The Effects of Statewide Transfer Agreements on Community College Enrollment

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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 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 attending a community college and 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. Based on my findings, an SAA will add a total of $22,160,160 to $43,781,760 in additional lifetime earnings as a result of students substituting away from four-year institutions into two-year institutions.[2] 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

[2]This is based on a "best case scenario" and is an upper bound on the gains students would experience.

state university system responds to changes in state legislation. I show that, when comparing 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 **??**.

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 regarding my identification strategy 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

In the first stage of this study I examine the effects of statewide articulation on transfer-in enrollment at four-year public institutions. As a result of data limitations, the estimation of this outcome is restricted to a case study of California. In particular, I estimate the effects of legislation that created a structured pathway from CCCs to CSU campuses, but not to UC campuses (the STAR act). This means that, 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 CSU campuses with enrollment in the UC system, before and after the legislation. However, before conducting this analysis, it is important that I establish that transfer-in enrollment in both systems evolved similarly before the policy was enacted; this is the standard "parallel trends" assumption that must be satisfied in any difference-in-differences setting 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 was enacted. 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 with first-time freshmen enrollment within an 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, but such an experiment is not feasible. To obtain causal estimates, I therefore use a difference-in-differences strategy, where I compare outcomes in treated states with outcomes in untreated states before and after the policy was enacted. There is one main threat to identification in this portion of the study, namely the potential for endogenous trends. The first-order objective of SAAs is to encourage students to transfer to four-year institutions, with or without associate's degrees. A second-order objective is to increase the efficiency of the transfer process and educational attainment. It may then be that states enact SAAs knowing that they might have spillover effects, perhaps to 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 effects of statewide articulation and other policies that are in place to increase community college enrollment. Fortunately, I can also evaluate the likelihood that this threat would occur 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 2007-2018 period, the years for which IPEDS transfer-in data are also available. The geographic unit of analysis for the second empirical strategy is the entire state. In this analysis I use only the IPEDS and HEGIS data, which are generated by surveying all institutions of higher

education in the United States every year. I restrict my main sample to publicly controlled institutions because they are the institutions primarily targeted by state policy. Over the entire sample period, I often observe that institutions merge and switch from two-year to four-year status or vice-versa. To maintain consistency in my sample I exclude institutions that ever report awarding certificates only, are not consistently classified as two-year or a four-year colleges, merge with other institutions, are ever not publicly controlled, are ever categorized as mixed baccalaureate/associate's colleges or associate's-dominant four-year colleges, are not accredited, or are institutions with a special focus.[19] I balance the sample by including only institutions that report outcomes from $T-3$ through $T+3$, while also keeping institutions that have data for only either the pre or post-period time frame. Additionally, I restrict my main analysis sample to institutions that report outcomes for at least 40 years, which avoids 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 subsection 6.4.

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 effects 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

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

[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 focuses. Special-focus four-year institutions include: faith-related institutions, medical schools and centers, other health professions schools, engineering schools, other technology-related schools, business and management schools, art, music and design schools, law schools, tribal colleges, and other special focus institutions.

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

CSU_{it} is an indicator that equals one for CSU and zero for UC institutions. Included in Equation 1 are institution and year fixed effects, indicated by α_i and α_t, respectively. The institution fixed effects adjust for time-invariant characteristics within institutions, 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]

I next 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 freshman at institution i in year t, and $Transfer_{it}$ is an indicator that equals one for transfer student observations.[22] The coefficients of interested are stored in vector β_{k7}, showing the effects of the 2010 policy on transfer-in relative to first-time freshman enrollment at the CSU campuses compared with enrollment at the UC campuses. 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 effects account for time varying trends at the CSU campuses, 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 CSU campuses for both transfer-in and first-time enrollment.

[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-in enrollment, and the other is for first-time freshmen.

Finally, I estimate a difference-in-differences model that shows the average effects of the policy in the post-treatment years, a weighted-average of the results produced by equation Equation 1:

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

where $Post_{it}$ is an indicator that equals zero in the years prior to 2011 and one thereafter. All other variables are the same as in 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 the transfer-in enrollment outcome 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, 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 begin this analysis similarly by estimating an event-study model to empirically test the parallel-trends assumption and show the evolution of the effects 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 effects of the SAA on students' decisions to enroll at community college and their subsequent decisions to obtain associate's degrees, 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 that equals 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 the event time defines the first treated cohort-i.e. students at time $k = 0$-and varies across outcomes. For example, when examining the effects of SAA on first-time freshman enrollment, the first cohort affected comprises students enrolling in college for the first time in the first year in which 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 degrees awarded, then the first treated cohort would still be the same (the 2000 cohort), but their outcomes would be reported in the 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 recall that, on average, time elapsed between policy enactment and when it becomes operational is 2.3 years, and I thus expect that the effects would be delayed by at least that long.

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

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

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 Effects of Statewide Articulation on Transfers, Enrollment, and Degree Attainment

In this section I present the main results. I start by assessing the validity of the difference-in-differences 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 the SAA. I proceed to discuss average and heterogeneous effects of the SAA on transfers into four-year public universities, first-time freshman enrollment, and associate's degree attainment at community colleges.

6.1 Transfer-in Enrollment at the California State Universities

To examine whether there is an increase in transfers into CSU campuses, regardless of changes in first-time freshman enrollment, I compare the CSU campuses with UC campuses using a difference-in-differences analysis. Figure 5(b) shows the results, in which there is a statistically significant average one-percentage-point 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 the STAR act passed, transfer-in rates are higher than in the years prior to the act, but the effect is decreasing over time and reaches zero after four years. The one-percentage-point increase translates to 191 additional students transferring into CSU campuses. 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 students per college per year.

I then estimate whether transfer-in enrollment increases relative to first-time freshman enrollment *within* both CSU and UC institutions. This would show whether there is an increase in transfer-in enrollment and, if so, whether it results in crowding out first-time freshmen. To do so, I conduct a triple differences analysis. The results 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 effects on transfer-in enrollment in comparison with first-time freshman enrollment, indicating that any increase in transfers is not crowding out first-time freshmen.

It is possible that the ADT does not increase transfers to the CSU schools because it

did not significantly (or meaningfully) lower the barriers to transfer. For instance, although the obtaining an ADT guarantees admission into a CSU school, not all ADTs are accepted at all CSU campuses. In particular, an ADT does not guarantee admission into a local CSU campus. This may pose difficulties for students 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 wishes to study engineering but is not accepted into a CSU school of engineering, that student may choose to enroll elsewhere even if it is not guaranteed that all their credits will transfer. 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 message that the transfer process is complicated and difficult, the policy might be unintentionally "cooling out" marginal students (Clark, 1963). Additional data are needed to investigate why transfers from CCCs to CSU schools do not increase as a result of the ADT program.

6.2 First-time Freshman Enrollment and Degrees Awarded

In this analysis, I begin by showing the dynamic effects of SAA policies in the ten years following their enactment, in particular on first-time freshman enrollment at community colleges. Figure 6 shows the main results, but most importantly it provides evidence of flat pre-trends, which validates the choice of research design. Figure 6(a) plots the effects of the SAA on total first-time freshman enrollment at community colleges and shows an increasing trend that is not transitory but in fact grows over time, although the rise is not statistically significant. It is, however, important to consider that community colleges disproportionately serve non-traditional students, so any effects would operate on this margin. Therefore, I examine the effects of the SAA on part-time and full-time students as proxies for traditional and non-traditional enrollment. The results of this analysis are illustrated in Figure 6(b), which shows larger effects 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 percent 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 again, on average, it takes around 2.3 years for the policies to be put into practice following enactment. These results are also summarized in Table 4 and Table 5.

I next investigate whether the increase in first-time community college enrollment can be attributed to students' substituting away from four-year institutions (the "substitution" channel). To that end, I estimate the effects of the SAA on first-time freshman enrollment at four-year institutions. Figure 7 shows evidence of flat pre-trends, and no statistically significant effects 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. To be sure, 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 the SAAs 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. I expect to find, as a result of the SAA, an increase in enrollment that would eventually lead to an increase in degrees awarded. Figure 9, however, shows no effects on associate's degrees awarded at community colleges in states that enact SAA legislation. There are several possible reasons that can explain this pattern. Since there are no effects on *overall* enrollment at community colleges, it is possible then that students are simply not affected at all by the SAA.[24] 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 because the degrees would be dispersed over 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 more frequently at institutions located within 50 miles of their permanent homes. To examine how this affects the student response to the SAA, I estimate the

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

[24] The IPEDS does not separate degrees awarded by full-time and part-time status so I am not able to explicitly examine the effects on degrees awarded by enrollment status.

effects on community colleges by the number of four-year institutions in their commuting zones.[25] Specifically, I examine the effects on community colleges in commuting zones with at least one four-year institution and compare them with the effects on community college in commuting zones that have none. The results are presented in Table 8 and show no heterogeneous effects on either first-time freshman enrollment or on 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 signs of the estimates are as expected, but they are not statistically significant.

I next explore how the effects differ across states with their own sub-policies in place, namely CCN, TC, and GAA. Figure 3 shows that some states have adopted only one of the aforementioned sub-policies, other states combine two, while the majority of states combine all three in their SAAs. The differences in policy combinations implemented by each state raises the question of comparability. The flat pre-trends presented in Figure 6 and Figure 9 provide evidence that the treatment and control groups are comparable, but it still leaves one question unanswered: how do the effects of SAAs differ across states with different sub-policy 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 that equal one if institution i is in a state s that combines three, two, or one of the sub-policies, respectively, in year t.[26] 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 effects on part-time enrollment in states that combine two sub-policies in their SAAs. I am not able to disentangle these factors further to examine the

[25] 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).

[26] $Three_{ist}$ includes states that combine a TC, CCN, and a GAA. Two_{ist} includes states that combine any two of these policies, e.g. a TC and CCN, a TC and a GGA, or CCN and a GAA. Finally, One_{ist} includes states that only have one of those policies in place.

effects of each policy combination. The most commonly adopted policy combination, which bundles two sub-policies and is likely driving this result, is the combination of the GAA and the TC. Surprisingly, however, I do not find statistically significant effects for states that implement all three policies in their SAAs, and in particular that adding a third policy to the mix appears to negate the effects on part-time enrollment. Additionally, it appears that states implementing only one policy in their SAAs actually experience negative effects. This is, in fact, consistent with qualitative evidence from Texas, which implements only the TC (Schudde, Jabbar and Hartman, 2020). My findings from this exercise provide evidence that the a GAA along with a TC is the most effective combination of sub-policies, and that if a state is to implement an SAA, it should consider including more than one of the aforementioned sub-policies. Without additional student level data, though, it is impossible to divide my sample into sub-samples based on the exact policy combination implemented without losing predictive power. [27]

6.4 Robustness Checks

In subsection 3.1 I discuss the method used to collect dates 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 and operational date while group two includes states for which I am able to obtain the original policy documents but *cannot* distinguish between policy enactment and the operational date.[28] Group three includes states for which I am not able to track down original policy documentation but can find secondary sources that mention the date of policy enactment. Group 4 is small and consists only of four states for which 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 of the date reported in Townsend and Ignash (2000). 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, or find evidence that an SAA existed within five years of the date reported in their study. States in the second and third groups create a minor problem

[27] I cannot assess the impact in states that implement a GAA and a TC in comparison with states that implement a GAA and CCN or a TC and CCN.

[28] Some policies will specify a timeline for 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.

wherein the effects of treatment might be lagged. For policies that do not specify when the corresponding SAAs 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 able, as I have noted in section 3, 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 possible dates of SAA enactment, so it is unclear what type of treatment is captured by each date, which makes it harder to interpret the results as causal. Group-five dates, on the other hand, are not only unverified but there are also lacking in available policy details, which raises the same issues as those associated with group four.

To alleviate concerns regarding 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 effects become larger and statistically significant once we remove more problematic states. Specifically, as can be seen in column (5), even though the magnitudes of the effects on part-time enrollment are smaller, they become more precise, and the effects on total enrollment become marginally significant. Degrees awarded exhibit some statistical significance when I omit states for which I have no details related to the date of articulation (other than just the date itself), 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 $T-3$ through $T+3$. Since enrollment data are first reported in 1968, and the first treated states are treated in 1971, the longest pre-period for which I can balance the sample is three years. There are, however, 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 $T-5$ through $T+5$. Table C3 shows the results of this analysis. Panel A shows the original main estimates, and panel B shows results for a sample that is balanced for the longer period of time. For total first-time freshman enrollment, restricting my sample to achieve a longer balanced panel results in smaller estimated effects.

7 Conclusion

This paper evaluates the effects of statewide articulation laws on transfers into four-year institutions, first-time freshman enrollment, and degree attainment at community colleges. The first-order objective of SAA policies is to increase transfers from community colleges to four-year institutions. Because detailed student transfer data are notoriously hard to come by, I collect data from the CSU and the UC systems. I conduct a case-study analysis of the effects of the STAR act, which implemented the ADT program. My results show a statistically significant one-percentage-point increase in transfer-in enrollment at CSU campuses relative to UC campuses in the first year after the policy was enacted. This effect, however, is not sustained over time. The one-percentage-point increase translates to 191 additional students transferring into CSU institutions. 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 transfer-in enrollment is one of the primary goals of the policy. Understanding why the reform is an important avenue for future research.

I next 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. To determine whether 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 attending a four-year institution is $12,285 (Ma, Pender and Welch, 2019).[29] Average lifetime earnings following the obtainment of a bachelor's degree, an associate's degree, and some college are estimated at $2,254,243, $1,612,050, and $1,485,955, respectively. Attending a community college and 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.[30] If an

[29] almost 70 percent of community college receive either federal or state aid in amounts that exceed tuition and fees.

[30] 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. The student then enrolls at

additional 113 students are enrolling and there are 880 treated community colleges in my sample, assuming that students eventually graduate with four-year degrees, 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 on the gains students would experience. Yet attending a community college, not conditional on graduating, always leaves students better off than if they attend only a four-year institution and drop out. On the other hand, if a student attends a community college and does ultimately obtains a bachelor's degree, she is worse off than if she had graduated from a four-year institution. Therefore, whether or not increasing enrollment is a positive or negative spillover depends on the student's ultimate educational outcome.

the four-year institution (full-time) and graduates after two years. I then compare this to what happens when 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 it takes six years for the student to graduate, the additional lifetime earnings are larger, $49,752.

References

Acemoglu, Daron, and David Autor. 2011. "Skills, tasks and technologies: Implications for employment and earnings." In *Handbook of labor economics*. Vol. 4, 1043–1171. Elsevier.

Anderson, Gregory M., Jeffrey C. Sun, and Mariana Alfonso. 2006. "Effectiveness of statewide articulation agreements on the probability of transfer: A preliminary policy analysis." *Review of Higher Education*, 29(3): 261–291.

Averett, Susan L., and Mark L. Burton. 1996. "College attendance and the college wage premium: Differences by gender." *Economics of Education Review*, 15(1): 37–49.

Baker, Rachel. 2016. "The Effects of Structured Transfer Pathways in Community Colleges." *Educational Evaluation and Policy Analysis*, 38(4): 626–646.

Becker, Gary S. 1993. *Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education.*

Bender, Louis W. 1990. "Spotlight on the Transfer Function: A National Study of State Policies and Pracitces."

Blankstein, Melissa, and Christine Wolff-Eisenberg. 2020.

Buchmueller, Thomas C., and Colleen Carey. 2018. "The effect of prescription drug monitoring programs on opioid utilization in medicare." *American Economic Journal: Economic Policy*, 10(1): 77–112.

Cameron, Stephen V., and James J. Heckman. 2001. "The dynamics of educational attainment for black, Hispanic, and white males." *Journal of Political Economy*, 109(3): 455–499.

Carrell, Scott E., and Michal Kurlaender. 2016. "Estimating the Productivity of Community College in Paving the Road to Four-Year Success." NBER Working Paper No. 22904.

Chetty, Raj, Nathaniel Hendren, Patrick Kline, and Emmanuel Saez. 2014. "Where is the land of opportunity? The geography of intergenerational mobility in the United States." *The Quarterly Journal of Economics*, 129(4): 1553–1623.

Clark, Burton R. 1963. "The" Cooling-Out" Function in Higher Education."

Denning, Jeffrey T. 2017. "College on the Cheap: Consequences of Community College Tuition Reductions." *American Economic Journal: Economic Policy*, 9(2): 155–88.

Dougherty, Kevin J. 1992. "Community Colleges and Baccalaureate Attainment." *The Journal of Higher Education*, 63(2): 188–214.

Dougherty, Kevin J, and Monica Reid. 2006. "Achieving The Dream In Connecticut : State Policies Affecting Access To , And Success In , Community Colleges For Students Of Color."

Doyle, William R. 2009. "Impact of increased academic intensity on transfer rates: An application of matching estimators to student-unit record data." *Research in Higher Education*, 50(1): 52–72.

Ginder, Scott A., Janice E. Kelly-Reid, and Farra B. Mann. 2019. "Enrollment and Employees in Postsecondary Institutions, Fall 2017; and Financial Statistics and Academic Libraries, Fiscal Year 2017: First Look (Provisional Data)."

Goodman, Joshua, Michael Hurwitz, and Jonathan Smith. 2017. "Access to 4-year public colleges and degree completion." *Journal of Labor Economics*, 35(3): 829–867.

Goodman, Joshua, Oded Gurantz, and Jonathan Smith. 2020. "Take Two! SAT retaking and college enrollment gaps." *American Economic Journal: Economic Policy*, 12(2): 115–158.

Government Accountability, Office. 2017. "Higher Education: Students Need More Information to Help Reduce Challenges in Transferring Credits."

Grubb, W. Norton. 1991. "The Decline of Community College Transfer Rates: Evidence from National Longitudinal Surveys." *The Journal of Higher Education*, 62(2): 194.

Hershbein, Brad, and Melissa Kearney. 2014. "Major Decisions: What Gradutes Earn Over their Lifetimes." The Hamilton Project.

Hillman, Nicholas, and Taylor Weichman. 2016. "Education deserts: The continued significance of "place" in the twenty-first century." *Viewpoints: Voices from the Field*.

Horn, Laura, and Paul Skomsvold. 2011. "Community College Student Outcomes: 1994-2009." NCES Report 2012253.

Kane, Thomas J., and Cecilia Elena Rouse. 1999. "The community college: Educating students at the margin between college and work." *Journal of Economic Perspectives*, 13(1): 63–84.

Kintzer, Frederick C., and James L. Wattenbarger. 1985. *The articulation/transfer phenomenon: patterns and directions.*

Leigh, Duane E., and Andrew M. Gill. 1997. "Labor market returns to community colleges: Evidence for returning adults." *Journal of Human Resources*, 32(2): 334–353.

Ma, Jennifer, Matea Pender, and Meredith Welch. 2019. "Education Pays 2019: The Benefits of Higher Education for Individuals and Society."

Marx, Benjamin M., and Lesley J. Turner. 2019. "Student Loan Nudges: Experimental Evidence on Borrowing and Educational Attainment." *American Economic Journal: Economic Policy*, 11(2): 108–41.

Oreopoulos, Philip, and Kjell G. Salvanes. 2011. "Priceless: The Nonpecuniary Benefits of Schooling." *Journal of Economic Perspectives*, 25(1): 159–84.

SB 1440, California Legislature. 2010. "SB 1440 - Student Transfer Achievement Reform Act."

Schudde, Lauren, Huriya Jabbar, and Catherine Hartman. 2020. "How Political and Ecological Contexts Shape Community College Transfer." *Sociology of Education*, 0038040720954817.

St. Amour, Madeline. 2020.

Stange, Kevin. 2012. "Ability sorting and the importance of college quality to student Achievement: Evidence from community colleges." *Education Finance and Policy*, 7(1): 74–105.

Tolbert, Charles M, and Molly Sizer. 1996. "US commuting zones and labor market areas: A 1990 update."

Townsend, Barbara K., and Jan Ignash. 2000. "Assumptions about Transfer Behavior in Sate-Level Articulation Agreements: Realistic od Reactionary?" 1.

Turley, Ruth N López. 2009. "College proximity: Mapping access to opportunity." *Sociology of Education*, 82(2): 126–146.

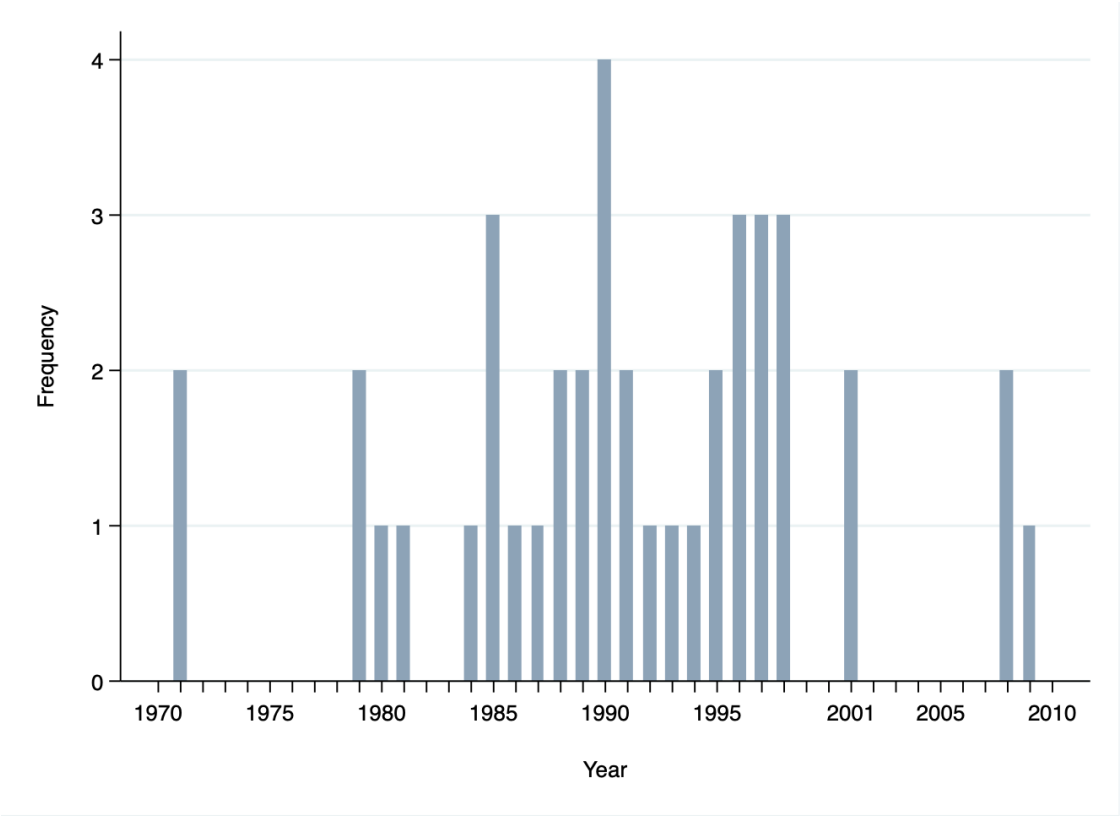
Wooldridge, Jeff. 2007. "What's new in econometrics? Lecture 10 difference-in-differences estimation." *NBER Summer Institute, available at: www. nber. org/WNE/Slides7–31–07/slides_10_diffindiffs. pdf, accessed April*, 9(2011): 85.

Worsham, Rachel, Melissa Whatley, Renee Barger, and Audrey J. Jaeger. 2020. "The Role of North Carolina's Comprehensive Articulation Agreement in Transfer Efficiency."

Zimmerman, Seth D. 2014. "The Returns to College Admission for Academically Marginal Students." *Journal of Labor Economics*, 32(4): 711–754.

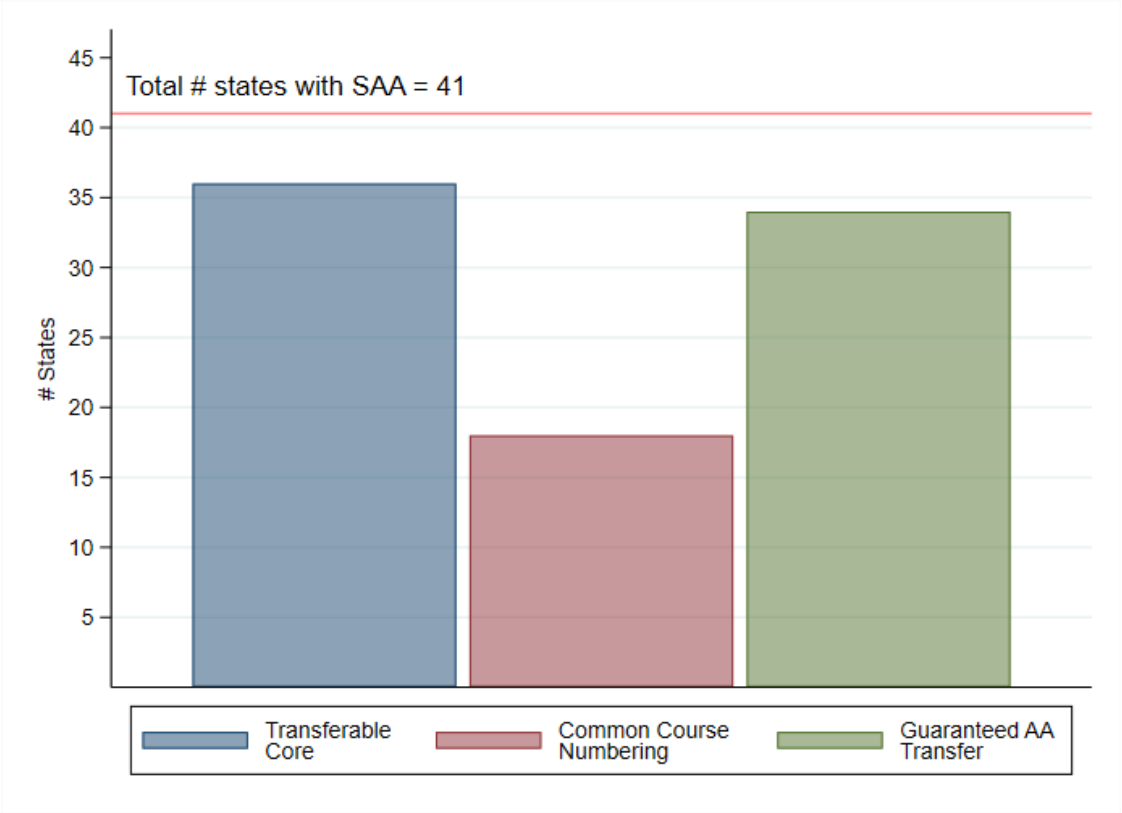
8 Tables and Figures

Figure 1: Distribution of Articulation Years



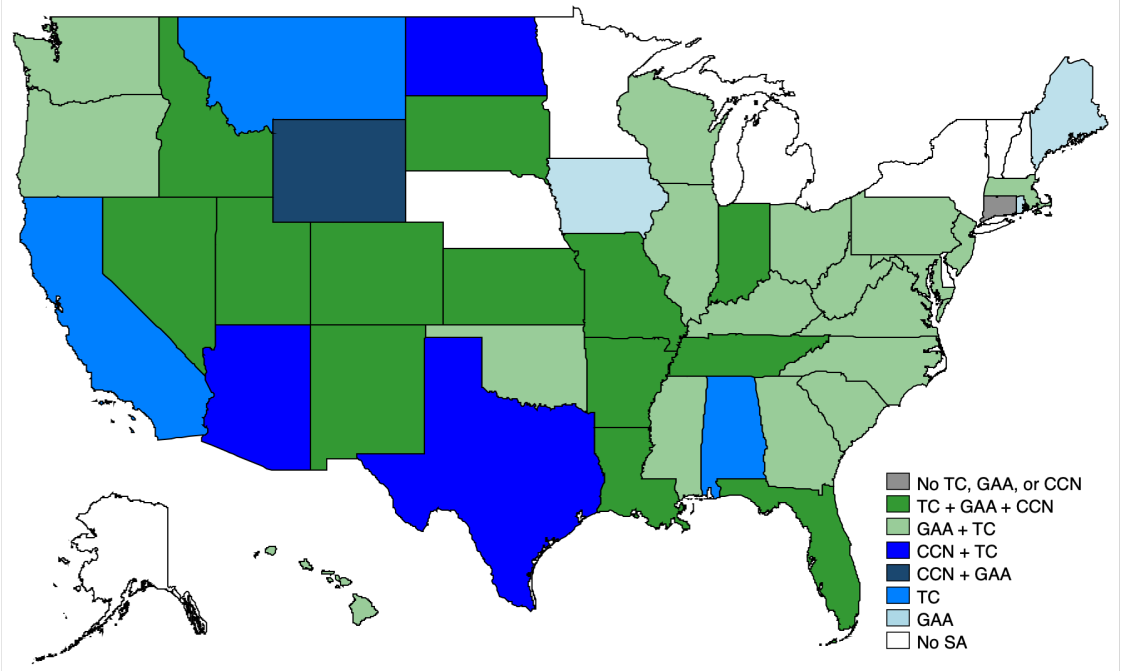
Notes: This figure shows the number of states implementing statewide articulations in each year. For details on how dates were collected, see subsection 3.1

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



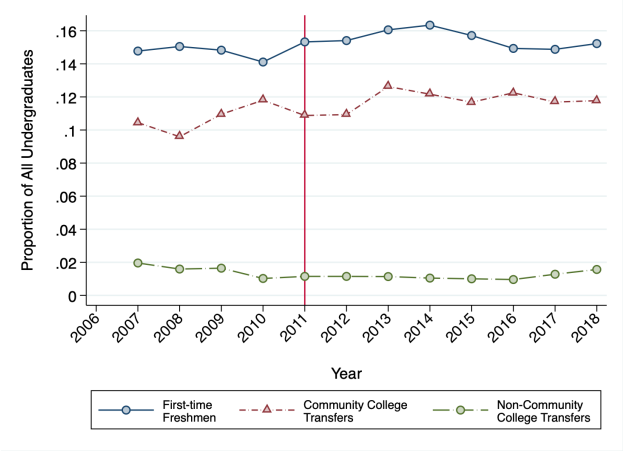
Notes: Each bar represents the number of states that implement each type of policy. They are not mutually exclusive, as states can implement one or more of the policies, and thus appear in more than one bar.

Figure 3: Map of Statewide Articulation in the United States

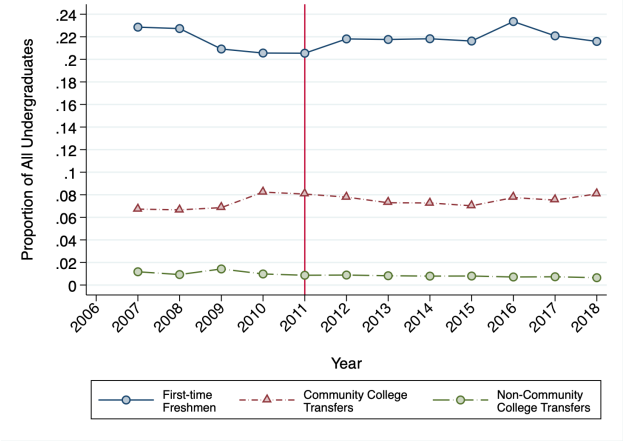


Notes: This map shows the distribution of states with each combination of the three statewide articulation policy components. These data are obtained from the website of the Education Commission of the States. No SA indicates states that never implemented an SAA policy, while the "No TC, GAA, or CCN"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

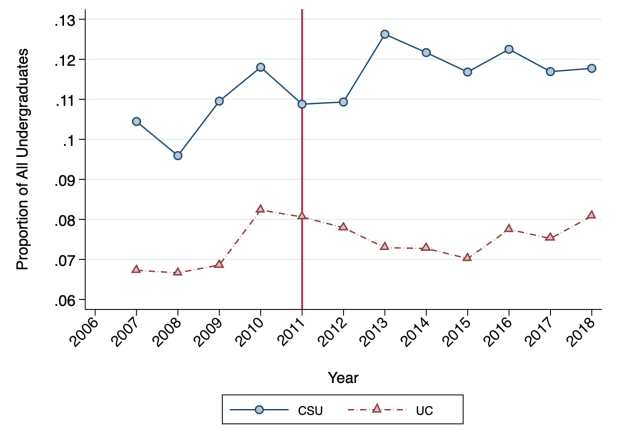
Figure 4: Trends in Enrollment at CSU and UC Campuses



(a) Transfers into CSU



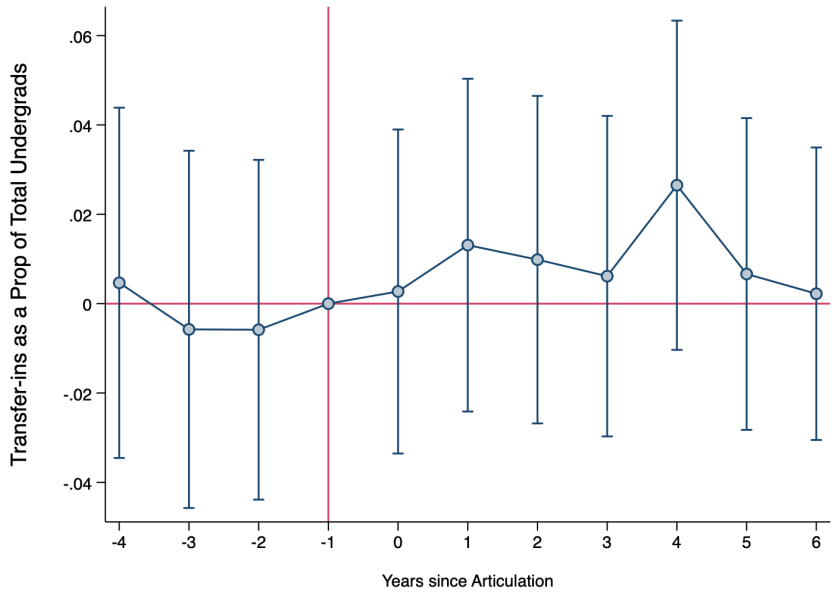
(b) Transfers into UC



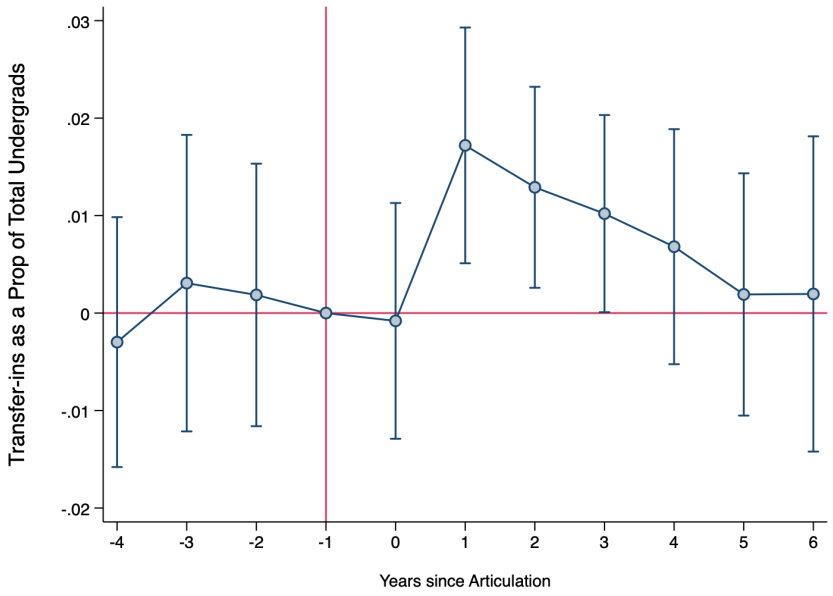
(c) CCC Transfers into CSU & UC

Notes: In this figure I show the average proportions 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 freshman enrollment are collected from the IPEDS, while detailed data on CCC and non-CCC transfers are obtained from the UC and CSU offices of institutional research and analysis.

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



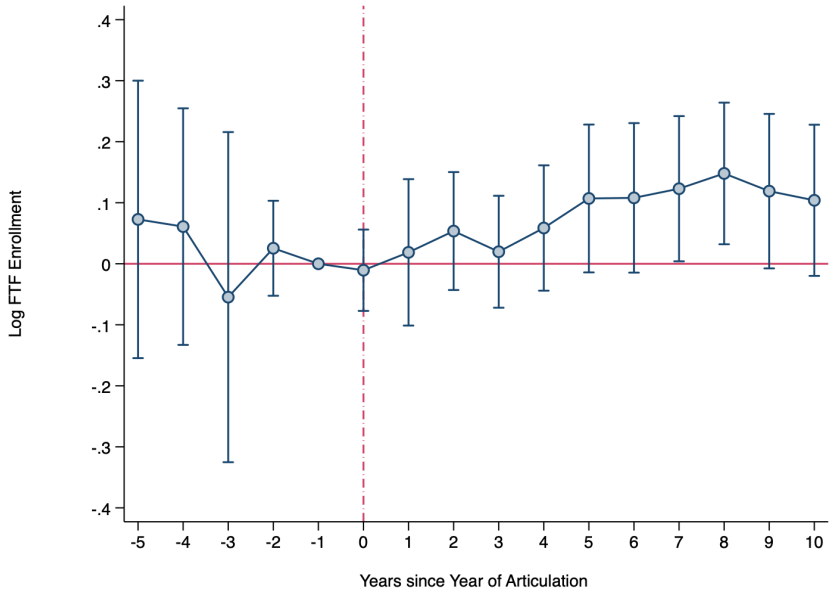
(a) Triple Difference - Transfer vs. First-time Freshman & CSU vs. UC



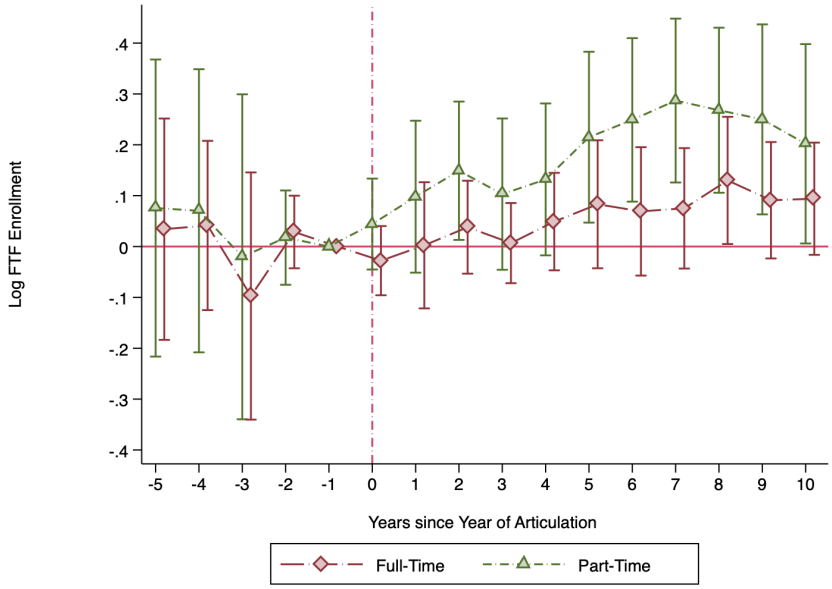
(b) Difference-in-Differences - Transfers to CSU vs. UC

Notes: Figure 5(a) shows the results of a triple differences analysis wherein I compare transfer-in enrollment with first-time freshmen enrollment, within each institution, at CSU and UC campuses. In Figure 5(b) I show the results of a difference-in-differences analysis where I compare only transfer-in enrollments at CSU and UC campuses. The outcome in each regression is transfers (of first-time freshman) 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 produced by Equation 1 and Equation 2 and are are weighted by total student population at the baseline. Bands indicate 95 percent confidence intervals. Robust standard errors are reported.

Figure 6: Effects of Statewide Articulation on First-time Freshman Enrollment



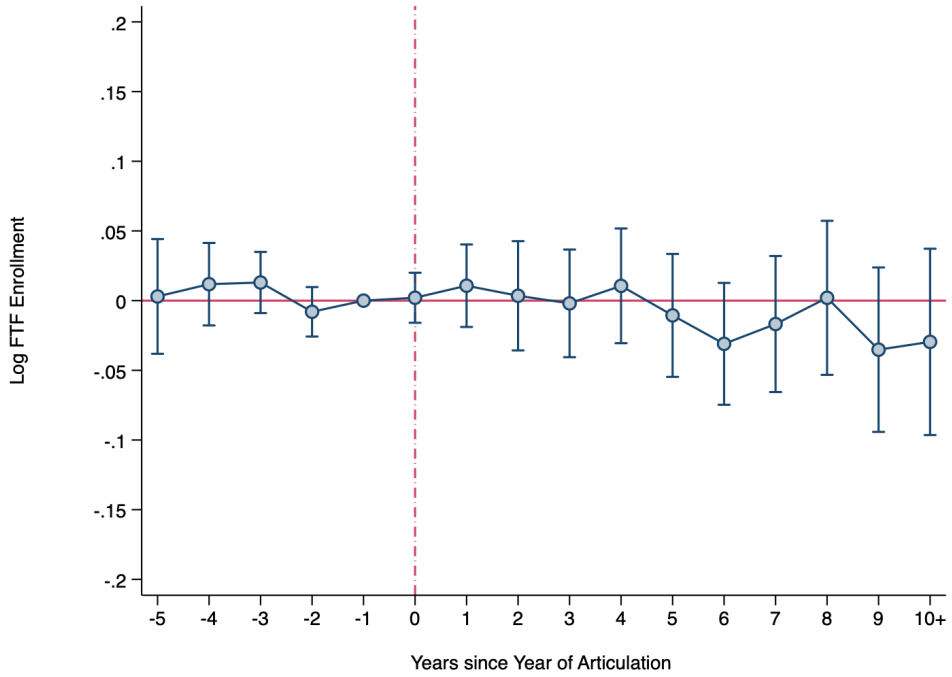
(a) Community College FTF



(b) Full-time vs. Part-time

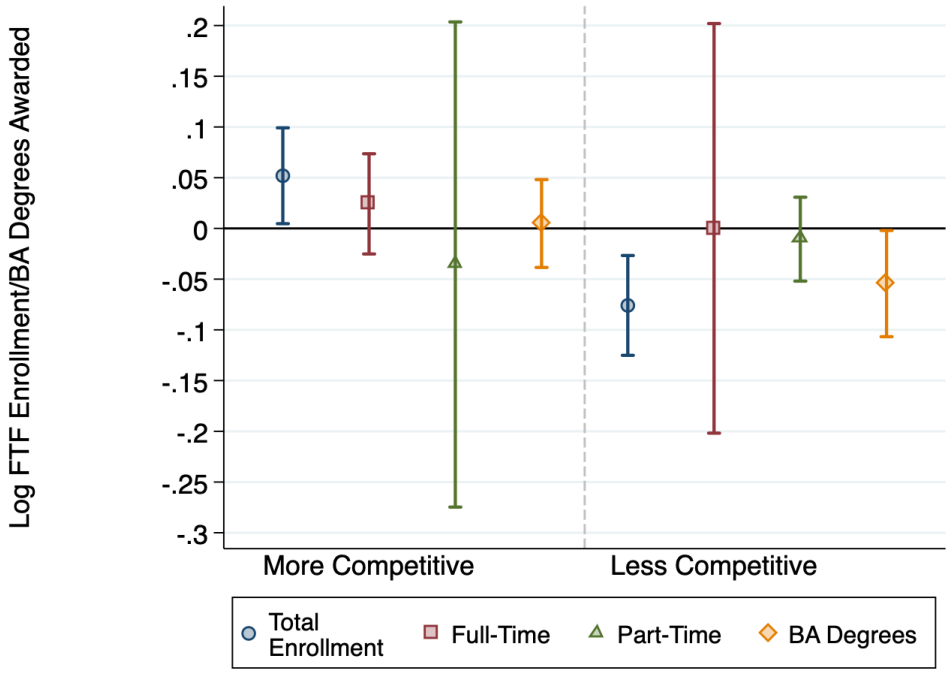
Notes: These figures plot the results of estimating a difference-in-differences analysis of the effects of statewide articulation on first-time freshman enrollment. The top panel shows the effects on total enrollment, while the bottom panel shows the effects by part-time and full-time status. The outcome 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 produced by Equation 5 and are are weighted by total student population at the 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: Effects of Statewide Articulation on First-time Freshman Enrollment at 4-Year Public Universities



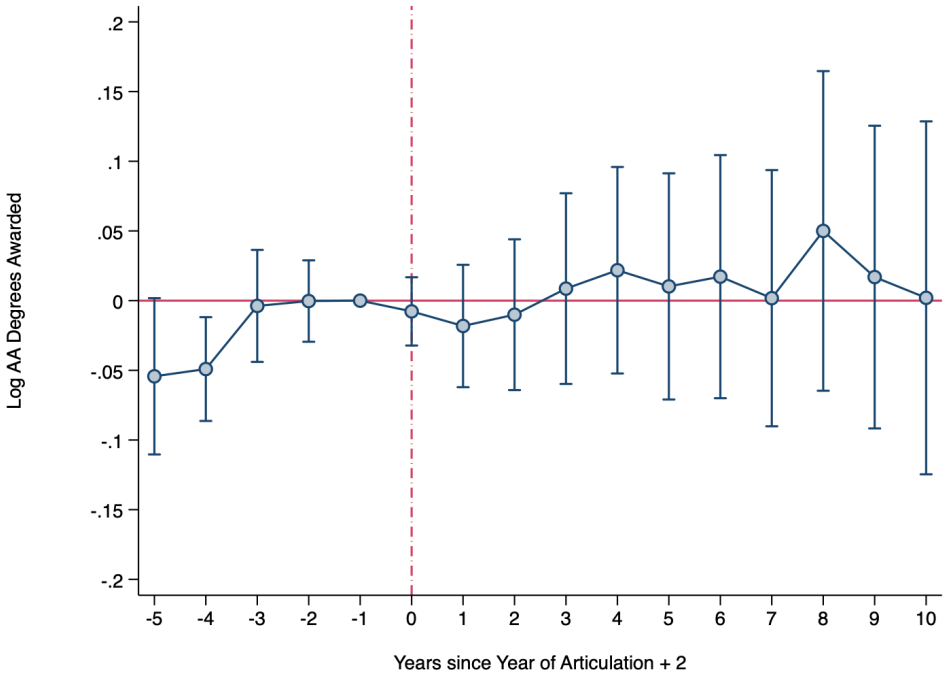
Notes: This figure shows the effects of statewide articulation on first-time freshman enrollment at four-year institutions. The outcome on the y-axis is the logarithm of total enrollment. The regression includes region-by-year and institution fixed effects. The reference year $T-1$ is the year prior to statewide articulation. These estimates are produced by 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: Effects of Statewide Articulation on 4-Year Public University First-time Freshman Enrollment by Selectivity



Notes: This figure plots the difference-in-differences estimates calculated to examine the effects of statewide articulation on first-time freshman enrollment by the four-year institution's selectivity. The selectivity measure used here is the Barron's ratings, which are updated 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 its 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 derived from Equation 5 and are are weighted by total student population at the baseline. Bands indicate 95 percent confidence intervals and standard errors are clustered at the state level.

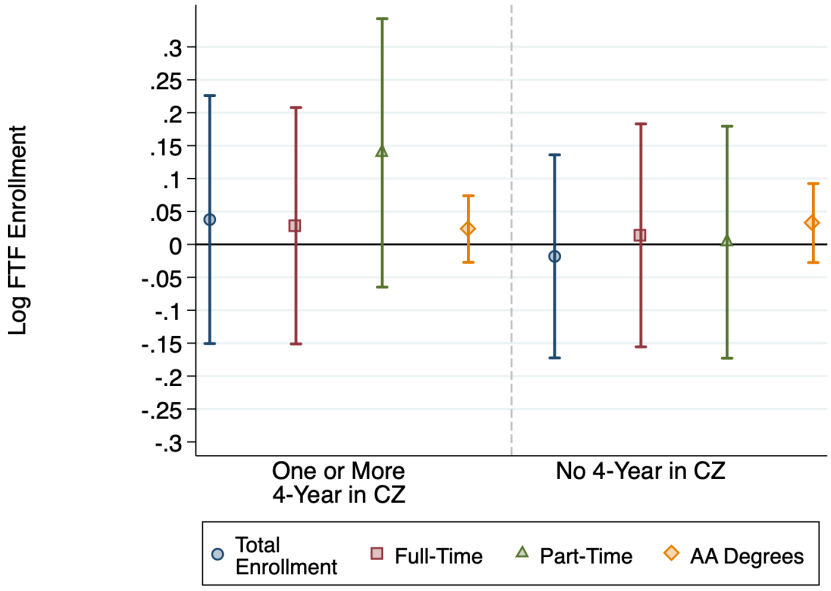
Figure 9: Effects of Statewide Articulation on Degrees Awarded



(a) Associate's Degrees Awarded

Notes: This figures shows the effects 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 of articulation plus one. These estimates are derived from 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: Effects of Statewide Articulation on Community College First-time Freshman Enrollment by Number of 4-Year institutions in CZ



Notes: This figure plots the difference-in-differences estimates calculated to examine the effects of statewide articulation on first-time freshman enrollment by the number of four-year institutions in a community college's commuting zone. These estimates are derived from 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
	(9,203.52)	(8,784.97)
First-time Freshman	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 enrollment, first-time freshman enrollment, and total transfers are obtained from the IPEDS. CCC and non-CCC transfers are obtained from the respective CSU and UC offices of institutional research and analysis. These data span the years 2007 - 2018. Means in 2007 are reported. Standard deviations are in parentheses.

Table 2: Descriptive statistics at the Baseline

	In States with SAA (1)	In States Without SAA (2)	Four-year Public Universities (3)
Total Enrollment:			
Total Undergraduate Enrollment	3,354.29	1,963.26	7,028.15
	(4,702.816)	(2,703.149)	(6,092.318)
First-time Freshman Enrollment	1,125.52	870.91	1,747.26
	(1,254.792)	(8,93.187)	(1,712.484)
First-time Freshman:			
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 (SAA) laws in column (1), averages for states that never pass SAA laws in column (2), and averages for all four-year institutions in column (3). All results were calculated in each institution's baseline year, i.e. the first year an institution is observed in the data. Data are from the IPEDS, the HEGIS, and the author's own data collection. Standard deviations are reported in parentheses.

[1] Results reported in columns (1) and (2) reflect the number of four-year institutions, and those reported in column (3) show the number of two-year institutions.

[2] The selectivity measure ranges from 1 through 6, with 1 being the highest and 6 the lowest.

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

Table 3: Transfer-in Enrollment Effects 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 Effects	X	X	X
Year × Student Type Fixed Effects	X	X	X
Student Type × CSU Fixed Effects	X	X	X
Student Type Fixed Effects	X	X	X
Institution Fixed Effects	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 Effects	X	X	X
Institution Fixed Effects	X	X	X
Controls	X	X	X

Notes: This table shows the average effects 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 pre-treatment transfer-in enrollment at the CSU campuses. All regression control for state-by-year unemployment levels. These estimates are derived from Equation 3 and Equation 4.

Table 4: First-time Freshman Enrollment and Degree-Attainment Effects 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 reported 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 the 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 years, I include an indicator for the first five years, and an indicator for post-treatment years 6 through 10. Dependent variable means are reported 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 the baseline.

Table 6: First-time Freshmen Enrollment and Degree-Attainment Effects 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 an indicator for post-treatment years with an indicator that equals one for institutions that are categorized as less competitive, and in a separate regression I interact the indicator for post-treatment years with an indicator equal to one with for institutions that are more competitive. Each column represents results derived from a single regression. Dependent variable means are reported 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 the baseline.

Table 7: First-time Freshman Enrollment and Degree-Attainment Effects of Articulation by Number of 4-Year institutions in Commuting Zones

	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 post-treatment years for all institutions, I include an indicator that equals one in post-treatment years for institutions in commuting zones with one or more four-year institutions and zero for institutions in commuting zones with no four-year institutions. I also include an analogous variable for institutions with no four-year institutions. Dependent variable means are reported 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 the baseline.

Table 8: First-time Freshman Enrollment and Degree-Attainment Effects at Community Colleges by Policy Combination

	Total Enrollment	Full-time	Part-time	Degrees
	(1)	(2)	(3)	(4)
Articulation × All 3 Sub-policies	-0.029	0.034	-0.093	0.063
	(0.064)	(0.063)	(0.104)	(0.055)
Articulation × Combine 2 Sub-policies	0.102	0.065	0.255**	0.023
	(0.103)	(0.102)	(0.104)	(0.028)
Articulation × Only 1 Sub-policy	-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 post-treatment years with an indicator that equals one for states that have one, two, or three policies in place. Each column represents results from a single regression. Dependent variable means are reported 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 the baseline.

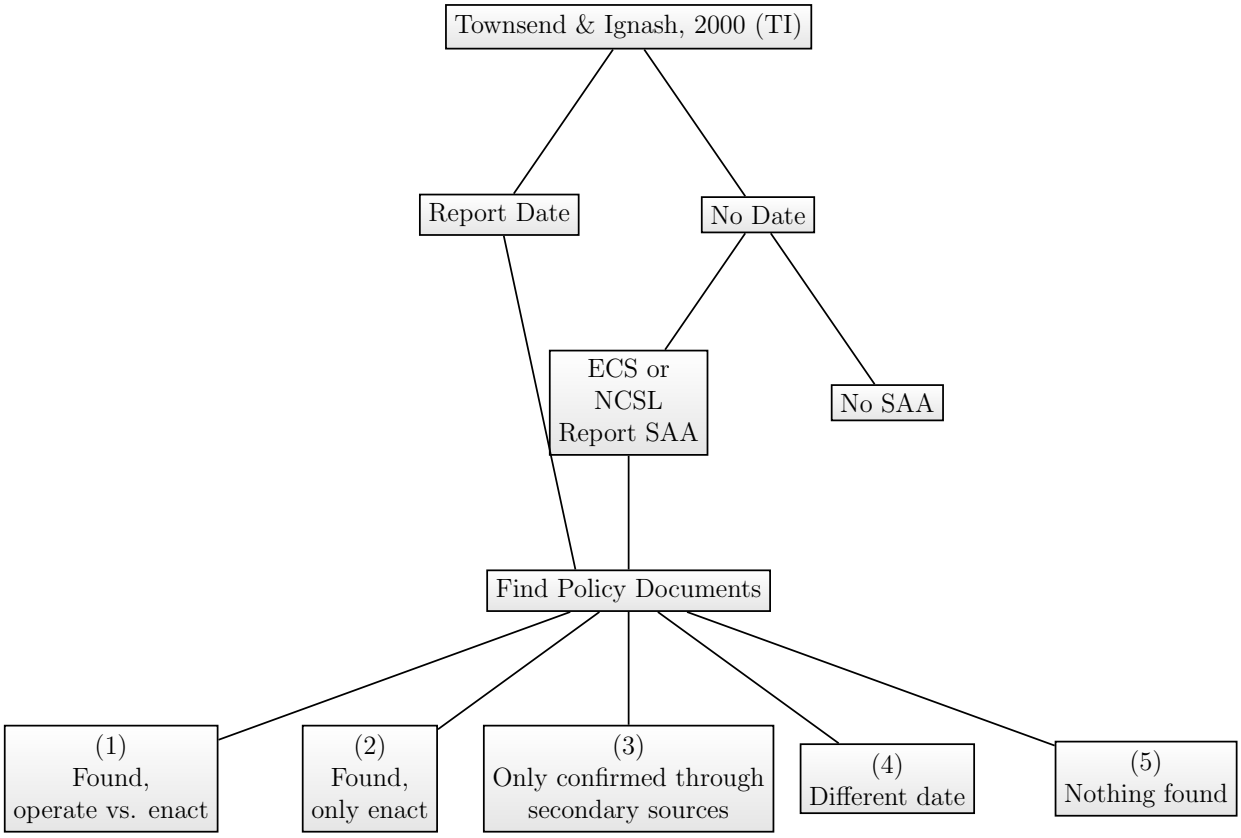
A Additional Details on California Articulation Laws

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 (CCCs), the University of California (UC) system, and the California State University (CSU) system must develop a common core curriculum in general education courses for the purpose of transfer and that it should be published and distributed to all public high schools and community colleges in California. Shortly after the law was enacted, all parties realized the confusing multiplicity of general education course requirements in the CSU system and the individual campuses, colleges, and programs of the UC system 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. 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 CSU system or the UC system without the need, after transfer, to take additional lower-division general education courses to satisfy general campus education requirements.

The educational code was amended again in 2000 to include a section mandating that a copy of the transfer core curriculum be distributed to each enrolled community college student in some form, whether by electronic or physical copies. Finally, another change in the legislation occurred in 2010, whereby the CSU system and the CCCs were required to inform students of the new program-which was called the "Associates Degree for Transfer" (ADT), a program created by California Senate Bill 1440 that 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 Legislatures, and SAAs 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 are obtained from an IPEDS subsample and Barron's ratings for 2008, which is the year of the most recent Barron's ratings.

Table C2: First-time Freshman Enrollment and Degree-Attainment Effects 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	1,088	1,137	1,165	1,195	1,121
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

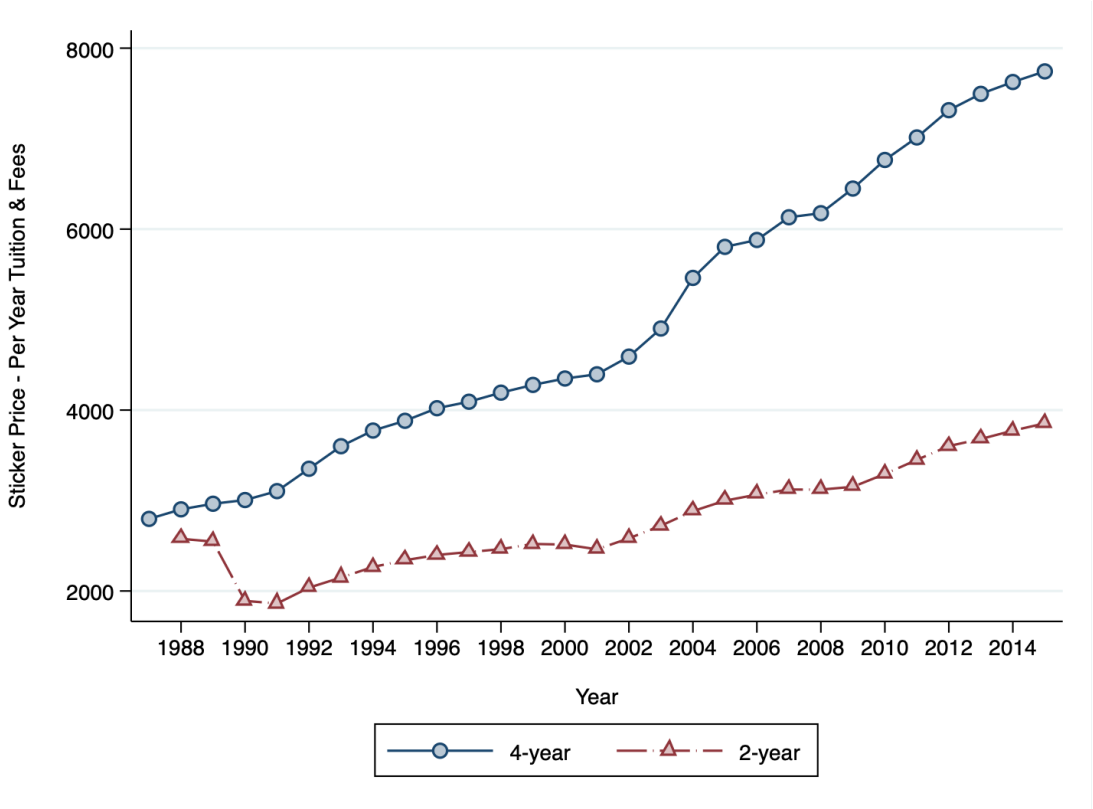
Notes: This table shows the results of estimating Equation 5, where column (1) replicates the results in Table 4. Starting in column (2), states are excluded from the analysis in steps. Column (2) shows the effects on all states excluding those for which I do not have sufficient information on policy dates. Column (3) shows the effects on states reflected column (2) while further excluding states for which I find conflicting dates. Column (4) shows the effects on states reflected in column (3), excluding states for which I do not have policy documentation. Column (5) excludes all of the above, in addition to states that have only an enactment date. In other words, column (5) displays the effects only for states that report an operational dates. Dependent variable means are reported 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 the baseline.

Table C3: First-time Freshman Enrollment and Degree-Attainment Effects 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

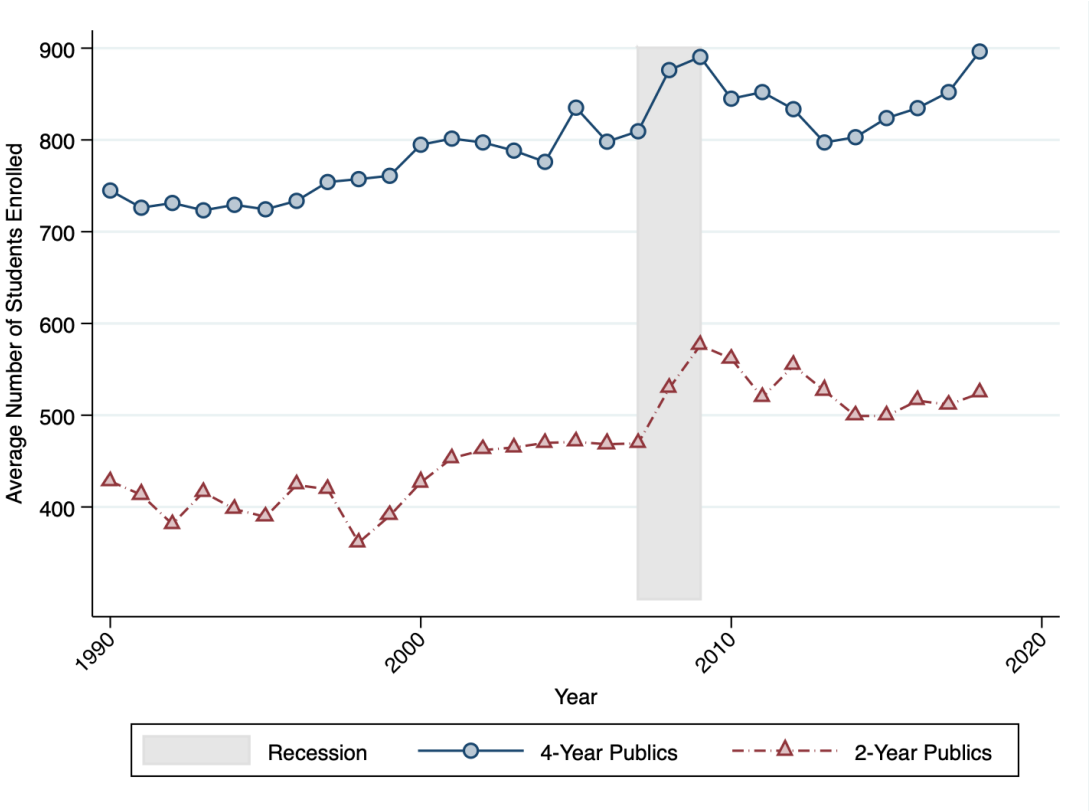
Notes: This table shows the results of estimating Equation 5. Panel A presents the same estimates as in Table 4, where I include only states that report data from at least $T-3$ through $T+3$. For panel B I restrict the sample to enhance the balance of my sample and include only states that report data from at least $T-5$ through $T+5$. Dependent variable means are reported 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 the baseline.

Figure C2: Trends in Undergraduate Tuition



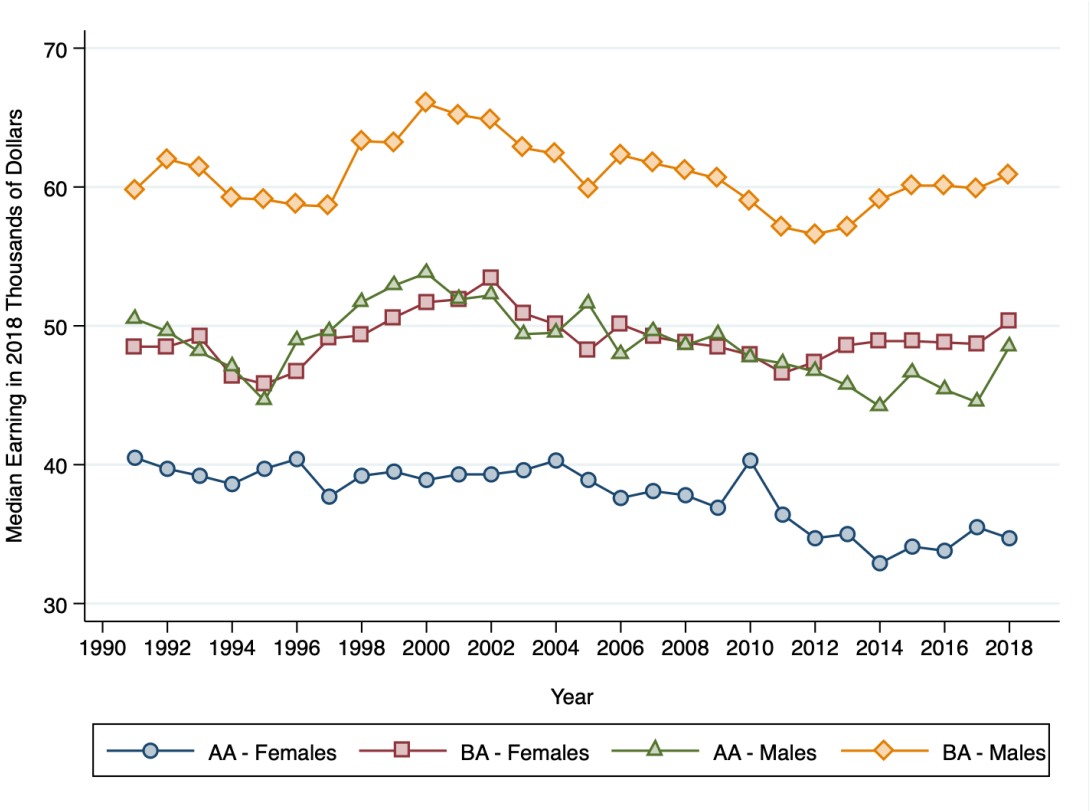
Notes: The figure above shows average sticker prices of per-year tuition and fees by level of institution (2-year vs. 4-year) from 1971 through 2015. All prices are adjusted to 2015 dollars. Calculated using *Delta Cost Project* variables.

Figure C3: Trends in Undergraduate Enrollment



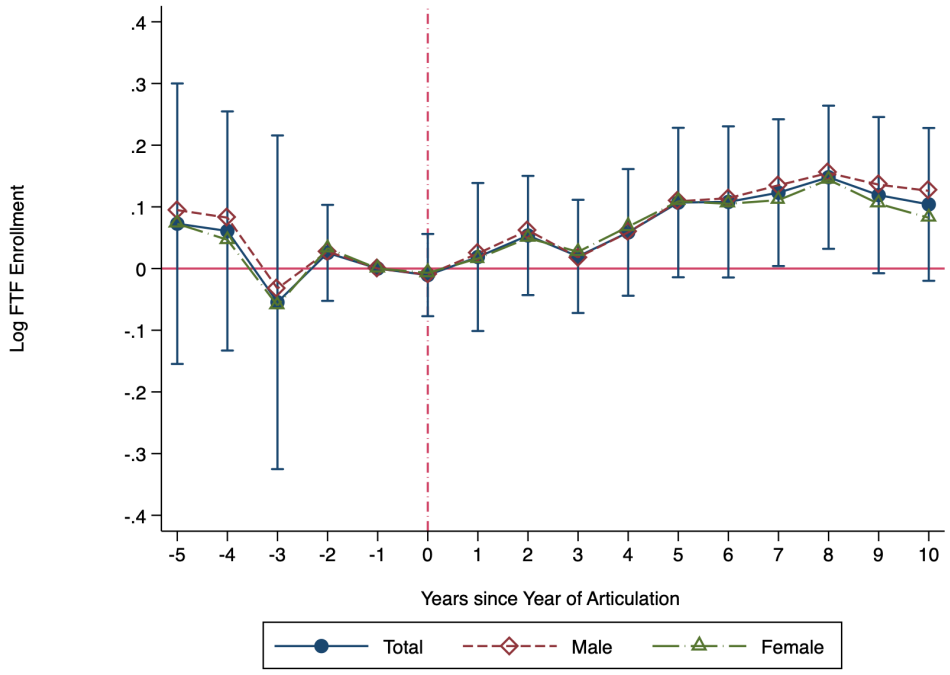
Notes: The figure above shows average enrollment per institution-year by level of institution (2-year vs. 4-year) from 1989 through 2018. The highlighted area represents NBER recession. Calculated using data from the IPEDS.

Figure C4: Trends in Median Earnings by Education Level and Sex

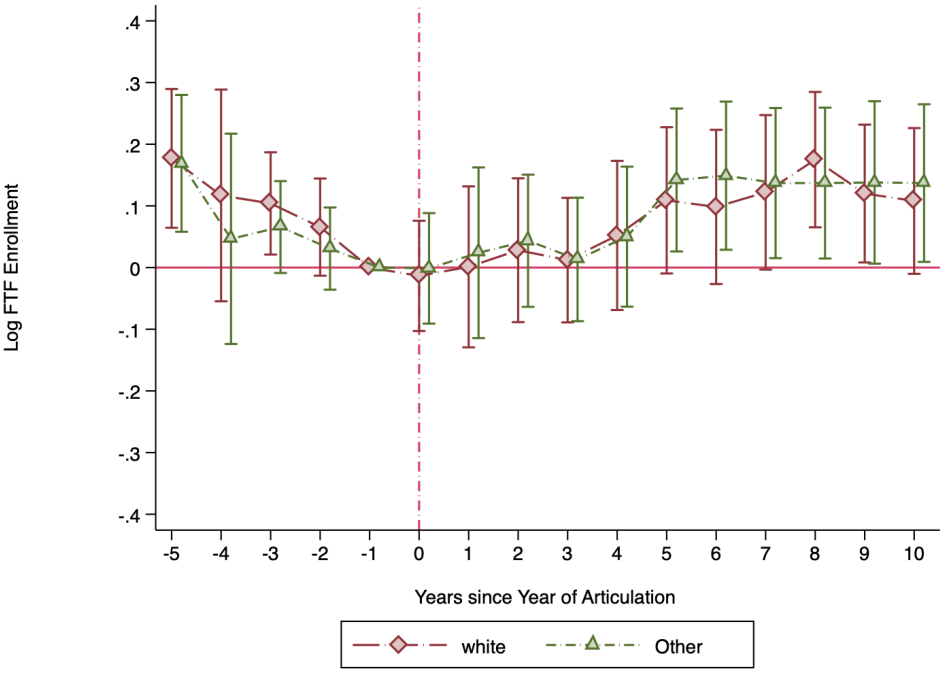


Notes: The figure above shows median earnings for full-time year round workers age 25 to 34 in 2018 thousands of dollars from 1991 through 2018. Data are obtained from the College Board Education Pays report of 2019.

Figure C5: Effects of Statewide Articulation on First-time Freshman Community College Enrollment by Sex and Race



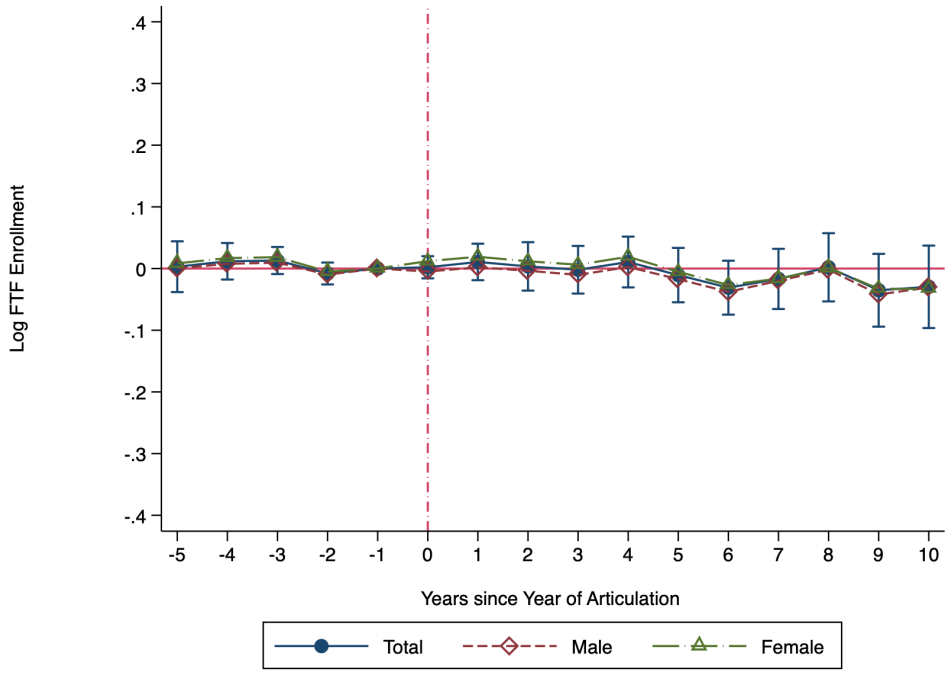
(a) By Sex



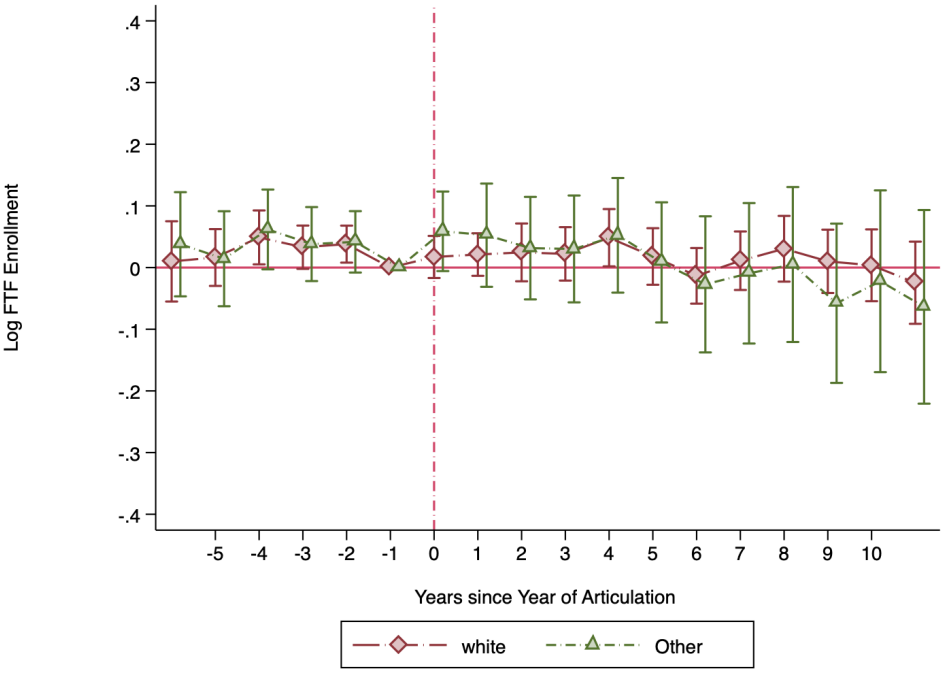
(b) By Race

Notes: These figures plot the results of estimating a difference-in-differences analysis of the effects of statewide articulation on first-time freshman enrollment. The top panel shows the effects on total enrollment by sex, while the bottom panel shows the effects 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 derived from Equation 5, and are are weighted by total student population at the 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 C6: Effects of Statewide Articulation on First-time Freshman Enrollment at 4-Year Public Universities by Sex and Race



(a) By Sex



(b) By Race

Notes: These figures plot the results of estimating a difference-in-differences analysis of the effects of statewide articulation on first-time freshman enrollment at four-year institutions. The top panel shows the effects on total enrollment by sex, while the bottom panel shows the effects 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 derived from Equation 5, and are are weighted by total student population at the 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 the SAA, is indifferent between starting at a two-year or a four-year institution:

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

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

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

if student i chooses to start at the community college and then transfer, her 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 years spent at the community college, and Z is the number of years at the four-year. institution 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 institution. This will increase X and decrease Z, and 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 entering 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 their expected lifetime earnings associated with enrolling at a 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 who is already enrolled at community college and is indifferent between obtaining a degree or not obtaining one:

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

An SAA will increase the probability that more credits will transfer, which will require students to take fewer credits at four-year institutions. 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 of any articulation and/or in which transfer policies were passed. I do not yet distinguish the dates for each component of the articulation policy (transferable core vs. common course numbering vs. guaranteed AA transfer). The dates provided do 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 that 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 thata it was the first year the policy was passed. *Verified date, no source* indicates 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 for which I was unable to find any policy documents/laws/or reports reflecting a date around the date reported in Townsend and Ignash (2000). *Enact vs. Implement* notes the states for which I can distinguish between policy enactment date and the date by the which the policy is to be implemented.