The Effects of Statewide Transfer Agreements on Community College Enrollment

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JOB MARKET PAPER

Access latest version here

October 29, 2020

Abstract

Community colleges provide entry points to higher education for 42 percent of undergraduates. To facilitate and encourage transfers, states have enacted statewide articulation laws, which mandate the development of formal transfer agreements between community colleges and public, four-year institutions. In this paper I estimate the direct effects of statewide articulation, namely whether they increase transfers from community colleges, and the indirect effects, whether they change student enrollment and attainment choices. I show evidence that statewide articulation laws increase transfers as well as community college enrollment. To investigate the effects of articulation agreements on transfers *into* four-year public universities, I collect community college transfer data from the state of California. My findings show that California's STAR act resulted in an additional 191 transfers per campus per year from California Community Colleges to California State University campuses. I further exploit a quasi-experiment wherein states implement articulation policies over multiple years, and find a statistically significant long-run increase in enrollment at community colleges. This effect is driven by students' substituting away from less competitive four-year institutions.

Keywords: Post-secondary Education; Community Colleges; Transfer; Articulation

JEL Classification: I21, I23, J24

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1 Introduction

Educational attainment is an important determinant of long-run labor-market outcomes. An average student with a college degree will earn twice as much as one with only a high school diploma (Acemoglu and Autor, 2011; Hershbein and Kearney, 2014; Oreopoulos and Salvanes, 2011). To address the rising costs of four-year institutions, community colleges were designed to provide a low-cost, easy-to-access pathway to the benefits associated with a college degree.[1] Since 1960, community colleges have educated nearly half of all first-time freshmen in the United States, of which 80 percent aspire to transfer to four-year institutions. Only a quarter of these students are able to transfer, however, and those who do lose an average of 26 percent of their completed credits in the process (Horn and Skomsvold, 2011; Government Accountability, 2017; Baker, 2016; Schudde, Jabbar and Hartman, 2020). Research highlights innate ability and socioeconomic background as potential explanations for low transfer rates. Much less work has discussed the role of institutional challenges that students face, in particular the difficulties they face with credit transfer.

In this paper I examine how transfer policies - statewide articulation agreements (SAAs) - affect students' transfer, enrollment, and degree-attainment decisions. SAAs are contracts between state community colleges and public universities that allow more credits to transfer across institutions more efficiently. This will encourage more students to transfer and will also alter the costs and benefits of attending community college, increasing its option value. Specifically, in states with an SAA, students can enroll in up to two years of coursework required for a bachelor's degree at a community college, at reduced tuition rates, without hindering their academic progress. Without an SAA, there is no guarantee that credits will transfer, which increases time-to-degree for students who choose the community college route. For this reason, the presence of an SAA can induce more first-time freshmen to enroll in the two-year sector. Finally, most SAAs require an associate's degree to guarantee transfer of credits, therefore making it more likely that a student desiring to transfer will obtain a credential from a community college along the way.

I start by estimating the direct effects of SAAs, namely whether transfers from community colleges into four-year institutions increase. To conduct this analysis I utilize hand collected data from the state of California. Existing data do not distinguish whether students transferred from another four-year institution or from a community college. Therefore,

[1] Kane and Rouse (1999) provide a summary of community colleges, their history and impacts

I collect detailed data on transfer-in enrollment by sending institutions from both the California State University (CSU) and the University of California (UC) systems. I focus my analysis on the 2010 California Students Transfer Achievement Reform Act (STAR), which developed an agreement between California Community Colleges (CCCs) and the CSU system. In principle, this act affected transfers into the CSU system but not the UC system. By comparing transfer-in rates into the CSU system with those into and UC system using a difference-in-differences and triple difference design, I show that the STAR act led to a statistically significant one-percentage-point increase in CCC transfer-in enrollment at CSU campuses relative to UC campuses. This estimate equates to an additional 191 students per CSU campus per year, relative to UC campuses. Considering that there are 112 community colleges in the state of California, this increase yields, on average, only two additional students transferring out of each CCC per year.

I then examine the indirect effects of SAAs using temporal variations in states' adoption of articulation policies. I use a difference-in-differences approach to estimate the effects on first-time freshman enrollment and degree attainment at community colleges. I show that SAAs lead to an increase in first-time freshman enrollment at community colleges. Insofar as community colleges disproportionately serve nontraditional students, I test whether SAA policies have a stronger effects on this population. Using full and part-time enrollment as proxies-for traditional and non-traditional students, respectively-I find that SAAs are more effective in increasing non-traditional enrollment in the long run. I further explore a possible mechanism through which enrollment could increase, specifically, whether students substitute away from four-year institutions. Initially, when pooling all four-year institutions together, I find no drop in first-time freshmen enrollment, indicating that students are *not* substituting away from four-year institutions. However, when I disaggregate by the selectivity of four-year institutions, I find evidence that students are substituting away from *less selective* four-year institutions into community colleges. I do not find an effect on associate's degrees awarded at community colleges in states that enact SAA policies. This is also consistent with previous research that finds no effect in all states that implement SAAs on increasing transfers (Anderson, Sun and Alfonso, 2006). If students are generally not more likely to transfer, then there is no reason to expect them to obtain associate's degrees following the passage of an SAA. Finally, I supplement all my main findings with several additional heterogeneity exercises and robustness checks to ensure the accuracy of my analysis.

Three key insights emerge from this analysis. First, the STAR act's goal was first and foremost to increase the number of associate's degrees awarded. The second goal of interest was increasing transfers into the CSU system. Baker (2016) suggests that the reform was able to achieve its primary goal, but my estimates indicate that this did not translate into a substantial increase in transfers. Second, SAA policies have spillover effects in the form of increasing part-time student enrollment. This increase is offset by a decrease in enrollment at less selective four-year institutions. To evaluate the net effect on students, I conduct a back-of-the-envelope calculation and show that enrolling at community college, without obtaining a degree, will leave students better off than if they enroll at a four-year and drop out.[2] Also, students who enroll at community college then transfer and obtain a four-year degree experience higher lifetime earnings than if they had started at a four-year institution. Third, degree completion is an important metric that affects community college funding (Blankstein and Wolff-Eisenberg, 2020; St. Amour, 2020), and therefore one of the main goals of SAAs is to increase associate's-degree attainment. To that end, almost all SAAs mandate that students must obtain an associate's degree to guarantee credit transfer, yet I observe no effects on degree attainment. This indicates that students are not responding to this portion of SAAs in the desired way, suggesting a need to revisit these policies.

My findings build on the literature on the effectiveness of statewide articulation efforts by providing new estimates of their causal effects on transfer rates from community colleges to four-year public institutions. Earlier studies on SAAs are mostly descriptive and to their credit have provided a wealth of information on patterns and types of agreements implemented across the United States (Kintzer and Wattenbarger, 1985; Bender, 1990; Townsend and Ignash, 2000). Related research that quantifies the effects of SAA is limited. Anderson, Sun and Alfonso (2006) explore the impact of SAAs on the probability of transfer, for all states, using a logistic regression analysis and find no significant effects. Worsham et al. (2020) focus on North Carolina SAA efforts, and examine metrics of success *after* transfer. A study that is close to my research is Baker (2016), who focuses on California, but utilizes a different identification strategy, finding similarly modest effects on transfers from CCC to CSU campuses. In this current study, I include the UC system in my analysis, enabling me to implement a new identification strategy and paint a broader picture of how an entire state university system responds to changes in state legislation. I show that, when compar-

[2]This is a particularly relevant comparison because less selective institutions have lower completions rates.

ing transfers across the CSU and UC systems, the magnitude of the effect is larger than when the UC system is excluded from the analysis.

This paper also provides new evidence pertaining to the determinants of community college attendance and degree attainment. This issue is particularly salient in light of the rising costs of four-year institutions and the emergence of the COVID-19 virus, both of which are forcing many students to stay closer to home and/or reconsider their enrollment decisions (Denning, 2017). Unlike most studies in this space, I focus on state policies that target community college students to further illuminate factors that contribute to their enrollment and educational-attainment decisions. Much of the existing literature examines only student and/or community college characteristics. Carrell and Kurlaender (2016), for example, examine whether observable characteristics of CCCs are significantly correlated with transfer productivity. Similarly, several other studies provide evidence of the effects of innate student ability, academic intensity, and family background on transfers and how well students perform after transferring (Grubb, 1991; Dougherty and Reid, 2006; Dougherty, 1992; Stange, 2012; Doyle, 2009; Leigh and Gill, 1997). Other studies that do examine state and federal policies are concerned primarily with financial aid, e.g. Marx and Turner (2019). I provide new evidence that state *transfer* policies can inadvertently increase enrollment at community colleges, a result which has not been documented in any prior work. [3]

The remainder of the paper proceeds as follows: In section 2, I provide detailed background information on statewide articulation in the United States as a whole as well as in-depth information on California in particular. In section 3, I describe the data. In section 4, I present a conceptual framework to provide a basis for my empirical analysis, and in section 5 I detail the sample construction, describe the identification strategy, and present the econometric models I use to estimate the effects of statewide articulation on transfers, enrollment, and degree attainment. In section 6, I discuss the main findings and heterogeneity, and present robustness analyses, and in section 7 I conclude.

[3]This work also adds to the broader literature on educational attainment and human capital accumulation (Cameron and Heckman, 2001; Averett and Burton, 1996; Goodman, Hurwitz and Smith, 2017; Goodman, Gurantz and Smith, 2020), notably building on the Becker (1993) model of human capital accumulation in a novel way.

2 Articulation Agreements: History and Background

2.1 Articulation in the United States

Articulation agreements were initially developed informally between individual institutions. State agencies and commissions later became involved via legislation or education code action (Kintzer and Wattenbarger, 1985). The *Florida Formal Agreement Plan* of 1971 was the first statewide agreements to be developed and approved. Since then, a total of 41 states have enacted mandatory SAAs through legislation and/or state education board policies. SAAs vary across states. According to the Education Commission of the States, there are three main transfer metrics to consider. A state can mandate the development of a common course numbering (CCN) scheme, which is a uniform numbering convention used at all public postsecondary institutions for lower-division courses. States can also institute a transferable core of lower-division courses (TC), wherein an agreed-upon set of general-education courses must be fully transferable at public institutions.[4] The final metric is the guaranteed transfer of an associate's degree (GAA). This guarantees that students who are awarded associate's degrees before transferring to four-year institutions can transfer all of their credits to those institutions and enter at the junior-standing level. The GAA does not guarantee *admission* to a four-year institution, but rather ensures that credits will be accepted conditional on being admitted.[5] Figure 2 shows the frequency of each policy, and Figure 3 shows that the most states combine a GAA with a TC. [6]

[4]Some agreements allow a state's transferable core to be transferable across *all* public institutions, while others will specify the institutions and/or university system that accepts the transfers. For example, in Alabama, the transferable core is fully transferable across all public institutions, whereas in Alaska it's only transferable across community colleges and the University of Alaska campuses. Institutions may have alternative naming conventions; however, if that is the case, there is a crosswalk for institutions to use in the transfer process.

[5]It is important to note that since a GAA requires that a student obtain an associate's degree, it would not operate through changing transfer-out rates, where transfer-out is defined as a transfer prior to completing degree requirements. Junior standing is achieved when a student successfully completes 60 credit hours. According to Government Accountability (2017), students transferring from 2-year schools to 4-year schools lose around 26 percent of completed credits, on average, in the transfer process. Therefore, to transfer with junior status, a student would have to have completed 81 credit hours at the community college. Most policies state that students are not required to complete any further general-education courses unless they are required for a specific major.

[6]See Figure 1 for a graphical history and progression of statewide articulation

2.2 Articulation in California

Articulation efforts in California date back to the 1970s when articulation agreements were voluntarily developed between institutions. In an effort to streamline the credit transfer process, however, as well as to increase associate's degree attainment among transfer-oriented students, in 2010 the California State Legislature enacted the Student Transfer Achievement Reform Act (STAR) through California senate bill 1440 (SB 1440). This act was designed to "increase the number of students who successfully transfer from California Community Colleges (CCC) to the California State University (CSU) system by establishing transfer degrees." Although bilateral agreements existed prior to this act, STAR differs in three key ways: (1) it guarantees that students who earn transfer degrees (Associate's Degrees for Transfer, ADTs) are admitted to the CSU system, (2) it further guarantees that they are admitted with upper-division junior status, and (3) it precludes CCCs from requiring additional courses for this degree (SB 1440, 2010). This intervention became operational in the fall of 2011, and was widely publicized by local media, CCCs, and the CSU system.[7]

3 Data

3.1 Statewide Articulation Policy Dates

I collect data on state policy dates from three sources: Townsend and Ignash (2000) (TI), the Education Commission of the States (ECS), and the National Conference of State Legislature (NCSL). Townsend and Ignash (2000) was published in 2000, and several states have since developed statewide articulation agreements. I therefore update their data to include states that passed laws more recently using the Education Commission of the States' (ECS) transfer and articulation policies database[8]. The ECS includes descriptions of each state's policies in addition to references to the relevant state code/board policy. For more recent policies I cross-reference the ECS sources with transfer and articulation laws collected by the *National Conference of State Legislature* (NCSL) to collect more details on the policy dates and history.[9]

In their study, TI sent out a survey to executive directors of state boards of higher

[7] See Appendix A for a history of articulation in California
[8] https://www.ecs.org/transfer-and-articulation-policies-db/
[9] The National Conference of State Legislatures provides data on laws passed beginning in 2008.

education and community college agencies, including two relevant questions: *"Does your state have a statewide articulation agreement?"*, and *"When was the agreement developed?"* They then published a list of states and their corresponding SAA years. Their study does not, however, provide sufficient details for me to determine what type of "treatment" actually occurred in the year they report as the first year a SAA was developed.[10] For this reason I use the ECS to locate the source documents/laws for each state. In some states, the statewide articulation clause is embedded within a larger education code. For example, the state of Alabama's clause on statewide articulation is included in a subsection of the *Code of Alabama Section 16-5-8*. In that case, I examine all archived versions of the law to determine the year in which the code was amended to include SAA sections. In other states, SAA laws are a standalone section, and I find the date in which that law was passed. I do this for all 50 states.

I distinguish between two types of dates: enactment dates and operational dates. The date of policy enactment is the year in which a policy/law is passed. For example, if a state reports passing a law in 2000 indicating that an SAA is to be developed, but does not mention anything else in regards to the timeline within which the SAA should be ready to use, I use the year 2000 as the **enactment** date (the first "treated" year). The date of operation is the date by which an SAA is to become operational and used by students and institutions. For instance, if a state passes a policy/law in 2000 indicating that an SAA is to be developed and ready for use by the 2002-2003 academic year, I then define 2002 as the **operational** date (the first "treated" year). On average, the difference between when a policy is enacted and when it becomes operational is 2.3 years.

Following the data-collection process, I create five categories in which each state fits based on my findings. The first category comprises states for which I can verify the TI dates, find the original policy documents, and find the actual operational dates (vs. the date a policy was enacted). The second comprises states for which I am able to find policy documents but am *not* able to find operational dates (only enactment dates). The third comprises cases where I am able to verify the date of agreement through secondary sources (such as reports and archived websites) but for which the original details and policy documents are not available. In these cases I am not able to distinguish between the dates of policy enactment and operation, nor can I determine what exactly is included in the policy.

[10] They list only the year reported by state executives, so I do not know, for instance, if the year listed is the date on which the policy was developed or the date on which it became operational in a state.

The fourth comprises states for which the policy documents I find list different dates from those reported in TI. Finally, the fifth comprises states where I am not able to verify the dates reported in TI or find any policy documents existing before 2000. See Figure B1 for a graphical summary of the data-collection process.

The year I use as the first "treatment" year (or "event time") is defined as the operational date for states that report one and the enactment date for states that do not. Finally, I flag each state in my data according to the above mentioned category into which it falls to conduct the robustness analyses discussed in subsection 6.4.

3.2 Enrollment, Degrees Awarded, and Transfers

Data on higher education outcomes come from the Integrated Post-secondary Education Data System (IPEDS) and its predecessor, the Higher Education General Information Survey (HEGIS). The IPEDS and the HEGIS provide institution-level data on all facets of higher education including, but not limited to, enrollment, graduations, financial aid, institutional finance, and faculty data. In this study I use the enrollment (1968-2018) and completions (1966-2018) surveys. Because the HEGIS is no longer available through the National Center for Education Statistics, I obtained data for the years 1966/68 - 1984 by downloading the HEGIS from the Inter-university Consortium for Political and Social Research (ICPSR).

The completions survey includes data on degrees awarded by degree level (associate's, bachelor's, certificate) and major. The enrollment survey provides information on enrollment by student level (first-time freshmen, sophomores, etc.), race, and full/part-time status. Additionally, the IPEDS reports data on transfer-in enrollment starting in 2007. Their data, however, do not provide enough detail to distinguish between community college transfers or transfers from other sectors. Therefore, I supplement IPEDS data on transfer-in enrollment by collecting data on transfers from community colleges to four-year institutions from the CSU and UC systems, from 2000-2019. For both the CSU and UC systems, data are provided through their respective institutional research offices' websites. Finally, I obtain unemployment rates at the state-by-year level from the Bureau of Labor Statistics and commuting zone data from the United States Department of Agriculture.

3.3 Descriptive Statistics

In Table 1 I report raw enrollment means from 2007 for the CSU and UC institutions that are included in the case study analysis, the first year in which the IPEDS reports transfer data. In this table I show that UC campuses enroll more first-time freshmen than CSU campuses, likely because they are more selective. The difference in number of transfer student enrollment is very small, only about 500 students. Similarly, non-CCC transfers make up only around 1-2 percent of total enrollment in both the CSU and UC systems. Apart from the greater selectivity of UC schools, the systems appear to be similar to one another.

Table 2 shows summary statistics for community colleges and four-year institutions in the IPEDS/HEGIS data at the baseline, i.e. the first year a college is observed in the data. In column (1) I report means at community colleges in states that ultimately pass articulation agreements while in column (2) I report averages for community colleges in states that do not have statewide articulation laws. In column (3) I report means for all four-year institutions. Four-year institutions enroll more total undergraduates and first-time freshman than community colleges, but all three groups of institutions exhibit a similar distribution of full-time, male, and white students. On average, each community college has three public four-year institutions in its commuting zone, and each four-year institution has five community colleges in its commuting zone.

4 Conceptual Framework

This paper examines how SAAs impact student decisions to enroll at a community college or a four-year institution, obtain an associate's degree, and to transfer. In this section, I describe the hypothesized effects of SAAs on choosing to enroll at a community college as a first-time freshman and to obtain an associate's degree, while focusing on the marginal student who will, at some degree of probability, start her higher education at a two-year institution.[11], [12]

Despite the large price tag, the lifetime income value of enrolling at a four-year institu-

[11] I provide additional details on the inequalities and comparative statics in Appendix D.

[12] As opposed to students who will always choose to start their higher educations at four-year schools. I use the terms "two-year institution" and "community college" interchangeably. Throughout this section I am referring to *public* four-year institutions.

tion and obtaining a bachelor's degree vastly outweighs the costs and early career earnings losses associated with completing four years of higher education (Zimmerman, 2014). Also, the payoff for obtaining a bachelor's degree is higher than that for obtaining an associate's degree and of not acquiring any higher education (Acemoglu and Autor, 2011; Hershbein and Kearney, 2014). Yet, not all students choose to enroll at four-year institutions.[13] This means that some students either incur very high idiosyncratic costs associated with attending a four-year institution or they have incorrect beliefs in regards to expected lifetime income. SAAs will operate in this framework by altering either expected lifetime earnings or costs.

A student graduating from high school has three main options-to enroll at a four-year institution, a two-year institution, or to enter the labor force.[14] Her decision will depend on the expected lifetime income associated with each option, weighed against the cost. The price of each option will consist of direct costs such as tuition, fees, and housing as well as indirect costs in the form of the opportunity cost. Students form beliefs on the returns on each college enrollment option prior to enrolling. After college, student i will enter the labor market and work for T years. The present discounted value of lifetime income for enrollment option j is $V(j,T) = \sum_{t=1}^{T} \beta^{t-1}(u(Y_{isjt}))$, where β is the discount factor and $u(Y_{isjt})$ is the value of earnings for individual i, in state s, for choosing enrollment option j in year t. Specifically, $u(Y_{isjt}) = log(Y_{isjt})$. Students will choose enrollment option j that will maximize their utility

$$\max_{j \in J} \; U(Y_{ist}^{j}, c_{st}^{j}) = \sum_{t=0}^{T} \beta^{t-1} Ln(Y_{ist}^{j}) - c_{st}^{j}$$

where $c_{isjt} = \tau_{ist}^{j} + \omega_{ist}^{j} + \epsilon_{ist}^{j}$. The variable τ_{ist}^{j} is the total cost of student i's higher education associated with *starting* with option j. For example, if student i chooses to start at a community college and then transfer to a four-year institution, τ_{ist}^{2yr} will include tuition paid at the community college as well as at the four-year institution. Finally, ω_{ist}^{j} is students i's opportunity cost of choosing option j, and I_{ist}^{j} is the idiosyncratic cost that the student incurs.[15]

[13] In 2017, only 53% of undergraduates were enrolled at four-year institutions (Ginder, Kelly-Reid and Mann, 2019).

[14] For simplicity, I abstract away from considering other options such as for-profit institutions, certificate programs, etc.

[15] Idiosyncratic costs can include things such as distaste for higher education bureaucracy, credit constraints, having to care for family and/or children, having a disability, etc.

Consider student i, a transfer-oriented prospective community college student. Prior to the SAA, this student is indifferent between starting their higher education at a two-year or a four-year institution.[16] With an SAA, this student can in principle enroll in more courses at the community college (earning up to 60 credits) and transfer more credits to the four-year institution. This will increase the total tuition paid at the community college, but decrease the tuition paid at the four-year institution. In other words, this will reduce τ_{ist}^{2yr}. Alternatively, a streamlined SAA can also reduce ϵ_{ist}^{2yr}, which encompasses the added cost of having to navigate the transfer system. In both cases, the SAA will improve the option value of community college, and tip the scales in favor of choosing to start her education at a two-year rather than a four-year institution. This will create what I call the "substitution" effect, where an increase in community college enrollment is accompanied by a decrease in enrollment at four-year public institutions.

Now consider a student i, who is indifferent between attending a community college and entering the labor force.[17] Since many SAAs specify that the affiliated programs are to be advertised to high school students, the implementation of an SAA will introduce to this student a new path to higher education that was previously unavailable. The introduction of an SAA will allow this student to update her expected lifetime earnings, $\sum_{t=0}^{T} \beta^{t-1} Ln(Y_{ist}^{2yr})$ and induce her to enroll at a community college rather than forgo higher education. I call this the "pull" effect.

Finally, consider another transfer-oriented student i who is already enrolled at a community college. Prior to the SAA, she is indifferent between obtaining an associate's degree and transferring with a credential. SAAs will often mandate that students obtain degrees from a community college to guarantee transfer. With an SAA, having an associate's degree will allow a student to transfer more credits with greater certainty. For a student on the margin of obtaining an associate's degree [18], the SAA will push student i to obtain a credential prior to transferring.

[16] A student can be indifferent because, for instance, even though she may know for certain that she will pursue a bachelor's degree, she is weighing the cost of transferring against the high four-year price. The community college may be cheaper, but transferring to a four-year school is complex and requires, among other things, navigating at least two separate education systems: the academic system of the two-year school and the transfer requirements of the four-year university (Baker, 2016; Schudde, Jabbar and Hartman, 2020). For this reason, students might consider taking out student loans to start at a four-year school instead.

[17] These students could be indifferent because they are misinformed about the costs and benefits of higher education, or are unaware of all the options that could ultimately lead to a degree.

[18] If student i had initially planned to enroll in the community college only for one year, SAA will not have an effect on the decision to obtain an associate's degree. The SAA will affect only students who are on the margin of obtaining a degree, i.e. plan to take close to 60 credits at the community college.

This framework produces three testable predictions that serve as a basis for my empirical analysis of first-time freshman enrollment and degree attainment. First, enacting an SAA will lead to an increase in first-time freshman enrollment at community colleges (as a result of the "substitution" or "pull" effect), which can be driven by either traditional or non-traditional students, i.e. full-time or part-time students. Second, this increase in first-time freshman enrollment is a result of students' substituting away from four-year institutions into community college. Finally, SAAs will result in an increase in the number of associate's degrees awarded.

5 Estimation Methodology

In this section I present details on identification and how I address possible identification threats. I also describe the sample of institutions I include in the analyses, and finally, I present the econometric models used to estimate the effects of statewide articulation.

5.1 Identification

The first part of this study aims to examine the effect of statewide articulation on transfer-in enrollment at four-year public institutions. Due to data limitations, the estimation of this outcome is restricted to a case study of California. In particular, I estimate the effect of legislation that created a structured pathway from CCCs to the CSU, but not the UC campuses (the STAR act). Meaning, in principal, the UC system is not affected by the policy. I use this variation to estimate a difference-in-differences strategy where I compare transfer-in enrollment at the CSUs to the UC system, before and after the legislation. However, before conducting this analysis it is important to establish that transfer-in enrollment at both systems evolved similarly before the policy was enacted, this is the standard "parallel trends" assumption that must be satisfied in any difference-in-difference setting in order to estimate a causal relationship. Parallel trends can be observed in the raw data, as seen in Figure 4, and I also evaluate the assumption empirically using an "event study" specification, in which I interact treatment status with an indicator for each year before and after the legislation. This provides an empirical test to confirm that the treatment and control groups are not exhibiting statistically significant differences in the dynamics of the outcome of interest in the years prior to treatment. Figure 5 shows evidence for

flat pre-trends, i.e no statistically significant differences between the CSU and UC systems. Finally, for a more robust analysis I also conduct a difference-in-difference-in-differences (triple difference) analysis as described in Wooldridge (2007). I compare transfer-in to first-time freshmen enrollment within institution, across the CSU and UC campuses. This will control for two possible confounding trends: changes in transfer-in enrollment across the whole state, and changes in overall enrollment trends at the CSU campuses (that may have nothing to do with the transfer legislation).

The second goal of this study is to estimate the causal impact of statewide articulation on enrollment and degree attainment. Ideally, statewide articulation would be randomly assigned to observably similar states, however, such an experiment is not feasible. Therefore, I use a difference-in-differences strategy, where I compare outcomes in treated states to outcomes in untreated states before and after the policy, to obtain causal estimates. There is one main threat to identification to this portion of the study, that is, potential endogenous trends. The first order objective of statewide articulation agreements is to encourage students to transfer to a four-year institution, with or without an associate's degree. A second order objective is to increase the efficiency of the transfer process and educational attainment. It may then be that states enact statewide articulation laws, knowing that it might have spillover effects, in order to potentially boost enrollment and improve their community college systems completion metrics. If this is true, then passing statewide articulation laws could coincide with other efforts that aim to increase enrollment and completions, which would inflate any difference-in-differences results. In addition, it would make it difficult to discern between the effect of statewide articulation and other policies that are in place to increase community college enrollment. Fortunately, I can also evaluate the potential of this threat by estimating an event study specification. This will empirically confirm that the treatment and control groups are not exhibiting statistically significant differences in trends prior to treatment.

5.2 Sample Restrictions

For the case study analysis, I restrict my sample to CSU and UC campuses in the years 2007-2018, the years for which IPEDS transfer-in data is also available. The geographic unit of analysis for the second empirical strategy are entire states. In this analysis I only use the IPEDS and HEGIS data, which survey all institutions of higher education in the

United States every year. I restrict my main sample to publicly controlled institutions since they are the institutions primarily targeted by state policy. Over the entire sample period, I often observe institutions merge and switch from two-year to four-year or vice-versa. To maintain consistency of my sample I exclude institutions that ever report only awarding certificates, are not consistently classified as a two-year or a four-year college, merge with another institution, are ever not publicly controlled, are ever categorized as a mixed baccalaureate/associate's college or associate's dominant four-year, not accredited, or an institution with a special focus.[19] I balance the sample by only including institutions that report outcomes from $T-3$ to $T+3$, while also keeping institutions that have data either only for the pre or post-period. Additionally, I restrict my main analysis sample to institutions that report outcomes for at least 40 years, this is to avoid issues caused by changing sample composition.[20] I also expand the balance thresholds to include institutions that report outcomes from $T-5$ to $T+5$ as a robustness exercise, presented in **??**.

5.3 California Case Study Econometric Models

I begin my formal analysis by estimating an event study design to show that the CSU and UC systems exhibit parallel trends prior to treatment, and to illustrate the evolution of the effect over time. The estimating equation is:

$$Y_{it} = \alpha_i + \alpha_t + \sum_{\substack{k=-5,\\ k\neq -1}}^{k=8} \beta_{k1} CSU_{it} + \sum_{\substack{k=-5,\\ k\neq -1}}^{k=8} \beta_{k2} \mathbb{1}(t = 2011+k) + \sum_{\substack{k=-5,\\ k\neq -1}}^{k=8} \beta_{k3} CSU_{it} \times \mathbb{1}(t = 2011+k) + \gamma_{st}\mathbf{X}_{st} + \epsilon_{it} \tag{1}$$

where Y_{it} is the outcome in institution i and year t, and is calculated as

$$Y_{it} = \frac{\sum_{it} \text{Transfer-in}}{\sum_{it} \text{Total Undergraduates}}$$

CSU_{it} is an indicator equal to one for CSU and zero for UC institutions. Included in Equa-

[19] I define accredited and Special use institutions based on their Carnegie classification. Special focus two-year colleges include: institutions with health professions, technical professions, arts & design, or other field focus. Special focus four-years include: faith-related institutions, medical schools & centers, other health professions schools, engineering schools, other technology-related schools, business & management schools, art, music & design schools, law schools, tribal colleges, or other special focus institutions.

[20] For example, if new schools enter (or exit due to closures) the sample disproportionately in certain years, that would bias my estimates.

tion 1 are institution and year fixed effects, indicated by α_i, α_t, respectively. The institution fixed effects adjust for time-invariant characteristics within institution, while the year effects capture time-varying changes at the state level, such as in aggregate business cycles or public-policy initiatives, that may be correlated with the outcomes. "Event time" defines the first treated cohort and is the year 2011. $\mathbf{X}_{st}$ controls for state-by-year unemployment rates. The coefficients of interest are expressed in the vector β_{k3}.[21]

Next I conduct the triple differences analysis by estimating the following fully interacted model:

$$Y_{it} = \alpha_i + \alpha_{t,csu} + \alpha_{t,type} + \alpha_{csu,type} + \sum_{\substack{k=-5,\\ k\neq -1}}^{k=8} \beta_{k1} CSU_{it} + \sum_{\substack{k=-5,\\ k\neq -1}}^{k=8} \beta_{k2} Transfer_{it} + \sum_{\substack{k=-5,\\ k\neq -1}}^{k=8} \beta_{k3} \mathbb{1}(t = 2011+k)$$
$$+ \sum_{\substack{k=-5,\\ k\neq -1}}^{k=8} \beta_{k4} CSU_{it} \times \mathbb{1}(t = 2011+k) + \sum_{\substack{k=-5,\\ k\neq -1}}^{k=8} \beta_{k5} Transfer_{it} \times \mathbb{1}(t = 2011+k) + \sum_{\substack{k=-5,\\ k\neq -1}}^{k=8} \beta_{k6} CSU_{it} \times Transfer_{it}$$
$$+ \sum_{\substack{k=-5,\\ k\neq -1}}^{k=8} \beta_{k7} CSU_{it} \times Transfer_{it} \times \mathbb{1}(t = 2011 + k) + \gamma_{st} \mathbf{X}_{st} + \epsilon_{it} \quad (2)$$

where Y_{it} is now defined as $\frac{\sum_{it} \text{Transfer-in}}{\sum_{it} \text{Total Undergraduates}}$ for transfer students, and $\frac{\sum_{it} \text{FTF}}{\sum_{it} \text{Total Undergraduates}}$ for first-time freshmen at institution i in year t, and $Transfer_{it}$ is an indicator equal to one for transfer student observations.[22] The coefficients of interested are stored in vector β_{k7}, showing the effect of the 2010 policy on transfer-in relative to first-time freshmen enrollment at the CSU campuses compared to the UCs. The triple difference design allows me to include multiple interacted fixed effects, namely, α_i, $\alpha_{t,csu}$, $\alpha_{t,type}$, and $\alpha_{csu,type}$ which represent institution, CSU-by-year, Student type (transfer, first-time freshman)-by-year, and CSU-by-student type effects, respectively. The CSU-by year-fixed effect accounts for time varying trends at the CSUs, Student type (transfer, first-time freshman)-by-year controls for changes in trends for transfers and first-time freshman, and finally, CSU-by-student type effects control for time invariant changes at CSUs for both transfer and first-time enrollment.

Finally, I estimate a difference-in-differences model that show the average effect of the

[21] I set $\beta_{-1} = 2010$ and assign all UC institution observations an event time equal to -1

[22] In my data, I have two observations per institution per year. One observation is for transfer enrollment, and the other for first-time freshmen.

policy in the years post treatment; a weighted average of the results produced by equation Equation 1. The model is:

$$Y_{it} = \alpha_i + \alpha_t + \beta_1 CSU_{it} + \beta_2 Post_{it} + \beta_3 CSU_{it} \times Post_{it} + \gamma_{st}\mathbf{X}_{st} + \epsilon_{it} \tag{3}$$

where $Post_{it}$ is an indicator equal to one starting in the year 2011 thereafter. All other variables are the same as in equation Equation 1. The main coefficient of interest in this analysis is β_3, which reflects a weighted average causal effect of the STAR reform on outcome transfer-in enrollment in the eight years following its enactment.

The analogous triple differences model for Equation 2 is:

$$\begin{aligned} Y_{it} = \alpha_i + \alpha_{t,csu} + \alpha_{t,type} + \alpha_{csu,type} + \beta_1 CSU_{it} + \beta_2 Post_{it} + \beta_3 Transfer_{it} \\ + \beta_4 CSU_{it} \times Post_{it} + \beta_5 CSU_{it} \times Transfer_{it} + \beta_6 Post_{it} \times Transfer_{it} \\ + \beta_7 CSU_{it} \times Transfer_{it} \times Post_{it} + \gamma_{st}\mathbf{X}_{st} + \epsilon_{it} \end{aligned} \tag{4}$$

where all variables are the same as in Equation 3, and with the addition of $Transfer_{it}$, an indicator for transfer student observations within an institution. The main coefficient of interest in this analysis is β_7.

5.4 Enrollment and Degree Attainment Econometric Model

I similarly begin this analysis by estimating an event study model to empirically test the parallel-trends assumption and show the evolution of the effect of statewide articulation over time. The estimating equation is:

$$Y_{ist} = \alpha_i + \alpha_{r(i)t} + \sum_{\substack{k=-5, \\ k\neq -1}}^{k=10} \beta_k \; Art_{ist} \; \mathbb{1}(t = t_i^* + k) + \gamma_{st}\mathbf{X}_{st} + \epsilon_{it} \tag{5}$$

where Y_{ist} is the outcome in institution i in state s and year t. To assess the effect of SAA on students' decision to enroll at community college, and their subsequent decision to obtain an associate's degree, the main outcomes of interest are the natural logarithm of first-time freshmen enrolled and the natural logarithm of associate's degrees awarded.

Art_{ist} is an indicator equal to one if institution i is in a state s that passes a statewide articulation law, and zero otherwise. Included in Equation 5 are institution and region-by-year fixed effects, indicated by $\alpha_i, \alpha_{r(i)t}$, respectively. The region-by-year fixed effects account nonparametrically for differential trends across regions of the United States, and $\mathbf{X}_{st}$ controls for state-by-year unemployment levels, which is intended to reduce standard errors and control for time-varying trends in college enrollment related to employment opportunities. The coefficients of interest are expressed in the vector β_{k3}. The construction of event time defines the first treated cohort - i.e students at time $k = 0$ - and varies across different outcomes. For example, when examining the effect of SAA on first-time freshmen enrollment, the first cohort affected is students enrolling in college for the first time in the first year SAA laws are operational. For this reason, if a state passes a law in, for instance, the year 2000, then the first treated cohort would be the 2000 cohort. On the other hand, when the outcome of interest is associate's degree awarded, then the first treated cohort would still be the same (the 2000 cohort), but their outcomes would be reported in IPEDS in 2002. For this reason, event time is defined as the year of articulation plus two for the associate's degrees awarded outcome. It is also important to note that, on average, time elapsed between policy enactment and when it becomes operational is 2.3 years, thus I expect that effects would be delayed by at least that long.

Next I estimate a pooled difference-in-differences model - two-way fixed effects - that shows the average effect of statewide articulation in the years post treatment. The model is:

$$Y_{ist} = \alpha_i + \alpha_{r(i)t} + \beta Art_{ist} + \gamma_{st}\mathbf{X}_{st} + \epsilon_{it} \tag{6}$$

where the variable Art_{ist} is an indicator that takes the value of one if a state passes statewide articulation laws in year t thereafter. All other variables are the same as in Equation 5. The main coefficient of interest in this analysis is β.

6 The Effect of Statewide Articulation on Transfers, Enrollment, and Degree Attainment

This section presents the main results. I start by assessing the validity of the difference-in-difference research design. Using an event study analysis, I show that the treated and control groups exhibit parallel trends in the years prior to the enactment of SAA. I proceed to discuss average and heterogeneous effects of SAA on transfers into four-year public universities, first-time freshmen enrollment, and associates degree attainment at community colleges.

6.1 Transfer-in Enrollment at the California State Universities

To examine if there is an increase in transfers into the CSUs, regardless of changes in first-time freshmen enrollment, I proceed to compare the CSUs to UC campuses using a difference-in-differences analysis. Figure 5(b) shows the results, in which there is an average of one percentage point, statistically significant, increase in transfer-in enrollment as a proportion of total undergraduates after the policy was enacted. The effect, however, is not sustained over time. In the second and third year after, transfer-in rates are higher than the years prior to the STAR act, but the effect is decreasing over time and reaches zero after four years. The increase of one percentage point translates to 191 additional students transferring into the CSUs. This may appear large at first glance, but considering that there are 112 community colleges in the state of California, this would yield approximately two student per college per year.

I then estimate whether transfer-in enrollment increases relative to first-time freshmen *within* institution, at both the CSUs and UCs. This would show if there is an increase in transfer-in enrollment, and if so, if it results in crowding out first-time freshmen. In order to do so, I conduct a triple differences analysis. The result of this estimation are presented in Figure 5(a). The event study figures show flat pre-trends indicating that the control group used in this analysis is a valid one. I find no effect on transfer-in enrollment when comparing it to first-time freshmen, meaning any increase in transfers is not crowding out first-time freshmen.

One possible reason that the ADT does not increase transfers to the CSUs is that it did not significantly (or meaningfully) decrease the barriers to transfer. For instance, although

the obtaining an ADT guarantees admission into a CSU, not all ADTs are accepted at all CSUs. In particular, an ADT does not guarantee admission into a local CSU. This may pose difficulties for student who are accepted at a campus that would require them to move. Additionally, it does not guarantee acceptance into a specific major. If a student desires to study engineering, and they are not accepted into a school of engineering at a CSU, they may choose to enroll elsewhere even if it means they will lose credits. Finally, Baker (2016) speculates that the ADT program could be unintentionally diverting students from four-year degrees; if the introduction of ADTs creates an atmosphere that communicates the transfer process is complicated and difficult, the policy might be unintentionally "cooling out" marginal students (Clark, 1963). Additional data is needed to investigate why transfers from CCCs to CSUs do no increase as a result of the ADT program.

6.2 First-time Freshmen Enrollment and Degrees Awarded

In this analysis, I start by showing the dynamic effect of SAA policies in the ten years following their enactment, in particular on first-time freshmen enrollment at community college. Figure 6 shows the main results, most importantly, it provides evidence for flat pre-trends, which validates the choice of research design. Figure 6(a) plots the effect of SAA on total first-time freshmen enrollment at community colleges and shows an increasing trend that is not transitory, and in fact, grows over time, albeit not statistically significant. However, it is important to consider that community colleges disproportionately serve non-traditional students, so any effects would operate on this margin. Therefore, I examine the effect of SAA on part-time and full-time as proxies for traditional and non-traditional enrollment. The results of this analysis are illustrated in Figure 6(b), which shows a larger effect for part-time students. The average effect is estimated at 21.4 percent, which equates to 113 additional part-time students enrolling per college per year. This increases part-time enrollment at community colleges from 48 to 59 percent of total enrollment. The result is only statistically significant in the long-run, which is defined as five or more years after SAA policies are enacted. This is to be expected given that, on average, it takes around 2.3 years for the policies to be put into practice after their enactment. These results are also summarized in Table 4 and Table 5.

Next I investigate if the increase in community college first-time enrollment is due to students substituting away from four-year institutions (the "substitution" channel). To that

end, I estimate the effect of SAA on first-time freshmen enrollment at four-year institutions. Figure 7 shows evidence for flat pre-trends, and no statistically significant effect of SAA on first-time enrollment. Four years after the policy is implemented, I do observe a decreasing trend, although it is not statistically significant. This analysis pools together all public four-year institutions. However, community colleges will not be attracting students who are considering attending very selective institutions, but rather students who are more likely to attend less selective institutions. Therefore, I explore how SAA affect four-year institutions, by institutional selectivity. The results are presented in Table 6, showing evidence that students are in fact substituting away from *less selective* institutions. In particular, enrollment at less selective four-year institutions decreases by 7.6 percent, which is approximately 122 students, per institution per year. This is almost exactly equal to the increase at community colleges. [23]

The final outcome of interest is associate's degrees awarded. As a result of SAA, I expect to find an increase in enrollment that would eventually lead to an increase in degrees awarded. Figure 9, however, shows no effect on associate's degrees awarded at community colleges in states that enact SAA legislation. There are several possible reasons for this pattern. Since there is no effect on overall enrollment at community colleges, it is possible then that students are simply not affected at all by the SAA. As for the increase in part-time students, they generally take longer to obtain a credential, which would make it difficult to observe an effect in the event study, since the degrees would be dispersed throughout the years (depending on how long it takes each student to graduate).

6.3 Heterogeneity

There is evidence that students make enrollment decisions based on distance to institutions of higher education (Hillman and Weichman, 2016; Turley, 2009). In particular, students, on average, enroll at institutions within 50 miles of their permanent home. To examine how this affects students' response to SAA, I estimate the effect on community colleges by the number of four-year institutions in their commuting zone.[24] Specifically, I examine the effect on community colleges in commuting zones with at least one four-year institution

[23] Table C1 shows some descriptive statistics on the characteristics of more and less competitive institutions.

[24] Commuting zones cluster counties according to journey-to-work data from the U.S. Census Bureau. They are increasingly popular measures of local areas, as seen in recent studies of upward mobility and labor market inequality (Tolbert and Sizer, 1996; Turley, 2009; Chetty et al., 2014).

to those in commuting zones that have none. The results are presented in Table 8, and do not show heterogeneous effect on first-time freshmen enrollment, nor associate's degrees awarded, based on proximity (or access) to four-year institutions. Ex-ante, one would expect to see no change in commuting zones with no four-year institutions, and a positive effect in commuting zones with at least one. The sign of the estimates are as expected, but they are not statistically significant.

Next I explore how the effect differs across states with different sets of subpolicies in place, namely, the common course numbering (CCN), transferable core of lower-division courses (TC), and the guaranteed transfer of an associate's degree (GAA). Figure 3 shows that some states have only one of the aforementioned subpolicies, other states will combine two, and the majority of states combine all three subpolicies in their SAA. The differences in the combination of policies implemented by each state raises the concern of comparability. The flat pre-trends presented in Figure 6 and Figure 9 are evidence that the treatment and control group are comparable, but it still leaves one question unanswered, that is, how does the effect of SAA differ across states with different subpolicy combinations? To answer this question, following Buchmueller and Carey (2018), I estimate the following modified version of Equation 6:

$$Y_{ist} = \alpha_i + \alpha_{r(i)t} + \beta_1 Art_{ist} \times Three_{ist} + \beta_2 Art_{ist} \times Two_{ist} + \beta_3 Art_{ist} \times One_{ist} + \gamma_{st}\mathbf{X}_{st} + \epsilon_{it} \quad (7)$$

where $Three_{ist}$, Two_{ist}, and One_{ist} are indicators equal to one if institution i is in a state s that combines three, two, or one of the subpolicies, respectively, in year t.[25] In this analysis, the coefficients of interest are β_1, β_2, and β_3. The results are shown in Table 8. The policies have the largest effect on part-time enrollment in states that combine two subpolicies in their SAA. I am not able to disentangle this further to examine the effect of each policy combination. However, the most commonly adopted policy combination that bundles two subpolicies, and is likely driving this result, is the guaranteed associate's degree transfer

[25] $Three_{ist}$ includes states that combine the transferable core, common course numbering, and guaranteed associate's degree transfer. Two_{ist} includes states that combine any two of these policies, e.g.: transferable core and common course numbering, transferable core and guaranteed associate's degree transfer, or common course numbering and the guaranteed associate's degree transfer. Finally, One_{ist} includes states that only have one of those policies in place.

(GAA) and the transferable core (TC). Surprisingly, however, I do not find statistically significant effects for states that implement all three policies in their SAA, and in particular that adding a third policy to the mix appears to negate the effect on part-time enrollment. Additionally, it appears that states implementing only one policy in their SAA actually experience negative effects. This is, in fact, consistent with evidence from Texas, which only implements the transferable core (Schudde, Jabbar and Hartman, 2020). My findings from this exercise provide evidence that the GAA along with a TC is most effective, and that if a state is to implement a SAA, they should consider including more than one of the aforementioned subpolicies. However, without additional student level data, it is not possible to divide my sample into sub-samples based on the exact policy combination implemented without losing predictive power. [26]

6.4 Robustness Checks

Subsection 3.1 discuses the method used to collect dates on when state policies were passed or implemented. Importantly, in the data collection process I categorize states into five distinct groups. Group one consists of states for which I am able to obtain original policy documents and distinguish between policy enactment vs. operational date, while group two includes states for which I am able to obtain the original policy documents but *cannot* distinguish between policy enactment vs. operational date.[27] Group three includes states for which I am not able to track down original policy documentation, but find secondary sources that mention the date of policy enactment. Group 4 is small and consists only of four states where I am not able to verify the same dates as Townsend and Ignash (2000) , but find a different SAA date within a five year window of it. Finally, group five includes states for which I am not able to either find original policy details, verify the date listed in Townsend and Ignash (2000) through secondary sources, nor find evidence that a SAA existed within five years of the date reported in their study. States in the second and third groups create a mild problem wherein the effect of treatment might be lagged. For policies that do not specify when the SAA are to be implemented, it is hard to discern when to expect to see an effect. Based on the states for which I do have operational dates, I am

[26] i.e. I cannot assess the impact in states that implement a GAA + TC compared to a states that implements GAA + CCN or a TC + CCN.

[27] Some policies will specify a timeline for the institutions of higher education and specifically mention a date by which the SAA should be implemented. Other policies are more general and do not specify the timeline for institutions.

able to calculate an average of 2.3 years between enactment and operation. The fourth and fifth groups are more problematic and pose more serious threats to identification; in group four, there are two different possible dates of SAA, it is unclear what type of treatment is captured by each date, which makes it harder to interpret the result as causal. Group five dates, on the other hand, are not only unverified, but there are also no available policy details, which raises the same issues as group four.

To alleviate concerns of clean identification, I estimate the main specification, Equation 6, and iterate through excluding each group, starting with the most problematic. The results of this robustness exercise are shown in Table C2. The effect becomes larger and statistically significant once we remove more problematic states. Specifically, in column(5), even though the magnitude of the effect on part-time enrollment is smaller, it becomes more precise, and the effect on total enrollment becomes marginally significant. Degrees awarded exhibit some statistical significance when I omit states that I have no details related to the date of articulation (besides just the date), and again when I include only the states that have verified policy enactment and operational dates. For more details on the states included in each category, please see Table D4 and Table D5

The main results presented in Figure 6 and Figure 9 include all institutions that report data from $T-3$ to $T+3$. Since enrollment data is first reported in 1968, and the first treated states are treated in 1971, the longest pre-period for which I can balance on is three years. However, there are only two states with a treatment date of 1971, Florida and Montana. To check the robustness of my estimates to a more balanced panel, I run the analysis on institutions that report data from $T-5$ to $T+5$. Table C3 shows the results of this analysis. Panel A shows that original main estimates, and panel B shows that results on more balanced sample. For total first-time freshmen enrollment, restricting my sample to be more balanced results in smaller estimated effects.

7 Conclusion

This paper evaluates the effect of statewide articulation laws on transfers into four-year institutions, first-time freshmen enrollment, and degree attainment at community college. The first-order objective of SAA policies is to increase transfers from community colleges to four-year institutions. Since detailed transfer student data is notoriously hard to come

by, I collect data from the *California State University* (CSU) and the *University of California* (UC) systems. I conduct a case study analysis on the effect of the STAR act, which implemented the Associate's Degree for Transfer (ADT) program. My results show d a one percentage point, statistically significant, increase in transfer-in enrollment at the CSU campuses relative to the UCs in the first year after the policy was enacted. This effect, however, is not sustained over time. The increase of one percentage point translates to 191 additional students transferring into the CSUs. Dividing this increase by the 112 community colleges in the state of California yields approximately two student per college per year. This effect is small, especially considering that increasing tranfer-in enrollment is one of the primary goals of the policy. Understanding why the reform was not effective required additional data on community college students.

Next, I show that SAA policies have spillover effects in the form of increasing enrollment at community colleges. Specifically, I observe a long-run increase in part-time student enrollment, which equated to an additional 113 enrolling in each community college per year. This effect on enrollment does not lead to an increase in associate's degrees awarded. I also show that the higher enrollment is a result of students substituting away from less competitive four-year institutions. In order to determine if this effect is a positive or negative spillover, it is necessary to consider students' eventual labor market outcomes.

The average cost, net of financial aid, of attending community college is -$306 per year, whereas the average cost of a four-year institutions is $12,285 (Ma, Pender and Welch, 2019). Average lifetime earnings for a bachelor's, associate's degree, and some college are estimated at $2,254,243, $1,612,050, and $1,485,955, respectively. Attending a community college, then transferring to a four-year institution and obtaining a bachelor's degree rather than starting at the four-year institution will add between $25,182 and $49,752 in lifetime earnings per student.[28] If an additional 113 students are enrolling and there are 880 treated community colleges in my sample, assuming they eventually graduate with a four-year degree, that amounts to a total of $22,160,160 - $43,781,760 in added lifetime earnings per year. This is based on a "best-case scenario" back-of-the-envelope calculation, and is an upper bound to the gains students would experience. However, attending a community college,

[28]This is a "best-case scenario" calculation where a student enrolls part-time at the community college (for four-year), paying an average cost (net of financial aid) of -$306 per year. Then they enroll at the four-year institution (full-time) and graduate after two years. I then compare this to if the student starts at the four-year institution and graduates in four years, in which case the added lifetime earnings (from starting at the community college) are $25,182. If they take six years to graduate, the additional lifetime earnings are larger, $49,752.

not conditional on graduating, always leaves students better off than if they only attend a four-year institution and drop out. On the other hand, if a student attends a community college and does ultimately obtain a bachelor's degree, they are worse off than if they had graduated from a four-year institution. Therefore, whether or not increasing enrollment is a positive or negative spillover depends the student's ultimate educational outcome.

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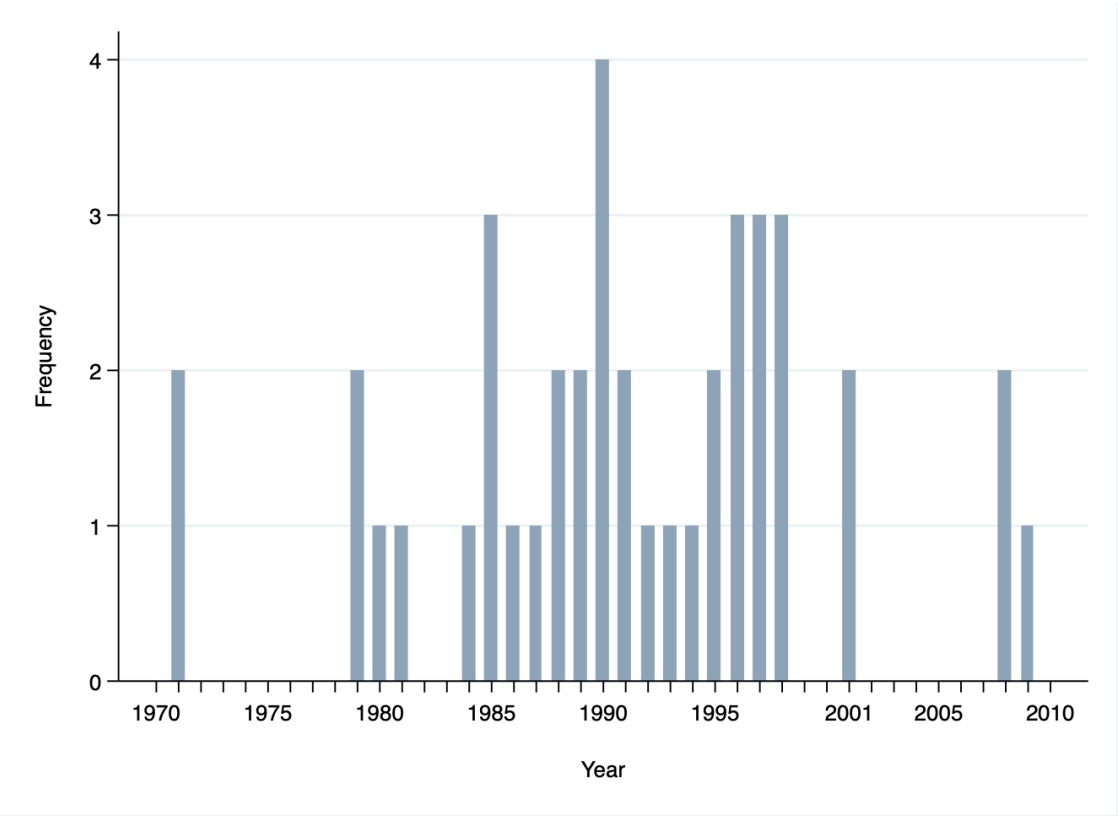
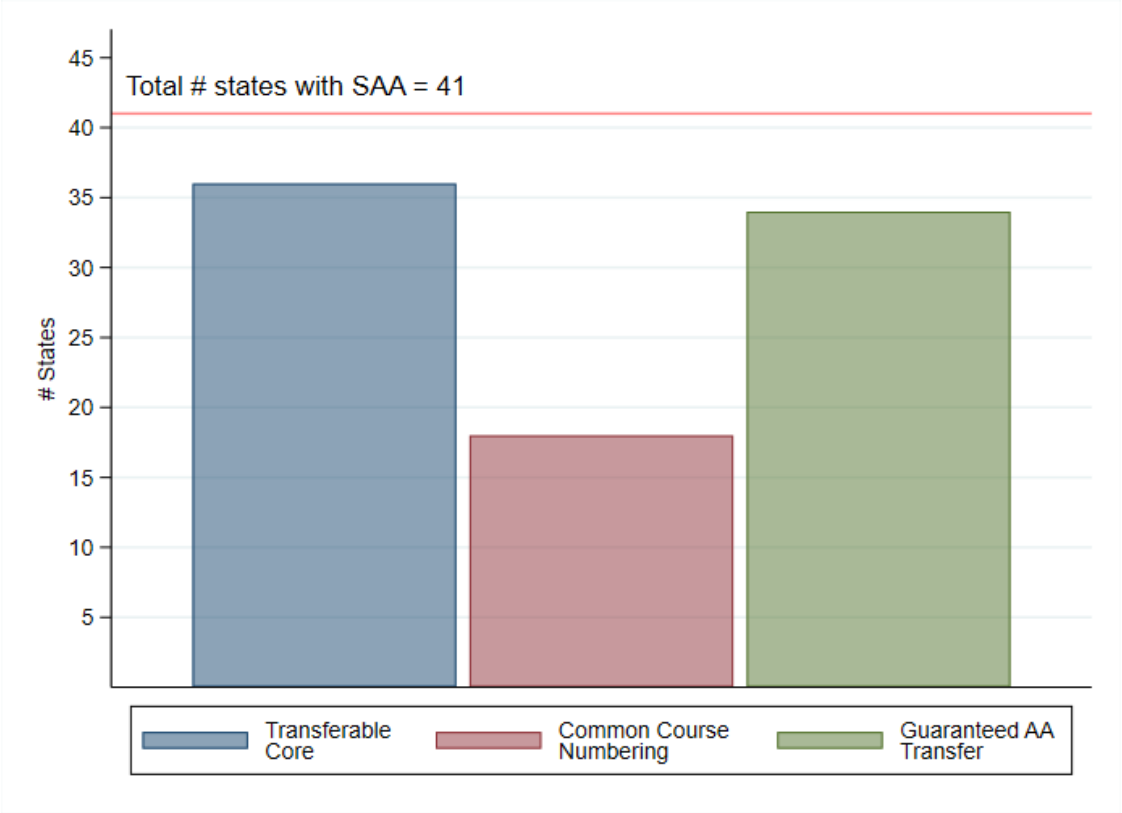
8 Tables and Figures

Figure 1: Distribution of Articulation Year



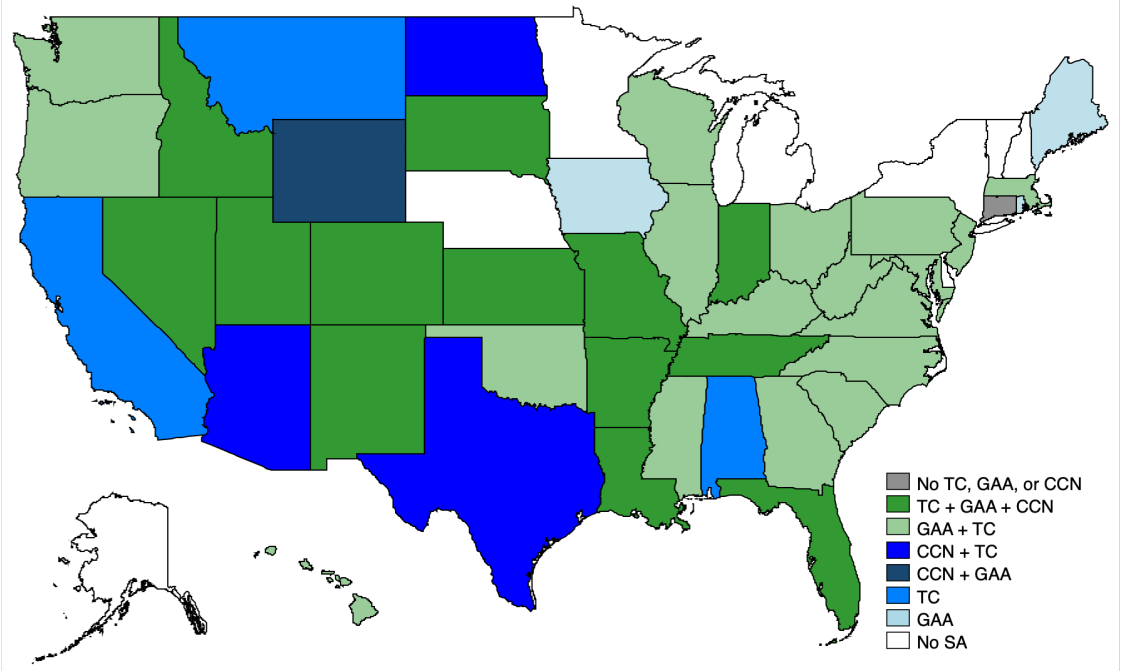
Notes: This figure shows the number of states implementing statewide articulations in each year. For details on how dates were collected, see subsection 3.1

Figure 2: Frequency of Transferable Core, Common Course Numbering, and Guaranteed Associates Transfer across states



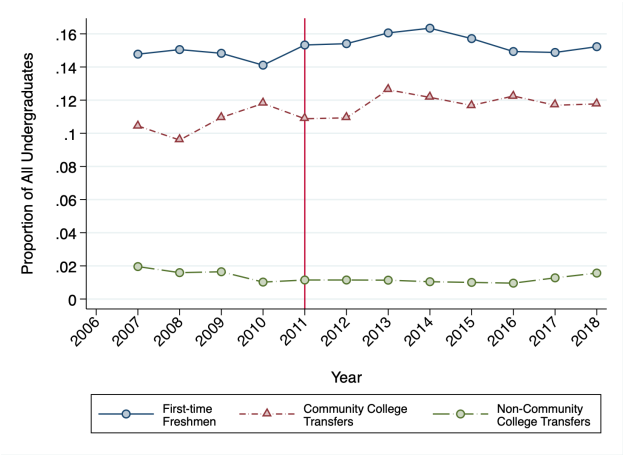
Notes: Each bar represents the number of states that implement each type of policy. They are not mutually exclusive, meaning states can implement one or more of the policies, and thus appear in more than one bar.

Figure 3: Map of Statewide Articulation in the United States

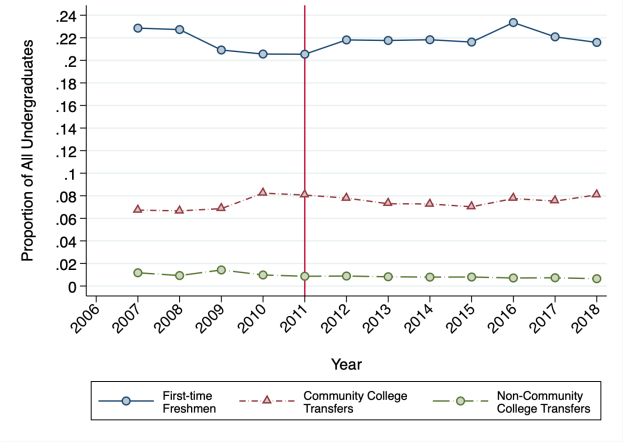


Notes: This map shows the distribution of states with each combination of the three difference statewide articulation policy components. This data is obtained from the *Education Commission of the States'* website. No SA indicates states that never implemented a SAA policy, while the "No TC, GAA, or CCN" category refers to states that implement a general SAA in which they do not specify any particular policies to be implemented.

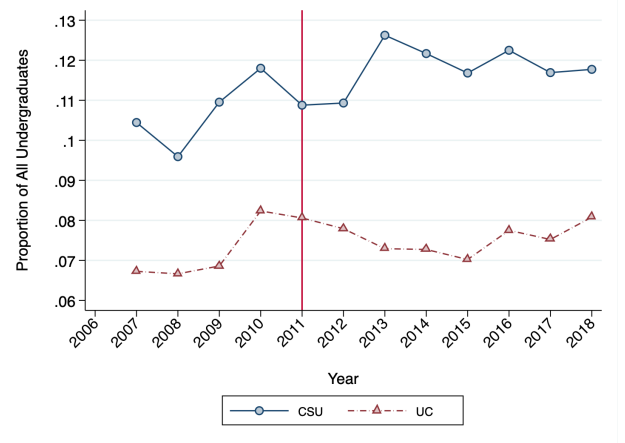
Figure 4: Trends in Enrollment at the CSU and UC Campuses



(a) Transfers into CSU



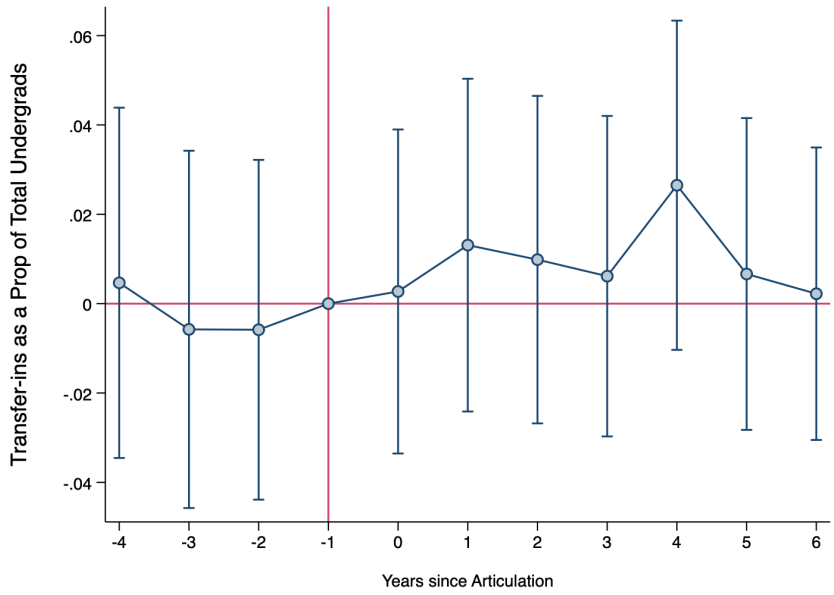
(b) Transfers into UC



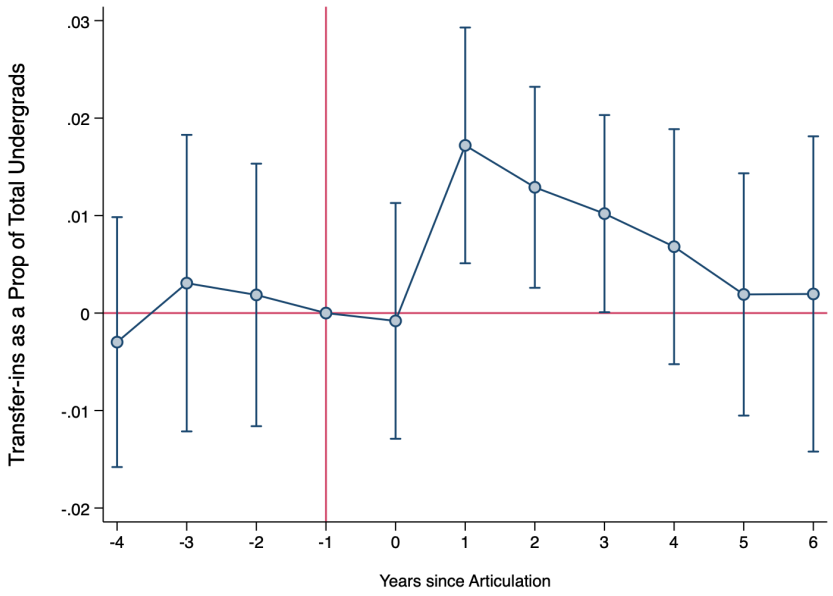
(c) CCC Transfers into CSU & UC

Notes: In this figures I show the average proportion of total undergraduates by year for both the UC and CSU systems. Figure 4(c) shows the average of CCC transfers as a proportion of total enrollment for the UC and CSU systems by year. Data on first-time freshmen enrollment are from IPEDS, while detailed data on CCC and non-CCC transfers are from the UC and CSU offices of institutional research and analysis.

Figure 5: Transfer-in Enrollment Effect of the ADT in California



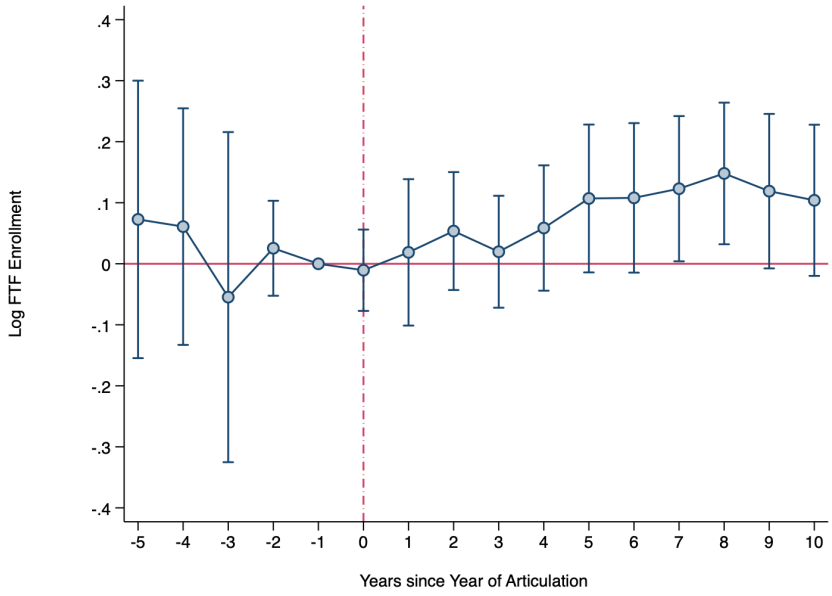
(a) Triple Difference - Transfer vs. First-time Freshmen & CSU vs. UC



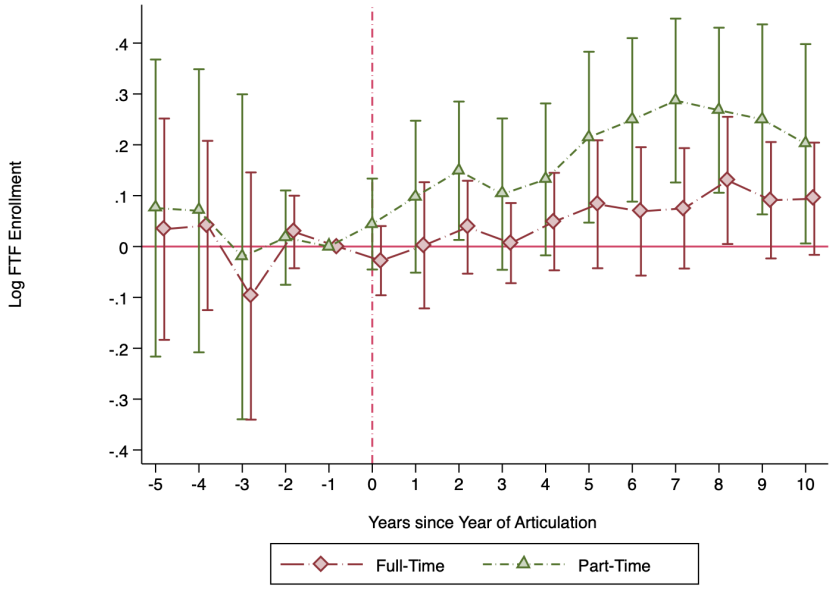
(b) Difference-in-Differences - Transfers to CSU vs. UC

Notes: Figure 5(a) shows the result of a triple difference analysis, wherein I compare transfer-in to first-time freshmen enrollment, within institution, at the CSUs to the UCs. In Figure 5(b) I show results of a difference-in-differences analysis where I only compare transfer-in enrollment at the CSUs to the UCs. The outcome in each regression is transfer (first-time freshmen) as a proportion of total undergraduates. The vertical line represents the year 2010, the year in which the policy was passed and a year before it became operational. These estimates are a result of Equation 1 and Equation 2, and are are weighted by total student population at baseline. Bands indicate 95 percent confidence intervals. Robust standard errors are reported.

Figure 6: Effect of Statewide Articulation on First-time Freshmen Enrollment



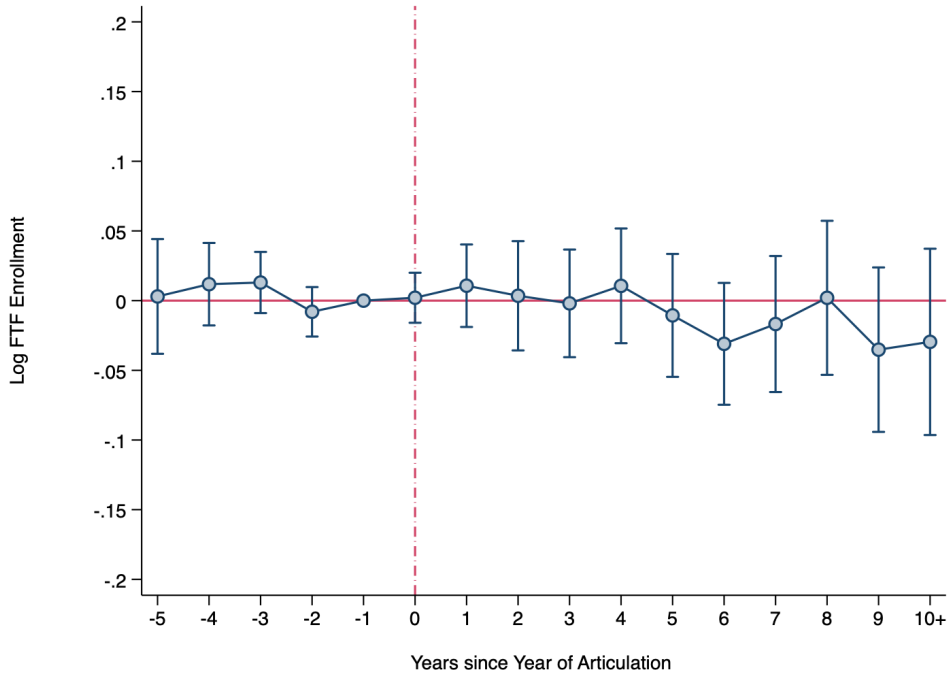
(a) Community College FTF



(b) Full-time vs. Part-time

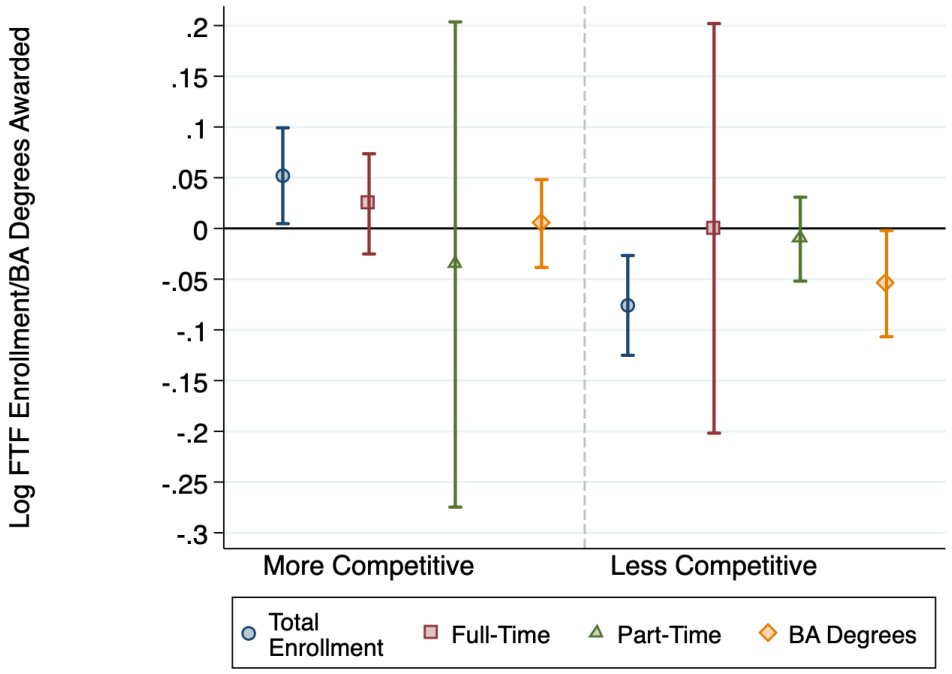
Notes: These figures plot the result of estimating a difference-in-differences analysis on the effect of statewide articulation on first-time freshmen enrollment. The top panel shows the effect on total enrollment, while the bottom panel shows the effect by part-time and full-time status. The outcome on the y-axis is the logarithm of total, full, and part-time enrollment. Both regressions include region-by-year and institution fixed effects. These estimates are a result of Equation 5, and are are weighted by total student population at baseline. The reference year $T-1$ is the year prior to statewide articulation. Bands indicate 95 percent confidence intervals, and standard errors are clustered at the state level.

Figure 7: Effect of Statewide Articulation on First-time Freshmen Enrollment - 4-Year Public Universities



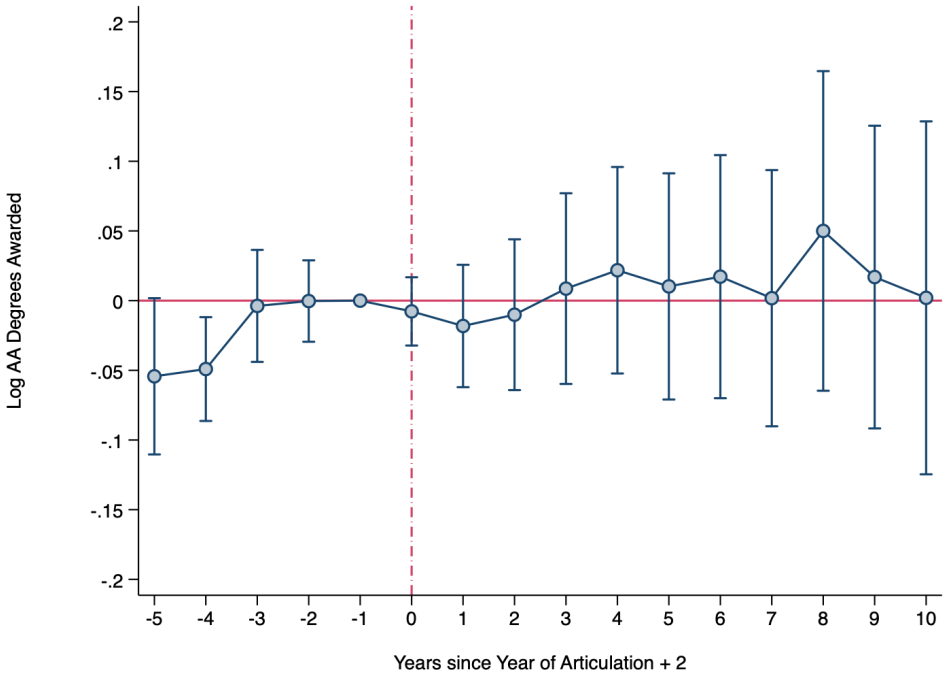
Notes: This figure shows the effect of statewide articulation on first-time freshmen enrollment at four-year institutions. The outcome on the y-axis is the logarithm of total enrollment. The regression includes region-by-year and institution fixed effects. The reference year $T-1$ is the year prior to statewide articulation. These estimates are a result of Equation 5, and are are weighted by total student population at baseline. Bands indicate 95 percent confidence intervals, and standard errors are clustered at the state level.

Figure 8: Effect of Statewide Articulation on 4-Year Public University First-time Freshmen Enrollment - by Selectivity



Notes: This figure plots the difference-in-differences estimates of examining the effect of statewide articulation on first-time freshmen enrollment by the four-year institution's selectivity. The selectivity measure used here is the Barron's ratings, which are updates for each institution every ten years. I define the rating for each institution as the rating in the most recent decade prior to articulation. For example, if a state passes their legislation in 2005, I use the 2000 rating for institutions in that state. More competitive institutions include those with a rating of one, two, or three. Less competitive institutions are those with a rating of four, five, or six. See Table C1 for additional information on the Barron's ratings. These estimates are a result of Equation 5, and are are weighted by total student population at baseline. Bands indicate 95 percent confidence intervals, and standard errors are clustered at the state level.

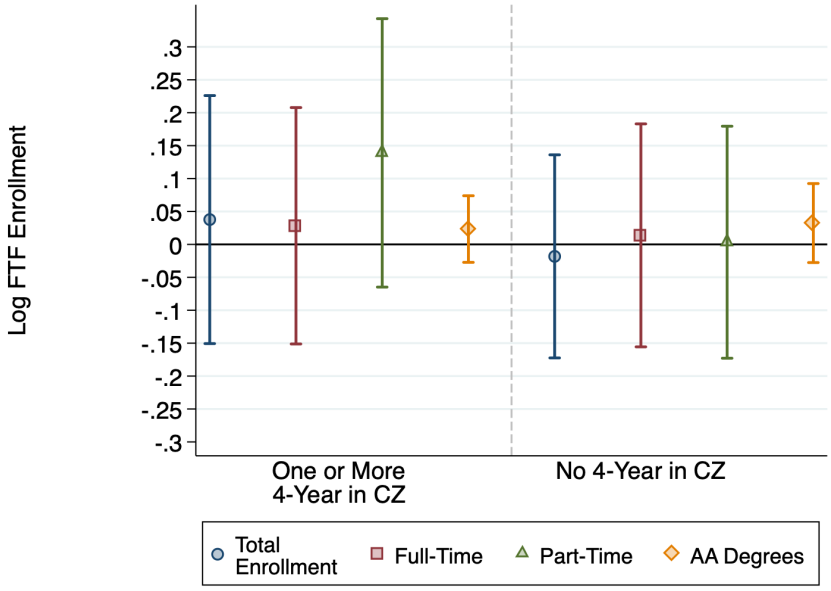
Figure 9: Effect of Statewide Articulation on Degrees Awarded



(a) Associate's Degrees Awarded

Notes: This figures shows the effect of statewide articulation on associate's degrees awarded. The outcome on the y-axis is the logarithm of associate's degrees awarded. The reference year $T-1$ is defined as the year or articulation plus one. These estimates are a result of Equation 5, and are are weighted by total student population at baseline. Bands indicate 95 percent confidence intervals, and standard errors are clustered at the state level.

Figure 10: Effect of Statewide Articulation on Community College First-time Freshmen Enrollment - By Number of 4-Year institutions in CZ



Notes: This figure plots the difference-in-differences estimates of examining the effect of statewide articulation on first-time freshmen enrollment by the number of four-year institutions in a community college's commuting zone. These estimates are a result of Equation 6, and are are weighted by total student population at baseline. Bands indicate 95 percent confidence intervals, and standard errors are clustered at the state level.

Table 1: California Public Universities - in 2007

	CSU	UC
	(1)	(2)
Total Undergraduate enrollment	15,677	16,819
	(9203.52)	(8784.97)
First-time Freshmen	2,264	3,542
	(1,359.61)	(1,659.86)
Transfers	1,835	1,345
	(1,155.61)	(940.84)
Proportion CCC Transfer-ins	0.10	0.07
	(0.03)	(0.02)
Proportion Non-CCC Transfer-ins	0.02	0.01
	(0.01)	(0.01)
Selectivity (Barron's)	4.25	2.56
	(0.57)	(0.98)
Observations	34	20

Notes: Data on total undergraduate, first-time freshmen enrollment, and total transfers are obtained from IPEDS. CCC and non-CCC transfers are collected from the CSU and UC's respective offices of institutional research and analysis. This data spans the years 2007-2018. Means in 2007 are reported. Standard deviations are in parentheses.

Table 2: Descriptive statistics - at Baseline

	In States with SAA	In States Without SAA	Four-year Public Universities
	(1)	(2)	(3)
Total Enrollment:			
Total Undergraduate Enrollment	3354.29	1963.26	7028.15
	(4702.816)	(2703.149)	(6092.318)
First-time Freshmen Enrollment	1125.52	870.91	1747.26
	(1254.792)	(893.187)	(1712.484)
First-time Freshmen:			
Full-time	0.71	0.73	0.87
	(0.230)	(0.192)	(0.165)
Male	0.52	0.53	0.55
	(0.191)	(0.171)	(0.127)
White	0.80	0.90	0.82
	(0.204)	(0.176)	(0.215)
Completions:			
Degrees awarded	315.85	154.88	738.80
	(613.051)	(291.579)	(902.697)
Number of 2/4-Year Institutions in CZ[1]	2.95	3.29	5.46
	(3.335)	(5.354)	(8.782)
Selectivity (Barron's)[2]			4.32
			(1.088)
Number of years between Enactment and Operational[3]	2.30		
	(0.897)		
Number of years in data	47.24	40.36	49.72
	(7.449)	(14.736)	(5.207)
Observations	880	115	336

Notes: This table shows averages for states that ultimately pass statewide articulation laws (SAA) in column (1), for states that never pass SAA laws in column (2), and for all four-year institutions in column (3). All columns were calculated in each institution's baseline year, i.e. the first year an institution is observed in the data. Data is from IPEDS, HEGIS, and own data collection. Standard deviations are reported in parentheses.

[1] columns (1) and (2) reflect the number of four-year institution, and column (3) shows the number of two-years.

[2] Selectivity measure ranges from 1 to 6, 1 being the highest and 6 the lowest.

[3] This is calculated based on states that report an operational date.

Table 3: Transfer-in Enrollment Effect of ADT in California

	Total Transfers (1)	CCC Transfers (2)	Non-CCC Transfers (3)
Panel A: Triple Difference:			
Articulation × Transfers	0.010	0.011	0.003
× CSU	(0.009)	(0.009)	(0.006)
Observations	648	648	648
Year × CSU Fixed Effect	X	X	X
Year × Student Type Fixed Effect	X	X	X
Student Type × CSU Fixed Effect	X	X	X
Student Type Fixed Effect	X	X	X
Institution Fixed Effect	X	X	X
Controls	X	X	X
Panel B: Difference-in-Differences:			
Articulation × CSU	0.005	0.007**	-0.001
	(0.003)	(0.003)	(0.001)
Observations	324	324	324
Mean Dependent Variable	0.122	0.107	0.0147
Student Type Fixed Effect	X	X	X
Institution Fixed Effect	X	X	X
Controls	X	X	X

Notes: This table shows the average effect of the STAR act reform in the years after the policy was implemented. The estimates summarize the effects shown in Figure 5. Dependent variable means are the proportion of transfer-in enrollment pre-treatment at the CSUs. All regression control for state-by-year unemployment levels. These estimates are a result of estimating Equation 3 and Equation 4.

Table 4: First-time Freshmen Enrollment & Degree Attainment Effect of Articulation

	Total Enrollment	Part-time	Full-time	Associate's Degrees
	(1)	(2)	(3)	(4)
Articulation	0.028	0.116	0.026	0.025
	(0.087)	(0.093)	(0.084)	(0.025)
Mean Dependent Variable	1088	525.8	562.7	399.4
Observations	13,241	13,241	13,241	13,038
Region × Year Fixed Effects	Yes	Yes	Yes	Yes
Institution Fixed Effects	Yes	Yes	Yes	Yes
Control	Yes	Yes	Yes	Yes

Notes: This table shows the results of estimating Equation 5. Dependent variable means are in levels. All regressions include region-by-year and institution fixed effects, control for state-by-year unemployment levels, and are weighted by total student population at baseline.

Table 5: Short-run vs. Long-run effects of Statewide Articulation

	Total Enrollment	Part-time	Full-time	Associate's Degrees
	(1)	(2)	(3)	(4)
Articulation	0.0283	0.116	0.0258	0.0249
	(0.0866)	(0.0926)	(0.0836)	(0.0245)
Within 5 Years of Articulation	0.0127	0.0905	0.0131	0.0229
	(0.0814)	(0.0869)	(0.0783)	(0.0220)
$>$ 5 Years After Articulation	0.0885	0.214**	0.0749	0.0337
	(0.0984)	(0.101)	(0.0996)	(0.0442)
Mean Dependent Variable	1088	525.8	562.7	399.4
Observations	13,241	13,241	13,241	13,038
Region $\times$ Year Fixed Effects	Yes	Yes	Yes	Yes
Institution Fixed Effects	Yes	Yes	Yes	Yes
Control	Yes	Yes	Yes	Yes

Notes: This table shows the results of estimating a variation of Equation 5 where instead of an indicator for all years post-treatment, I include an indicator for the first five years, and an indicator for the years 6 to 10 post-treatment. Dependent variable means are in levels. All regressions include region-by-year and institution fixed effects, control for state-by-year unemployment levels, and are weighted by total student population at baseline.

Table 6: First-time Freshmen Enrollment & Degree Attainment Effect at 4-year institutions - by Selectivity

	Total Enrollment	Full-time	Part-time	Degrees
	(1)	(2)	(3)	(4)
Articulation × Competitive	0.052**	0.024	-0.036	0.005
	(0.024)	(0.025)	(0.122)	(0.022)
Articulation × Less Competitive	-0.076***	-0.0544**	0.000	-0.011
	(0.025)	(0.027)	(0.103)	(0.021)
Mean Dependent Variable	1607	1488	119	1698
Observations	8,842	8,842	8,842	8,692
Region × Year Fixed Effects	Yes	Yes	Yes	Yes
Institution Fixed Effects	Yes	Yes	Yes	Yes
Control	Yes	Yes	Yes	Yes

Notes: This table shows the results of estimating a variation of Equation 5 where I interact the indicator for years post-treatment with an indicator equal to one for institutions that are categorized as less or more competitive. Each column represents results from a single regression. Dependent variable means are in levels. All regressions include region-by-year and institution fixed effects, control for state-by-year unemployment levels, and are weighted by total student population at baseline.

Table 7: First-time Freshmen Enrollment & Degree Attainment Effect of Articulation - By Number of 4-Year institution in Commuting Zone

	Total Enrollment	Part-time	Full-time	Degrees
	(1)	(2)	(3)	(4)
At least one 4-year in CZ	0.038	0.139	0.028	0.054***
	(0.096)	(0.104)	(0.092)	(0.018)
No 4-year in CZ	-0.018	0.003	0.014	0.060**
	(0.079)	(0.090)	(0.086)	(0.029)
Mean Dependent Variable	1088	525.8	562.7	399.4
Observations	13,241	13,241	13,241	13,027
Region × Year Fixed Effects	Yes	Yes	Yes	Yes
Institution Fixed Effects	Yes	Yes	Yes	Yes
Control	Yes	Yes	Yes	Yes

Notes: This table shows the results of estimating a variation of Equation 5 where instead of one indicator for years post-treatment for all institutions, I include an indicator equal to one in the years post-treatment for institutions in commuting zones with one or more four-years, and zero for institutions in commuting zones with no four-years. I also include an analogous variable for institutions with no four-year institutions. Dependent variable means are in levels. All regressions include region-by-year and institution fixed effects, control for state-by-year unemployment levels, and are weighted by total student population at baseline.

Table 8: First-time Freshmen Enrollment & Degree Attainment Effect at Community Colleges - by Policy Combination

	Total Enrollment	Full-time	Part-time	Degrees
	(1)	(2)	(3)	(4)
Articulation × All 3 Subpolicies	-0.029	0.034	-0.093	0.063
	(0.064)	(0.063)	(0.104)	(0.055)
Articulation × Combine 2 Subpolicies	0.102	0.065	0.255**	0.023
	(0.103)	(0.102)	(0.104)	(0.028)
Articulation × Only 1 Subpolicy	-0.162***	-0.123**	-0.154**	-0.014
	(0.045)	(0.061)	(0.064)	(0.063)
Mean Dependent Variable	1088	526	563	399
Observations	13,241	13,241	13,241	13,038
Region × Year Fixed Effects	Yes	Yes	Yes	Yes
Control	Yes	Yes	Yes	Yes

Notes: This table shows the results of estimating a variation of Equation 5 where I interact the indicator for years post-treatment with an indicator equal to one for states that have one, two, or three policies in place. Each column represents results from a single regression. Dependent variable means are in levels. All regressions include region-by-year fixed effects, control for state-by-year unemployment levels, and are weighted by total student population at baseline.

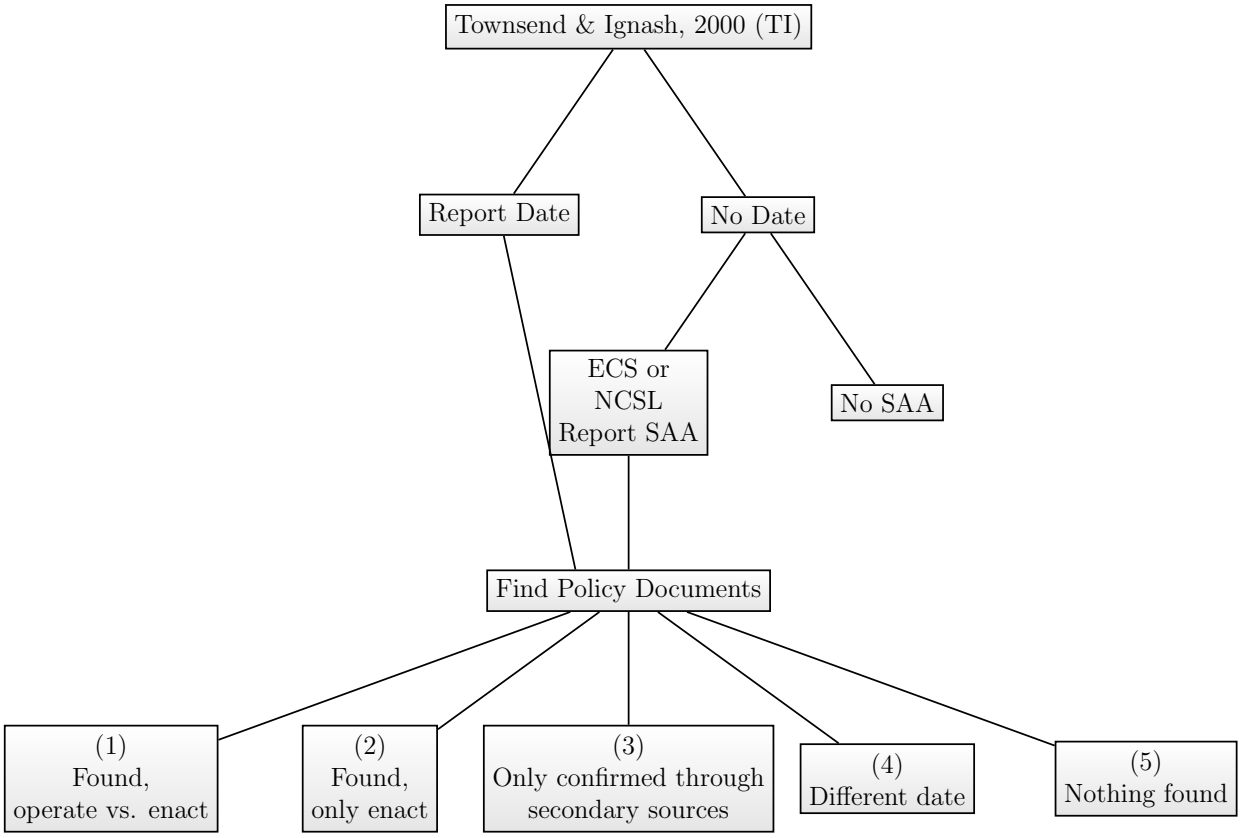
A Additional Details on California Articulation Laws

Articulation agreements were first mentioned in the California state legislature in 1988 under *Cal. Educ. Code* § *66720-66721*, the law states that California Community Colleges (CCC), the University of California (UC), and the California State University System (CSU), shall develop a common core curriculum in general education courses for the purpose of transfer and that it be published and distributed to all public high schools and community colleges in California. Shortly after, all parties realized the confusing multiplicity of general education course requirements of the CSU system and the individual campuses, colleges, and programs of the UC were still a barrier to students who wished to transfer. Therefore, the education code was amended in 1991 to create the California Intersegmental Articulation Committee (CIAC), which worked to consolidate articulation efforts into one unified statewide agreement, and became operational in 1994. This is the year I use in the analysis as the date of the first articulation policy. The CIAC developed an Intersegmental General Education Transfer Curriculum (IGETC) that permitted a student to transfer from a community college to a campus in either the California State University or University of California system without the need, after transfer, to take additional lower division, general education courses to satisfy campus general education requirements.

The educational code was amended again in the year 2000 to include a section mandating that a copy of the transfer core curriculum is to be distributed to each enrolled community college student in some form, whether it be electronic or physical copies. Finally, another change to the legislature occurred in 2010, where the CSU system and CCCs were required to inform students of the new program called the "Associates Degree for Transfer" (ADT), a program created by California Senate Bill 1440 - which guarantees students who complete an ADT, a spot at a CSU campus - prior to its implementation to give students a chance to enroll. This program was implemented beginning in the 2011-2012 academic year.

B Data Collection

Figure B1: Graphical Depiction of Statewide Articulation Policy Dates Data Collection Process



Notes: This figure is a graphical depiction of the data collection process described in subsection 3.1. ECS refers to the *Education Commission of the States*, NCSL is the *National Conference of State Legislature*, and SAA are Statewide Articulation Agreements.

C Additional Tables and Figures

Table C1: College Ranking Descriptive Statistics

	Average Barron's Rating	N
	(1)	(2)
Land Grant	4.01	67
	(0.86)	
Non-Land Grant	4.32	438
	(0.90)	
Under 1,000	3.69	8
	(1.92)	
1,000 - 4,999	4.64	124
	(0.94)	
5,000 - 9,999	4.45	130
	(0.77)	
10,000 - 19,999	4.26	127
	(0.77)	
20,000 and above	3.77	116
	(0.79)	
More Competitive - Random Sample		
University of California-Berkeley		
University of North Carolina at Chapel Hill		
Michigan State University		
University of Illinois at Urbana-Champaign		
University of Colorado at Boulder		
The University of Tennessee		
University of Kansas		
University of Nebraska-Lincoln		
Less Competitive - Random Sample		
University of Houston-Downtown		
University of Northern Iowa		
The University of Texas at San Antonio		
Wichita State University		
Fort Lewis College		
California State University-Chico		
East Carolina University		
Ohio University-Main Campus		

Notes: Data is from an IPEDS subsample and Barron's ratings for the year 2008, which is the year of the most recent Barron's ratings.

Table C2: First-time Freshmen Enrollment & Degree Attainment Effect of Articulation - By Policy Date Robustness

			Excluding		
	All	No Info	Different Dates	Enactment - No Document	Only Enactment
	(1)	(2)	(3)	(4)	(5)
Total Enrollment	0.0283	0.0645	0.0997	0.1910	0.0909*
	(0.0866)	(0.0942)	(0.1050)	(0.1500)	(0.0513)
Full-Time Enrollment	0.0258	0.0707	0.0914	0.1830	0.1080
	(0.0836)	(0.0892)	(0.1010)	(0.1480)	(0.0741)
Part-time Enrollment	0.1160	0.1380	0.2010*	0.3060**	0.1880***
	(0.0926)	(0.1010)	(0.1070)	(0.1400)	(0.0635)
Degrees Awarded	0.0249	0.0431*	0.0326	0.0679**	0.0687
	(0.0245)	(0.0240)	(0.0258)	(0.0305)	(0.0417)
Mean Dependent Variable	1088	1137	1165	1195	1121
Observations	13,241	11,820	11,062	9,861	7,601
Region × Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Institution Fixed Effects	Yes	Yes	Yes	Yes	Yes
Control	Yes	Yes	Yes	Yes	Yes

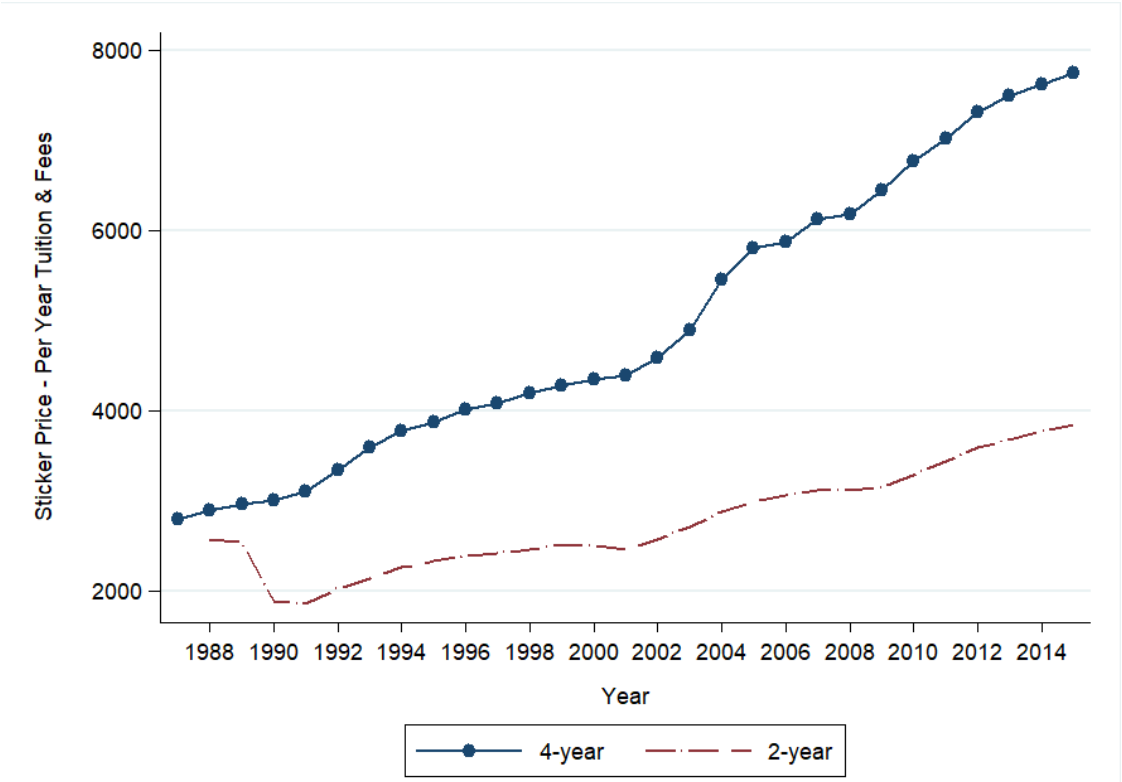
Notes: This table shows the results of estimating Equation 5, where column (1) is the same as the results in Table 4. Starting in column (2), states are excluded from the analysis in steps. Column (2) shows the effect on all states excluding those that I do not have sufficient information on policy dates for. Column (3) shows the effect on the states in column (2) but further excluding states for which I find conflicting dates. Column (4) shows the effect on the states in column (3) excluding states that I do not have policy documentation for. Column (5) excludes all the above, in addition to states that only have an enactment date. In other words, column (5) displays the effect only for states that report an operational date. Dependent variable means are in levels. All regressions include region-by-year and institution fixed effects, control for state-by-year unemployment levels, and are weighted by total student population at baseline.

Table C3: First-time Freshmen Enrollment & Degree Attainment Effect of Articulation - By Sample Balance

	Total Enrollment	Part-time	Full-time	Associate's Degrees
	(1)	(2)	(3)	(4)
Panel A: Balanced from $T-3$ to $T+3$				
Articulation	0.028	0.116	0.026	0.025
	(0.087)	(0.093)	(0.084)	(0.025)
Mean Dependent Variable	1088	526	563	399
Observations	13,241	13,241	13,241	13,038
Panel A: Balanced from $T-5$ to $T+5$				
Articulation	0.0223	0.106	0.0210	0.0202
	(0.0843)	(0.0905)	(0.0819)	(0.0245)
Mean Dependent Variable	1091	528	563	400
Observations	13,131	13,131	13,131	12,923
Region × Year Fixed Effects	Yes	Yes	Yes	Yes
Institution Fixed Effects	Yes	Yes	Yes	Yes
Control	Yes	Yes	Yes	Yes

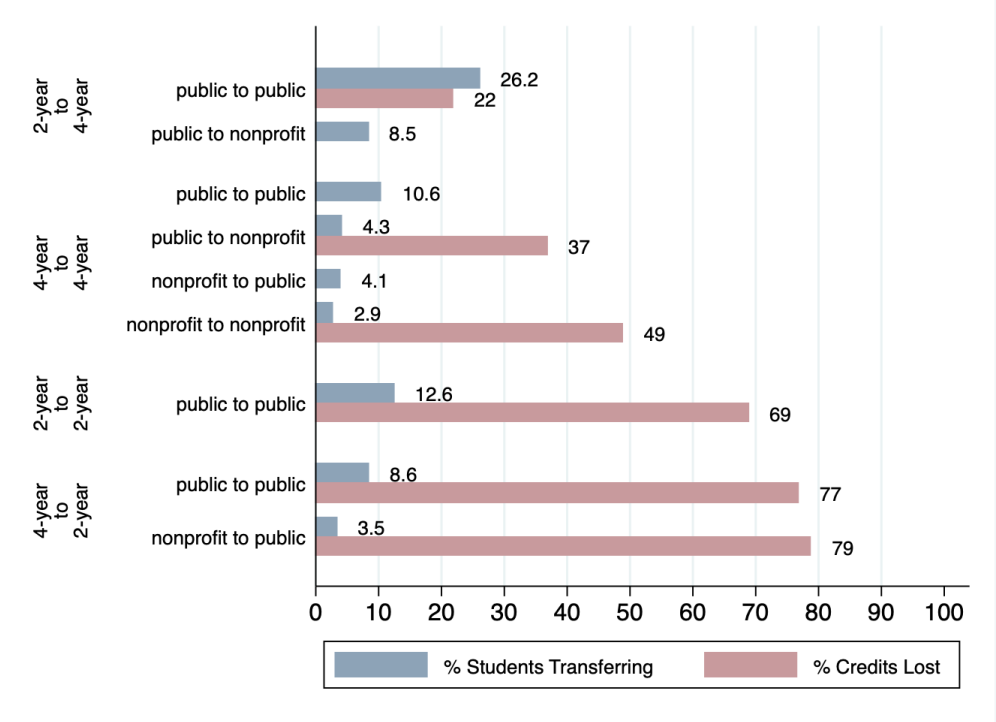
Notes: This table shows the results of estimating Equation 5. Panel A presents the same estimates as in Table 4, where I only include states that report data from at least $T-3$ to $T+3$. Whereas panel B restricts the sample to increase the balance of my sample, and only include states that report data from at least $T-5$ to $T+5$. Dependent variable means are in levels. All regressions include region-by-year and institution fixed effects, control for state-by-year unemployment levels, and are weighted by total student population at baseline.

Figure C2: Trends in Undergraduate Tuition



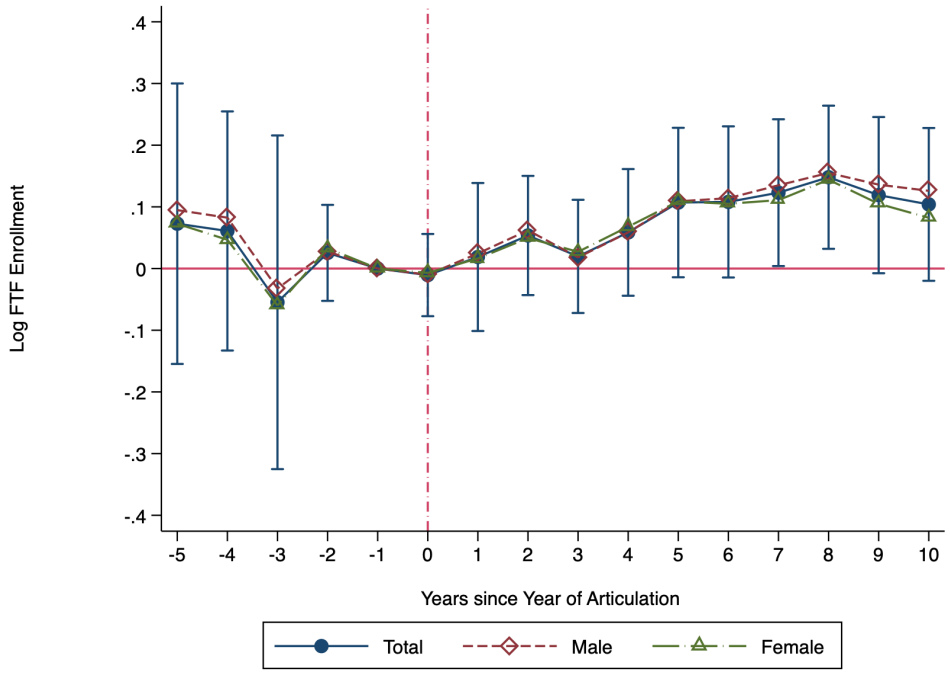
Notes: The figure above shows average sticker price of per year tuition & fees, by level of institution (2-year vs. 4-year) from 19871 to 2015. All prices are adjusted to 2015 dollars. Calculated using *Delta Cost Project* variables.

Figure C3: Transfer Patterns and Credit Loss

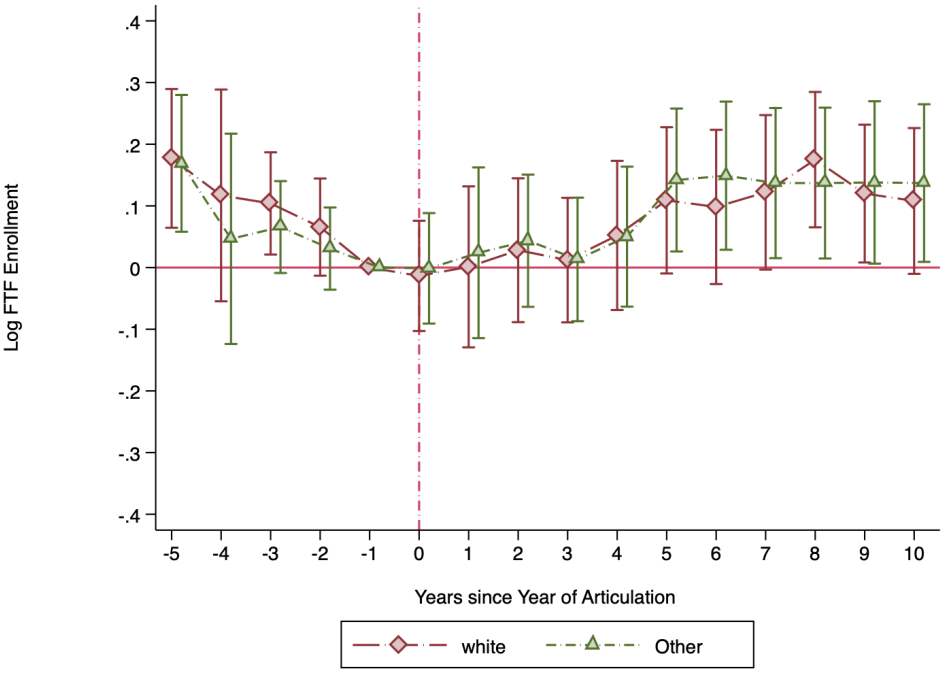


Notes: Data source is the Government Accountability office 2017 Report

Figure C4: Effect of Statewide Articulation on First-time Freshmen Enrollment - Community College, by Sex and Race



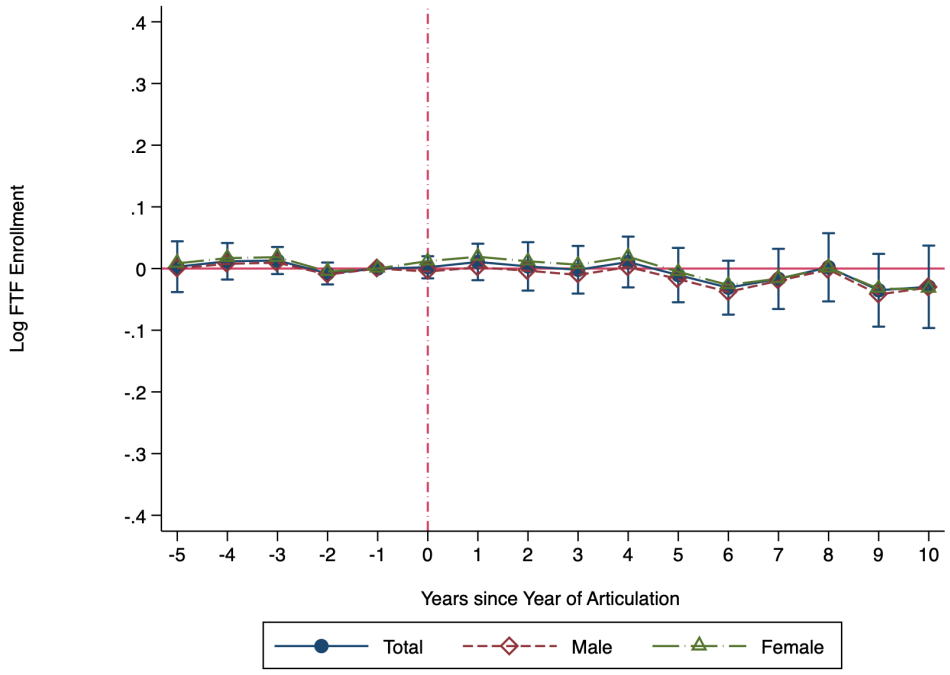
(a) By Sex



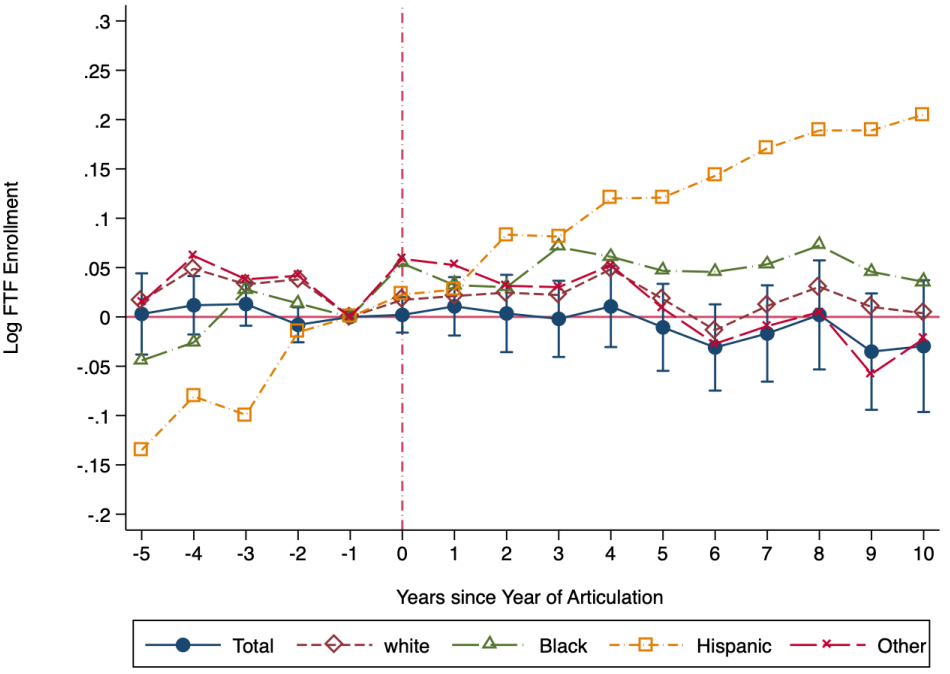
(b) By Race

Notes: These figures plot the result of estimating a difference-in-differences analysis on the effect of statewide articulation on first-time freshmen enrollment. The top panel shows the effect on total enrollment by sex, while the bottom panel shows the effect by race. The outcome on the y-axis is the logarithm of total, full, and part-time enrollment. Both regressions include region-by-year and institution fixed effects. These estimates are a result of Equation 5, and are are weighted by total student population at baseline. The reference year $T-1$ is the year prior to statewide articulation. Bands indicate 95 percent confidence intervals, and standard errors are clustered at the state level.

Figure C5: Effect of Statewide Articulation on First-time Freshmen Enrollment - 4-Year Public Universities by Sex and Race



(a) By Sex



(b) By Race

Notes: These figures plot the result of estimating a difference-in-differences analysis on the effect of statewide articulation on first-time freshmen enrollment at four-year institutions. The top panel shows the effect on total enrollment by sex, while the bottom panel shows the effect by race. The outcome on the y-axis is the logarithm of total, full, and part-time enrollment. Both regressions include region-by-year and institution fixed effects. These estimates are a result of Equation 5, and are are weighted by total student population at baseline. The reference year $T-1$ is the year prior to statewide articulation. Bands indicate 95 percent confidence intervals, and standard errors are clustered at the state level.

D Conceptual Framework Details

High school students will choose to start at option $j \in \{\text{Labor Force}, \text{2year}, \text{4year}\}$. Student i is a prospective transfer-oriented community college student.

Student i, prior to SAA, is indifferent between starting a two-year or a four-year:

$$U(Y_{ist}^{2yr}, c_{st}^{2yr}) = U(Y_{ist}^{4yr}, c_{st}^{4yr}) \iff$$

$$\sum_{t=0}^{T} \beta^{t-1} Ln(Y_{ist}^{2yr}) - c_{st}^{2yr} = \sum_{t=0}^{T} \beta^{t-1} Ln(Y_{ist}^{4yr}) - c_{st}^{4yr} \iff$$

$$\sum_{t=0}^{T} \beta^{t-1} Ln(Y_{ist}^{2yr}) - \tau^{2yr} - \omega_{ist}^{2yr} - \epsilon_{ist}^{2yr} = \sum_{t=0}^{T} \beta^{t-1} Ln(Y_{ist}^{4yr}) - \tau^{4yr} - \omega_{ist}^{4yr} - \epsilon_{ist}^{4yr}$$

if student i chooses to start at the community college and then transfer, their total tuition will be $\tau^{2yr} = X\tau^{CC} + Z\tau^{4yr}$, where τ^{CC} is tuition paid at the community college, X is the number of year spent at the community college, and Z is the number of years at the four-year. With a SAA, more credits will transfer from the two-year institution, and student i will in turn take more credits at the two-year. This will increase X and decrease Z, in total it will decrease τ^{2yr}. Similarly, the SAA can instead reduce ϵ_{ist}^{2yr} by streamlining the process of transferring credits. In both cases

$$U(Y_{ist}^{2yr}, c_{st}^{2yr}) > U(Y_{ist}^{4yr}, c_{st}^{4yr})$$

If instead we consider a student who is indifferent between enrolling at community college or going into the labor force, then

$$U(Y_{ist}^{LF}, c_{st}^{LF}) = U(Y_{ist}^{2yr}, c_{st}^{2yr}) \iff$$

$$\sum_{t=0}^{T} \beta^{t-1} Ln(Y_{ist}^{LF}) - c_{st}^{LF} = \sum_{t=0}^{T} \beta^{t-1} Ln(Y_{ist}^{2yr}) - c_{st}^{2yr} \iff$$

$$\sum_{t=0}^{T} \beta^{t-1} Ln(Y_{ist}^{LF}) - \tau^{LF} - \omega_{ist}^{LF} - \epsilon_{ist}^{LF} = \sum_{t=0}^{T} \beta^{t-1} Ln(Y_{ist}^{2yr}) - \tau^{2yr} - \omega_{ist}^{2yr} - \epsilon_{ist}^{2yr}$$

Upon learning of the SAA and the options it provides, students will update the lifetime expected earnings associated with enrolling at community college, which would increase $\sum_{t=0}^{T} \beta^{t-1} Ln(Y_{ist}^{2yr})$ and in turn

$$U(Y_{ist}^{LF}, c_{st}^{LF}) > U(Y_{ist}^{2yr}, c_{st}^{2yr})$$

Finally, for a transfer oriented student already enrolled at community college and indifferent between obtaining a degree or not:

$$U(Y_{ist}^{2yr}, c_{st}^{2yr})_{NoAssoc.} = U(Y_{ist}^{2yr}, c_{st}^{2yr})_{Assoc.}$$

A SAA will increase the probability that more credits will transfer, which will require students to take fewer credits at the four-year institution. This will decrease the total tuition associated with obtaining an associate's degree, since it will reduce tuition paid at the four-year institution. This will result in

$$U(Y_{ist}^{2yr}, c_{st}^{2yr})_{Assoc.} > U(Y_{ist}^{2yr}, c_{st}^{2yr})_{NoAssoc.}$$

■

D.1 Articulation Legislation and Policies Details

Table D4: Summary of State Articulation Laws

State	Final Date	Adoption Date	Implementation Date	Transferable Core	Common Course Numbering	Guaranteed AA Transfer
Alabama	1998	1994	1998	✓		
Arizona	1998	1996	1998	✓	✓	
Arkansas	1989	1989		✓	✓	✓
California	1994	1991	1994	✓		
Colorado	1988			✓	✓	✓
Connecticut	1991	1991				
Delaware						
Florida	1971			✓	✓	✓
Georgia	1985			✓		✓
Idaho	1986			✓	✓	✓
Illinois	1990	1990		✓		✓
Indiana	1992			✓	✓	✓
Iowa	1981	1981				✓
Kansas	1991	1991		✓	✓	✓
Kentucky	1993			✓		✓
Louisiana	1996			✓	✓	✓
Maine	2009	2009				✓
Maryland	1996	1995	1996	✓		✓
Massachusetts	1984			✓		✓
Michigan						
Minnesota					✓	
Mississippi	1989			✓		✓
Missouri	1987			✓	✓	✓
Montana	1971			✓		
Nebraska						
Nevada	1997	1997		✓	✓	✓
New Hampshire						
New Jersey	2008	2008		✓		✓
New Mexico	1995	1995		✓	✓	✓
New York						
North Carolina	1997	1995	1997	✓		✓
North Dakota	1990			✓	✓	
Ohio	1990	1989	1990	✓		✓
Oklahoma	1995			✓		✓
Oregon	1988			✓		✓
Pennsylvania	2008	2006	2008	✓		✓
Rhode Island	1979					✓
South Carolina	1996			✓		✓
South Dakota	1998	1998	1999	✓	✓	✓
Tennessee	2001	2000	2001	✓	✓	✓
Texas	1997	1997		✓	✓	
Utah	1980			✓	✓	✓
Vermont						
Virginia	1990			✓		✓
Washington	1985	1983	1985	✓		✓
West Virginia	1979			✓		✓
Wisconsin	2001			✓		✓
Wyoming	1985				✓	✓

Notes: [1] Year any articulation and/or transfer policies were passed. I do not, yet, distinguish the dates of each component of the articulation policy (transferable core vs. common course numbering vs. guaranteed AA transfer). The date provided does not reflect any reverse transfer policies.

Table D5: Summary of State Articulation Laws (cont.)

State	Verified Source	Corrected Date	Verified Date No Primary Source	Cannot Verify Date	Enact vs. Implement	Statute/Legislation /Board Policy Source
Alabama	✓				✓	FL Statutes Act 1007.23
Arizona	✓				✓	Arizona State Revised Statute 15-1824; Report of the Transfer Articulation Task Force (1996)
Arkansas	✓				✓	Act 98 of the 1989 Regular Session H.B 1133
California	✓				✓	California Educ. Code [6670-66722.5]
Illinois	✓				✓	IBHE Policies on Undergraduate Education - Transfer and Articulation
Maine	✓				✓	NCSL: ME S 367 Pilot law, Maine Revised Statute § 10907-A
Maryland	✓				✓	"MHEC Student Transfer Policies & COMAR Title 13B - Maryland Higher Education Commission Student Transfer Policies
New Jersey	✓				✓	Lampitt Bill of 2007
New Mexico	✓				✓	N.M. Stat. § 21-1B-3
North Carolina	✓				✓	1995 Session Ratified Bill Chapter 625 Senate Bill 1161
Ohio	✓				✓	Ohio department of higher education transfer policy appendices, Appendix A
Ohio						
Pennsylvania	✓				✓	§ 20-2004-C. Transfer and Articulation Oversight
Pennsylvania						Committee; 24 P.S. § 20-2002-C
South Dakota	✓				✓	1988 H.B 1146
Tennessee	✓				✓	Tenn. Code Ann. § 49-7-202
Texas	✓				✓	Texas Educ. Code Sec. 61.822 and Educ. Code Sec. 61.832
Washington	✓				✓	Washington State Revised Code 28B.77.210
Connecticut		✓			✓	Policy manual of the board of trustees of community-technical colleges
Iowa		✓			✓	Articulation and Transfer between Public Institutions of Higher Education in Iowa - Progress Report to the General Assembly 2009
Kansas		✓			✓	1991 Kan. SB 34
Nevada		✓			✓	Nev. Rev. Stat. Ann. § 396.568
Colorado			✓			
Florida			✓			
Massachusetts			✓			
Oregon			✓			
Rhode Island			✓			
South Carolina			✓			
Wisconsin			✓			
Georgia				✓		
Idaho				✓		
Indiana				✓		
Kentucky				✓		
Louisiana				✓		
Mississippi				✓		
Missouri				✓		
Montana				✓		
North Dakota				✓		
Oklahoma				✓		
Utah				✓		
Virginia				✓		
West Virginia				✓		
Wyoming				✓		

Notes: This information is collected by the author. *Verified source* means I was able to confirm the date in Townsend and Ignash (2000) is correct and found the corresponding policy documents. *Corrected date* means I was not able to confirm that the date in Townsend and Ignash (2000) was correct, but I found policy documents with a date prior to 2000 indicating it was the first year the policy was passed. *Verified date, no source* are states where I was able to verify the date listed in Townsend and Ignash (2000) through secondary sources, but was not able to find the corresponding policy documents or details. States in the *cannot verify date* category are the ones that I was not able to find any policy documents/laws/or reports reflecting a date around the reported date in Townsend and Ignash (2000). *Enact vs. Implement* notes the states for which I can distinguish between policy enactment date vs. the date by the which the policy is to be implemented.