equation 3.

$$\gamma_{st} = \propto\, + \delta_{DID}\, ARTICULATION_{st} + \sum_{k=Virginia}^{Arkansas} \beta_k STATE_{ks} + \, \beta_s time \, + \, \epsilon_{st}$$

The model now controls for fixed effects between states, while leaving time as a

continuous variable. $\delta_{DID}\, ARTICULATION_{st}$ is the covariate representing the state and year of

articulation agreement adoption, as an interaction term. The equation, $\sum_{k=Virginia}^{Arkansas} \beta_k STATE_{ks}$,

is the observation for states included in the analysis. It is important to recognize that k = s, as this is a dummy variable representing when a state has adopted a policy. $\beta_s time$ is the year variable representing the effect of each year on the outcome variable. To adjust for multiple policy adoption year, the time variable is created as a centered variable. Time ranges from one, four-years prior to the policy adoption, and goes to nine, four-years post policy adaption. Five is the centered policy adoption year. Using a centered policy adoption year removes the need to run the model with time fixed effects as all states now have the same policy adoption time point. The β_k and β_s are coefficients representing state fixed effects and time effects. State fixed effects eliminate state effects which do not vary over time, or time-invariant variables. Also, it is possible to add additional controls for variables which may change over time, referred to as time-variant variables.

Controlling for state effects are important, but it does not fully address policy impacts occurring over time. This study uses a lag in the DiD model to allow time for the policy to take effect. The lag for this policy is set at one year, a separate model is then run for two-years post-policy adoption, and a third model is run for a lag of three-years post policy adoption. The lags are included because articulation agreements may impact students relatively quickly or take a while to see effects. For instance, students who are near completion at four-year institutions, but are missing a general education course, may return to a community college to complete a course over the summer and subsequently graduate the following year. A one-year lag incorporates students who are not seeking a two-year degree or are benefiting from the articulation agreement by taking summer courses.

Conversely, policies may take two or three years to see an effect because the communication about the policies may take time to reach all students. Students who start in

community colleges may not know the policy upon starting, but upon learning it may encourage

the student to complete his or her degree to save money and transfer into a four-year university

as a junior. Further, it may encourage students at four-year universities to take credits at two-year

institutions more often, in order to finish more quickly thereby increasing the number of

graduates in the second or third year post policy. In either case, multiple time lags are needed to

measure any trends which may emerge from the data.

With all 16 states incorporated into the model for each of the 9 years, as the time variable

is centered at the policy adoption, and additional controls, the equation now becomes:

Equation 4.

$$\gamma_{st} = \propto + \delta_{DID} \, ARTICULATION_{st-1} + \sum_{k=Virginia}^{Arkansas} \beta_k STATE_{ks} + \beta_s time + \epsilon_{ist}$$

The equation, $\delta_{DID} \, ARTICULATION_{st-1}$, is the covariate representing the interaction term

between post policy adoption and the treated states, lagged by one year (or two or three years

depending on the model). The calculation, $\sum_{k=Virginia}^{Arkansas} \beta_k STATE_{ks}$, shows the states included in

the analysis. The equation, $\beta_s time$, expresses centered policy adoption time, with the fifth year

representing the adoption of a policy. The formula adds X'_{ist} as the vector of state-level control

variables that change over time and between states. Equation 4 can be used to answer the state-

level effect of articulation agreements on community college enrollment, associate degree

attainment, and baccalaureate achievement.

Finally, Angrist and Pischke (2009) point out that additional dimensions on which

policies can vary are helpful in estimating policy effects on specific populations. A sub-question

for this study is whether articulation agreements induced students from lower incomes to enroll

in college. To measure the effect of articulation policies on college enrollment for federal

financial aid recipients, Equation 5 will be estimated. The number of students receiving federal

financial aid in a given year is only included as enrollment data in IPEDS; therefore, only

enrollment data will be included in Equation 5. The model allows for an additional fixed effect

for enrollment students who receive federal financial aid. This provides additional information

on enrollment levels for students from lower socioeconomic backgrounds within a state adopting

an articulation agreement at a specific time. This can help answer research question one by

demonstrating if there is a shift in enrollment among a specific population post policy adoption.

Equation 5.

$$\gamma_{FA\ enrollment,st} =$$

$$\propto\ +\ \delta_{DID}\ ARTICULATION_{st-1} + \sum_{k=Virginia}^{Arkansas} \beta_k STATE_{FA\ enrollment,ks}$$

$$+\ \beta_s time_{FA\ enrollment,jt} + X'_{FA\ enrollment,ist} +\ \epsilon_{FA\ enrollment,ist}$$

The formula, $\delta_{DID}\ ARTICULATION_{st-1}$, is the covariate representing the state and year of

articulation agreement adoption, lagged by one year. Models will be run with a one-, two-, and

three-year time lag, as exemplified in Baker's (2016) DDD work on California's SMART Act.

The equation, $\sum_{k=Virginia}^{Arkansas} \beta_k STATE_{FA\ enrollment,ks}$, shows the states included in the analysis

controlling for enrollment while the calculation, $\beta_s time_{FA\ enrollment,jt}$, describes the year

representing adoption of a policy, but also controlling for enrollment. The formula,

$X'_{FA\ enrollment,ist}$, is the state level vector of control variables over time and between states,

controlling for all other enrollments.

Variable Selection, Data Sample and Collection

Time-varying state-level and institutional-level variables will be used by accessing the Integrated Postsecondary Education Data System (IPEDS). IPEDS is the post-secondary branch of the National Center of Education Statistics (NCES), which is a part of the U.S. Department of Education. IPEDS data are collected annually from higher education institutions receiving financial aid across the country. Additional state-level covariates will be obtained from the Bureau of Labor Statistics (BLS), which provides employment data per state. The Bureau of Economic Analysis (BEA) provides data on the per capita gross state product, which measures overall financial wellbeing of each state. NCES provide total high school enrollment in states per-year to control for migration of soon to be college-aged students in each state. IPEDS data were downloaded at the institution level and then aggregated into a single, state-level dataset. Table 2 provides a list of control variables and the data source where the control variables are obtained.

Using enrollment and graduation data for the years of 2000-01 to 2014-15 allows a minimum of four years before and after the adoption of a statewide articulation agreement policy. The range allows the researcher to measure the effects of an enacted policy for each of the ten states multiple times across multiple variables using the DiD with fixed-effects approach. By using panel data, the analysis provides multiple observations across the state's higher education population, each year. The total sample is 240 observations

Sample

Between 2004 and 2010, the states of Arkansas, Kentucky, Louisiana, Maine, Mississippi, New Jersey, Pennsylvania, Tennessee, and Virginia adopted statewide articulation agreements. New York and Minnesota have system wide policies, but those policies do not cover

all the four-year and two-year institutions. New York and Minnesota are not included in either group because the policies cover large swaths of students, but not all the institutions. However, they cover large enough segments of the public institutions in the state that they fall somewhere between having a statewide policy and having no policy. Therefore, these two states are not included in the analysis. States included in the list of treated states adopted a statewide articulation agreement at varying times between 2004 and 2010. These treated states were directed to institute articulation agreements from various sources. In most cases states were mandated through direct legislation to create articulation agreements. In other states a board overseeing education in the state implemented the polices which cover all public institutions. Two analyses are completed. The first analysis runs all the models with every state with a statewide policy included as a treated state for one, two, and three years' post-policy adoption. A second analysis only includes states with a direct legislated policy for one, two, and three years' post-policy adoption. Using only states with a direct legislated policy eliminates Maine and Mississippi from second analysis.

Since states do not share a single unified adoption date, each state will be compared to other states who adopted articulation agreements between the same years, as well as across states which did not adopt, or have in place, any statewide policy. The policy adoption date is centered, creating a group variable taking the overall trends prior and post treatment. Comparison states are then matched by policy adoption year to treated states to ensure a similar time trends are occurring. Seven states including Connecticut, Delaware, Michigan, Nebraska, New Hampshire, Vermont, and Wisconsin, do not have statewide articulation agreements and will act as comparison states. It is important to consider the comparison group policy adoption dates because there could be effects which occur in comparison states that are not occurring in treated

states (Wing, Simon, Bello-Gomez, 2018). For instance, a state which adopts an articulation agreement in 2009 may experience effects of the recession. Comparing the treated state to a comparison state in 2005 may result in biased trends because the underlying fundamentals occurring in the two states are different. Comparing treated and comparison states during similar times allows for less bias in the trend changes and an increased likelihood that states are experiencing similar national occurrences during the study.

A key feature of this study is creating a comparison and treatment group. While ECS (2017) specifies various components of an articulation agreement, this study uses only a binary variable to identify whether a state belongs in the treatment or comparison group. The comparison group consists states which did not adopt an articulation agreement at any time. The treatment group consists of states which have adopted a general statewide articulation agreement. Specific components of articulation agreements are constantly in flux making research on the impact of a specific component difficult. An articulation agreement policy may be adopted but a state may change or add specific components over time at their discretion. States may also have different policy components further complicating the creation of a counterfactual group. Using a broad definition of articulation agreements allows this research to measure the effect of overall policy adoption within the state.

Description of Control Variables

Additional control variables are used to ensure more precise estimates. With a fixed-effects model, additional control variables need to vary over time and between states. Any time and state invariant controls are controlled for with fixed effects. Control variables also create a quasi-experimental principle that allows dependent variables to be measured and holds all other

variables which could impact the policy equal. Since this study uses state-level aggregates, controls outside of IPEDS are aggregated at the state level.

Including multiple variables that control for similar things, such as median income in a state and proportion of the population with degrees, would make it difficult to measure the direct effects either variable has on attainment or enrollment. Here, control variables measure broad categories related to the cost of higher education placed on students, the overall financial wellbeing in a state, the total migration into and out of the state, and complete unemployment levels in the state. Table 2 provides a list of variables and the data sources of each variable.

Table 2.

Study Variables and Data Sources

Outcome Variables	Data Source	Variable Description
Four-year Enrollment Community College Enrollment	IPEDS	College financial aid cohort in fall term of each year (SFA2000-SFA2015_RV)
Bachelor's Attainment Associate Attainment	IPEDS	College graduation raw number reported at the end of the fiscal year (GR2000_RV-GR2015_RV)
Control Variables	**Data Source**	**Variable Description**
Enrollment Count	IPEDS	Derived from total Fall student count figures (SFA2000-SFA1516_RV)
Cost of Attendance	IPEDS	In-state cost of attendance including tuition and fees (DRVIC2000-DRVIC2015)
Gross State Product per Capita	Bureau of Economic Analysis (BEA)	GSP, Per Capita-Chained 2009
Total High School Enrollment	NCES	Total high school enrollment by state and year (Education Digest Table 203.20)
Unemployment Rate	BLS	Seasonally Adjusted, Monthly U-4 2000-2015

Cost of Attendance. Cost of attendance will be used to control for cost increases in higher education over time, this variable comes from IPEDS and is the overall cost of attendance by year and institution. The variable will be adjusted to 2009 dollars to match the 2009 chained gross state product. The cost of attendance has been shown to influence students' likelihood of attending college (Heller, 1999). For instance, as the cost of college increases, students are more likely not to attend.

Gross State Product, Per Capita. Chained gross state product per capita will be used to measure the overall wealth of the state (LaSota & Zumeta, 2014). It is in chained 2009 dollars. Anderson et al. (2006) found the per capita measure of gross state product to be correlated with states' funding of higher education. Other research has found gross state product to be correlated with the proportion of the states holding bachelor's degrees. To avoid multicollinearity, gross state product will be used instead of the proportion of students in a state with associate and bachelor's degrees. Gross state product also gives a measure of overall wealth in the state, reducing the need to use median household income as an additional control variable.

Unemployment Rate. The monthly unemployment rate has been used as a control for enrollment trends at community colleges during economic downturns and upturns (Kienzl, Wesaw, Kuma, 2011). It is expected that as unemployment increases, college enrollment will increase as well (Heller, 1999). Students may return to college to gain additional qualifications for work, as the labor market demands. When unemployment declines, it is expected that students will join the labor force, as the opportunity cost of attending college increases. For students deciding between college or the work force, the opportunity cost of college means that the prospect of lost wages from forgone work would exceed what the student is willing to give up for the benefits of a college degree. The monthly rate will be used to report August

unemployment numbers in each year, as the unemployment rate in August could most directly impact a student's decision on whether to enroll in college.

        High School Enrollment and College Enrollment Count. Total high school enrollment will be used as a proxy for population growth and migration into the state, as exemplified by Duan-Bennet (2011). High school enrollment, and migration, are important to control for the naturally occurring population of soon to be college aged students within the state. The high school figures control for sudden increases in enrollment which could be attributable to more students entering college, instead of related to the policy adoption. High school enrollment is only used in models where the outcome variable is enrollment. In models where the outcome is the number of graduates, enrollment count is use. Enrollment count is used to control for the overall size of the current college student population within the state. This variable is chosen for only the models measuring the number of graduates, since it makes sense to use a control to measure the size of the institution when measuring the number of graduates instead of the number of students enrolling.

Description of adjustments to data

        Pulling data from multiple data sources means that the year format of data sets had to be adjusted to reflect an academic year as opposed to a calendar year. Since academic years span two calendar years, all years represent the spring, or graduation year. Terms for most institutions in the data set occur on a semester system. As such the year refers specifically to August of the prior year to May of the next year. For instance, the 2014/2015 academic year is referred to as 2015, and specifically August 2014 through May of 2015. The use of academic year for some metrics in the data and calendar years for other metrics in the data provide some specific challenges that need to be addressed through data manipulation. All variables in the data were

adjusted to reflect the academic year with the spring year stated. One clear example of how the difference between calendar year and academic year required data manipulation can be seen in the August unemployment rate.

The August unemployment rate is technically the beginning unemployment rate for the academic year. August unemployment data is included in the 2015 calendar year, though it pertains to the 2014 year. High school enrollment has also been manipulated to reflect its lagged nature. High school enrollment refers to the prior year's high school enrollment as opposed to the current year's high school enrollment. High school enrollment is lagged to control for the population of students eligible to begin college in the coming years, as opposed to the students currently in high school. In this manner, any variable with an "August" or "Fall" count is technically the calendar year before, but are coded in the data as the spring of the academic year (i.e. any August or Fall 2014 data is included in the 2015 academic year).

Additional edits to the data include ensuring that all any variable dealing with currency or referencing financial controls, such as cost of attendance and median gross domestic product, per capita, are set to reflect 2009 dollars. While the median gross domestic product, per capita is listed in 2009 dollars, cost of attendance needed to be adjusted to reflect inflation. According to NCES, cost of attendance figures reflect the cost of attendance in that year and are not inflation adjusted. Using 2009 measures all data from 2000 to 2015 were recalibrated to reflect what the cost of attendance would have looked like in 2009 dollars.

Descriptive Statistics

Tables 3 - Table 6 describe the variables used in the data set, during the time periods the variables are included. Each state has a total of nine time points used for the descriptive tables. The first-time point is four-years prior to the policy adoption. The middle time point, five, is the

policy adoption year. Time points six-nine represent four-years post policy adoption. If the state is a comparison state, the policy adoption date is used to set a faux post-policy date to which trends in treated states can be compared.

Table 3 and Table 4 provide descriptive information for the mean, standard deviations, minimum and maximum for each variable for the two-year and four-year models, aggregated into treated and comparison states. Tables 3 and 4 highlight that treated and comparison states consist of a mix of large and small states. The differences in the number of states included in the two-year and four-year model are because Delaware has no two-year public institutions with data available in IPEDS. The changes and similarities between the states provide additional evidence for the controls used in the analysis. Appendix B includes the means standard deviations for each state included in the analysis. The tables in Appendix B also include information on the amount of change each state experienced of the course of the analysis.

Table 5 and Table 6 are summary tables for each variable included in the models. The summary tables show the difference in the summary statistic as well as the average for each variable in treated and comparison groups. These tables help show how similar or dissimilar treated and comparison states are. Table 6 expresses these same summary statistics as Table 5 but only includes states with a specific legislative requirement for the creation of an articulation agreement which excludes Maine and Mississippi.

Of specific note from Tables 3-6 are that on average treated states have more students enrolled in high schools but are less wealthy on average. Treated states also have similar unemployment rates compared to comparison states. Although comparison states have a larger rage in unemployment rates than that of treated states. Treated and comparison states have similar average costs of attendance, with the average varying by less than 1000 dollars,

regardless of the model for two-year colleges and between 1000 dollars and 2500 dollars for four-year colleges. Finally, treated and comparison states show vast differences in the number of students enrolling and graduating during the study. Despite differences in the means, the standard deviations between treated and comparison states are similar. The statistical analysis controls for the variety of differences between the treated and comparison states to determine if difference is significant holding all else equal.

Table 3.

Means, standard deviations, minimum and maximums for all variables included for four-year institutions

Variable	n	Mean	SD	Min	Max
Comparison States	63				
Prior Year HS Enrollment		171890	171332	26338	555916
August Unemployment Rate		5.2	1.9	2.2	14.4
May Unemployment Rate		5.5	2.2	3.0	14.2
Gross State Product - Per Capita		51004	10090	36676	71155
Fall In-State Enrollment		11044	11939	1233	38057
Enrollment Count		19445	20264	3881	73109
Federal Grant Aid Enrollment		3674	3998	636	16413
Cost of Attendance		18070	2579	13608	24793
Four-year Graduates		13338	12951	2702	42037
Treatment States	81				
Prior Year HS Enrollment		263863	160282	60579	650986
August Unemployment Rate		6.2	1.9	3.1	10.8
May Unemployment Rate		6.4	2.0	2.9	10.8
Gross State Product - Per Capita		42457	7714	31175	57860
Fall In-State Enrollment		15674	9622	3062	39028
Enrollment Count		25818	15023	4348	63627
Federal Grant Aid Enrollment		6248	3294	1793	16252
Cost of Attendance		19066	3652	13663	27078
Four-year Graduates		19045	11313	3450	46707

Table 4.

Means, standard deviations, minimum and maximums for all variables included for two-year institutions

Variable	n	Mean	SD	Min	Max
Comparison States	54				
Prior Year HS Enrollment		194473	175218	26338	555916
August Unemployment Rate		5.3	2.0	2.2	14.4
May Unemployment Rate		5.6	2.2	3.0	14.2
Gross State Product - Per Capita		48300	8121	36676	70096
Fall In-State Enrollment		2527	1626	153	6483
Enrollment Count		12498	12670	558	52958
Federal Grant Aid Enrollment		2242	1932	61	8890
Cost of Attendance		14940	3722	11049	25672
Two-year Graduates		5658	5106	453	18424
Treatment States	81				
Prior Year HS Enrollment		263863	160282	60579	650986
August Unemployment Rate		6.2	1.9	3.1	10.8
May Unemployment Rate		6.4	2.0	2.9	10.8
Gross State Product - Per Capita		42457	7714	31175	57860
Fall In-State Enrollment		5024	3472	1044	15144
Enrollment Count		22119	13285	1985	50066
Federal Grant Aid Enrollment		6956	4535	796	16755
Cost of Attendance		13900	2007	9783	17737
Two-year Graduates		8132	4999	1035	19786

Table 5.

Variable totals and changes over time using all states

Variable	Summary Metric	Summary - Treated	Summary - Comparison	*Difference in Sum*	Average Change - Treated	Average Change - Comparison	*Difference of Average*
Prior Year HS Enrollment	Total	2374769	1203226	*1171542*	23581	16822	*6760*
August Unemployment Rate	Average	6.2	5.2	*1.0*	4.1	4.2	*-0.2*
May Unemployment Rate	Average	6.4	5.5	*1.0*	4.6	4.3	*0.3*
Gross State Product - Per Capita	Average	42457	51004	*-8547*	3522	5259	*-1737*
Fall In-State Enrollment (4 year)	Total	146413	77308	*69105*	2502	2525	*-23*
Enrollment Count (4-year)	Total	232359	136112	*96247*	10449	6672	*3776*
Federal Grant Aid Enrollment (4 year)	Total	56231	25717	*30513*	2280	1970	*310*
Cost of Attendance (4 year)	Average	19066	18070	*995*	3889	3734	*156*
4 Year Graduates	Total	171404	93366	*78038*	3887	2368	*1519*
Fall In-State Enrollment (2 year)	Total	45213	15163	*30051*	3009	1902	*1107*
Enrollment Count (2 year)	Total	199072	74990	*124082*	13140	8765	*4375*
Federal Grant Aid Enrollment (2 year)	Total	62603	13454	*49149*	4266	1858	*2408*
Cost of Attendance (2 year)	Average	13900	14940	*-1040*	2173	2677	*-504*
2 Year Graduates	Total	73188	33951	*39237*	3564	1930	*1634*

Table 6.

Variable totals and changes over time not including Maine and Mississippi

Variable	Summary Metric	Summary - Treated	Summary - Comparison	*Difference in Sum*	Average Change - Treated	Average Change - Comparison	*Difference of Average*
Prior Year HS Enrollment	Total	2595066	1203226	*1391840*	27713	16822	*10892*
August Unemployment Rate	Average	6.1	5.2	*0.9*	4.2	4.2	*0.0*
May Unemployment Rate	Average	6.4	5.5	*0.9*	4.8	4.3	*0.5*
Gross State Product - Per Capita	Average	46012	51004	*-4992*	3879	5259	*-1380*
Fall In-State Enrollment (4 year)	Total	152400	77308	*75092*	22476	2525	*19951*
Enrollment Count (4-year)	Total	241641	136112	*105530*	112214	6672	*105542*
Federal Grant Aid Enrollment (4 year)	Total	56017	25717	*30300*	22032	1970	*20062*
Cost of Attendance (4 year)	Average	20509	18070	*2439*	3932	3734	*198*
4 Year Graduates	Total	182001	93366	*88635*	38605	2368	*36237*
Fall In-State Enrollment (2 year)	Total	41535	15163	*26373*	22439	1902	*20537*
Enrollment Count (2 year)	Total	208235	74990	*133245*	124262	8765	*115498*
Federal Grant Aid Enrollment (2 year)	Total	60580	13454	*47126*	41041	1858	*39183*
Cost of Attendance (2 year)	Average	14698	14940	*-242*	2104	2677	*-573*
2 Year Graduates	Total	77866	33951	*43915*	33579	1930	*31649*

Limitations

This model identifies the impact articulation agreements have on states adopting the policy in the time frame set forward. National policies which could impact state polices at the same time are not included in this model. The DiD model controls for trends occurring in all states included in the analysis during the time-period to limit the effect of national policies. Statewide articulation policy components may also vary between states. This study does not account for specific components stated by the board or legislation directing the policy. However, LaSota & Zumeta (2016) find only small non-significant effects of various policy elements.

A second and common limitation is due to omitted variable bias (Woolridge, 2009). There may be additional time and state covariates that fluctuate to impact the outcome but are not included as controls. Additional related covariates could cause the estimated impact of an articulation policy to be biased upward. Since data are aggregated at the state level, the model will account for several variables related to income, migration, and unemployment. Using a variety of covariates as additional controls ensures a minimized potential of omitted variable bias. The model itself also limits omitted variable bias, as the model controls for state-level trends which would be impacting college enrollment and attainment.

A third and unavoidable limitation is that this research is designed to measure one specific policy (Daun-Barnett, 2011). Other policy changes influencing baccalaureate attainment in the state may have been enacted. As described above, states enact several policies each year in pursuit of improving higher education. These policies have different timelines, may impact different institutions, and may boost attainment rates among a specific subset of individuals (Jaquette & Curs, 2015). Since this research isolates only one policy, it does not account for the impact of other policies. The estimate will be biased upward if another policy has gone into

effect in a state during a similar time as the articulation agreement policy and is not accounted for by the state-level fixed effects or time fixed effects.

These policies may also affect students in various segments of their journeys. A policy may take over one year to show an impact. For instance, a policy dedicated to boosting baccalaureate rates for high school seniors may take a minimum of four years to see college attainment results. Another policy may be dedicated to improving educational outcomes of junior and senior college students, thereby boosting college attainment in two years. The results from this study may conflate positive results with the results of another policy which is just beginning to yield desired impacts. Including control variables around a variety of state-level and higher-education observables will limit the conflation of policy measurements. Further, time trends will also pick up increases occurring before the policy in question has gone into effect.

Similarly, this study only focuses on public institutions. It does not include private institutions. Students may transfer between public and private establishments, regardless of whether the specific state-level articulation agreement covers the institutions. As such, some students may not be included in attainment measures. It may be that overall attainment as a function of articulation agreements may be underestimated because students may use an articulation policy to gain credits which permit them to transfer into private institutions.

Standard Error and Sample Specific Limitation

Related to omitted variables is the assumption of the composite error term in a fixed-effects model. It is assumed that the error term is unbiased and should not be correlated with any of the explanatory variables. This is not the case in panel data. As with any time series dataset, a regression model will suffer from serial correlation (Angrist & Pischke, 2015) in which each state observation is correlated with a previous state observation. On the face of it, this makes

sense. Since the data are not randomly drawn, a state's previous years' data will be related to its future year data. If the results of this correlation are not properly addressed, then the results of any regression will be biased. As Angrist and Pischke (2015) explain, articulating state "serial correlation is a deviation from randomness, with the important consequence that each new observation in a serially correlated time series contains less information than would be the case if the sample were random." (p. 207).

In time series data, the serial correlation is addressed through clustering standard errors at the state level (or whatever unit of analysis is relevant for that model) (Pustejovsky & Tipton, 2016, Angrist & Pischke, 2009). Clustering at the state level allows for the statistical model to adjust for the non-random design of panel series data. The clustering adjustment provides more precise error terms for the regression. However, a model using a clustered standard error needs a large enough sample size to properly work (Angrist & Pischke, 2015, Angrist & Pischke, 2009, Pustejovsky & Tipton, 2016). A smaller number of states over time, as is the case for this study, reduces the number of clusters available for estimation, and subsequently could bias, or at a minimum, lend to misleading results (Angrist & Pischke, 2009, Pustejovsky & Tipton, 2016).

There is no specific set number of clusters where it is considered "too few" clusters to conduct analysis. Cameron and Douglas (2015) point out that the issue with too few clusters is about how it is better to have more data, as opposed to having too little data. Angrist and Pischke (2009) put the number at 42[1]. The risk is that the standard errors would be too large and therefore lead to an over-rejection of results. Further, Nichols and Shaffer (2007) point out that we could do more damage by over correcting the model. Later, Angrist and Pischke (2009) point

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[1] This is to demonstrate that the estimate is not a hard and fast rule, as the number 42 is considered the answer to the universe in Douglas Adams' *Hitchhikers Guide to the Universe*.

out that aggregation to the group level (in this case the average overall in treated states and non-treated states) may work well if the regressors are fixed within groups and that one shows the inferences are consistent with the group averages overall. To adjust for the smaller sample of 16 states in four-year institutions and 15 states for two-year institutions this model uses STATA's *robust* option. The *robust* option provides the Huber/White sandwich estimator, which helps provide more appropriate standard errors.

Robustness Check

Robustness checks can provide further confirmation that the estimation method produces results which can be trusted. Up to this point, the models have adhered to the common trends assumption. The common trends assumption can be relaxed by introducing a model where each state has its own trends over time. Using a regression, expressed in Equation 6, a state with a significant policy change can show smooth deviations from other states. Treatment states' trends should differ from control states' trends absent of any specific treatment (Angrist & Pischke, 2015).

Equation 6.

$$\gamma_{st} = \alpha + \delta_{DID} \, ARTICULATION_{st} + \sum_{k=Virginia}^{Arkansas} \beta_k STATE_{ks} + \sum_{j=2015}^{2000} \gamma_j YEAR_{jt}$$

$$+ \sum_{k=Virginia}^{Arkansas} \theta_k (STATE_{ks} X \, t) + \epsilon_{st}$$

Further the study uses different policy adoption dates for comparison states to ensure that the model is not picking up time specific changes. The main model sets comparison states policy adoptions at multiple time points similar to the years treated states adopted the policy. The model

is re-estimated comparing to different comparison state dates to ensure trends remain consistent and coefficients remain statistically significant in multiple models.

Summary

Through fitting a DiD model with fixed effects, this study seeks to measure the impact a statewide adoption of articulation has on a) the total baccalaureate and associate degree attainment in states adopting the policy and b) community college enrollment, as well as seeing the specific enrollment of federal financial aid recipients. The primary dependent variables are college enrollment and the number of associate degrees and bachelor's degrees attained. The dependent variables are measured using a one, two, and three-year lag to produce estimates on the policy impact at each time point, post policy.

This study will run three models on community college enrollment, associate degree attainment, and baccalaureate attainment at each time lag. Each model will use the robust command to cluster standard errors at the state level and adjust for a smaller sample size. Data is aggregated to the state level; therefore, only state-level controls are included. Robustness checks will be included to confirm results from the model and model fit.

Chapter 4: Findings

This study examines the effect adopting a statewide articulation agreement on postsecondary enrollment and attainment compared to states that do not adopt similar policies. The study sought to first determine if the adoption of a statewide articulation agreement shifted enrollment patterns in general, and then among a specific subset of federal grant aid recipients over the course of three years. The second question pertains to whether the adoption of an articulation agreement shifted the overall production of graduates in a meaningful manner. A DiD modeling approach is applied to answer both questions.

The study focuses only on public two-year and four-year institutions. The first section of this chapter reviews trends of outcome variables throughout the entire time-series included in the data. The chapter concludes with a section on the results of two models, one with all states included in the sample and a second model including only states where the creation of policies is legislated.

Common Trends Assumption:

The main purpose of the common trends assumption is to ensure that post-policy adoption measures are measuring the changes happening post policy. If the common trends assumption is violated results may be only demonstrating a consistent already established trend as opposed to any real change. However, the fixed effects regression can control for differences between comparison and treated states. This is important because by their nature, comparison states do not have a post-policy time-period. For comparison states, the policy adoption date is a faux policy adoption date. Since the comparison states do not have a policy adoption date it is important to show how the comparison and treated states differ in the dependent variables.

Figures 5 – Figures 10 show the trends for the dependent variables for the years 2001 -
2015. Treated and comparison states are separated by two-year and four-year institutions
creating six figures, two for each of dependent variables: enrollment, enrollment for federal grant
aid recipients, and number of graduates. Each variable for two-year and four-year follow similar
trends throughout the period included in the data. The changing in trends, while mimicking each
other, provide a unique challenge in setting a faux policy adoption for comparison states. As
such, rather than setting a single policy adoption date for all states this study assigns different
policy adoption dates to comparison states. The study then conducts a robustness check using a
single policy adoption date for all comparison states. The comparison group maintains similar
trends, after the sample is centered at the policy adoption date.

Figure 5.

Average Fall In-State Enrollment at 4-year institutions over time
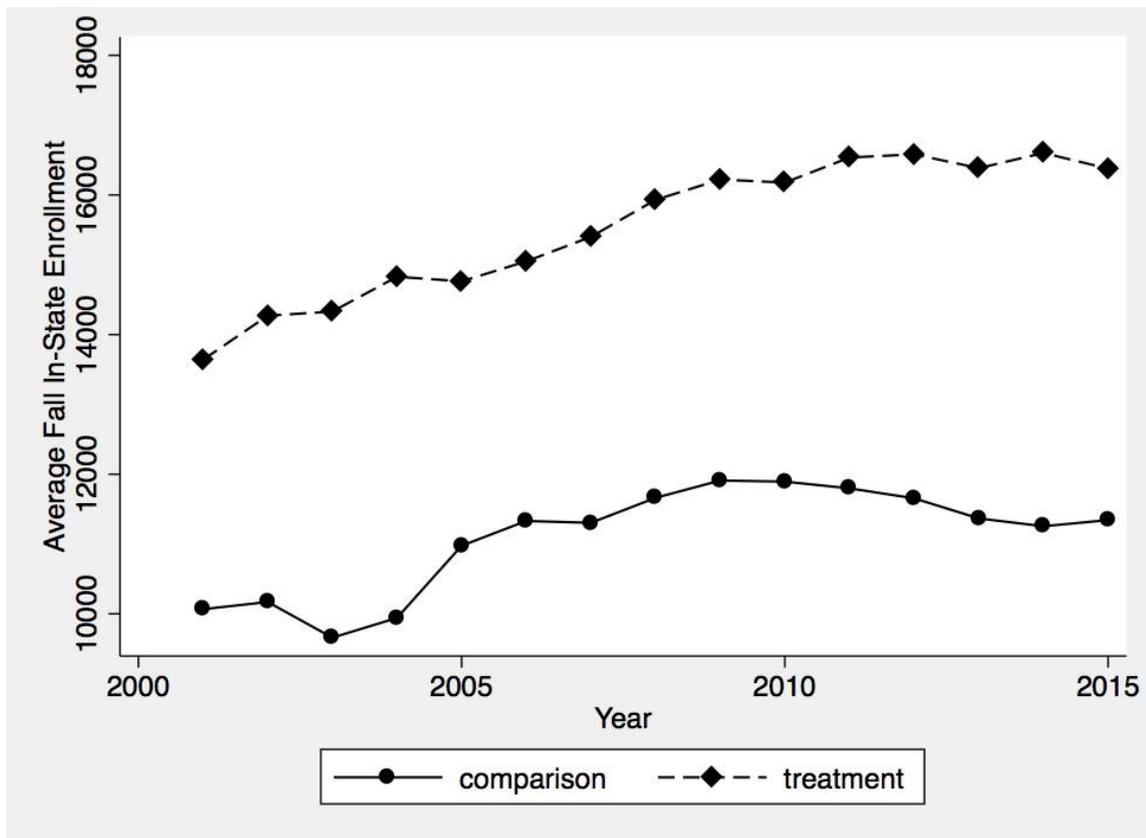
Figure 6.

Average Fall In-State Enrollment at 2-year institutions over time
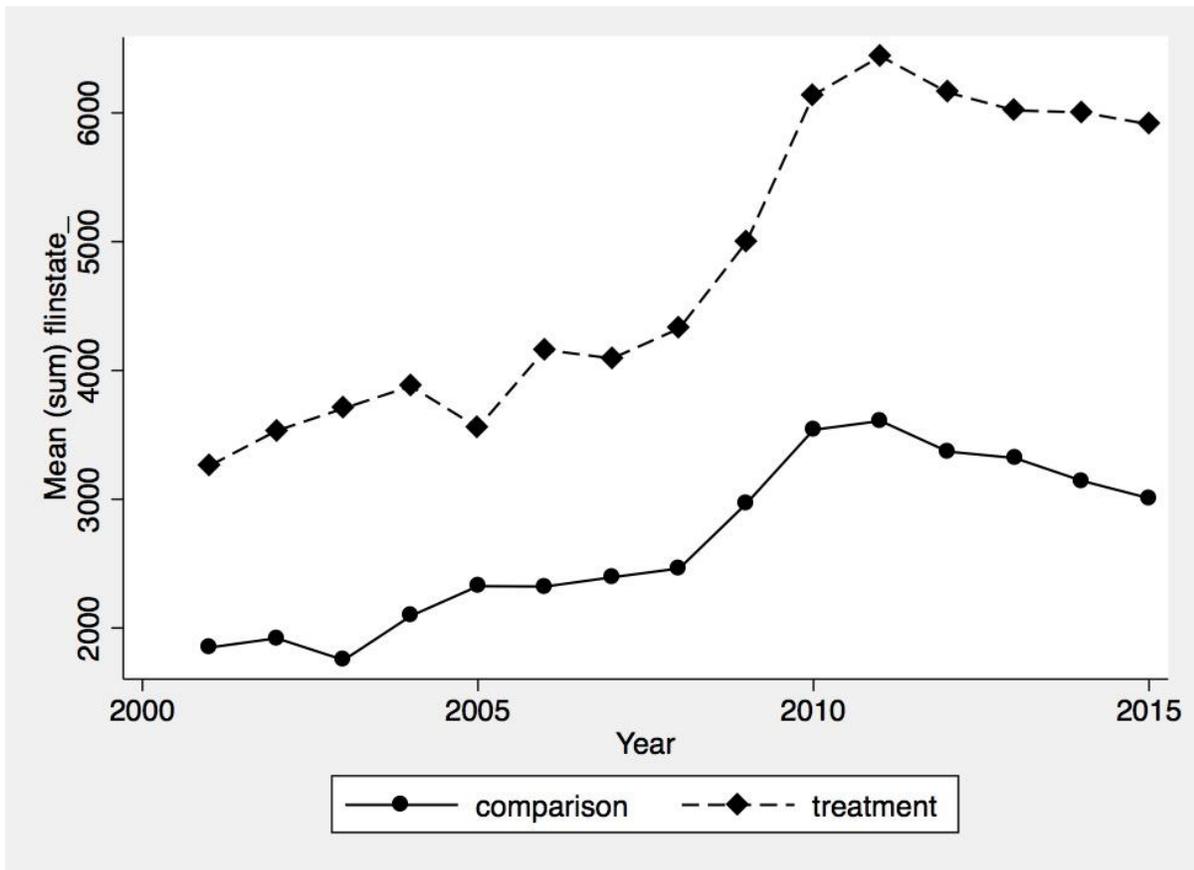
Overall, comparison states and treatment states follow similar trends throughout the time-period included in the study. With a few minor exceptions, the slopes of the lines tend to be a little more extreme for treated states. However, there is no clear difference, apart from a few single individual years, in the enrollment trends for two-year and four-year institutions. The trends lend credence to the hypothesis that the creation of statewide articulation agreements tend not to impact enrollment overall.

Figure 7.

Average Enrollment for Federal Grant Aid Recipients at 4-year institutions
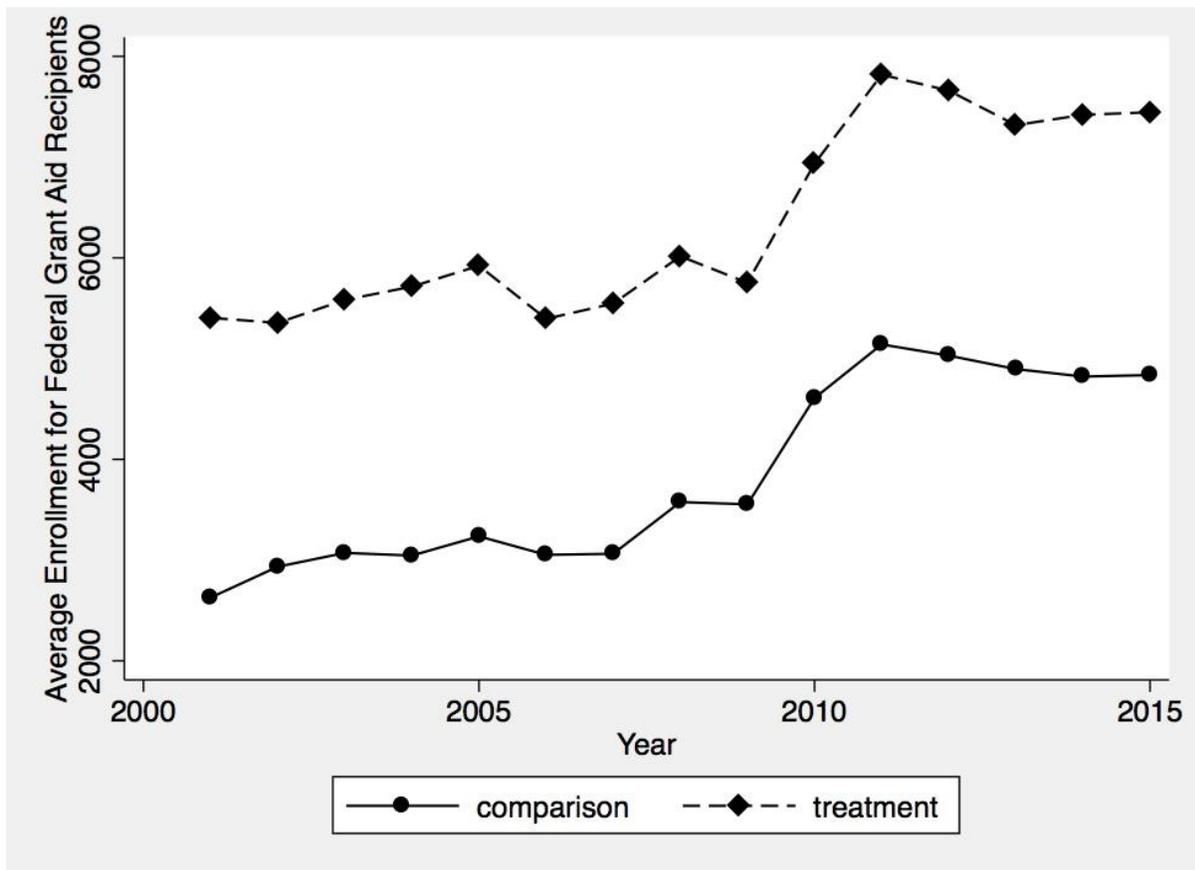
Figure 8.

Average Enrollment for Federal Grant Aid Recipients at 2-year institutions
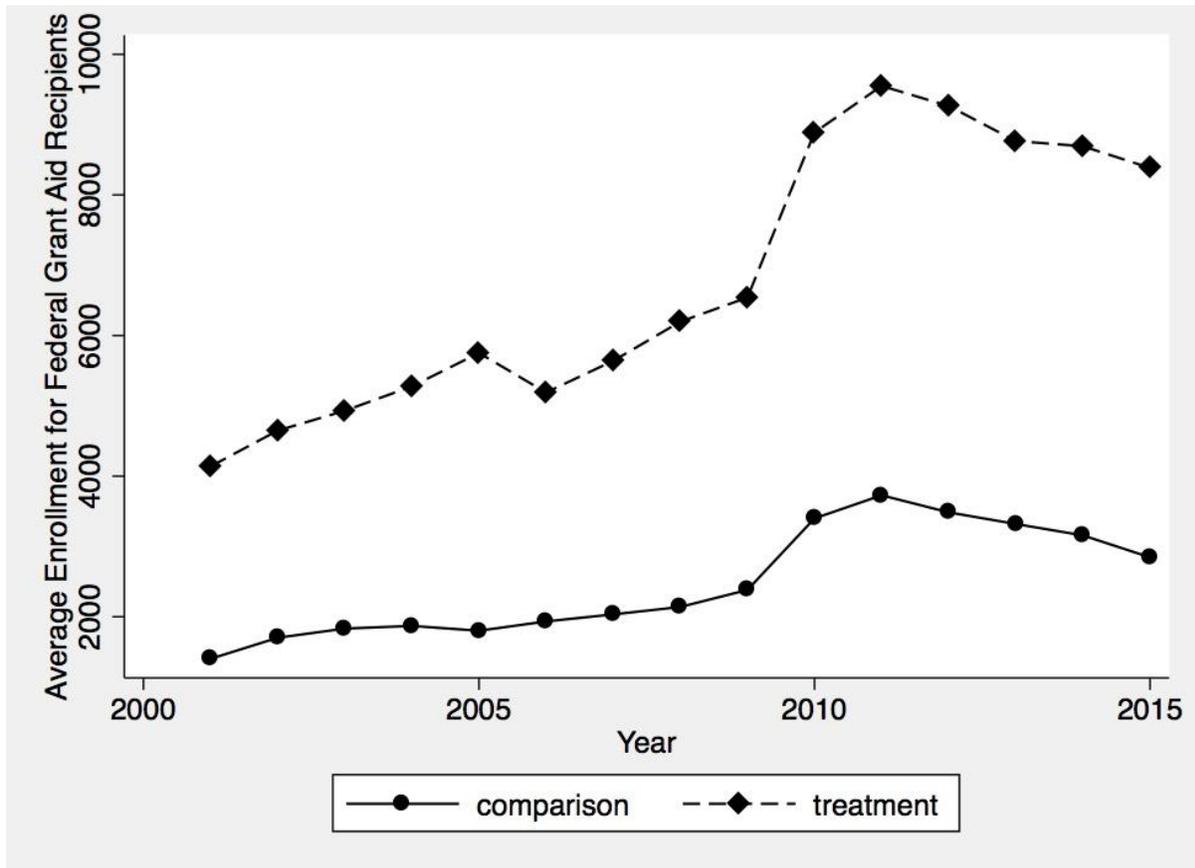
The trends in enrollment for first-time first-year financial grant aid recipients follows similar trends between treated and comparison states. Of note is that the federal financial aid recipients in treatment states experienced a slight decline in 2006, before resuming a slightly increased rate of enrollment. 2009 through 2010 results in a markedly drastic increase in the enrollment of recipients of federal financial grant aid. The resulting increase in enrollment of federal grant aid recipients is likely a direct result of the Great Recession. The rates reach their peak in 2010 and decline in the subsequent years.

Figure 9.

Average number of graduates at 4-year institutions over time
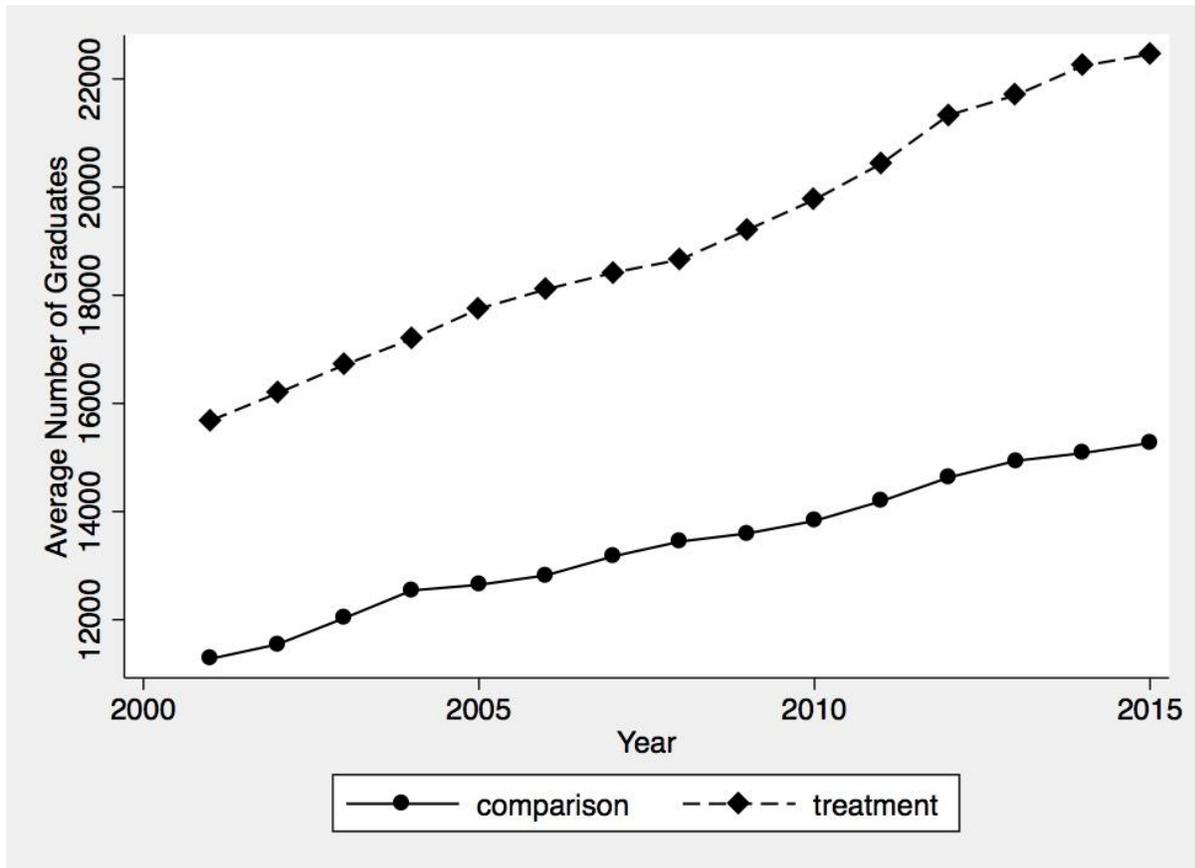
Figure 10.

Average number of graduates at 2-year institutions over time
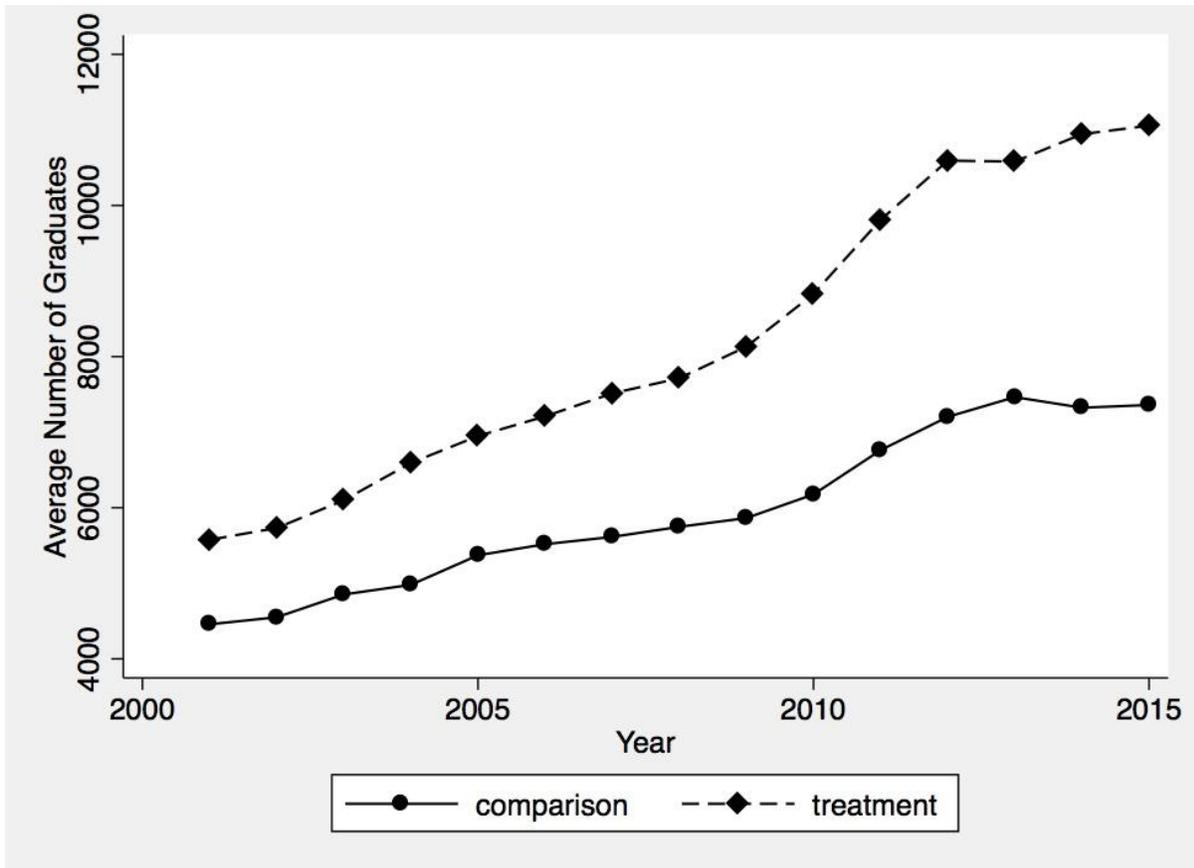
The average number of graduates for treatment and comparison states follow similar

trends in both two-year and four-year universities. However, there is a clear difference in the

slopes of these lines for both two-year and four-year universities. Both treated and comparison

states see consistent increases in the number of students who graduate. For two-year colleges,

treatment states experience a clear diversion from comparison states. Four-year colleges

experience an increase slope over the course of the time-period, but it is less clear on the

difference and when the trajectories first begin to differ. Both the two-year and four-year trends

for graduates support a hypothesis that the creation of a mandated articulation agreement

increases the number of graduates.

Results of Fixed Effects Model with All States

There are two sets of results. The first set of results include all selected comparison and treated states. Table 7 and Table 8 express the results of the first model for four-year and two-year institutions. Each table shows the coefficient (ß) and Standard Errors (SE) for one, two and three-year post-policy, in that order. The comparison states are the set of seven states which have either a legislated policy within their state or a board of higher education policy that governs all the public four-year and two-year institutions within the state. Only two states, Maine and Mississippi, lack a specific legislative directive. Maine and Mississippi's board govern the public four-year and two-year sectors, and, therefore, have a statewide policy.

Results are analyzed using the *xtreg* command in STATA. The, *robust* and *fe* are included in the model to control for the smaller sample size and cluster standard errors at the state level. The *fe* command estimates the fixed-effects or within treated state average change for the specified year post policy adoption. This panel dataset includes 16 states over nine-years for the models run with four-year institutions and 15 states over nine-years for the models run with two-year institutions.

Two robustness checks were conducted to verify the results. The first robustness check included individual state trends. Allowing states to have their own intercept helps to show how states vary from each other. The trends should still be the same. The standard errors will also be larger than the *fe* model.

The second robustness check is related to how the comparison states are coded as pre-policy adoption and post-policy adoption in the data. Changing the comparison dates to a single date, should demonstrate similar trends, even though it will change the estimates. The second robustness check runs the same fixed and random effects model 1, 2, and 3-year post policy

adoption, but sets the date of policy adoption for comparison states at 2005. While the estimates change, the trends (or lack of a trend) and significance are similar to the main model. The results of this model can be seen in Appendix C.

Two-year Colleges. Table 7 highlights the results of the DiD model for two-year institutions. The adoption of an articulation agreement has a positive effect on the difference in the number of two-year graduates adopting states produce, after the third-year the policy was in place (ß = 1151.5, *p<.05, d=.24).* The adoption of an articulation agreement policy did show effects on enrollment as well, specifically producing a difference in enrollment after the first year of the policy among first-year, first-time students who received federal financial aid (ß = 842.6, *p<.05, d=.2).* Controlling for several predictors, adopting a statewide articulation agreement did not significantly impact enrollment, in general. As, Table 7 highlights first-time, first-year enrollment at two-year colleges did show a slight non-significant difference in average one-year after policy adoption (ß= 589.9, *p=.2).* The average coefficient for enrollment at two-year colleges declines precipitously by the third year, from a ß of 589.9 to 156.3 and remains nonsignificant three-years post-policy adoption. However, the trend does not hold when changing the policy comparison date to 2005, as can be seen in Appendix C.

The only control variable that is significant for enrollment is the August unemployment rate. The August unemployment rate ranges from 489 predicted students enrolled ($p < .01$) in the first-year post policy to 385.3 projected students enrolled ($p < .05$). While the specific estimate changes in the 2005 robustness check the trend and directionality is consistent with a difference of less than a hundred projected enrollees each year post-policy.

Further, the effect of adopting a state-wide articulation agreement does seem to play a role in how many federal grant aid recipients enroll in the first year after the policy was adopted.

This effect goes away after the second and third years of the policy. The unemployment rate in August remains significant when looking at enrollment for federal grant aid recipients. Each year post-policy adoption, the projected enrollment of federal financial grant aid recipients attributed to the August unemployment rate declines, but the coefficient remains highly significant ($p <$ .001). The August unemployment rate is the only variable that maintains its significance regardless of the policy adoption date. The multi-year policy adoption and 2005 policy adoption models yield similar estimates providing further verification of the effect the unemployment rate has on the number of students eligible for grant aid seeking to enroll in two-year colleges. In short, adopting a statewide articulation agreement does not influence enrollment trends in general, but does influence additional students receiving grants as a part of federal financial aid to enroll.

Adopting a statewide articulation agreement does have statistically significant effect on the number of students who graduate three-years post-policy (ß=1151.5, *p* < .05*; d=.24)*. After the third-year of post policy adoption, all else being equal, states with a statewide articulation agreement policy experienced an average difference over 1000 graduates with a two-year degree. The adoption of a mandatory articulation agreement is associated with a .24 standard deviation increase in the difference of students who graduate in adopting states. Each year post policy adoption the average number of graduates increases above that of comparison states, while other controls stay consistent and nonsignificant each year. The average difference in graduates at two-year institutions post policy adoption is also consistent to robustness checks.[2]

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[2] When switching the policy adoption date for the comparison states the estimate decreases by 179 graduates and remains significant (*p* < .01), while the trend of increased graduates every year post-policy remains consistent

Table 7.

Results at 2-year institutions using fixed effects regression model with multi-year comparison group

	1 Year		2 Year		3 Year	
	ß	SE	ß	SE	ß	SE
Articulation Agreements effect on:						
Graduations	713.1	428.0	787.3	468.9	1151.5*	411.3
First-Time, First-Year Enrollment	589.9	442.0	63.8	499.6	156.3	511.5
First-Time, First-Year Enrollment for Federal Grant Aid Recipients	842.6*	342.4	710.7	406.3	401.6	464.5

Note: *p < .05. **p < .01. ***p < .001. Gross State Product – Per Capita and Cost of Attendance are set to 2009 dollars. All coefficients are from the DiD regression, using fixed effects. Control variables and coefficients are available in Appendix C.

Four-year Colleges. Adopting a statewide articulation agreement did not significantly impact enrollment, or specifically, enrollment for first-time, first-year students who received federal grant aid at any time post policy adoption. No variables were significant predictors of enrollment in the model for four-year institutions. Enrollment at four-year institutions did not drastically vary from year-to-year in the same manner as enrollment at two-year institutions. The increase in enrollment remained steady, with the slope of the line for enrollment continuing an upward trend, not significantly different from comparison states or prior trends, as can be seen in Figure 5.

Four-year institutions experienced a similar uptick in enrollment of federal grant aid recipients post the Great Recession (Figure 7). The adoption of a statewide articulation agreement does not show to have had a significant effect on the number of students who received grant aid from the federal government. Instead, the unemployment rate appears to have a significant effect on the number of students receiving federal grant aid enrolling at four-year institutions. The effect of the unemployment rate at the time of enrollment at four-year institutions is less than half that of two-year institutions. Four-year institutions experienced a

significant uptick, which stands up to robustness checks, in students who receive federal grant aid enrolling when the unemployment rate increased but not as a result of policy adoption.

The increase in the number of students who graduate three-years post-policy adoption in adopting states approaches statistical significance (ß=1189.9, *p = .091*). This estimate is consistent when setting the policy adoption year at 2005 for comparison states (ß=1276.3, *p = .051*). The trend of increasing graduates in states adopting statewide articulation agreement policies is consistent regardless of the models, while the number of graduates remains insignificant. It is clear there is a trend, with adopting states increasing the number of graduates by over 1000 in the third-year of the policy compared to if the policy had not been adopted. The increase in the number of graduates within adopting states and the trends for adopting states are similar across all models for two-year and four-year public institutions.

Table 8.

Results at 4-year institutions using fixed effects regression model with multi-year comparison group

	1 Year		2 Year		3 Year	
	ß	SE	ß	SE	ß	SE
Articulation Agreements effect on:						
Graduations	468.1	390.5	692.5	499.1	1189.9	658.0
First-Time, First-Year Enrollment	262.1	513.4	287.0	647.3	308.7	875.1
First-Time, First-Year Enrollment for Federal Grant Aid Recipients	265.8	339.7	54.8	368.4	131.2	401.3

Note: *p < .05. **p < .01. ***p < .001. Gross State Product – Per Capita and Cost of Attendance are set to 2009 dollars. All coefficients are from the DiD regression, using fixed effects. Control variables and coefficients are available in Appendix C.

Results of Fixed Effects Model Including Only States with a Legislated Policy

Table 9 – Table 10 express the results of the second model for four-year and two-year institutions. The second model is similar to the first but excludes states without a policy directed

in some fashion from the state legislature. Maine and Mississippi are the only treated states with a statewide policy that is not directed by the state legislature. The second model focuses on only state legislative policies. The second model includes seven treated and seven comparison states. In the same manner as the first model, each table includes the beta and standard error for one, two, and three-years post-policy.

The results are verified through two additional models. The first robustness check using a random effects model to allow states to vary, instead of estimating a single mean for all treated states. These results reflect similar coefficients as the fixed effects model, but provide different standard errors. The random effects model also provides additional information on how closely states are correlated with each other around the specific variables used in this analysis.

An additional robustness check changes the policy comparison year to reflect a different year. Controlling for the same variables but during a different time could result in different coefficients. Coefficients may fall into or out of significance if the model is simply measuring the difference in treated and comparison states at that specific time point, or the trends occurring in states that are not related to any specific policy. Results which are significant in both models show that the model is measuring the impact of the policy, or the effect other controls have on the dependent variables which are not related to policy.

Two-year Colleges. The adoption of a statewide articulation agreement does have a significant effect on the difference in the number of students who graduate at two-year institutions in the third year after policy adoption ($ß=1302$, $p < .05$; $d=.27$). There is also evidence of a sustained but declining effect on the change in enrollment among first-year, first-time students who receive federal financial aid. While enrollment does show a jump the first-year after the policy adoption, the difference is not sustained and is not statistically significant.

While differences may exist beyond three-years, there is essentially no difference between

enrollment between treated and non-treated states among two-year institutions after the first year

when using a three-year lag.

Focusing only on enrollment for first-time, first-year students who receive federal grant

aid yields statistically significant results in the first year (ß=1215, $p < .01$; $d=.28$), and second

year post-policy (ß=1130.6, $p < .05$; $d=.28$). The results suggest that the adoption of a mandatory

statewide articulation agreement increases enrollment among federal grant aid recipients in

adopting states by .28 of a standard deviation, in the first two-years of the policy. The increase

among enrollees in adopting states becomes non-significant by the third year. In this model the

August Unemployment rate, Gross State Product, cost of attendance, and time also show

significant effects on federal grant aid enrollment.[3] While it does not appear that adopting a

statewide legislated articulation agreement has any long-term effect on general enrollment, there

is evidence that the adoption of articulation agreement has an initial impact on low-income

students at two-year colleges in adopting states.

The change in the number of graduates shows a steady increase above comparison states

every year post-policy adoption, resulting in a statistically significant difference in graduates in

the third-year post-policy (ß=1302, $p < .05$; $d=.27$).[4] Focusing only on states where policies are

mandated from the legislature finds a .27 standard deviation increase in the difference of students

who graduate. The results highlight that the adoption of statewide legislative articulation

agreement seems to be similar to that of having any statewide policy in place for two-year

institutions, as limiting the model to only states with mandated statewide policies only increases

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[3] Only the Gross State Product-Per Capita and time remain significant regardless of the policy
adoption date for comparison states.
[4] The result is replicated in the robustness checks.

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the effect size by .03. The difference in the average number of graduates between two-year institutions with a legislated statewide policy and a non-legislated, but board directed, policy is less than 150 students. In both sets of analyses the increase in graduates at two-year institutions is statistically significant three-years post-policy adoption.

Table 9.

Results at 2-year institutions with state legislated policy using fixed effects regression model with multi-year comparison group

	1 Year		2 Year		3 Year	
	ß	SE	ß	SE	ß	SE
Articulation Agreements effect on:						
Graduations	663.7	393.4	940.3	501.7	1302.0*	439.5
First-Time, First-Year Enrollment	603.2	546.6	174.9	614.5	153.4	601.6
First-Time, First-Year Enrollment for Federal Grant Aid Recipients	1215.0**	317.9	1130.6*	424.2	892.4	456.8

Note: *p < .05. **p < .01. ***p < .001. Gross State Product – Per Capita and Cost of Attendance are set to 2009 dollars. All coefficients are from the DiD regression, using fixed effects. Control variables and coefficients are available in Appendix C.

Four-year Colleges. Table 10 shows the results of the DiD model for four-year institutions. Adopting a mandated statewide articulation agreement did lead to a statistically significant average difference of 1633 graduates ($p < .05$; $d=.13$) at four-year institutions three-years post-policy adoption. In both models, enrollment at four-year institutions remained relatively stable, experiencing only a slight and non-significant difference between expected trends. The adoption of articulation agreement did not change enrollment trends for first-time, first-year students at either two or four-year institutions in any model.

Regardless of the inclusion of Maine and Mississippi, the change in the number of students who receive federal grant enrolling does not show any clear pattern in any of the models for four-year institutions. While states with a statewide articulation agreement have a slightly

higher change than comparison states, the difference is not significant and varies widely between states. Students with federal grant aid who enroll at four-year institutions do not seem to be as sensitive to the cost of attendance, nor does the wealth of the state seem to impact the decision to enroll. In fact, the only significant predictor of students with federal grant aid enrolling at four-year institutions was the unemployment rate.

Removing states with only state board mandated policies did not change the enrollment trends, but did increase the difference in the number of graduates in adopting states by 500 students in the third-year.[5] Including only states with articulation agreements mandated by the state legislature, results in a statistically significant difference in the number of graduates after the third-year post-policy adoption (ß=1633.2, $p < .05$; $d=.13$). The adoption of a mandatory articulation agreement is associated with a .13 standard deviation increase in the difference of students who graduate in adopting states. The results highlight that adopting a statewide articulation agreement results in positive increases in the number of students who graduate from four-year institutions regardless of whether the policy is directed by a board or mandated by the state legislature. However, policies mandated by the state legislature are the only ones that have a statistically significant effect for four-year institutions.

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[5] These results are robust in the sensitivity analysis, where the policy adoption date for comparison states is set at 2005.

Table 10.

Results of fall enrollment at 4-year institutions with state legislated policy using fixed effects regression model with multi-year comparison group

	1 Year		2 Year		3 Year	
	ß	SE	ß	SE	ß	SE
Articulation Agreements effect on:						
Graduations	652.0	421.3	985.6	566.0	1633.2*	746.4
First-Time, First-Year Enrollment	345.4	557.7	383.3	700.3	421.5	914.7
First-Time, First-Year Enrollment for Federal Grant Aid Recipients	343.4	381.8	185.4	410.7	260.2	399.9

Note: *p < .05. **p < .01. ***p < .001. Gross State Product – Per Capita and Cost of Attendance are set to 2009 dollars. All coefficients are from the DiD regression, using fixed effects. Control variables and coefficients are available in Appendix C.

Chapter 5: Discussion

This research provides a new layer to existing studies. This research, following a human capital theory perspective, uses state level data to measure the impact of statewide adoption of articulation agreements, by following states that adopted policies from Fall 2004 to Fall 2010. The study compares treated states - those states that adopted a policy - to states which have no statewide policy in place. The study utilized a DiD regression modeling approach. This study sought to answer two research questions:

1. Is there an increase in enrollment at either two-year or four-year institutions after the enactment of statewide articulation agreements? Is there evidence of an increase in enrollment for federal financial aid recipients post policy adoption at either two-year or four-year institutions?

2. To what extent do statewide articulation agreements affect bachelor's degree attainment? To what extent do statewide articulation agreements affect associate degree attainment?

This research provides additional information to the current conversation around the impact of articulation agreements. Existing research on the effect of articulation agreements is primarily focused on individuals' propensity to transfer and attain a degree in states where articulation agreements exist (Anderson et al., 2006; Goldhaber, Gross, & DeBurgomaster, 2008; B. Gross & Goldhaber, 2009; LaSota & Zumeta, 2016; Baker, 2016; Roksa & Keith, 2009; Stern, 2016). Results of articulation agreement studies are mixed. Several researchers have found that articulation agreements did not increase the number of students who transfer from two-year institutions or enroll at two-year institutions (Anderson et al, 2006; Goldhaber, Gross, & DeBurgomaster, 2008; Gross & Goldhaber, 2009). Other studies found that a shift in statewide

policy did, in fact, increase the number of students at two-year institutions pursuing transfer degrees (Baker, 2016). Finally, a group of studies has found that students in states with articulation agreements showed a greater propensity to attain a four-year degree (LaSota & Zumeta, 2016; Stern, 2016).

Only LaSota & Zumeta (2016) and Baker (2016) accounted for specific articulation agreement policies in their studies. However, only Baker's (2016) study highlights the results of a policy change enacted in a specific state. Baker follows changes to the STAR legislation in California, where she found that the changes in articulation agreements increased the number of transfer degrees earned after the third year of the policy. The remaining studies on articulation agreement suffer from using non-state weighted samples to measure the effect of a policy. These studies do not attempt to use policy adoption dates or state level populations to measure how articulation agreements shift enrollment and graduation trends.

The research affirms other research on general enrollment trends, finding that general enrollment at four-year institutions remained relatively stable, increasing at a steady pace prior to and after the policy went into place. States where articulation agreements were adopted did not show a substantive different growth in general enrollment compared to non-adopting states. Two-year institutions experienced a non-significant increase in enrollment after the first year of the policy adoption, but that change did not reach significance in the first year and the difference in enrollment between treated and untreated states declined in subsequent years. Overall, differences in general enrollment between comparison states and treated states among four-year and two-year institutions did not significantly vary from one another.

Though two-year and four-year institutions with state mandated articulation agreements did not show a significant difference in enrollment compared to non-policy adopting states, this

study found significant differences in enrollment among students receiving federal grant aid. The trend in enrollment among low-income students, as measured by first-time first-year enrollment for students who received federal grant aid, increased significantly the year after policy adoption. A significant difference in low-income student enrollment between comparison and treated states is seen a second year after policy adoption only in states where articulation agreements are mandated by the state legislature. The difference in the number of low-income students is not statistically significant in the third year of the policy adoption. This finding supports that while these students from low-income backgrounds who attended two-year colleges showed specific sensitivity to the unemployment rate and cost of attendance the adoption of articulation agreements enticed more low-income students to enroll. The controls also support previous research by showing that as unemployment increased, so did enrollment of low-income students. Conversely, enrollment declined as the cost of attendance went up. However, the decline in enrollment due to the cost is a fraction of the increase in enrollment due to the unemployment rate. As the economy improved, low income enrollment overall declined. The lack of significance in low-income enrollment by the third year could be because the opportunity cost of going to college increases in the face of rising employment prospects. It may be that low-income students are substituting employment, as employment would provide an immediate source of revenue, for college enrollment.

This study makes it clear that the adoption of statewide articulation agreements leads to significant increases in the number of graduates at two-year colleges. States that adopted articulation agreements begin to increase the number of graduates greater than expected immediately post-policy. However, these differences did not reach significance until the third year. By the third-year post-policy adoption treated states saw a difference of over 1000

graduates above that of comparison states. The length it takes for the effects of the policy to reach significance are likely due to the time it takes for the practical implications of the policy to reach students. Students intending to finish their degrees one-year post policy adoption likely have already determined the necessary steps to complete college prior to policy adoption. Students three years post-policy adoption have more time to adjust coursework in order to maximize the benefits of articulation agreements. In short, this result provides evidence that the act of adopting a statewide articulation agreement, regardless of the specifics in the policy, by either the board governing both four-year and two-year institutions or by the state legislature has a positive impact on the number of students who graduate from a two-year college.

It does seem to matter where the policy originates for four-year institutions. Controlling for states where policy adoption is directed by the state legislature adds nearly 500 additional graduates at four-year institutions after the third year of the policy. States with legislative directed policies saw an average increase of 1600 more graduates than the counterfactuals. While only the model including legislative directed policies showed a significant difference in the number of graduates between treated and comparison states, both models showed an increase in the trend of graduates at four-year colleges residing in states that had adopted policies above that of states without statewide policies in place. The effects due to where the policy originates could be due to the emphasis policies directed by law may have on the actions of institutions. The differing impacts of policies mandated by the state legislature are further discussed in implications sections of this chapter.

These results are further supported by Stern's (2016) and Baker's (2016) findings on the impact of articulation agreements. The study provides additional insight into the impact of policy adoption at a state level. These insights include important implications to state policymakers, as

well as, higher education administrators and practitioners. Finally, this study raises several important questions for future research on articulation agreements' impact at a state and institution level. The remainder of this chapter will discuss the implications of this research and suggest future lines of research.

Implications for Theory

The findings presented here support the idea that articulation agreements increase the number of graduates without changing the number of students enrolled at four-year institutions. Evidence from this study suggests that these policies seemed to encourage more low-income students to start at two-year institutions during the first two-years post-policy adoption. By increasing the numbers of low-income students enrolling and subsequently increasing the number of two-year and four-year graduates', articulation agreements seem to provide a low-cost way of creating pathways to completion for more students within adopting states.

One important implication is that a statewide articulation agreement policy did not act as a diverting force among students. This means that articulation agreements did not increase enrollment at two-year institutions at the expense of enrollment at four-year institutions. Making a more seamless pathway to graduation did not shift enrollment away from four-year institutions. Instead, enrollment remained stable at four-year institutions. Enrollment among low-income students significantly increased above the expected trend at two-year institutions immediately following the policy change, even while holding economic trends constant. The fear that students would forgo starting at four-year institutions, based on research showing low-income students tend to under match in institutional selection and highlighting the difficulties in transferring between institutions, seems unfounded. Instead this research shows that articulation agreements

seem to be enticing new students, specifically low-income students, to enter at two-year institutions.

The results also demonstrate that articulation agreements are not a panacea for enrollment writ large. This study finds several nonsignificant findings that align with the idea that articulation agreements increase college attainment but have less of an impact on enrollment. General enrollment at two-year and four-year institutions is not significantly different in adopting states. It may be that articulation agreements do not actually address increasing overall enrollment because the agreements do nothing to change the start-up cost of enrolling in college. Instead articulation agreements may only change incentives for low-income students unsure about college attendance.

The decline in the number of low-income students in the third year of the policy provides interesting evidence that supports human capital theory and bounded rationality. Low-income enrollment is highly sensitive to a variety of factors, such as employment, cost of attendance, and gross state product. In tumultuous times, such as when unemployment is high, gross state product declines, and costs rise, low-income students may turn to the education system as a viable alternative to other avenues. It may be that while subsequent students view the opportunity cost of college as too high when economic conditions improve, others may find that the streamlined pathway through college offered by articulation agreements worth the forgone wages of employment. One piece of evidence to support this conclusion is that the difference in low-income enrollees declines but does not return to zero, instead it maintains a difference of 900 students into the third year of the policy. It may be that the adoption of articulation agreements still provides enough incentive to encourage low-income students into post-secondary education even when economic times are improving.

The creation of articulation agreements may reduce the information asymmetry existing between low-income students and those who generally enroll. For general enrollment students, additional clarity may act only as a convenience in enrollment decisions. These students have already decided to attend college. Their decisions may be focused on their major or the type of institution at which to begin. These students have a different sent of bounded rational decisions to make which are unaffected by the creation of articulation agreements. For low-income students, who have less information upon which to make decisions, streamlined pathways could have an outsized effect. In creating a simplified model, articulation agreements may be lowering the overall opportunity cost to a threshold where low-income students find enrollment in community college the most rational decision.

For low-income students, it could be that that the policies reduce the overall risk of starting college without a specific major or being unsure of where to attend college. The assurance these students could transfer or change pathways, or the ease of understanding pathways, may provide enough push to encourage students to enroll in a two-year institution. This may not be the case for the general student who has already decided whether or not they will continue education beyond high school.

States with articulation agreements realized statistically significant more graduates three years after implementing an articulation agreement relative to those with no articulation agreements. Support that the policy brings about an average increase over time gives credence to the idea that it takes time for practitioners and students to understand policy specifics and adopt to the policies that have the greatest benefit. Providing a pathway seems to follow the theory laid out by Baker (2016), among others (Paulson, 2001; DesJardins & Toutkoushian, 2006; Chen, 2008; Goldrick-Rab et al., 2009; Scott-Clayton, 2011) that providing a clear direction allows for

students to expend less energy in making positive choices on their next steps. For instance, by providing a student with a clear articulation policy, students who want to transfer can make better decisions on their degree choice. The choices for students are clearly laid out in front of them and their next decision simply becomes where they would like to transfer.

By creating clear options across all institutions in a state, articulation agreement policies serve as a democratizing force in higher education. Students can understand the requirements necessary to transfer and choose pathways that can take them between institutions prior to earning a degree. For instance, students who need fewer credits to complete a degree can use the articulation agreement to attend community colleges for a term or two before completing a four-year degree. These students can obtain the necessary courses at a lower cost, closer to home, and during the summer, thereby reducing the time to completion and, subsequently, easing the path to graduation.

Articulation agreements help students who do not complete at four-year institutions, as well. By providing greater flexibility to flow between institutions, articulation agreements increase the opportunities to achieve a degree at a two-year college prior to transferring. Providing incentives to earn a degree prior to transferring allows students to have a safety net in case they are unable to complete at a four-year institution post-transfer. In the end, the data brings to bear that articulation agreements increase the number of students who complete two-year and four-year degrees above what the state would have produced prior to the existence of the policy. In improving outcomes for students, articulation agreements are increasing the overall human capital available in adopting states. Individuals are also benefitting from the increased wages that usually are attributed to earning a degree (Kreisman, Jacob, & Dynarski, 2017).

Implications for Policy

If policymakers are looking to increase enrollments for all students, this study does not suggest that articulation agreements would be the appropriate policy. Instead, articulation agreements would be part of a package of policies dedicated to reducing the risk of enrolling in higher education institutions by providing a pathway to degree attainment. In one sense this research is verification of Knoell's (1990) assessment that state legislators must be involved in the creation of policies to drive a more equitable environment for all students. This is not to say that an articulation agreement policy directed from the legislature is responsible for the creation of a more equitable environment for all students. Only that, the act of a state policy can be symbolic of the values a state holds (Miller, 1998). By enacting a policy focused on streamlining the process through higher education, the state is placing emphasis on the needed changes, calling to action those institutions responsible for the changes, and placing a value on following through on mandated changes. These changes can lead to increased degree production, specifically at two-year institutions.

Articulation agreements showed positive trends in the number of graduates, including statistically significant results for the difference in two-year graduations when all states mandating a policy were included, regardless of the policy origination. These differences in outcomes went beyond the number of two-year graduates, all states mandating policies also showed a significant difference in low-income enrollment one-year after policy adoption. Focusing only on states where articulation agreements were mandated through legislative acts accentuates these findings. An important caveat is that only two states did not have legislated directed policies, Maine and Mississippi.

The accentuation of findings when focusing only on states with a legislated policy provides support to the idea that governing board may be limiting the capacity of institutions to advocate for effective change. Previous research found that governing boards often prevented individual districts from lobbying their state representatives directly for appropriations (Tandberg, 2013, p. 529). In reducing the ability for individual institutions to go straight to the legislature, governing boards serve to "buffer" legislatures from special interest groups and individual entities. On the one hand, acting as a shield to the legislature from special groups or individual entities may increase the likelihood that the legislature listens to those the governing board sends to report on various decisions. On the other hand, by enacting policies without legislative actions the systems may be missing important stakeholders who would otherwise be present in legislative sessions.

It may be that states with legislated articulation agreements demonstrate increased changes because they come from outside any single system. A governing board may not have the same emphasis on informing the public about new policies. A lack of public knowledge or internal support of a policy could be detrimental to the success of the policy. Especially considering that in this case public policy is particularly relevant for streamlining the pathways to completion given the needed increase in the number of graduates required by states to be economically competitive and the dismal percentage of students who start college but never finish. Articulation agreements place an emphasis on making the lowest net cost higher education opportunity easier to access for the most at-risk students and provides ample opportunities for students to increase skill levels and degree attainment. Essentially these policies changed the social and economic incentives for students to attend college, which is important to successful policy making (Coburn, 2016).

It may be that legislative directives provide incentive for all those within in a system to act. By placing an emphasis on the need to create structured pathways, the policy encourages individual actions which in turn can impact student behavior (Rigby, Woulfin, Marz, 2016). Students, specifically low-income students, may not know the opportunities available to them when they enter college. Imagine a student who only enters a two-year institution to earn a specific credential related to machinery. Throughout the student's first term, they may interact with a variety of institutional staff, such as instructors, administrators, and advisors. These instructors hold knowledge on the specific policy, which could be relayed to the student. Throughout the student's first year, the student may receive a variety of signals leading them to realize the opportunity to become an engineer exists by transferring. Under a normal set of circumstances this student may have already charted a course that would make it hard to become an engineer without costing the student more than they can bear. An articulation agreement provides the opportunity for the student to earn an associate degree or to transfer prior to the associate degree to pursue an engineering degree without being set back. Institutional actors may play a key role in providing the student this information, changing the institutional role by encouraging changes in the higher education system.

Articulation agreement policies are not only providing economic incentive and improving costs for students to pursue education, but they are calling to action those who are in the systems. Highlighting that policy requires human agency to be successful implemented in institutions (Marz, Kelchtermans, Dumay, 2016). By enacting statewide mandated policies, the legislature is forcing two disparate systems in education to align for the benefit of students. This requires the engagement, agency, and expertise among stakeholders in both types of institutions to be successful. Perhaps, by policy being a symbolic force that pushes systems to focus on the

problem it is providing institutional stakeholders the opportunities to create the underlying structure to support policy implementation.

Articulation agreements manage to be successful from a top down and a bottom up view. The key focus of the policies is about encouraging the success of students through creating more streamlined pathways through education systems. From the top view the value in completing the policy lies in creating the appropriate incentives and costs to encourage students to pursue the best outcomes without being held back by the structure of higher education. These policies place a priority on what higher education administrators must accomplish. As such, articulation agreement policies encourage the creation of systemic models to facilitate the movement of students between institutions. These structures can force institutions which would otherwise not engage with one another to engage on behalf of students. Finally, these structures then have to be feasible enough and effective enough for policymakers and educational administrators to defend them to constituents (Teisman, 2000; McLendon & Cohen-Vogel, 2008).

Articulation agreements provide a blueprint for successful policy making in relation to degree attainment. In this case, articulation agreements help address a need within the state, encourage collaboration between institutional entities, and provide for human agency to institutionalize the policy. Articulation agreements provide avenues for students to move through institutional structures in ways which encourage institutional actors to help students through the system by producing a value driven symbolic change. These agreements help encourage students to pursue varying goals by reducing costs. At the same time articulation agreements meet a state's needs through increasing the total number of graduates the state produces. Policymakers can continue to encourage these systematic structures further down the education chain through policies around dual enrollment and college readiness at the high school level.

Policymakers should utilize articulation agreements for what they are: tools that provide systemic pathways through the higher education system in order to increase the number of graduates. If policymakers are in states without mandated articulation agreement policies, then articulation agreements present an opportunity to connect two-year and four-year institutions in meaningful and impactful ways that could produce additional graduates. In states which already have adopted articulation agreement policies, policymakers should focus energy on ensuring that policies are updated, encapsulate the full breath of degrees and pathways needed in the workforce, and ensure that policies are communicated across education systems.

Policymakers also need to ensure that stakeholders responsible for the implementation of articulation agreements have the flexibility and freedoms necessary to work across education systems. This means that those responsible for implementation should have the ability to refine policies as needed, update policies when necessary, and regularly commit to review policies to ensure they are relevant to the student populations they serve. Policymakers can ensure policies are updated by requiring those responsible to regularly report updates to the legislature.

Future Research

Alternative Model. Results from this study should be taken with caution. There are no studies to the researcher's knowledge which have conducted this type of analysis on articulation agreements. While DiD is a common method to study policy adoption there are issues that arise from its use. Due to the limited nature of the states, a different analysis may be conducted to further curtail the small sample size. Future research could use different estimation methods to look at the same or a similar sample of states.

One specific modeling estimation that can be applied to this analysis is the use of a synthetic control modeling approach. A synthetic control model could provide for a different

comparison group that aligns even better with the treated states. A synthetic control model would provide a comparison group that stands in for the treated states if they had never been treated. Using a synthetic comparison model would remove much of the worry about having common trends prior to treatment among the comparison and treated group.

Future models could also look at adding additional years to the analysis. This research does not address whether differences in graduates between adopting and non-adopting states maintain or increase four or more years post policy adoption. It would also be good to add additional years in looking at enrollment trends. It could be that enrollment differences among low-income students started off large because of initial communication around the policy entices those low-income students unsure about attending college. It would be interesting to see if the differences in low-income student enrollment continue to decline. Adding additional years to measure general enrollment could address whether it takes longer for the potential benefits of articulation agreements to embed themselves in student decision making. It could also be that while students took advantage of the policy initially, future students need time for the policy to be promoted in high schools where most students are beginning to explore college options. These additional models could provide additional verification of the results, while providing interesting data on how model specifications may lead to varying interpretations of the results when using similar datasets.

Additional research. This study aggregates data to the state-level and conducts state-level analyses. Additional research should be conducted at the institutional level. There are several institutional level data points which could be added to the analysis to provide more nuanced results. For instance, one question that arises from this analysis is whether the effects of articulation agreements were felt equally at all institutions throughout treated states. It would

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stand to reason that regional institutions may have experienced different results in graduation trends than flagship institutions. It may also be the case that more highly selective public institutions do not see a change in the number of graduates post-policy. State trends may be masking the differential impacts articulation agreements have because some highly selective institutions may already churn out a high number of graduates and not have as much capacity to turn out more. Additional research could provide a great deal of insight into the role selectivity plays in the success of articulation agreement policies.

Looking at the distance between community colleges and other institutions within the state may provide an additional avenue for future research. Research has found having a four-year university in the same county as a community college increases the likelihood of student success (Umbach, Tuchmayer, Clayton, Smith, 2018). Additional research can add another layer to this existing research by studying whether the adopting of an articulation agreement policy increases the number of graduates at two-year and four-year institutions in the same region. Specifically, does creating articulation agreement help entice students to move to four-year institution earlier or only after obtaining a two-year degree?

Differences between unilateral, or institution-to-institution articulation agreements compared to mandated statewide policies should also be studied. It would be good to know if statewide policies provide a different impact than policies agreed upon between two institutions. It may be that states without statewide policies have unilateral agreements that have a significant impact on the local region, even if that impact is less seen at the state level. It may also be that state level effects are augmented by additional unilateral agreements. Additional research can provide insight to decision makers at the local level when deciding how to go about creating and

implementing articulation agreements or advocating for the state to implement or adjust statewide articulation agreement policies.

An analysis of the cost-benefit ratio of statewide articulation agreements could provide an additional avenue of quantitative analysis. Cost-benefit analysis could show the relative cost of implementing a statewide approach to articulation agreements compared to the overall benefits the state yields from positively increasing degree attainment. A cost-benefit analysis could show the differential benefits in producing more associate degree earners than baccalaureate degree earners. There may also be additional opportunities to compare the cost and benefits of a statewide policy compared to institution-to-institution policies.

Qualitative research. There are also several qualitative research questions which can provide further clarification to this research agenda. Using a state-level analysis only addresses what is occurring; it does not address why it is occurring. Qualitative research could provide answers to how specific policy components of articulation agreements are implemented at community colleges. Qualitative research could also provide information on the practical aspects of what communication works in reaching students to educate them on specific policies. Further, qualitative research could provide information on why articulation agreements have the intended impact on students, so practices can be replicated in future policy rollouts.

Qualitative research would be a better solution than quantitative research to study the efficacy of specific policy components within states. One issue with disaggregating articulation agreements and attempting to measure the impact of specific policy components is that there may not be enough states adopting a single component in a similar manner to measure the effect of adoption. Qualitative research could investigate the impacts of specific policy components,

including how those policy components are adopted, how the institutional systems manage the specific components, and how the components are understood by students.

Qualitative research could also conduct implementation studies around how policies are rolled out to students, institutions, and communities. It would be helpful for policymakers to know who to include in policy decisions. Both systems and policymakers could benefit from a further understanding on how policy decisions are interpreted by high school counselors who are helping students answer initial questions around college attendance. Implementation studies could provide a roadmap for the creation of effective policy which includes the appropriate stakeholders in its creation, while also including communication methods and language for the practical implementation of the policy.

Conclusion

The current economic reality is that the United States needs to increase the number of individuals who have a post-secondary credential (Falconetti, 2009; Long, 2005; Perna & Finney, 2014). Yet, several thousands of students start a higher education pathway without ever finishing (Shapiro, Dunbar, Yuan, Harrell, Wild, & Ziskin, 2014). Among those who do not finish are low-income and underrepresented groups of students, leading to a continued gap in degree attainment (Page & Scott-Clayton, 2016). Further, as the US continues to need more degree holders, those without degrees are increasingly falling behind in wage growth and salaries (Autor, 2011).

Following a human capital theory perspective, one way to increase degree attainment is to reduce the cost of post-secondary education, both in making post-secondary education less expensive and by making the process of transferring easier. Articulation agreements provide an option that has a low-price tag at the state level, and would reduce costs for students, while also

increasing their ability to make better decisions (Baker, 2016; Scott-Clayton, 2011). For example, a streamlined pathway created by an articulation agreement allows students to attend a college close to home at a lower cost. These students can then transfer to a different college to receive additional training and degrees without losing credits or being set back by policies unbeknownst to them at the start of their journey. Between 2005 and 2010, nine states adopted a statewide mandated articulation agreement that all public two-year and four-year institutions abide by.

This study sought to exploit the various policy adoption dates using a quasi-experimental DiD approach. The study centered nine treated states on the year they adopted a mandated articulation policy which covered all public institutions within the state. The study compared the trends one, two, and three-years post-policy adoption to seven comparison states without any adopted policy. This study repeated the analysis with states that only had a legislated requirement for an articulation agreement, reducing the number of adopting states to seven. The results of the analysis support the idea that articulation agreements produce additional two-year graduates regardless of where the policy originates. States where the policy originates from the state legislature produce an additional number of two-year graduates, and a significant difference in the number of four-year graduates.

Overall, articulation agreements have a positive, significant impact on the number of graduates at two-year and four-year institutions. These impacts increase among states where the articulation agreement policy is legislated. The results highlight that articulation agreement policies legislated by the state create streamlined pathways for students in higher education. Further, articulation agreements set forward by state policy have a democratizing effect on higher education populations. States where articulation agreements were mandated by the state

legislature saw an average difference of over 1600 baccalaureate recipients at four-year institutions and 1300 associate degree recipients at two-year colleges. These are an average 2900 students who otherwise would not have had a degree if the state continued its trajectory prior to policy adoption.

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APPENDICES

<center>**Appendix A**</center>

State Policy Context

   Studies of state policies are often predicated on the legislative action that drives statewide policy decisions. Although there are times when statewide policy is also implemented by state agencies acting with statutory authority. Governing bodies overseeing some, or all, of public education in a state can implement policy without direct state legislation. Governing bodies exist in varied formats, from governing boards to commissions set up by the legislature. Studies only using state legislative action miss policies enacted by governing boards. Therefore, this study includes articulation agreement policies enacted by either the state legislature or a governing board with governing power. States included in this analysis are as follows:

Arkansas

   Community Colleges in Arkansas are governed by the Arkansas Higher Education Coordinating Board (Fridel, Killacky, Miller, Katsinas, 2014). The Arkansas Higher Education Coordinating Board oversees the Arkansas Department of Higher Education. However, the state legislative assembly holds a great deal of sway over the community college system. In 2005, the legislative body passed the state's initial transfer policy, Act 672 (ECS, 2014).

   Act 672 directed the Arkansas Higher Education Coordinating Board to implement a transfer curriculum between the public university and community college systems (ECS, 2014). The legislature's bill set the implementation of the transfer curriculum the following year, in 2006 (Act 672, 2005). The Arkansas General Assembly added to this policy with the passage of the Robert Phillips Transfer Act of 2009 (WICHE, 2014). The Robert Phillips Transfer Act guarantees students who transfer with an Associate of Arts and Associate of Science degrees to public institutions in the state will enter the public universities at Junior standing. The action of

the legislature in 2005 set in motion the growth of transfer policies and the creation of the articulation agreement. This study will use fall 2005 as the initial policy start date for the analysis.

Kentucky

The Council of Postsecondary Education (CPE) in Kentucky is responsible for transfer and articulation policies in the state. CPE has existed since the 1997 enactment of The Kentucky Postsecondary Improvement Act; however, the committee did not create a transfer policy until 2004 (WICHE, 2014). In 2012, KRS 164.2951codified the review of policies into law, and created The Kentucky Transfer Action Plan. A part of the Kentucky Transfer Action Plan updated the initial 2004 transfer policy. This study will use The General Education Transfer Policy and Implementation Guidelines of 2004 as the initial transfer policy change date. The guide in 2004 is the first policy governing transfer between public institutions within the state at a statewide level. This study will use fall 2004 as the implementation of a statewide articulation agreement policy in Kentucky.

Louisiana

The Louisiana Community and Technical College system and university system are governed by the Board of Regents (Friedel et al, 2014). In 2000, the Louisiana state legislature instructed to the Board of Regents to create a list of transfer courses (WICHE, 2014; ECS, 2014). By Fall 2000, the legislation instructed the Board of Regents to compel "postsecondary management boards to adopt and implement articulated units of course work common among specified degree programs, taking into consideration the accreditation criteria of the institution receiving the credit." (LA. REV. STAT ANN. §17:3129.1, 2000) Articulation Agreements were

further expanded by legislative directive in 2009 when RS17:3167 appointed the Statewide

Articulation and Transfer Council.

The Statewide Articulation and Transfer Council created a statewide comprehensive

articulation policy. In 2010, the Statewide Articulation and Transfer Council developed the

Louisiana Transfer Degree which guarantees 60 hours of coursework transfers towards a

baccalaureate degree at a public university in the state. While the 2000 policy implementation

requires a conversation regarding transfer courses, the 2009 legislation stipulates clear and direct

transfer protocols for all public community colleges in the state. For this study, the fall 2009

implementation of a comprehensive articulation will be used.

Maine

Maine is split between the University of Maine system and the Maine Community

College System. Maine does not have a state legislative driven policy. However, in 2005 the

University of Maine System and the Maine Community College System developed a program

called "Advantage U" (ECS, 2014). The Advantage U program guarantees admission to a Maine

University System college for those who obtain an A.A. at one of the Maine Community

Colleges. While this is not a state policy, it captures all public universities and community

colleges in the state of Maine. The implementation of Advantage U in 2005 will serve as the

policy implementation date for this study. Fall 2005 will be coded as the implementation date for

this study.

Mississippi

Mississippi does not have any statewide legislation governing articulation and transfer

agreements during the study's time-period. However, the Board of Trustees of State Institutions

of Higher Learning did enact a system wide policy governing transfer agreements in 2010

(WICHE, 2014; ECS, 2014). The Board of Trustees for the Institutions of Higher Learning govern the eight public universities of Mississippi, including the flagship University of Mississippi and the land grant institution, Mississippi State University (Friedel et al, 2014). A policy enactment from the Board of Trustees functions as a statewide mandate to the university system.

Policy 520 in the Institutions of Higher Learning policy guide allows students who graduate with an associates' degree from any of the public community or junior colleges in the state to have credits counted toward the general core curriculum of the university (Board of Trustees, 2018). The Board of Trustees also sets forward a general system wide articulation agreement. The agreement is agreed upon by both the Board of Trustees of State Institutions of Higher Learning and the Mississippi State Board for Community and Junior Colleges. Both the Mississippi Board of Trustees of Institutions of Higher Learning and the Mississippi State Board for Community and Junior Colleges continued to expand this policy in 2014 (Board of Trustees, 2018). Since this 2010 enactment of the board policy went into effect immediately, fall 2010 will be used as the year of implementation for this policy.

New Jersey

The 2007 statute 18A:3B-14 directs the implementation of a statewide articulation agreement program specific to all public universities and community colleges. The statute stipulates that the New Jersey Commission for Higher Education and the New Jersey President's Council must coordinate transfer policies. The Commission for Higher Education is the statewide governing body for New Jersey, while the New Jersey President's Council consists of the presidents for New Jersey's public and private universities, as well as community colleges (Friedel et al, 2014). New Jersey released the statewide articulation agreement, applying to

Associate of Arts. and Associate of Science degrees earned at a New Jersey Community College, in 2008. The policy applied to all students starting in the fall of 2008, as such, fall 2008 will be the year of policy implementation for this study.

Pennsylvania

In 2006, PA Statute 24 P.S. 20-2004-C, established the Transfer and Articulation Oversight Committee (TAOC). TAOC is the primary body responsible for Pennsylvania's transfer policies (Friedel et al, 2014). Among other things, the legislation directed TAOC to certify a core of transferable courses between the state's 14 public universities and 14 community colleges. TAOC, through the legislature, also implemented transfer agreements granting junior status in comparable programs for students earning an Associate of Arts. or an Associate of Science degree at the community college. One other direct result of TAOC's work is an interactive website and reporting structure to assess articulation agreements and transfer policies. PA Statute 24 P.S. 20-2004-C stipulates that all institutions must comply by policies set forward by TAOC in June 2008. This study will use fall 2008 as the start of the policy implementation.

Tennessee

The Tennessee Board of Regents governs all aspects of Tennessee's six universities, 13 community colleges and 27 technical colleges. Tennessee's community colleges functioned as 13 independent entities until 2010 (Friedel et al, 2014). The Complete College Tennessee Act (CCTA) of 2010 created a unified community college system (ECS, 2014). The Tennessee Board of Regents coordinates with the Tennessee Higher Education Commission (THEC) (Friedel et al, 2014).

THEC is the governmental oversight body for all of Tennessee higher education. CCTA instructed THEC to coordinate with the University of Tennessee system, separate from the board of regents, and the Board of Regents to create unified articulation agreements across all public institutions. By Fall 2010, THEC instituted several policies required by CCTA. By the Fall of 2011 THEC set forward articulation agreements granting junior status and guaranteed admission to all Associate of Arts. or Associate of Science degree earners. Since some policies were set in place by CCTA by Fall of 2010, the study will use the fall of 2010 as the year of implementation.

Virginia

In Virginia, the State Council of Higher Education Virginia (SCHEV) makes policy recommendations to the governor and state legislature (Friedel et al, 2014). SCHEV works with the Virginia Community College System (VCCS) to implement transfer programs between the centralized system of 23 community colleges and 15 public universities. The goal of SCHEV has been to ensure higher education in Virginia functions as a continuum for students, where students can seamlessly transfer to the university system from the community college system (SHEV, 2016).

State policy 23-9.2:3.02, passed in 2005, instituted the creation of a one-year Certificate of General Studies. The Certificate of General Studies, earned at a community college, consists of all transferable coursework accepted at any public university. An additional policy, 23-9.14:2 creates the State Transfer Module. Through the State Transfer Module, students' general education courses completed with various associate degrees are counted toward the fulfillment of general education courses at the university. In addition, the completion of general education courses grants students' junior status at four-year public universities. The 2005 policies will be

considered the year of enactment for the policies, making fall 2005 the initial year coded as implementation in the study.

Note on New York and Minnesota

New York and Minnesota do not have statewide articulation agreements. However, both of these states have large systems that have articulation agreements between each other. New York has an articulation agreement between the State University of New York (SUNY) system. The City University of New York (CUNY) has an articulation agreement with community colleges in New York City. However, these systems do not have agreements with each other. Since these agreements cover such large swaths of the New York population, New York is not included as a comparison state.

Minnesota has a similar situation. Minnesota does not have a statewide policy, but the Minnesota State College and University system and University of Minnesota have an articulation agreement. However, there is no unified program that covers all community colleges, state colleges and universities, and the University of Minnesota. Since so many students are covered by the existing articulation agreement, though not everyone, Minnesota is excluded from the comparison group and not included as a treated group.

Appendix B

State Level Descriptive Information for All Variables

Table 11.

Descriptive information for variables in treated states

State	Variable	*n*	Mean	SD	Min	Max	Change over time
Arkansas		9					
	Prior Year HS Enrollment		135901	3045	131882	139857	7975
	August Unemployment Rate		5.7	0.9	5.0	8.0	3.0
	May Unemployment Rate		6.0	1.2	5.0	8.1	3.1
	Gross State Product - Per Capita		34252	1429	31685	35803	4118
	Fall In-State Enrollment (4 year)		9562	547	8815	10391	1576
	Enrollment Count (4 year)		14911	3503	11182	19244	8062
	Federal Grant Aid Enrollment (4 year)		4877	463	4422	5941	1519
	Cost of Attendance (4 year)		17464	1203	15651	19758	4107
	4 Year Graduates		8998	631	8009	10032	2023
	Fall In-State Enrollment (2 year)		3214	967	2202	4693	2491
	Enrollment Count (2 year)		10572	2915	7663	15869	8206
	Federal Grant Aid Enrollment (2 year)		3840	800	2958	5795	2837
	Cost of Attendance (2 year)		13922	907	12264	15258	2995
	2 Year Graduates		3964	761	2845	5383	2538
Kentucky		9					
	Prior Year HS Enrollment		190728	6211	180872	197826	16954
	August Unemployment Rate		5.6	0.7	4.1	6.7	2.6
	May Unemployment Rate		6.2	1.7	4.9	10.6	5.7
	Gross State Product - Per Capita		37162	1236	35497	38856	3359
	Fall In-State Enrollment (4 year)		12334	1193	10835	13709	2874
	Enrollment Count (4 year)		18506	3417	14584	23949	9365
	Federal Grant Aid Enrollment (4 year)		4760	559	3675	5606	1931
	Cost of Attendance (4 year)		16122	2409	13663	19504	5841
	4 Year Graduates		13654	1220	11944	15134	3190
	Fall In-State Enrollment (2 year)		6768	1178	5522	8482	2960
	Enrollment Count (2 year)		10329	2986	7105	14681	7576
	Federal Grant Aid Enrollment (2 year)		3820	740	2824	4779	1955
	Cost of Attendance (2 year)		12458	1395	9783	13823	4040
	2 Year Graduates		4972	1509	3025	6860	3835

Table 11. Continued

State	Variable	n	Mean	SD	Min	Max	Change over time
Louisiana		9					
	Prior Year HS Enrollment		182504	4501	172444	188181	15737
	August Unemployment Rate		6.2	1.5	4.2	8.2	4.0
	May Unemployment Rate		6.2	1.5	4.3	7.9	3.6
	Gross State Product - Per Capita		46678	1627	43721	49164	5443
	Fall In-State Enrollment (4 year)		17921	296	17438	18435	997
	Enrollment Count (4 year)		26921	1913	22015	28207	6192
	Federal Grant Aid Enrollment (4 year)		7701	394	7101	8123	1022
	Cost of Attendance (4 year)		17676	778	16517	19094	2577
	4 Year Graduates		18026	619	16955	18800	1845
	Fall In-State Enrollment (2 year)		5906	2807	2526	9176	6650
	Enrollment Count (2 year)		14249	5346	4743	20781	16038
	Federal Grant Aid Enrollment (2 year)		4507	1983	1781	6629	4848
	Cost of Attendance (2 year)		14230	742	13492	15754	2261
	2 Year Graduates		3303	942	2031	4804	2773
Maine		9					
	Prior Year HS Enrollment		62539	1393	60579	65503	4924
	August Unemployment Rate		5.1	1.2	4.0	8.2	4.2
	May Unemployment Rate		5.5	1.5	4.3	8.2	3.9
	Gross State Product - Per Capita		38380	777	36995	39288	2293
	Fall In-State Enrollment (4 year)		3289	127	3062	3469	407
	Enrollment Count (4-year)		5292	982	4348	6660	2312
	Federal Grant Aid Enrollment (4 year)		1885	94	1793	2085	292
	Cost of Attendance (4 year)		15951	1306	14232	18165	3933
	4 Year Graduates		3987	345	3450	4338	888
	Fall In-State Enrollment (2 year)		2001	470	1281	2612	1331
	Enrollment Count (2 year)		4117	1920	1985	7609	5624
	Federal Grant Aid Enrollment (2 year)		1050	224	796	1474	678
	Cost of Attendance (2 year)		13656	910	12619	14724	2105
	2 Year Graduates		1475	257	1035	1839	804

Table 11. Continued

State	Variable	n	Mean	SD	Min	Max	Change over time
Mississippi		9					
	Prior Year HS Enrollment		138775	1629	136154	140829	4675
	August Unemployment Rate		8.2	1.6	6.0	10.1	4.1
	May Unemployment Rate		8.3	1.7	6.2	10.6	4.4
	Gross State Product - Per Capita		31844	543	31175	33128	1953
	Fall In-State Enrollment (4 year)		6085	932	4518	7068	2550
	Enrollment Count (4-year)		16246	1559	14129	18128	3999
	Federal Grant Aid Enrollment (4 year)		4102	562	3304	4757	1453
	Cost of Attendance (4 year)		17372	1089	16100	18813	2713
	4 Year Graduates		10853	828	9865	12064	2199
	Fall In-State Enrollment (2 year)		5562	1547	3026	7099	4073
	Enrollment Count (2 year)		28348	2130	24027	31122	7095
	Federal Grant Aid Enrollment (2 year)		12127	1381	10544	14663	4119
	Cost of Attendance (2 year)		11295	585	10356	11857	1502
	2 Year Graduates		10415	1821	8159	12755	4596
New Jersey		9					
	Prior Year HS Enrollment		421611	6346	408855	427930	19075
	August Unemployment Rate		6.8	2.5	4.3	9.5	5.2
	May Unemployment Rate		7.1	2.5	4.2	9.5	5.3
	Gross State Product - Per Capita		56202	1382	54281	57860	3579
	Fall In-State Enrollment (4 year)		15361	1101	13962	16879	2917
	Enrollment Count (4-year)		30821	10802	16079	40567	24488
	Federal Grant Aid Enrollment (4 year)		5774	1259	4144	7401	3257
	Cost of Attendance (4 year)		25807	914	23982	27078	3096
	4 Year Graduates		25437	2432	22946	29658	6712
	Fall In-State Enrollment (2 year)		3885	267	3448	4210	762
	Enrollment Count (2 year)		41627	7279	31341	50066	18725
	Federal Grant Aid Enrollment (2 year)		11155	3012	7327	14769	7442
	Cost of Attendance (2 year)		17436	270	16854	17737	883
	2 Year Graduates		16568	2784	12886	19786	6900

Table 11. Continued

State	Variable	n	Mean	SD	Min	Max	Change over time
Pennsylvania		9					
	Prior Year HS Enrollment		591020	26452	558945	650986	92041
	August Unemployment Rate		6.4	1.7	4.5	8.3	3.8
	May Unemployment Rate		6.5	1.8	4.2	8.6	4.4
	Gross State Product - Per Capita		45996	1034	44585	47554	2969
	Fall In-State Enrollment (4 year)		37557	1401	35128	39028	3900
	Enrollment Count (4-year)		57430	7953	43427	63627	20200
	Federal Grant Aid Enrollment (4 year)		13733	1639	11555	16252	4697
	Cost of Attendance (4 year)		24386	1427	22015	26779	4764
	4 Year Graduates		42677	2880	39219	46707	7488
	Fall In-State Enrollment (2 year)		3730	804	2514	4826	2312
	Enrollment Count (2 year)		35734	6016	26124	42039	15915
	Federal Grant Aid Enrollment (2 year)		7290	1804	5180	9581	4401
	Cost of Attendance (2 year)		15992	436	15223	16512	1288
	2 Year Graduates		12710	1253	11097	14480	3383
Tennessee		9					
	Prior Year HS Enrollment		285457	2212	281971	288408	6437
	August Unemployment Rate		7.6	1.9	4.7	10.8	6.1
	May Unemployment Rate		7.6	2.1	4.2	10.8	6.6
	Gross State Product - Per Capita		40828	1065	39096	42177	3081
	Fall In-State Enrollment (4 year)		17475	849	15594	18430	2836
	Enrollment Count (4-year)		28952	1286	26586	30756	4170
	Federal Grant Aid Enrollment (4 year)		7899	1397	5749	9363	3614
	Cost of Attendance (4 year)		19455	1101	17879	20804	2925
	4 Year Graduates		19166	1583	16936	20893	3957
	Fall In-State Enrollment (2 year)		12724	1905	9754	15144	5390
	Enrollment Count (2 year)		28169	2940	25173	33142	7969
	Federal Grant Aid Enrollment (2 year)		13883	2513	10085	16755	6670
	Cost of Attendance (2 year)		14306	407	13646	14728	1081
	2 Year Graduates		8174	1213	6741	9498	2757

Table 11. Continued

State	Variable	n	Mean	SD	Min	Max	Change over time
Virginia		9					
	Prior Year HS Enrollment		366234	16757	336907	381320	44413
	August Unemployment Rate		4.0	1.1	3.1	6.9	3.8
	May Unemployment Rate		4.4	1.5	2.9	7.2	4.3
	Gross State Product - Per Capita		50772	1914	47962	52866	4904
	Fall In-State Enrollment (4 year)		21482	1581	18583	23042	4459
	Enrollment Count (4-year)		33279	6760	26616	41865	15249
	Federal Grant Aid Enrollment (4 year)		5500	831	4923	7658	2735
	Cost of Attendance (4 year)		17360	1787	14791	19840	5048
	4 Year Graduates		28607	2199	25249	31927	6678
	Fall In-State Enrollment (2 year)		1424	426	1044	2156	1112
	Enrollment Count (2 year)		25928	11589	11331	42439	31108
	Federal Grant Aid Enrollment (2 year)		4931	1835	3379	8825	5446
	Cost of Attendance (2 year)		11801	1033	10056	13456	3400
	2 Year Graduates		11607	1427	9631	14124	4493

Table 12.

Descriptive information for variables in comparison states, using variable years as the policy adoption

State	Variable	*n*	Mean	SD	Min	Max	Change over time
Connecticut		9					
	Prior Year HS Enrollment		169618	7833	155734	177037	21303
	August Unemployment Rate		4.4	1.1	2.2	5.9	3.7
	May Unemployment Rate		4.9	1.3	3.1	7.7	4.6
	Gross State Product - Per Capita		64808	3484	61233	70096	8863
	Fall In-State Enrollment (4 year)		7080	388	6479	7710	1231
	Enrollment Count (4 year)		9822	2022	8400	13791	5391
	Federal Grant Aid Enrollment (4 year)		7701	1557	258	1289	2184
	Cost of Attendance (4 year)		18456	1634	16377	20680	4303
	4 Year Graduates		8704	1214	6898	10077	3179
	Fall In-State Enrollment (2 year)		4558	1342	2884	6483	3599
	Enrollment Count (2 year)		8994	2733	6461	14195	7734
	Federal Grant Aid Enrollment (2 year)		4507	1604	466	1067	2532
	Cost of Attendance (2 year)		14358	677	12660	14849	2189
	2 Year Graduates		3619	359	3147	4285	1138
Delaware		9					
	Prior Year HS Enrollment		36387	1851	34121	39091	4970
	August Unemployment Rate		4.5	1.6	3.3	8.5	5.2
	May Unemployment Rate		5.0	2.0	3.4	8.5	5.1
	Gross State Product - Per Capita		67226	2581	62535	71155	8620
	Fall In-State Enrollment (4 year)		2019	355	1520	2504	984
	Enrollment Count (4-year)		5612	675	4910	6533	1623
	Federal Grant Aid Enrollment (4 year)		1885	877	119	749	1170
	Cost of Attendance (4 year)		15763	1500	13608	17588	3980
	4 Year Graduates		3939	121	3797	4132	335

Table 12. Continued

State	Variable	n	Mean	SD	Min	Max	Change over time
Michigan		9					
	Prior Year HS Enrollment		538006	14801	507906	555916	48010
	August Unemployment Rate		7.7	2.7	5.2	14.4	9.2
	May Unemployment Rate		8.4	2.9	6.3	14.2	7.9
	Gross State Product - Per Capita		41260	1957	36676	42919	6243
	Fall In-State Enrollment (4 year)		34289	3784	27093	38057	10964
	Enrollment Count (4-year)		56241	12506	44298	73109	28811
	Federal Grant Aid Enrollment (4 year)		4102	11317	2167	9581	16413
	Cost of Attendance (4 year)		16144	854	15083	17527	2443
	4 Year Graduates		39449	1997	35784	42037	6253
	Fall In-State Enrollment (2 year)		3462	952	2626	5434	2808
	Enrollment Count (2 year)		35568	12436	24255	52958	28703
	Federal Grant Aid Enrollment (2 year)		12127	5262	1681	3378	8890
	Cost of Attendance (2 year)		12420	390	11957	13123	1166
	2 Year Graduates		15067	2076	11754	18424	6670
Nebraska		9					
	Prior Year HS Enrollment		89751	1643	87792	91811	4019
	August Unemployment Rate		3.9	0.6	3.1	4.8	1.7
	May Unemployment Rate		3.9	0.7	3.0	4.7	1.7
	Gross State Product - Per Capita		48162	1999	45488	51378	5890
	Fall In-State Enrollment (4 year)		6619	371	6015	7004	989
	Enrollment Count (4-year)		10309	1964	7225	11999	4774
	Federal Grant Aid Enrollment (4 year)		5774	2274	280	1879	2573
	Cost of Attendance (4 year)		15975	915	14036	16974	2937
	4 Year Graduates		7691	448	7352	8449	1097
	Fall In-State Enrollment (2 year)		3272	1083	1687	4458	2771
	Enrollment Count (2 year)		7622	850	6654	9283	2629
	Federal Grant Aid Enrollment (2 year)		11155	2235	454	1751	2880
	Cost of Attendance (2 year)		11602	480	11049	12459	1410
	2 Year Graduates		4268	433	3829	5085	1256

Table 12. Continued

State	Variable	n	Mean	SD	Min	Max	Change over time
New Hampshire		9					
	Prior Year HS Enrollment		64790	2334	60805	67384	6579
	August Unemployment Rate		4.6	1.2	3.5	6.5	3.0
	May Unemployment Rate		4.7	1.2	3.3	6.5	3.2
	Gross State Product - Per Capita		48220	560	47265	48857	1592
	Fall In-State Enrollment (4 year)		2654	168	2364	2862	498
	Enrollment Count (4-year)		6157	788	4831	6865	2034
	Federal Grant Aid Enrollment (4 year)		13733	967	299	636	1361
	Cost of Attendance (4 year)		22090	1780	19819	24793	4973
	4 Year Graduates		4782	452	4177	5366	1189
	Fall In-State Enrollment (2 year)		1674	407	1129	2266	1137
	Enrollment Count (2 year)		4146	2048	2356	7768	5412
	Federal Grant Aid Enrollment (2 year)		7290	644	269	321	988
	Cost of Attendance (2 year)		22237	2850	18392	25672	7280
	2 Year Graduates		1555	141	1378	1845	467
Vermont		9					
	Prior Year HS Enrollment		28917	1849	26338	31659	5321
	August Unemployment Rate		4.9	1.0	3.8	6.6	2.8
	May Unemployment Rate		4.9	1.1	3.6	6.9	3.3
	Gross State Product - Per Capita		42277	871	40855	43222	2367
	Fall In-State Enrollment (4 year)		1431	102	1233	1580	347
	Enrollment Count (4-year)		4727	383	3881	5169	1288
	Federal Grant Aid Enrollment (4 year)		7899	971	150	746	1178
	Cost of Attendance (4 year)		20206	1589	18207	22627	4420
	4 Year Graduates		3232	306	2702	3572	870
	Fall In-State Enrollment (2 year)		231	50	153	320	167
	Enrollment Count (2 year)		1154	301	558	1491	933
	Federal Grant Aid Enrollment (2 year)		13883	126	45	61	200
	Cost of Attendance (2 year)		15288	766	14488	16342	1853
	2 Year Graduates		499	39	453	552	99

Table 12. Continued

State	Variable	n	Mean	SD	Min	Max	Change over time
Wisconsin		9					
	Prior Year HS Enrollment		275757	10863	264550	292100	27550
	August Unemployment Rate		6.5	1.6	4.8	8.9	4.1
	May Unemployment Rate		6.5	1.7	4.4	8.7	4.3
	Gross State Product - Per Capita		45072	977	43215	46456	3241
	Fall In-State Enrollment (4 year)		23216	925	21689	24349	2660
	Enrollment Count (4-year)		43244	894	41640	44425	2785
	Federal Grant Aid Enrollment (4 year)		5500	7752	1416	5430	9223
	Cost of Attendance (4 year)		17859	862	16174	19252	3079
	4 Year Graduates		25569	1373	23776	27427	3651
	Fall In-State Enrollment (2 year)		1964	325	1421	2351	930
	Enrollment Count (2 year)		17507	2359	14273	21449	7176
	Federal Grant Aid Enrollment (2 year)		4931	3583	874	2575	4813
	Cost of Attendance (2 year)		13735	691	12725	14887	2162
	2 Year Graduates		8943	792	8074	10026	1952

Appendix C

DiD Regression Tables with Controls

Table 13.

Results at 2-year institutions using fixed effects regression model with multi-year comparison group

	1 Year		2 Year		3 Year	
	ß	SE	ß	SE	ß	SE
Articulation Agreements' effect on:						
Graduations	713.1	428.0	787.3	468.9	1151.5*	411.3
First-Time, First-Year Enrollment	589.9	442.0	63.8	499.6	156.3	511.5
First-Time, First-Year Enrollment for Federal Grant Aid Recipients	842.6*	342.4	710.7	406.3	401.6	464.5
Controls						
Measuring Graduation						
Time	420.6*	150.0	378.0*	129.1	387.6**	126.5
Total Enrollment	0.05	0.04	0.07*	0.02	0.08**	0.02
Cost of Attendance	-0.13	0.13	-0.19	0.14	-0.20	0.16
Gross State Product- Per Capita	-0.16*	0.07	-0.10	0.08	-0.10	0.07
May Unemployment Rate	-104.0	62.1	-49.0	76.9	-97.5	62.2
Measuring Enrollment						
Time	142.0	104.1	192.5	104.1	193.6	109.2
Cost of Attendance	-0.15	0.16	-0.11	0.14	-0.15	0.16
Gross State Product- Per Capita	0.10	0.12	0.00	0.13	0.02	0.12
Prior High School Enrollment	0.00	0.01	0.01	0.01	0.02	0.01
August Unemployment Rate	489.0**	143.6	394.3*	144.3	383.5*	160.6
Measuring Enrollment - Federal Grant Aid						
Time	347.8*	124.9	279.7*	108.5	278.8*	108.4
Cost of Attendance	-0.33**	0.11	-0.29*	0.12	-0.34*	0.15
Gross State Product- Per Capita	-0.21	0.12	-0.16	0.09	-0.14*	0.06
Prior High School Enrollment	0.01	0.01	0.01	0.01	0.01	0.01
August Unemployment Rate	504.0***	100.0	590.4***	101.8	617.3***	109.3

Note: *p < .05. **p < .01. ***p < .001. Gross State Product – Per Capita and Cost of Attendance are set to 2009 dollars. All coefficients are from the DiD regression, using fixed effects.

Table 14.

Results at 4-year institutions using fixed effects regression model with multi-year comparison group

	1 Year		2 Year		3 Year	
	ß	SE	ß	SE	ß	SE
Articulation Agreements' effect on:						
Graduations	468.1	390.5	692.5	499.1	1189.9	658.0
First-Time, First-Year Enrollment	262.1	513.4	287.0	647.3	308.7	875.1
First-Time, First-Year Enrollment for Federal Grant Aid Recipients	265.8	339.7	54.8	368.4	131.2	401.3
Controls						
Measuring Graduation						
Time	157.4	106.0	248.6*	99.0	267.6*	111.0
Total Enrollment	0.05*	0.02	0.06*	0.02	0.08**	0.02
Cost of Attendance	0.19	0.11	-0.08	0.13	-0.09	0.17
Gross State Product- Per Capita	0.09	0.07	0.13	0.06	0.10	0.06
May Unemployment Rate	81.3	60.4	93.0	62.9	38.3	72.0
Measuring Enrollment						
Time	275.5	174.2	245.2	178.1	269.6	190.5
Cost of Attendance	0.17	0.19	0.11	0.19	0.08	0.25
Gross State Product- Per Capita	-0.05	0.12	-0.01	0.11	-0.06	0.10
Prior High School Enrollment	0.04	0.03	0.05	0.03	0.04	0.03
August Unemployment Rate	-22.3	96.7	74.1	79.4	91.0	80.1
Measuring Enrollment - Federal Grant Aid						
Time	112.3	108.8	172.7	92.4	144.5	90.7
Cost of Attendance	0.08	0.13	-0.13	0.10	-0.08	0.12
Gross State Product- Per Capita	-0.06	0.09	-0.01	0.07	0.01	0.06
Prior High School Enrollment	-0.01	0.01	-0.01	0.01	-0.01	0.01
August Unemployment Rate	216.4*	82.5	265.6**	78.3	263.8***	64.5

Note: *p < .05. **p < .01. ***p < .001. Gross State Product – Per Capita and Cost of Attendance are set to 2009 dollars. All coefficients are from the DiD regression, using fixed effects.

Table 15.

Results at 2-year institutions with state legislated policy using fixed effects regression model with multi-year comparison group

	1 Year		2 Year		3 Year	
	ß	SE	ß	SE	ß	SE
Articulation Agreements' effect on:						
Graduations	663.7	393.4	940.3	501.7	1302.0*	439.5
First-Time, First-Year Enrollment	603.2	546.6	174.9	614.5	153.4	601.6
First-Time, First-Year Enrollment for Federal Grant Aid Recipients	1215.0**	317.9	1130.6*	424.2	892.4	456.8
Controls						
Measuring Graduation						
Time	388.3*	156.4	357.3*	142.0	355.5*	136.6
Total Enrollment	0.06	0.04	0.07*	0.03	0.07***	0.02
Cost of Attendance	-0.12	0.13	-0.17	0.14	-0.20	0.16
Gross State Product- Per Capita	-0.11	0.05	-0.08	0.08	-0.06	0.07
May Unemployment Rate	-105.8	73.7	-55.8	90.3	-50.2	64.0
Measuring Enrollment						
Time	128.9	107.4	177.2	110.8	159.4	116.7
Cost of Attendance	-0.14	0.16	-0.07	0.14	-0.12	0.17
Gross State Product- Per Capita	0.09	0.12	-0.02	0.15	0.02	0.13
Prior High School Enrollment	0.00	0.01	0.01	0.01	0.02	0.01
August Unemployment Rate	453.3*	169.0	344.9	181.7	364.8	197.6
Measuring Enrollment - Federal						
Time	381.9*	128.9	317.1*	113.2	309.9*	114.8
Cost of Attendance	-0.33*	0.11	-0.30*	0.12	-0.36*	0.16
Gross State Product- Per Capita	-0.25*	0.11	-0.19*	0.07	-0.16*	0.05
Prior High School Enrollment	0.01	0.01	0.01	0.01	0.01	0.01
August Unemployment Rate	436.5**	124.7	521.2**	138.4	557.0**	143.4

Note: *p < .05. **p < .01. ***p < .001. Gross State Product – Per Capita and Cost of Attendance are set to 2009 dollars. All coefficients are from the DiD regression, using fixed effects.

Table 16.

Results at 4-year institutions with state legislated policy using fixed effects regression model with multi-year comparison group

	1 Year		2 Year		3 Year	
	ß	SE	ß	SE	ß	SE
Articulation Agreements' effect on:						
Graduations	652.0	421.3	985.6	566.0	1633.2*	746.4
First-Time, First-Year Enrollment	345.4	557.7	383.3	700.3	421.5	914.7
First-Time, First-Year Enrollment for						
Federal Grant Aid Recipients	343.4	381.8	185.4	410.7	260.2	399.9
Controls						
Measuring Graduation						
Time	197.9	123.5	287.6*	118.6	268.9	134.0
Total Enrollment	0.0	0.0	0.0	0.0	0.05*	0.0
Cost of Attendance	0.2	0.1	-0.1	0.1	-0.1	0.2
Gross State Product- Per Capita	0.1	0.1	0.13*	0.1	0.1	0.1
May Unemployment Rate	81.0	67.5	99.2	69.4	97.7	64.9
Measuring Enrollment						
Time	308.0	191.5	272.8	195.8	283.8	209.4
Cost of Attendance	0.16	0.19	0.10	0.19	0.09	0.26
Gross State Product- Per Capita	-0.05	0.12	-0.01	0.11	-0.07	0.10
Prior High School Enrollment	0.04	0.03	0.04	0.03	0.04	0.03
August Unemployment Rate	-68.2	101.9	39.6	86.4	74.5	90.7
Measuring Enrollment - Federal						
Time	147.0	117.4	208.5	101.2	167.5	102.4
Cost of Attendance	0.05	0.13	-0.15	0.11	-0.08	0.12
Gross State Product- Per Capita	-0.05	0.10	0.00	0.07	0.02	0.06
Prior High School Enrollment	-0.01	0.01	-0.01	0.01	-0.01	0.01
August Unemployment Rate	227.2*	90.4	276.2**	82.6	286.8***	67.2

Note: *p < .05. **p < .01. ***p < .001. Gross State Product – Per Capita and Cost of Attendance are set to 2009 dollars. All coefficients are from the DiD regression, using fixed effects.

2005 Comparison Year Tables for Two and Four-Year Institutions with All States

Table 17.

Results at 2-year institutions using fixed effects regression model with 2005 comparison group

	1 Year		2 Year		3 Year	
	ß	SE	ß	SE	ß	SE
Articulation Agreements' effect on:						
Graduations	420.6	408.6	493.3	471.1	972.5**	306.0
First-Time, First-Year Enrollment	479.2	487.9	210.4	561.2	627.1	575.8
First-Time, First-Year Enrollment for Federal Grant Aid Recipients	438.6	438.0	498.0	629.3	187.9	668.1
Controls						
Measuring Graduation						
Time	502.3***	125.2	433.9**	126.3	444.8**	118.3
Total Enrollment	0.04	0.03	0.06*	0.03	0.08***	0.02
Cost of Attendance	-0.12	0.14	-0.12	0.15	-0.14	0.15
Gross State Product- Per Capita	-0.25*	0.09	-0.20	0.10	-0.18	0.09
May Unemployment Rate	-76.9	49.5	-32.8	75.3	-119.5	69.6
Measuring Enrollment						
Time	206.1	153.6	249.0	141.4	186.6	186.3
Cost of Attendance	-0.13	0.28	0.03	0.19	0.03	0.19
Gross State Product- Per Capita	-0.05	0.16	-0.15	0.17	-0.07	0.21
Prior High School Enrollment	0.00	0.01	0.00	0.01	0.01	0.01
August Unemployment Rate	417.7*	172.5	302.1	168.1	316.2	207.6
Measuring Enrollment - Federal						
Time	487.6**	155.0	374.9*	127.9	320.1*	144.5
Cost of Attendance	-0.32	0.18	-0.22	0.17	-0.20	0.18
Gross State Product- Per Capita	-0.37*	0.14	-0.31*	0.11	-0.25	0.12
Prior High School Enrollment	0.00	0.01	0.00	0.01	0.00	0.01
August Unemployment Rate	421.1**	120.3	512.6***	95.0	568.9***	105.8

Note: *p < .05. **p < .01. ***p < .001. Gross State Product – Per Capita and Cost of Attendance are set to 2009 dollars. All coefficients are from the DiD regression, using fixed effects.

Table 18.

Results at 4-year institutions using fixed effects regression model with 2005 comparison group

	1 Year		2 Year		3 Year	
	ß	SE	ß	SE	ß	SE
Articulation Agreements' effect on:						
Graduations	521.2	396.3	862.8	508.2	1276.3	601.6
First-Time, First-Year Enrollment	-303.0	594.1	-93.1	629.2	-295.5	770.0
First-Time, First-Year Enrollment for Federal Grant Aid Recipients	305.8	236.7	422.6	280.7	118.8	341.1
Controls						
Measuring Graduation						
Time	233.0	145.1	259.4	137.4	268.8	144.6
Total Enrollment	0.03	0.02	0.07*	0.03	0.10*	0.03
Cost of Attendance	0.16	0.12	-0.02	0.12	-0.03	0.17
Gross State Product- Per Capita	0.01	0.08	0.07	0.08	0.04	0.08
May Unemployment Rate	109.5	77.4	111.9	76.4	47.6	75.3
Measuring Enrollment						
Time	300.2	169.5	230.2	173.6	264.0	182.7
Cost of Attendance	0.13	0.17	0.09	0.17	0.02	0.21
Gross State Product- Per Capita	-0.19	0.15	-0.11	0.14	-0.12	0.12
Prior High School Enrollment	0.03	0.02	0.03	0.02	0.03	0.02
August Unemployment Rate	-83.9	134.2	41.9	109.1	49.8	103.2
Measuring Enrollment - Federal						
Time	135.7	136.2	132.2	118.0	105.4	117.2
Cost of Attendance	0.04	0.13	-0.08	0.10	-0.04	0.12
Gross State Product- Per Capita	-0.11	0.10	-0.02	0.08	-0.02	0.06
Prior High School Enrollment	0.00	0.01	-0.01	0.01	0.00	0.01
August Unemployment Rate	186.5	101.1	265.9*	96.1	269.4**	78.9

Note: *p < .05. **p < .01. ***p < .001. Gross State Product – Per Capita and Cost of Attendance are set to 2009 dollars. All coefficients are from the DiD regression, using fixed effects.

2005 Comparison Year tables for Two and Four-Year Institutions for Only States with a Policy Originating from the State Legislature.

Table 19.

Results at 2-year institutions with state legislated policy using fixed effects regression model with 2005 comparison group

	1 Year		2 Year		3 Year	
	ß	SE	ß	SE	ß	SE
Articulation Agreements' effect on:						
Graduations	464.3	400.5	677.0	484.9	1120.8**	348.5
First-Time, First-Year Enrollment	554.7	590.7	348.6	675.8	677.8	675.7
First-Time, First-Year Enrollment for Federal Grant Aid Recipients	842.0	415.8	929.9	655.8	685.3	679.5
Controls						
Measuring Graduation						
Time	469.7**	121.7	415.4*	141.3	412.5**	130.5
Total Enrollment	0.04	0.03	0.06	0.03	0.07***	0.01
Cost of Attendance	-0.12	0.16	-0.10	0.15	-0.13	0.15
Gross State Product- Per Capita	-0.20*	0.07	-0.18	0.11	-0.15	0.09
May Unemployment Rate	-78.5	55.1	-38.3	92.6	-76.4	83.4
Measuring Enrollment						
Time	179.1	164.5	228.6	159.6	134.9	206.4
Cost of Attendance	-0.08	0.29	0.09	0.20	0.08	0.19
Gross State Product- Per Capita	-0.05	0.17	-0.16	0.19	-0.06	0.23
Prior High School Enrollment	0.00	0.01	0.00	0.01	0.01	0.01
August Unemployment Rate	384.1	192.8	249.2	207.9	302.6	250.7
Measuring Enrollment - Federal						
Time	551.5**	156.7	440.8**	131.1	368.7*	148.4
Cost of Attendance	-0.31	0.20	-0.22	0.18	-0.21	0.20
Gross State Product- Per Capita	-0.42*	0.14	-0.36**	0.11	-0.28*	0.12
Prior High School Enrollment	0.00	0.01	0.00	0.01	0.00	0.01
August Unemployment Rate	341.3*	143.5	425.2**	137.2	495.5**	143.4

Note: *p < .05. **p < .01. ***p < .001. Gross State Product – Per Capita and Cost of Attendance are set to 2009 dollars. All coefficients are from the DiD regression, using fixed effects.

Table 20.

Results at 4-year institutions with state legislated policy using fixed effects regression model with 2005 comparison group

	1 Year		2 Year		3 Year	
	ß	SE	ß	SE	ß	SE
Articulation Agreements' effect on:						
Graduations	755.5	420.7	1110.8	574.2	1573.8*	715.3
First-Time, First-Year Enrollment	-131.0	618.1	41.2	681.4	-161.6	801.6
First-Time, First-Year Enrollment for Federal Grant Aid Recipients	378.7	291.9	532.5	334.6	230.7	351.5
Controls						
Measuring Graduation						
Time	293.4	172.4	304.4	168.7	266.6	182.4
Total Enrollment	0.0	0.0	0.1	0.0	0.08*	0.0
Cost of Attendance	0.1	0.1	0.0	0.1	0.0	0.2
Gross State Product- Per Capita	0.0	0.1	0.1	0.1	0.0	0.1
May Unemployment Rate	115.6	90.3	124.3	87.1	114.2	66.8
Measuring Enrollment						
Time	340.5	189.4	261.7	195.9	276.6	206.3
Cost of Attendance	0.11	0.16	0.08	0.17	0.03	0.22
Gross State Product- Per Capita	-0.21	0.16	-0.12	0.14	-0.13	0.13
Prior High School Enrollment	0.03	0.02	0.03	0.02	0.03	0.02
August Unemployment Rate	-151.8	143.9	-9.8	122.4	21.5	116.0
Measuring Enrollment - Federal						
Time	179.1	152.7	174.6	134.1	125.7	139.2
Cost of Attendance	0.01	0.13	-0.09	0.11	-0.04	0.13
Gross State Product- Per Capita	-0.12	0.11	-0.03	0.08	-0.02	0.06
Prior High School Enrollment	0.00	0.01	-0.01	0.01	0.00	0.01
August Unemployment Rate	187.9	112.6	267.1*	102.5	290.1**	87.7

Note: *p < .05. **p < .01. ***p < .001. Gross State Product – Per Capita and Cost of Attendance are set to 2009 dollars. All coefficients are from the DiD regression, using fixed effects.