Improving the Community College Transfer Pathway to the Baccalaureate: The Effect of California's Associate Degree for Transfer

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Abstract

The transfer between two-year and four-year colleges is a critical path to baccalaureate attainment. Yet, students face a number of barriers in transfer pathways, including a lack of coherent coordination and articulation between their community colleges and four-year institutions, resulting in excess units and increased time to degree. In this paper we evaluate the impact of California's Student Transfer Achievement Reform Act, which aimed to create a more seamless pathway between the Community Colleges and the California State University. We investigate whether the reform effort met its intended goal of improving baccalaureate receipt, and greater efficiency in earning these degrees, among community college transfer students. We tease out plausibly causal effects of the policy by leveraging the exogenous variation in the timing of the implementation of the reform in different campuses and fields of study. We find that this reform effort has led to significant reductions in time to baccalaureate receipt among community college transfers and reduced total unit accumulation. These positive effects were shared across all student subgroups.

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INTRODUCTION

The transfer function has always been an essential component of the mission of community colleges, and today, it has become even more important. Financial and capacity constraints have limited access to many four-year universities, making community colleges the primary entry point into higher education for many students. Moreover, many BA-bound students prefer (or require) the open-access, increased flexibility, and lower cost that community colleges provide. As such, transfer between two-year and four-year colleges has become a critical pathway to a baccalaureate degree.

The complexity of the transfer process has been well documented in prior literature (Jenkins & Fink, 2016; Scott-Clayton, 2015; Long & Kurlaender, 2009; Melguizo, 2009). The administrative costs of transferring to a four-year college are prohibitive for many community college students. Students face a number of structural, financial, and informational barriers, including a lack of coherent coordination between their community colleges and four-year institutions and limited information about which courses transfer for credit and which do not. A key obstacle to transfer is the lack of systemwide articulation agreements between the two-year and four-year segments of higher education. Moreover, even when students do successfully transfer to a four-year institution, many do so without an associate degree and often with a lack of certainty over whether their courses will "count" toward a bachelor's degree.

A decade ago, California established a statewide framework for a more seamless pathway between the Community Colleges and the California State University (CSU). California Senate Bill 1440, adopted September 2010, stipulates that a student that earns a designated "Associate Degree for Transfer" (ADT) – a specific set of lower division major-required courses plus CSU-transferrable general education courses – will be admitted to at least one CSU campus with junior status provided they obtain a minimum grade point average of 2.0. Mandated implementation of this legislation began the following year. In this paper we evaluate the impact of this policy on outcomes at the four-year campuses, investigating whether the ADT met its intended goal of improving baccalaureate receipt, and greater efficiency in earning these degrees, among community college transfer students.

PRIOR LITERATURE

Community colleges are a critical point of entry to postsecondary schooling for many students, and the large majority of these students (80% from national statistics) aspire to earn a bachelor's degree (Bailey, Jaggars, & Jenkins, 2015). Prior work has demonstrated that students who transfer with an associate degree (or the equivalent) are more likely to complete their bachelor's degree than students who transfer without a community college degree (Gorbunov, Doyle, & Wright, 2012). And those students who transfer without having earned a community college degree and never earn a bachelor's degree leave college, often after several years of enrollment, with no degree at all. Yet, nationally, less than one-third of community college students earn an associate degree before they transfer (Jenkins & Fink, 2016).

Moreover, several studies have documented the significant credit loss community college transfer students face when they transfer to four-year institutions (Xu, Ran, Fink, Jenkins & Dundar, 2018; Belfield et al., 2017; USGAO, 2017). Data from nationally representative samples suggest that only 58% of community college transfer students were able to transfer the majority of their credits to the receiving four-year institution, and that this credit loss has significant consequences for students' likelihood of graduation (Monaghan & Attewell, 2015). Studies have also found that students of color are more likely to experience credit loss as compared to White students (Giani, 2019). For decades, hundreds of institution-to-institution and subject-by-subject or even course-by-course agreements have governed which courses from the community college count towards BA requirements (Moore, Shulock, & Jensen, 2009; Jenkins & Fink, 2016).

The ubiquitously complex process of transfer pathways has oft-been criticized as a culprit for weak degree receipt and transfer outcomes (Scott-Clayton, 2015, Schudde, Jabbar & Hartman, 2020). Prior work suggests that course-taking and career decision making may be challenging for students, absent strong institutional advising and clear degree pathways (Baker, Bettinger, Jacob & Marinescu, 2018; Baker, 2016; Scott-Clayton, 2015; Bailey et al., 2015; Rosenbaum, Deil-Amen, & Person, 2006). State articulation policies aim to facilitate a smoother transition for students transferring from community colleges to public four-year colleges. These policies have two main goals: to ensure access to BA-granting institutions for community college students and to improve efficiency in BA attainment by reducing credit loss between the two sectors (Roksa & Keith, 2008). Statewide policies, as compared to individual agreements between pairs of schools, aim to simplify the transfer process by removing the ability for individual BA-granting campuses within a state to establish their own determinations of credit applicability and major-ready status (Hodara, Martinez-Wenzl, Stevens, & Mazzeo, 2016). The scope of these policies varies across states, for example whether all colleges are covered, or only a subset, and whether there are common general education requirements (Hodara et al, 2016). Some state policies ensure common course numbering across community colleges and four-year colleges; California (the setting for this study) does not.

Prior studies that have evaluated the impact of articulation policies have found mixed results. A correlational study of statewide articulation policies found a positive association between state-level articulation agreements and BA degree attainment, though not necessarily on likelihood of transfer or reduced time-to-degree (Stern, 2016). A recent study of North Carolina's articulation agreements found that the revised policy increased bachelor's degree receipt by 3-5 percent but found no effects on time-to-degree (Worsham et al., 2020). In evaluating Ohio's transfer articulation policy, researchers found that students who completed the transfer module (i.e., a prescribed set of courses) are more likely to transfer, to earn an associate degree, and to transfer to a four-year university, when compared to students who did not complete the module; however, this did not translate to a shorter time-to-degree for the BA (Boatman & Soliz, 2018). Finally, recent work from Virginia suggests that more transparent information on transfer admissions standards can facilitate improved transfer outcomes among community college students (Shi, 2020).

Importantly, the scope of California's articulation policy (an actual type of associate degree) and scale of the policy (encompassing California's entire community colleges and state university system – 137 institutions in total) makes the Associate Degree for Transfer a critical reform to investigate. Prior work exploring California's specific articulation efforts through the ADT has found significant positive effects on the number of students earning an associate degree and marginally significant effects on transfer rates (Baker, 2016). Other work has also documented—descriptively—improvements in transfer outcomes since the introduction of the Associate Degree for Transfer (RP Group, 2017; Campaign for College Opportunity, 2020; Johnson & Cuellar Mejia, 2020). And a recent working paper utilizes aggregate data on enrollment and degree outcomes to explore the impact of the ADT on transfer rates across the state. Shaat (2020) finds that the introduction of the ADT led to a small, statistically significant increase in transfer enrollment at CSU (relative to the University of California campuses), but no impact on overall degree attainment. The results from this study, however, mask important campus differences and rely on the UC campuses as a comparison group, which might bias estimates towards zero as there were a number of transfer policies that also affected the UC during this period. The aggregate data also do not allow for analyses by student subgroup, and concerns about inequitable outcomes across student subgroups were an important motivation for this legislation.

There are two primary mechanisms by which statewide articulation policies such as the ADT could affect student outcomes: (1) changing administrative structures and policies (e.g., credit articulation guarantees, GPA bumps for four-year admission); and (2) changing student decision making at the course or major level by providing clearer structure and guidance. That is, these policies could both improve the outcomes of students on particular pathways and could affect the pathways that students choose. These mechanisms might be differentially effective for various groups of students. For example, students with weaker informational networks might benefit more from the improved structure and guidance (Stanton-Salazar, 2011) and students with lower GPAs might benefit more from administrative changes such as GPA bumps.

In this paper we link student-level records from the full CCC and the CSU systems (114 community colleges and 23 state universities) to examine the effects of the Associate Degree for Transfer on BA outcomes conditional on transfer to the CSU. Due to our access to statewide linked student-level data, our paper makes several key contributions to the literature on transfer pathways and state articulation policies. First, we are able to provide important descriptive evidence on student take-up of this transfer degree. Such analyses provide policy makers and administrators with evidence on the potential equity implications of articulation policies. The California community college context, with remarkable diversity of students and the institutions that serve them, provides an important backdrop to examine articulation reform (one in five community college students in the U.S. are enrolled in a California community college). Second, this is the first paper, to our knowledge, to examine the effects of this statewide policy on individual BA/BS outcomes. As such, we are able to test a key goal of articulation policies—greater efficiency in BA receipt. Finally, we are able to account for both campus and field of study differences at a large scale, which allows for a credibly causal identification strategy. Thus, our paper offers important insight into the extent to which joint policies between community colleges and four-year schools can affect baccalaureate attainment rates for students who begin at a community college.

We find that the policy led to greater efficiency in BA/BS receipt for CSU transfer students. Compared to similar students who did not have access to these transfer degrees, students who earned ADTs were enrolled for approximately 0.2 fewer semesters and were significantly more likely to graduate within two years of enrollment at the CSU. We also find suggestive evidence that ADTs increased overall BA/BS attainment rates for CCC-CSU transfer students. Our findings are broadly consistent across student subgroups. These findings, combined with past work that has shown an effect on transfer rates (Baker, 2016), provides compelling evidence that statewide transfer policies can increase efficiency in BA/BS attainment for students who start at a community college.

SETTING AND POLICY REFORM

California Community Colleges

California's 1960 Master Plan for Higher Education established the state's three-segment system of public higher education: the selective University of California (UC) designated as the state's primary academic research institution and reserved for the top one eighth of the State's graduating high school class; the California State University (CSU) four-year system reserved for the top third of the state's graduating high school class, and the open access California Community College (CCC) system. Each sector had its own mission and purview and together they were designed to serve the varied and dynamic needs of California citizens. This structure has contributed to California's high rates of college enrollment, but it has also resulted in a number of undesired challenges for the many baccalaureate-intending students that begin their studies at a community college.

In California, two-thirds of all college students attend a Community College. These colleges enroll more than two million students annually and provide common lower-division coursework to prepare students for transfer to a California State University (CSU) or University of California (UC) campus. The community college students in California that do successfully transfer to a four-year college overwhelmingly (57%) enroll at one of the campuses of the CSU system.[1] The 23-campus CSU system is the largest public four-year higher education system in the country.

California is an ideal state in which to investigate transfer between the public two-year and broad access four-year colleges. California's public two-year and four-year colleges are situated in urban, suburban and rural areas of the state, and their students come from public high schools that are both among the best and the worst in the nation. Thus, the diversity of California's community college population reflects the student populations of other states in the U.S. and the mainstream public two-year colleges that educate them. As such, we believe that other states can learn important lessons from California's public postsecondary institutions.

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[1] In 2018-19, 6,813 CCC students transferred to an in-state private institution, 14,784 transferred out-of state, 21,828 enrolled at UC and 58,534 enrolled at CSU. Source- Data Mart, UC Accountability, CSU Dashboard.

Associate Degrees for Transfer

Prior to 2011, a cumbersome system of major-specific, unique bilateral articulation agreements between individual CCCs and CSUs and between individual CCCs and UC campuses produced a complicated and uncertain transfer process for students. This complexity and uncertainty resulted in numerous undesirable outcomes: many transfer-intending students never transferred; many students who did transfer did so without first earning an associate degree; and most students who did successfully transfer accumulated far more credits than necessary at their CCC and then ended up repeating numerous lower division courses at their CSU or UC.

In 2010, California Senate Bill 1440 established a statewide framework for a more seamless pathway between the CCCs and CSUs. The Student Transfer Achievement Reform Act (Senate Bill 1440) stipulates that a student who earns a designated ADT with a grade point average of at least 2.0 shall be granted admission for transfer with junior status into at least one CSU. The aim of Senate Bill 1440 was to establish statewide consistency in order to simplify transfer from any community college to any CSU campus. To meet this goal, a statewide curricular framework for the major component of a community college degree was developed for each major jointly by the faculty who teach at community colleges and at CSU.[2]

ADTs differ from local Associate degrees in a few key ways. First, within majors the

[2] These curricula were designed roughly in the order of student demand; the largest transfer majors were among the first to have approved curricula for ADTs. Appendix A Figure A1 presents the cumulative number of approved curricula between 2011 and 2018. In 2011, ADTs were offered in fewer than 10 fields; by 2018 almost 40 majors offered ADTs. Once the curricula were approved at the state level, CCCs could begin to offer the degrees as soon as the department had identified the specific courses that met the state guidelines, each course received a course number according to a statewide numbering system, and the curriculum had been approved at the campus level. These two sources of variation – variation at the state level in when curricula were approved across fields and variation at the campus level in how quickly departments started to offer ADTs in fields with approved curricula – resulted in ADTs being rolled out across fields, across campuses, over time. Appendix A Figure A2 presents the number of ADTs offered on each CCC campus in each year between 2010-2011 and 2018-2019. As the figure shows, there is considerable variation, both over time and across campuses. As we discuss in the methods section below, this variation is crucial for our ability to determine the effects of ADTs on student outcomes.

curricula for ADTs are common across all CCCs (i.e. the classes taken to fulfill the requirements for an ADT in psychology will be the same across all CCCs); this is in contrast to traditional AA/AS degrees, for which each CCC campus can create its own curriculum and set of course requirements. An ADT also fulfills the lower-division requirements at all CSUs that accept it, while traditional AA/AS requirements in a given field do not always overlap entirely with lower-division requirements at CSU. ADTs confer some CSU admissions advantages to students who earn them: ADT earners are guaranteed admission to at least one CSU campus, and in some impacted majors/campuses, ADT earners receive a GPA bump in the admissions process. Additionally, students who earn an ADT and enter CSU in their ADT major are guaranteed that they will need no more than 60 additional units at the CSU to earn a BA/BS in that field. In other words, CSU campuses cannot require students who earn ADTs to repeat courses that are similar to those already taken at the community college.[3]

The introduction of ADTs could affect both the extensive margin of the transfer function of community colleges, as well as intensive margin of BA completion and efficiency once students transfer to a CSU.[4] Prior work (Baker, 2016) has shown that the introduction of the ADT in particular fields led to a significant increase in the number of students earning associate degrees in those fields and to higher transfer rates from CCCs that offered more ADTs (the extensive margin). In this paper we extend that work and explore the intensive margin to explore whether the ADT met its intended goal of improving probability of BA/BS receipt, and

[3] When community colleges started to offer ADTs in a given field, some stopped offering their local AA/AS in that field. Other community colleges continue to offer both local AA/AS degrees and ADTs in the same field. Guidelines varied a bit across CCC campuses, but, in general, students were able to earn both an AA/AS in a given field if they fulfilled the (often overlapping) course requirements for each degree.

[4] We note that it is important to consider who is the appropriate comparison for each of these questions (e.g., CCC-CSU transfer students who earn no CCC degree versus CCC-CSU transfer students who earn an AA/AS before transferring). We return to this consideration in greater detail in the methods section.

efficiency in earning these degrees, among community college transfer students to the California State University.

Specifically, we ask the following research questions:

1. Did the introduction of ADTs increase the probability that community college transfer students earned a BA/BS?
2. Did the introduction of ADTs improve the efficiency with which community college students earned BA/BS degrees?
3. Did the introduction of ADTs improve baccalaureate attainment and/or efficiency more for certain groups of students?

DATA AND SAMPLE

For all of the analyses in this paper, we use a rich dataset comprised of student-level administrative records from both the CCC Chancellor's Office (CCCCO) and the California State University Chancellor's Office (CSU). The CCCCO data include the census of all California community college students enrolled from 1992-2014 across the State's 114 community college campuses.[5] The data come from student application information and from student course-taking records and include detailed information on student demographics, enrollment, financial aid, and degrees earned. The CSU data include student application, enrollment and degree files across the 23 CSU campuses. Like the CCCCO data, these data include detailed information on student demographics, enrollment, financial aid, and degrees

[5] We exclude students from noncredit CCC Centers (San Diego Adult, San Diego Continuing, Marin Continuing, San Francisco Centers, Santa Barbara Continuing, North Orange Adult and Rancho Santiago CED). These centers and campuses primarily provide noncredit instruction that does not count toward associate degrees or transfer.

earned. We merge the CCC and CSU datasets using students' first name, last name, and birthdate.[6]

Sample Characteristics

We focus on three cohorts of students (those who first enrolled at the CSU in the 2012-13 through 2014-15 academic years) and limit our sample to upper-division transfer students from a California Community College (defined by CSU as students whose institution of origin is a CCC), who had not previously earned a BA or BS (132,894 students in total).[7]

The first column of Table 2 presents descriptive information on the students in our matched CCC-CSU sample. Fifty-four percent of students in our sample identify as female, 35% are white, 5% Black, 18% Asian, and 33% Latinx. Seventy percent of students in the sample received a Board of Governors Fee waiver at the CCC (the BOG Fee waiver, now known as the California College Promise Grant, waives enrollment fees for students who meet income eligibility requirements). Students had, on average, a 3.06 CCC GPA at time of transfer. Sixty-two percent of CCC-CSU transfer students in our sample earned a BA/BS within three years of transfer. Of those students who earned a BA/BS, 82% did so in the major field in which they entered CSU, they were enrolled for an average of 4.91 semesters at time of graduation with a BA/BS, and they had earned, on average, 135 units at graduation.

[6] We conducted the merging process in a number of steps. We first excluded students who were missing name and/or birthdate (32% of CCC students and 4.3% CSU students), in addition to those with duplicated name and birthdate (7.5% CCC students and 2% CSU students). In the first merge with full name and birthdate, we merge 198,695 students for a merge rate of 76.43%. For those students not matched by full first name, last name and birthdate, we ran an additional merge based on the first three letters of first name and last names (prior to 2012, the CCCCO only reported the first three letters of first and last names). With this merge, we pick up an additional 37,684 students. While we do not successfully match 23,520 students, our overall merge rate is 91%.

[7] Because we rely on administrative data we have relatively low levels of missing data. The variable that exhibits the highest degree of missingness is last term enrolled at the CCC, which is missing for 9.0% of our student observations. We are missing race information for about 4% of our student observations, and all other CCC variables are missing for fewer than 0.2% of observations. We employ listwise deletion, as we do not feel that we can accurately impute race and last term of CCC enrollment is crucial for our identification strategy.

This table also provides descriptive evidence of differences in outcomes between students who earn ADTs as compared to those who transfer with no degree and those who transfer with an AA/AS. Students who earn an ADT before transferring (with or without an AA/AS) are at least 10 percentage points more likely to earn a BA than students who transfer with no CCC degree and at least seven percentage points more likely to earn a BA than students who transfer with only an AA/AS. Similarly, students who transfer with an ADT are also enrolled for fewer semesters at graduation than students who transfer with no degree or with an AA/AS. These findings, albeit entirely descriptive, foreshadow potentially positive effects of the ADT on BA outcomes among community college transfer students.

ANALYTIC APPROACH

Our primary research question examines whether the introduction of the ADT improved the four-year degree outcomes of CCC students. Specifically, we examine if the ADT led to higher BA attainment rates and if it reduced time-to-degree for CCC-to-CSU transfer students.

For example, using time-to-degree as the outcome of interest, we could examine this basic model:

$$TTD_{icsmt} = \beta_1 ADT_i + \varepsilon_i \qquad (1)$$

Specifically, is receipt of the ADT associated with time-to-degree at CSU for student *i* who attended CCC *c* and transferred to CSU campus *s* in declared major *m* in cohort *t*? In this naïve model, we worry that differences in outcomes between ADT earners and those who transfer without an ADT cannot necessarily be attributed to the ADT. There are two main sources of potential bias. First, unobserved student selection into ADTs (i.e., there may be unmeasurable student characteristics that are correlated both with selection into ADTs and with academic outcomes). Indeed, Table 3, which predicts if a CCC-CSU transfer student will earn an ADT (as compared to either transferring with no CCC degree (column 1) or earning an AA/AS before transfer (column 2)) using CCC campus-by-major fixed effects shows that ADT earners are different than these two groups along a number of observable dimensions. A second source of potential bias is that there may be programmatic or structural differences between fields that offer ADTs and those that do not, and between campuses that offer more or fewer ADTs and the speed with which ADTs were offered, all of which might be correlated with student success outcomes.

Basic models

Student selection. To account for observable student-level characteristics that may be associated with both obtaining an ADT and with our outcomes, we add a vector of covariates, X_i to equation (1):

$$TTD_{icsmt} = \beta_1 ADT_i + X_i + \varepsilon_i \qquad (2)$$

Included in the vector of student-level characteristics (χ_i) are gender, high school graduation year, binary variables for race/ethnicity, CCC GPA, and a binary variable indicating if the student received the BOG fee waiver (a proxy for low-income status). Model (2) allows us to compare the outcomes of students with and without ADTs who are similar in observed ways.

This reduces the extent to which observable student selection into ADTs will bias our estimated effects of ADTs on educational outcomes.

Supply of ADTs. Another potential source of bias is differences between majors/campuses/cohorts that have access to ADTs and those that do not. For example, CCCs with better outcomes might offer more ADTs. Or fields in which students have better outcomes might be more likely to offer ADTs. Or CSUs with better average student outcomes might accept more ADTs. Moreover, our outcomes across the system might be improving over time, which coincides with the increased offering of ADTs. Not accounting for differences in the offer of ADTs at any of these levels could lead to biased estimates of the effects of ADTs.

We first examine the potential for such biases descriptively by observing average raw BA outcomes (probability of earning a BA and time-to-degree) for transfer students who earned ADTs, AA/ASs, or no degree, *within* cohorts, *within* majors, and *within* CSUs.[8] These simple descriptive exercises allow us to visually examine if there is clear evidence that students who earn ADTs before transferring have better outcomes due to differences in the supply of ADTs. However, these within major/campus/cohort analyses (the descriptive equivalent of introducing campus, major, or cohort fixed effects into Model 1 above) do not allow us to systematically estimate the effect of ADTs, nor do they allow us to control for student-level characteristics or potential interactive effects (e.g. anything unique about a particular major at a particular college).

Fully Saturated Fixed Effects Regression

To address these deficiencies, we formalize these results by using regressions with multiple sets of one- and two-way fixed effects to compare outcomes for ADT earners and non-

[8] Descriptive analyses that compare raw BA outcomes (probability of earning a BA and time-to-degree) for transfer students who first earned ADTs, AA/ASs, or no degree *within CCC campuses* are available by request. They show the same general pattern that we present in the other descriptive analyses.

ADT earners within the same department, within the same CCC, and within the same CSU. These models also include the vector of student-level characteristics we introduced in model (2) above.

$$Prob(BA)_{icsmt} = \beta_0 + \beta_1 ADT_i + \beta_2 AA/AS_i + \chi_i + \pi_{CCC} + \boldsymbol{\theta}_{CSU} + \varepsilon \quad (3)$$

The vector of student-level characteristics is defined as above. Included in the vector of CCC-level controls (π_{CCC}) are CCC campus, student major[9], and CCC cohort fixed effects and all two-way combinations. Included in the vector of CSU-level controls ($\boldsymbol{\theta}_{CSU}$) are CSU Campus, CSU Cohort, and CSU major fixed effects and all two-way combinations. In this model, β_1 provides an estimate of the relationship between earning an ADT, as compared to no degree (the omitted category), and the probability of earning a BA. Comparing β_1 and β_2 (using a post-estimation F-test) allows us to compare the relationship between earning and ADT and the probability of earning a BA to the relationship between earning an AA/AS and the probability of earning a BA.[10]

[9] In these analyses, we define a student's major as the major they entered at the CSU, since we do not have a record of community college major for students who transferred to a CSU without having first earned a degree at a community college (46% of CCC-CSU transfers in 2014). As these students are an important point of comparison for students who earn ADTs, we wish to keep them in the analysis. Our imputed major might not match students' intended major at the CCC. Indeed, for 45% of students who earn a degree at a CCC in the 5 largest ADTs (Business Administration, Psychology, Administration of Justice, Sociology and Speech Communication) and transfer to a CSU, their CCC major does not match their CSU major. However, other methods for imputing students' major, such as using course taking records, are generally untenable as degree requirements overlap substantially and students often do not follow predictable paths to degrees (Crosta, 2014). To interrogate the robustness of our analyses to this imputation decision, we run a separate set of analyses, limiting our sample to students who earned an award at a CCC. This necessarily limits our comparison to students who earned an ADT instead of an AA, and does not include students who earned no degree. The results of these analyses, presented in Appendix B, are similar in sign and magnitude to our primary analyses.

[10] Estimation of this model is possible due to the staggered roll-out of ADTs, across departments, across CCCs, over time. For example, two students who entered the same major at the same CCC one year apart might have different access to ADTs. Or, students who entered neighboring CCCs in the same major in the same year might have differential access to ADTs. Or, students who entered similar majors at the same CCC in the same year might have differential access to ADTs. Thus, this strategy leverages the variation in the availability of ADTs to control for meaningful differences in ADT supply.

By including the full set of major, community college, and cohort two-way fixed effects ($CCC * Cohort$, $Major * Cohort$, and $CCC * Major$), we control for cohort differences, and for the factors that are unique about departments, colleges, and departments-within-colleges. For example, if students who earn biology degrees at Irvine Valley College tend to have particularly good BA degree outcomes because the biology curriculum at that community college is very strong, we will be able to control for other such unobserved factors about that major at that college. Similarly, if students who graduated with degrees in computer science in 2014 were able to earn bachelor's degrees at uniquely high rates due to statewide curriculum reform, we can control for anything that is unique about that major in that year. And if students who graduated from American River College in 2013 fared especially well once they transferred to a CSU because of a redesign of the advising system in that college in that year, we can control for anything unique about that college in that year.

One complicating factor to this estimation strategy is that while treatment is given at one level (CCC), outcomes are observed at another level (CSU). Even after controlling for differences in access at the CCC, students who earn ADTs could still have better BA outcomes at the CSU if CSUs with more ADTs have better outcomes on average, if fields that offer ADTs have better CSU outcomes on average, or if cohorts that have ADTs available have better outcomes on average. We address these concerns by including a vector of one- and two-way CSU fixed effects, specifically, CSU Campus * CSU Cohort fixed effects, CSU Campus * CSU Major fixed effects, and CSU Cohort * CSU Major fixed effects.[11]

[11] We are able to do so due to variation in ADT status at CSU. Similar to implementation variation in ADTs at the community colleges, CSU campuses also experienced variation in ADT implementation by campus and major over time. Thus, within a major at a specific CSU, there is variation in ADT status because there is variation in ADTs within a CCC over time and across CCCs; within a cohort in a CSU, there is variation in ADT status because there is variation in ADT availability across majors and across CCCs, and within a cohort of students in the same major, there is variation in ADT availability because some CSUs don't accept ADTs and some CCCs don't offer ADTs.

Our fully-saturated two-way fixed effects approach accounts for potential biases due to differential offering across campuses, majors, and cohorts and partially accounts for strategic sorting at the student level. However, this approach also runs the possibility of muting our estimated effect of ADTs by absorbing two mechanisms by which ADTs could have effects on student outcomes: (1) if the offer of ADTs could affect student pathways (either the majors that students chose or the CSU to which they transfer) or (2) spillover effects by increasing overall efficiencies in upper division credit completion across majors and CSUs. Either of these mechanisms would be obscured in this modeling approach. However, given that it is impossible to disentangle such overall effects from strategic sorting on the part of students or increased efficiencies on the part of institutions and majors, we present these models as intentionally overly conservative.

Addressing Potential Unobserved Student Selection

The major limitation of the fully saturated fixed effects models is that it might not fully address potential *strategic sorting at the student level*, in degree type, and thus might lead us to falsely equate differences in outcomes between students who earn ADTs and those who do not as the effects of ADTs. For example, within a cohort at a particular CCC, students could choose across similar majors (e.g. biology and chemistry) to select the one that offers ADTs. We must assume that students may have different strategies for choosing whether and what two-year degree to obtain before transferring to a CSU, and much of that process is unobserved by researchers and may also be related to our outcomes of interest. Students that have chosen to earn an ADT may also be students who have behaviors that lead them to persist at CSU and to obtain their degree more quickly than those that do not.

We address this concern by estimating a model similar to model (3) above, but use the *availability of ADTs* of as our predictor of interest. That is, we lean on the plausibly exogenous variation in the timing of the introduction of the ADT in different campuses and fields of study. Given that evidence suggests that there is little sorting of students across community colleges (students typically enroll in the campus nearest to their home (Stange, 2012)) we use the timing of the *availability* of the ADT at a given college and in a given field for identification. Conditional on these two-way fixed effects, we can consider the *offer* of ADTs at the CCC-by-major-by-year level to be essentially exogenous. This helps us to address sorting into ADTs at the student level; within a CCC-by-major-by-cohort cell, we do not differentiate between those students who earned ADTs and those who did not.

$$Prob(BA)_{icsmt} = \beta_0 + \beta_1 ADT\_Offer_{ctm} + \chi_i + \pi_{CCC} + \boldsymbol{\theta}_{CSU} + \varepsilon \quad (4)$$

The key variable of interest in this model is ADT_Offer which is a binary variable equal to one if ADTs were offered in the student's major, at their community college, in the year they graduated.[12]

Again, our major concern with this estimation strategy is that there might be meaningful selection into fields by students; while the offer of ADTs is plausibly exogenous, student selection into majors may not be considered random. For example, a student may be willing to switch between two majors (e.g. accounting and economics) at their college if one offers an ADT

[12] Again we note that we do not have a record of community college major for students who transferred to a CSU without having first earned a degree at a community college so we proxy for intended CCC major using major at CSU entry. Thus, our indicator for if ADTs were available in major *m* at community college *c* in year *y* is constructed using CSU entry major. That is, all students who transfer from the same CCC and enter the same CSU major in the same year will have the same value for this indicator. This is a noisy measure of availability, as there is not a strict correspondence between community college major and CSU major. However, this is also a conservative measure of availability and thus should bias our estimates of the effects of ADTs toward zero.

and the other does not. Such sorting could be correlated with factors that are also correlated with CSU BA outcomes (e.g. knowledge of school structures, access to informational networks).

To address the fact that students might select into a major based on the availability of ADTs, we re-estimate this model using more conservative measures of access to ADTs: availability in broad major groups and availability in disciplinary groups. We first group all available majors into 51 broad major groups. CSU majors are identified by five-digit Degree Program Codes. The first three digits indicate broad major categories and the last two digits indicate concentrations within those majors. We consider any majors that share the first three digits of the Degree Program Code to be in a "broad major group" (e.g. biology, environmental biology, human biological sciences, evolutionary biology, botany, and zoology are grouped together). The logic behind this decision is that if students take the availability of ADTs into account when selecting majors, they are might be willing to change within a group of majors but not a across groups; a student might be willing to change from environmental biology to evolutionary biology in order to earn an ADT, but is likely unwilling to switch between, for example, biology and business administration.

Because this assumption of willingness to switch is untestable given our data (though it is supported by work that has examined students' consideration sets of majors – Baker, 2018), we make a more conservative assumption by increasing the size of our major groups. Instead of grouping majors by the first three digits of their major code, we group majors using the first two digits of their major code. We refer to this as a "discipline." This results in 21 grouped disciplines. Using this strategy, the groups of majors are relatively diverse (e.g., English, Linguistics, Speech Communication, Philosophy, and Religious Studies are in one group).[13] We

[13] These grouping strategies rely on administrative categorizations of degrees which do not always align with how students choose majors (Baker, 2018). To address this concern, we also test the robustness of our results by hand

then re-estimate our primary models using availability within these disciplines as our key predictor.

This general approach of using availability rather than receipt of an ADT is a very conservative approach to test the impact of the ADT for two reasons. First, because we include the vectors of two-way fixed effects, we again absorb some of the intended effects of the policy, such as shifting students into majors with better outcomes and potentially increasing overall efficiencies in upper division credit completion across majors at CSUs. Second, because we consider students in untreated departments, and untreated students in treated departments, as treated, we bias our estimates toward zero.

Potential Mechanism

As previously discussed, one potential way in which the ADT could increase efficiency is that CCC-CSU students would be more likely to graduate with a degree in the major that they entered CSU. If ADTs increase the probability that students stay in their initial major, students will be less likely to incur the costs associated with switching majors.

We explore this by first examining whether ADTs are associated with an increased probability of students staying in their first CSU major:

$$Prob(grad\ in\ 1st\ major)_{icsmt} = \beta_0 + \beta_1 ADT_i + \beta_2 AA/AS_i + \chi_i + \pi_{CCC} + \boldsymbol{\theta}_{CSU} + \varepsilon \quad (5)$$

grouping available majors into 93 groups of majors that we deemed similar (and not including majors that we considered to not have reasonable groupings). The goal of this exercise was to create groups of majors that we believe students would be willing to select between. One example of a group majors that are deemed similar using this strategy, but would fall into different categories using the strategies above, is Anthropology, History, Political Science, International Studies, and Government.

If there is evidence of this first stage, we will explore if this relationship explains any of the effect of ADTs on student efficiency. Specifically, we include a binary term indicating if a student graduated in their entering CSU major into model (3) and presented in model (6):

$$TTD_{icsmt} = \beta_0 + \beta_1 ADT_i + \beta_2 AA/AS_i + \beta_3 Grad1stMajor_i \ + \chi_i + \pi_{CCC} + \boldsymbol{\theta}_{CSU} + \varepsilon \qquad (6)$$

If an increased probability of graduating with the degree in one's entering CSU major explains observed ADT effects on time to degree, we expect that the coefficient on ADT, β_1, will be significantly smaller than in model (3). In addition to these two models, we also estimate models in which the coefficient of interest is the offer of an ADT (a version of model (4)).

Subgroup Effects

Our third research question asks whether the introduction of ADTs improve baccalaureate attainment and/or efficiency more for certain groups of students. There are several factors that motivate this question. First, there are large disparities in transfer and BA/BS completion across racial, ethnic, gender, and socio-economic lines (Ginder, Kelly-Reid, & Mann, 2018), and given these differences in base rates, policies such as the ADT could attenuate or exacerbate these gaps. Second, our own descriptive work (Baker, Kurlaender, Friedmann, 2020) shows differences in take-up of ADTs across subgroups of students. Finally, there is rich theoretical motivation suggesting that explicit informational and structural interventions might be particularly helpful for students who rely on institutional agents and structures for information (e.g., Woolcock & Narayan, 2000; Stanton-Salazar, 2011). Thus, examining the effects of ADTs on BA outcomes across racial, ethnic, gender, and socio-economic lines allows us to examine if there is evidence that the introduction of ADTs could address gaps in BA attainment rates.[14] To explicitly examine this hypothesis, we re-estimate our main models (models (3) and (4)) for certain subgroups of students. Specifically, we examine if ADTs had effects on the probability of earning a BA/BS and on time-to-degree for eight subgroups of students: female students, White students, Black students, Latinx students, Asian students, students receiving financial aid at the CCC, students with CCC GPAs at least one standard deviation above the sample mean, and students with CCC GPAs at least one standard deviation below the sample mean.

RESULTS

Descriptive Results – Receipt of ADTs

Figure 1 shows the quick growth in the number of ADTs granted statewide between 2011 and 2018. By 2018, more than 60,000 ADTs were being granted across the CCC system each year. Figure 2 presents results showing the number of CCC-CSU transfer students who enter CSU with no CCC degree, with only an AA/AS, with only an ADT, or with both an AA/AS and an ADT for each of the three cohorts included in our sample. In the 2012 entering cohort, 2% of students entered with an ADT, while in the 2014 entering cohort, 15% of students did.

The rates of ADT receipt presented in Figure 2 reflect both availability of ADTs (across majors, across cohorts, and across campuses), and student selection into ADTs. Table 1 provides information on variation in student selection into ADTs, conditional on availability, by showing the proportion of CCC-CSU transfer students who earned ADTs for different groups of students. Columns 1–4 show all CCC-CSU transfers, including those who transfer without having first

[14] Examining subgroup effects by estimating our main models on subsamples of students does not allow us to examine if there are statistically significant differences in the effects of ADTs across groups of students. To examine this more explicitly, we have also estimated models with interaction terms (interactions of binary indicators for group membership and ADT). These models are available upon request.

earned an associate degree. Columns 5-7 include only students who earned a degree before transferring. Column 1 of Table 1 shows that just under 9% of all CCC-CSU transfers in these three cohorts earned an ADT. When we condition on having ADTs available in one's CCC, for one's cohort, and in: one's discipline (Column 2), broad major group (Column 3) or one's major (Column 4), we see a higher rate of ADT receipt (almost 20% if an ADT was available in one's discipline, almost 22% if an ADT was available in one's broad major, and over 30% if an ADT was available in one's major). When we limit the sample to students who earned any associates degree before transferring (Columns 5 -7), we see that almost 40% of students who had ADTs available in their discipline earned one (Column 5), 45% of students who had ADTs available in their broad major earned one (Column 6), and almost 75% of students who had ADTs available in their major earned one (Column 7).

We further examine the roles that differential availability and student selection play into ADT uptake in Table 2 and Table 3. Table 2 presents demographic information for four subgroups of students in our sample: CCC-CSU transfer students who enter with no degree (column 2), students who earn an AA/AS (column 3), students who earn an ADT (column 4) and students who earn both an ADT and an AA/AS (column 5). We present information on the full sample in column 1. We see some key differences across groups. We find that female students, as compared to male students, are underrepresented in the "no CCC degree group." We also see that White and Asian students are more likely to transfer without having earned a CCC degree, while the opposite is true for Latinx students. Students who have received financial aid at the CCC (the BOG fee waiver) are more likely to transfer with a degree than without a degree, and are especially likely to have earned both an ADT and an AA/AS. Finally, this table shows that students who transfer with a degree (ADT or AA/AS) have higher GPAs, on average, than students who transfer without a CCC degree.

These demographic differences could reflect differences in availability across schools or majors (e.g., schools that are more heavily Asian offered fewer ADTs on average (Baker, Kurlaender, Friedmann, 2020)), or they could reflect differential selection into degrees. To interrogate this more explicitly, we present results in Table 3 in which we predict earning an ADT (as compared to no degree in column 1 and as compared to earning a AA/AS in column 2) using CCC campus-by-major fixed effects. This allows us to control for differences that are due to availability and thus more precisely capture differences across subgroups in probability of opting into an ADT. The results in this table are consistent with the raw descriptive statistics presented in Table 2: female students are more likely than male students to earn ADTs as compared to no CCC degree, White and Asian students are less likely to earn ADTs than to transfer with no degree, and students who earn ADTs are more likely to have received a BOG fee waiver than students who transfer with no degree. There are fewer differences between ADT earners and the students who earn an AA/AS before transferring. ADT earners, as compared to AA/AS earners, are less likely to be Black, and are more likely to have received a BOG fee waiver.

Descriptive Results – Outcomes by CCC degree

The bottom panel of Table 2 presents differences in CSU outcomes for CCC-CSU transfer students by prior degree. These raw differences are large: students who earn an ADT before transferring are 13 percentage points more likely to earn a BA/BS than students who transfer with no degree and 10 percentage points more likely to earn a BA/BS than students who transfer with a local AA. Among those students who do earn a BA/BS, students who enter with an ADT are more efficient, taking 4.5 semesters to graduate, as compared to 5.0 semesters for students who enter with no CCC degree and 4.9 semesters for students who enter with an AA/AS.

Of course, these descriptive statistics do not allow us to determine if these raw differences are due to differences in the supply of ADTs across schools, majors, or cohorts. We next present descriptive results in Figures 3 - 8 that examine outcomes (probability of earning a BA/BS and number of semesters enrolled at graduation) by entering degree, holding constant major, cohort, or CSU campus. For example, Figure 3 shows the average probability of earning a BA for students who transferred from a CCC to a CSU *separately for each of the five biggest transfer majors*. Within each major, we examine outcomes for students who transferred having first earned no degree (red bar), an AA (blue bar), or an ADT (yellow bar). The figures that follow repeat this same exercise looking within CSU campuses (Figures 5 and 6) and within cohorts (Figures 7 and 8).

The consistency of these findings – that students who earn ADTs are more likely to earn BAs and to do so in fewer semesters, even when comparing students within departments, within cohorts, or within four-year campuses— supports the hypothesis that ADTs led to better outcomes for students. Raw differences in outcomes do not appear to be due to differences in the offer of ADTs across majors, across CSUs, or across cohorts.

Estimates of the Effect of ADTs on BA Outcomes

In Table 4, we present results that formalize these descriptive findings by estimating models that predict these same outcomes using a bivariate regression as presented in (Model 1), using models that include a vector of student academic and demographic characteristics (Model

2) and models that include a full set of one- and two-way fixed effects (Model 3). While the raw difference in probability of earning a BA/BS between students who transfer with an ADT and those who transfer with no degree is over 12 percentage points (shown in Model 1 of the first panel), this is reduced to about 10 percentage points when we control for observable student characteristics (Model 2) and to about four percentage points when we include major, CCC campus, CSU campus, and cohort one- and two-way fixed effects. This indicates that about 20% of the difference in BA/BS attainment between ADT earners and students who transfer with no CCC degree is explained by observable student selection into ADTs and that two-thirds of the raw difference is explained by student selection and major, campus, and cohort differences. Even with this rich set of controls, we still observe large differences in BA/BS attainment. Specifically, four percentage points represents a roughly 7% increase on the BA/BS attainment rate for students who transfer with no CCC degree.

In Panel 2 of Table 4, we examine the results on student efficiency (number of semesters enrolled when students graduate). Students who earn ADTs graduate in roughly 0.5 fewer semesters than those who transfer without a CCC degree (Model 1 in the second panel). This difference is reduced very slightly when we control for observable student selection (Model 2). However, when we control for the full set of one- and two-way CCC and CSU fixed effects, this difference is reduced by 70% to 0.16 fewer semesters (Model 3 in the second panel). This indicates that much of the difference in observed efficiency between ADT earners and students who transfer with no CCC degree is due to average differences in time-to-degree across major, CCC campus, CSU campus, and cohort. As the cost of increased time to degree is great (both in tuition costs and opportunity cost), a significant reduction in semesters at graduation is an important finding. And, as we noted above, this model necessarily absorbs any effect that the policy achieves by sorting into majors or campuses with better average outcomes.

The omitted category in each of the models presented in Table 4 is CCC-CSU transfer students who did not earn a CCC degree. Another important comparison group are CCC-CSU transfer students who earned a local AA/AS. We examine if there are significant differences in BA/BS outcomes between ADT and AA/AS earners by computing post hoc F-tests on the ADT and AA/AS coefficients presented in Table 4 (results available upon request). In general, these results are similar to the comparison between ADT earners and those students who transfer without having first earned a CCC degree, but are uniformly smaller in magnitude; students who enter with an ADT are more likely to earn a BA/BS and to do so in fewer semesters than students who transfer having earned a traditional associates degree.

In Table 5 we present results examining the same two outcomes using our more conservative approach of estimating the effect of *offering ADTs* in a student's own major or a related major. In each of the two panels of this table, we present the results from four models. Model 1 operationalizes ADTs as being available to student x if any student from student x's CCC, in student x's cohort, entered student x's CSU major with an ADT. In Models 2 and 3, we consider ADT availability in broad groups of majors (the first 3 digits of the CSU major codes) and in disciplines (the first 2 digits of the CSU major codes). In Model 4, we consider availability in our hand-coded buckets of similar majors. All models in this table include both a vector of student characteristics and a fully saturated set of CCC and CSU fixed effects. The results of these analyses are consistent across models: the availability of ADTs did not affect a student's probability of earning a BA/BS (first panel), but it did induce students to graduate more efficiently (panel 2).

In additional analyses, we examine the effects on efficiency more closely in two ways. First, we estimate three models with binary outcomes: graduating within four, five, or six semesters. We find positive significant effects for four and five semesters, but not for six semesters (in models using both receipt and availability of ADT as the key predictor, results available upon request). Thus, we conclude that ADTs were inducing more students to graduate within two and two-and-a-half years at the CSU. Second, we estimate models in which the outcome is number of CSU units at graduation. These results are broadly consistent with our examination of the effects of ADTs on time-to-degree: our analyses indicate that ADTs induced students to earn fewer CSU units at graduation (between one and three fewer units, depending on model specifications; results presented in Appendix C).

Potential Mechanism

In Table 6, we examine if there is evidence that an increased probability of graduating in the major in which one entered the CSU explains our observed effects of the ADT on time to degree. In Models (1) and (2) presented in Table 6, we examine if ADTs induced students to graduate in their starting CSU major. We observe weak evidence that this is the case.

In Models (3) and (4) in Table 6, we examine whether this relationship explains ADT effects on time-to-degree by including a binary indicator of graduating with one's entering major in our main models. Comparing the coefficients on earning an ADT/having an ADT available in these models to the same coefficients presented in Table 4 and Table 5, we see no evidence that graduating with the entering major explains ADTs effects on efficiency. The coefficient on earning and ADT is reduced from 0.160 to 0.157 and the coefficient on having an ADT available is reduced from 0.027 to 0.026.

Subgroup Effects

Table 7 reports the estimated effects of ADTs on the probability of earning a BA/BS and time-to-degree for various groups of students. In general, we find that the overall results are not driven by any one subgroup; for both outcomes the magnitude and sign of the coefficients are broadly consistent across subgroups. There is evidence that ADTs led to a higher probability of earning a BA/BS for all CCC-CSU transfer students; the coefficients from the fully saturated two-way fixed effects models are positive and generally significant across all groups except for Asian students and those with high CCC GPAs. Results on ADT effects on efficiency are also largely consistent. With the exception of Black students (for whom we have a relatively small sample), all subgroups saw reductions in the number of semesters enrolled. estimates using *availability of ADTs* as the key predictor are available in Appendix D.

DISCUSSION AND CONCLUSION

This is the first paper to examine the effects of a statewide transfer degree on BA/BS outcomes; it offers crucial insights into the extent to which joint policies between community colleges and four-year schools can affect baccalaureate attainment rates. Specifically, we find clear evidence that the Associate Degree for Transfer led to more efficient BA/BS attainment for students who transfer from a California Community College to a California State University campus. Moreover, our results are broadly consistent across student subgroups. We also find suggestive evidence that the ADT led to a higher probability of students earning a Bachelor's degree.

Importantly, our results are *conditional on transfer to the CSU*. Thus, to understand the overall effect of ADTs on BA/BS production, one must take into account the effects of ADTs on transfer rates. Past work (Baker, 2016; Shaat, 2020) has found evidence that the introduction of the ADT led to a higher probability of CCC-CSU transfer. To further investigate this, we replicate Baker's (2016) findings using student-level data. Using CCC campus and cohort fixed effects, with number of ADTs available on a given campus in a given year as the variable of interest, we find that the introduction of ADTs led to approximately a one percentage point increase in the probability of transfer for transfer-intending beginning CCC students (full methods and results are available in Appendix E).[15]

As our estimates suggest either slight positive or no effects on BA receipt conditional on transfer, we conclude that this policy is increasing BA receipt among transfer-intending students who start at CCCs. This provides important context for our findings; if ADTs induced marginal students to transfer, we could reasonably expect negative effects of the ADT on BA receipt, conditional on transfer to the CSU. Our null effects on BA/BS completion suggest otherwise. Moreover, our findings suggest that ADTs are inducing more efficient BA production; students experience reduced time-to-degree and lower credit accumulation at time of graduation.

Our consistent findings across subgroups are also an important finding. Conditional on transferring to a CSU, we find similar effects across subgroups on probability of earning a BA/BS and on efficiency in doing so. While our analyses indicate that certain subgroups of students (particularly Latinx students) are especially likely to earn ADTs, we do not find evidence that there are differential effects across student groups. There is not strong evidence that ADTs are attenuating the White-Latinx and Asian-Latinx gaps in BA/BS attainment.

[15] The results presented in Appendix E Table 2 also show similar effects on transfer across student subgroups.

While these positive outcomes should not be minimized, some policymakers and administrators in California expected the introduction of the ADT to lead to greater gains and reduced inequalities in BA receipt among California Community College students (Campaign for College Opportunity, 2020). There are a number of potential explanations as to why we do not find larger effects of this policy. First, information barriers remain an obstacle; qualitative evidence suggests that knowledge of ADTs is weak and uneven among students, so availability on the books at campuses might not translate into actual participation. One piece of evidence that suggests low general awareness of ADTs is that many CCC to CSU transfer students do not apply to CSU with the ADT, despite the fact that their community college record suggests they obtained it, and many students who state they have an ADT on their CSU application have not in fact earned an ADT and are not close to doing so (based on their course behavior). Thus, even if students know about the ADT, they may be unaware of whether and how it might streamline the pathway to the BA. Second, because earning an ADT is often not the most efficient transfer route for students who have a clear sense of their intended transfer school and major, counselors might encourage some students to transfer as quickly as possible and not try to earn an ADT. Finally, the marketing and communication for the ADT might have communicated to students that transfer is complicated and difficult, which could have deterred some students from attempting transfer.

Some factors that might have led to smaller-than-hoped effects of ADTs are related to institutional practices in both community colleges and receiving four-year schools. First, there was considerable variation in how quickly CCCs were able to offer ADTs. Some of this variation is due to differences across departments and across schools in creating a curriculum to match the state guidelines. However, some delays in offering ADTs, and the failure for some campuses to offer ADTs in certain fields at all, is due to delays at the state level in getting specific courses approved.[16] There is also some evidence that CSU campuses lived by the letter of the legislation, but not the spirit of the legislation. Examples of this include some CSU campuses requiring extra transfer coursework in certain majors above what is required to earn the ADT, CSU campuses that did accept ADTs even when they offered a seemingly similar major, and CSU campuses that accepted ADTs in some, but not all, concentrations within a major.

Another way in which ADTs can fail to live up to the hopes of administrators and policy makers is by not reducing performance gaps across student subgroups. In this paper, we examine student outcomes within majors and campuses. However, our prior research (Baker, Kurlaender, Friedmann, 2020) shows that there is differential access to ADTs across CCC campuses. Specifically, schools that enroll more Black and Asian students offer fewer ADTs, on average. As students are relatively inelastic in their geographic preferences (Stange, 2012), differences in ADT offerings across CCC campuses has important implications for student access. Similarly, there are important differences across CSU campuses in how many ADTs they accept. As students don't generally engage in a statewide CSU transfer search/process (among CCC students that transfer nearly 90 percent apply to only one CSU, and 80 percent enroll in the CSU that is closest to their community college[17]), differences in ADT acceptance also have important implications for equity. Prior work has found consider differences across both community college and state university campuses on both student characteristics and degree outcomes (Carrell and Kurlaender, 2019).

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[16] Each course that is part of an ADT curriculum must be approved for articulation by a statewide committee (https://c-id.net/about-us). In individual communication with articulation officers at CCCs, we have learned that this can be a slow and seemingly arbitrary process.
[17] Authors' calculations from administrative data.

The transfer pathway has been long criticized for being too cumbersome and opaque. In an effort to improve transfer outcomes, California Senate Bill 1440 created a new type of Associate Degree for Transfer (ADT), and established a statewide framework for a more seamless pathways between the state's community colleges and CSU campuses. Ten years after the passage of Senate Bill 1440 we are seeing promising results, and the Governor's recent budget proposal aims to expand the reach of the ADTs. Our findings suggest that this may indeed be a worthwhile investment for California, and a useful model for states that want to strengthen the community college transfer pathway. Yet, policymakers should also temper their expectations for greatly increasing BA completion and reducing time to degree absent deeper attention to implementation across campuses and fields, and to the mechanisms that lead to weak transfer outcomes for community colleges in the first place, among them, informational barriers and credit mobility.

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Figures & Tables

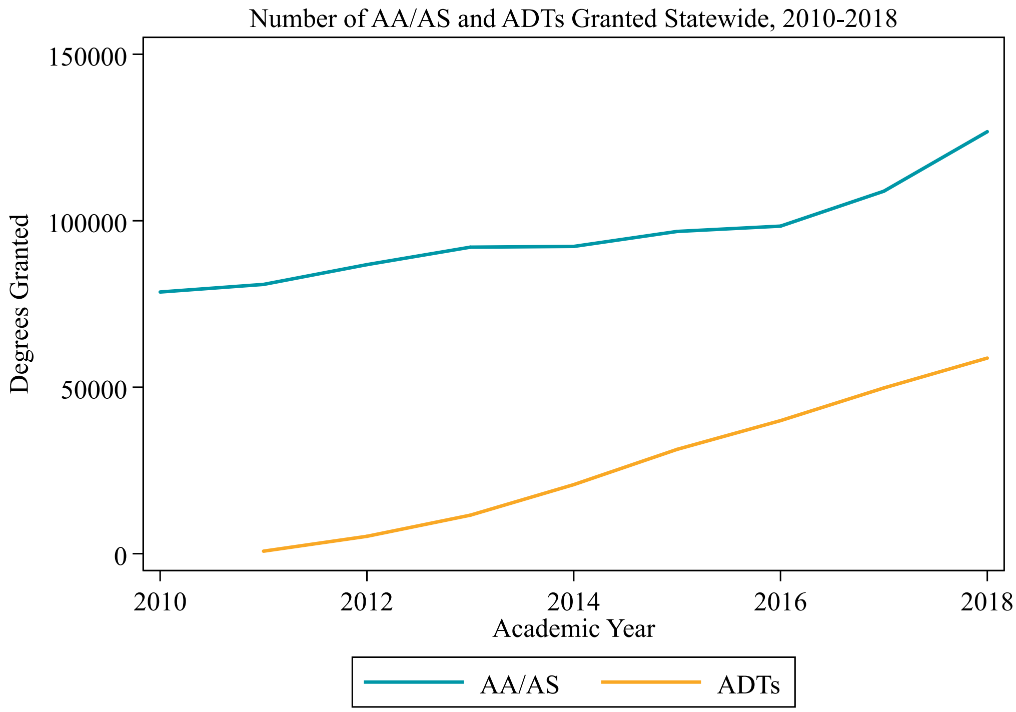

Figure 1. Number of AA/AS and ADTs Granted Statewide, 2010-2018

Notes: Authors' calculations from California Community College Chancellor's Office student-level administrative data. Counts include degree-level, not student-level, and students may have earned multiple AA/AS degrees, multiple ADTs, or both ADTs and AA/AS degrees.

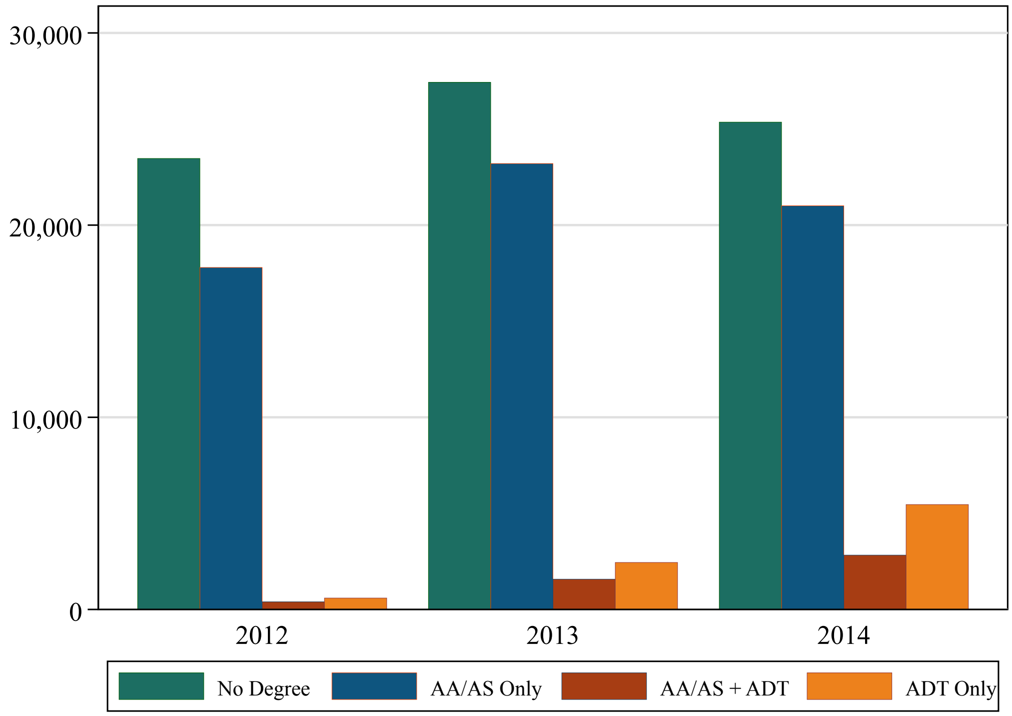

Figure 2. Number of Entering CCC-CSU Students, by Cohort, by Prior Degree

Notes: Author's calculations from matched CCC-CSU student-level data. Sample includes only students who transferred to a CSU after having earned at least 60 units at a CCC. Cohort years indicate year of entry at a CSU campus, and not necessarily last year of enrollment at a CCC.

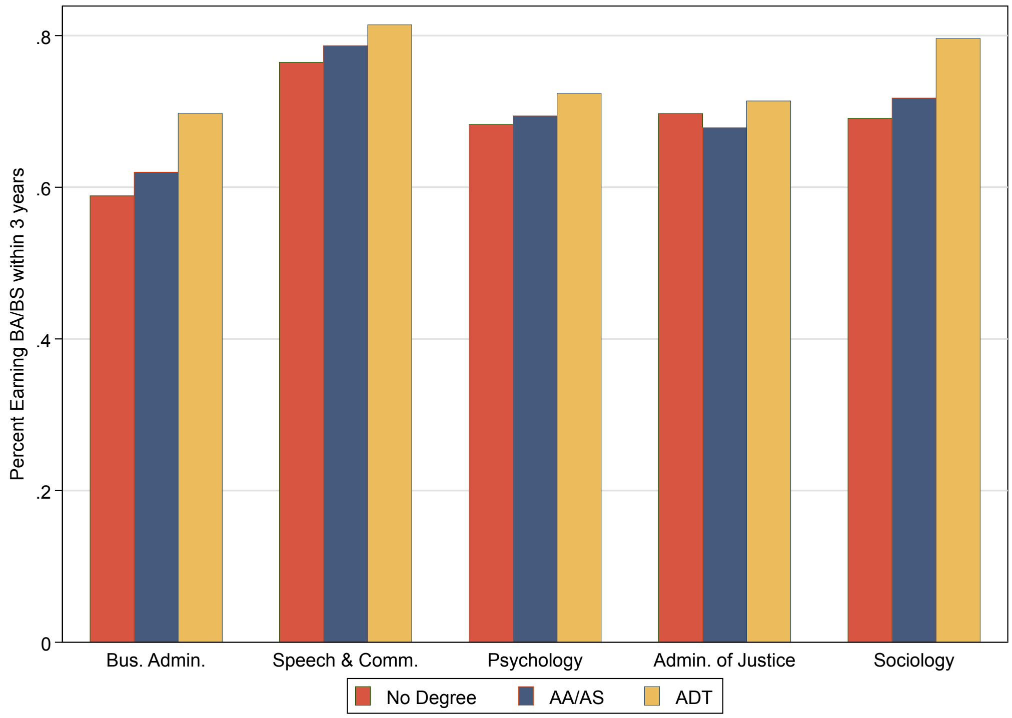

Figure 3. Percent Earning BA/BS Within 3 Years, by Major, by CCC Degree

Notes: Author's calculations from matched CCC-CSU student-level data of students who CCC transfer students who entered a CSU in 2012, 2013 or 2014. Sample includes only students who transferred to a CSU after having earned at least 60 units at a CCC. Cohort years indicate year of entry at a CSU campus, and not necessarily last year of enrollment at a CCC. Majors are CSU entry major.

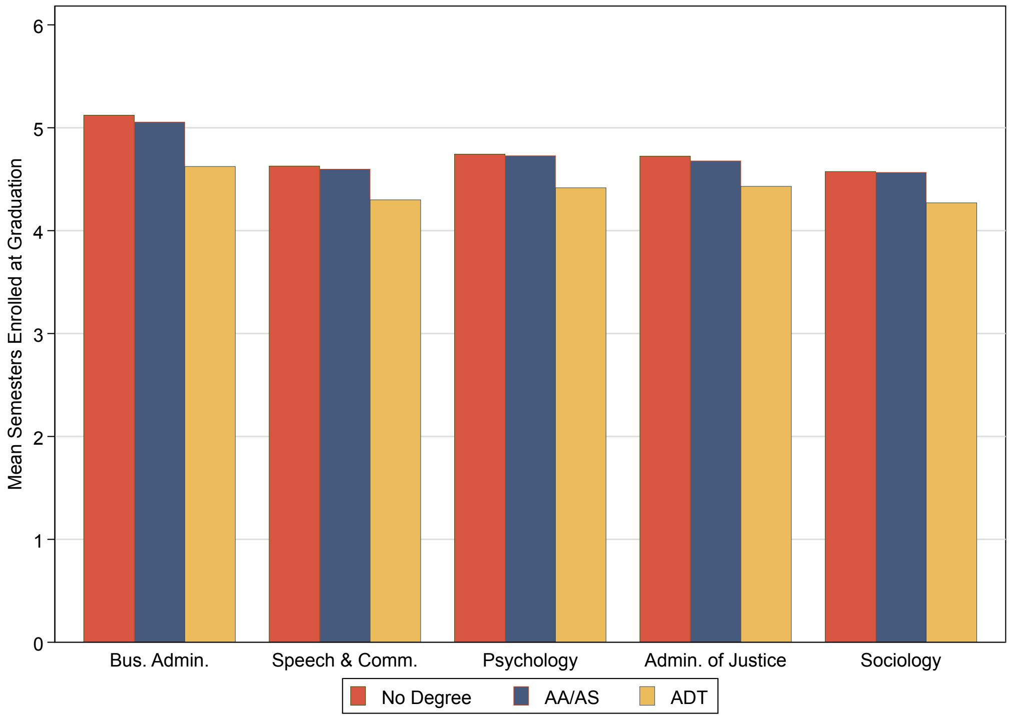

Figure 4. Mean CSU Semesters at Graduation, by Major, by CCC Degree.

Notes: Author's calculations from matched CCC-CSU student-level data of students who CCC transfer students who entered a CSU in 2012, 2013 or 2014. Sample includes only students who transferred to a CSU after having earned at least 60 units at a CCC. Cohort years indicate year of entry at a CSU campus, and not necessarily last year of enrollment at a CCC. Majors are CSU entry major. "Semesters at graduation" is defined only for students who graduated within three years of CSU matriculation.

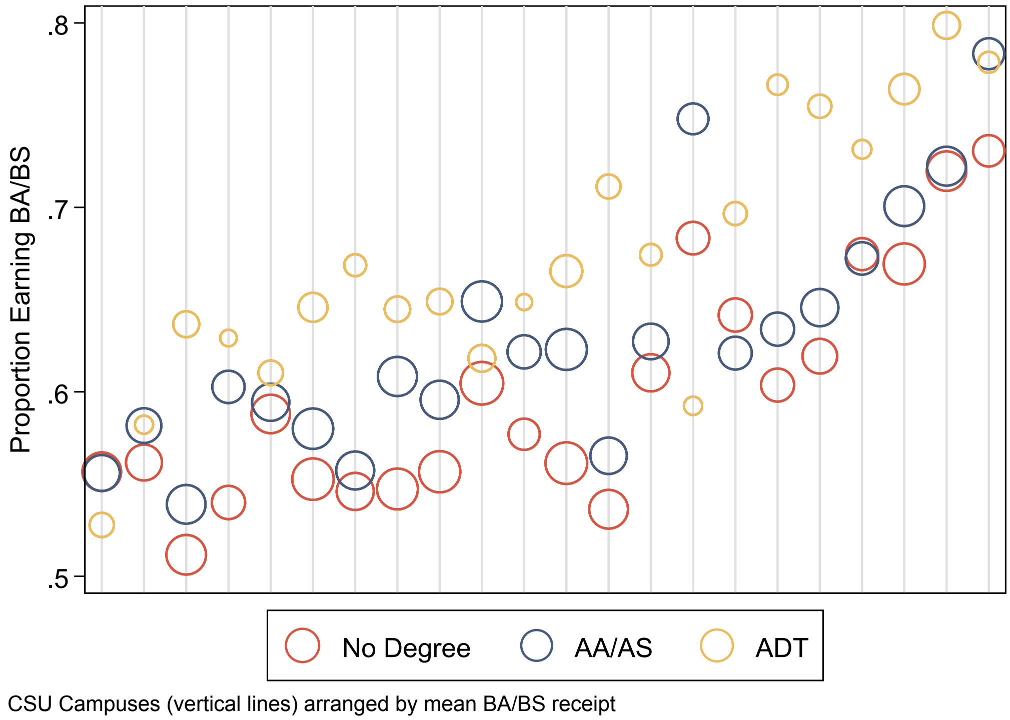

Figure 5. Proportion Earning BA/BS within 3 Years, by CCC Degree, by CSU Campus

Notes: Author's calculations from matched CCC-CSU student-level data of students who CCC transfer students who entered a CSU in 2012, 2013 or 2014. Sample includes only students who transferred to a CSU after having earned at least 60 units at a CCC. Cohort years indicate year of entry at a CSU campus, and not necessarily last year of enrollment at a CCC. Bubbles are sized by the natural logarithm of the size of the cohort (campus, CCC degree).

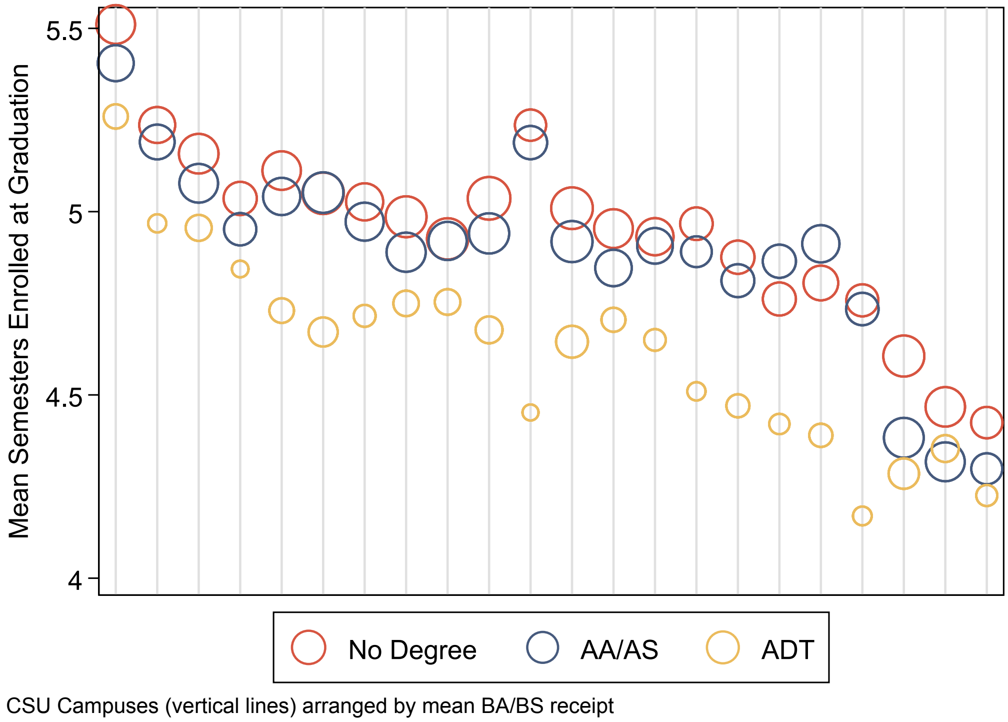

Figure 6. Mean Semesters Enrolled at Graduation, by CCC Degree, by CSU Campus

Notes: Author's calculations from matched CCC-CSU student-level data of students who CCC transfer students who entered a CSU in 2012, 2013 or 2014. Sample includes only students who transferred to a CSU after having earned at least 60 units at a CCC. Cohort years indicate year of entry at a CSU campus, and not necessarily last year of enrollment at a CCC. "Semesters at graduation" is defined only for students who graduated within three years of CSU matriculation. Bubbles are sized by the natural logarithm of the size of the cohort (campus, CCC degree).

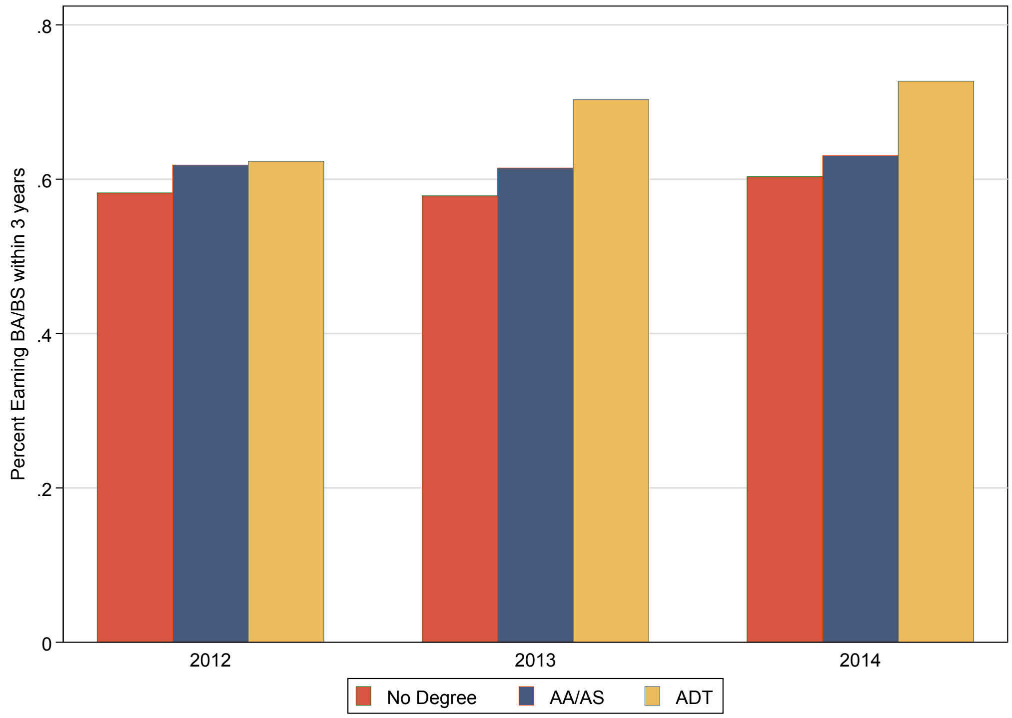

Figure 7. Percent Earning BA/BS within 3 Years, by Cohort, by CCC Degree

Notes: Author's calculations from matched CCC-CSU student-level data of students who CCC transfer students who entered a CSU in 2012, 2013 or 2014. Sample includes only students who transferred to a CSU after having earned at least 60 units at a CCC. Cohort years indicate year of entry at a CSU campus, and not necessarily last year of enrollment at a CCC.

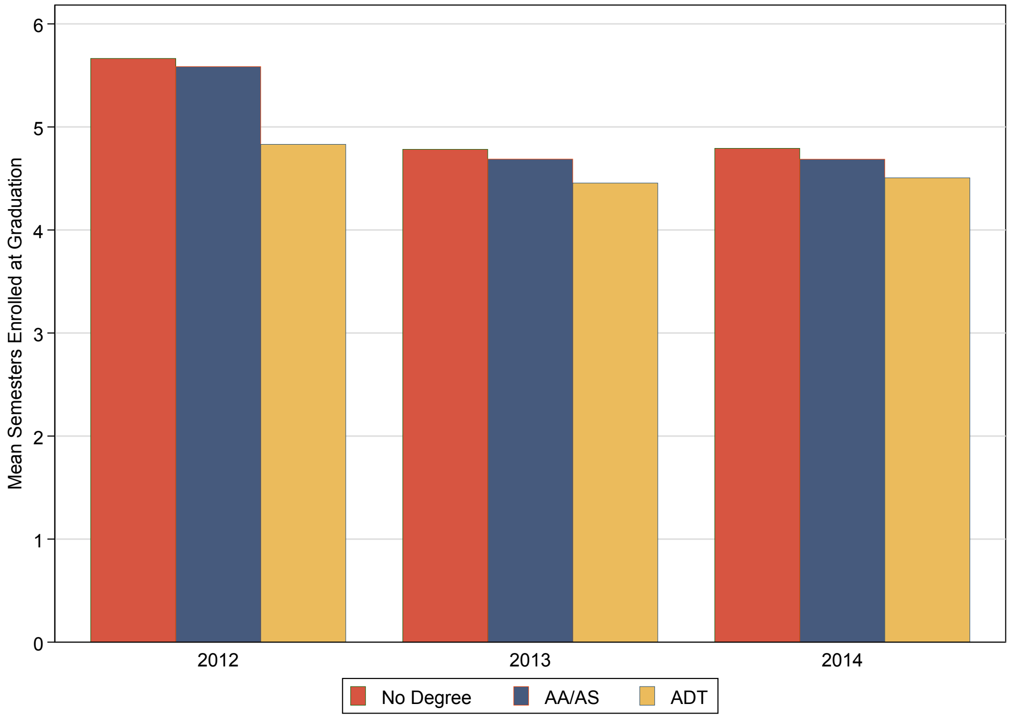

Figure 8. Mean Semesters Enrolled at CSU Graduation, by Cohort, by CCC Degree

Notes: Author's calculations from matched CCC-CSU student-level data of students who CCC transfer students who entered a CSU in 2012, 2013 or 2014. Sample includes only students who transferred to a CSU after having earned at least 60 units at a CCC. Cohort years indicate year of entry at a CSU campus, and not necessarily last year of enrollment at a CCC. "Semesters at graduation" is defined only for students who graduated within three years of CSU matriculation.

Table 1: Percent of students earning CCC degrees, CSU entering cohorts 2012, 2013, 2014

	All CCC-CSU Transfers								*CCC-CSU Transfers Who Earned an Associates*					
	(1)		(2)		(3)		(4)		(5)		(6)		(7)	
	Overall		ADTs available in CSU discipline		ADTs available in CSU broad major		ADTs available in CSU major		ADTs available in CCC major discipline		ADTs available in CCC broad major		ADTs available in CCC major	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*
No Degree	76,785	50.3	28,805	42.0	25,496	41.3	16,090	36.8	--		--		--	
AA/AS	62,454	40.9	26,481	38.6	22,980	37.2	14,376	32.8	13,991	51.2	11,322	46.0	4,655	25.9
ADT	8,509	5.6	8,509	12.4	8,509	13.8	8,509	19.4	8,509	31.2	8,509	34.5	8,509	47.3
ADT + AA/AS	4,809	3.2	4,809	7.0	4,809	7.8	4,809	11.0	4,809	17.6	4,809	19.5	4,809	26.8
Total	152,557		68,604		61,794		43,784		27,309		24,640		17,973	

Notes: Author's calculations from matched CCC-CSU student-level data of students who CCC transfer students who entered a CSU in 2012, 2013 or 2014. Sample includes only students who transferred to a CSU after having earned at least 60 units at a CCC. Cohort years indicate year of entry at a CSU campus, and not necessarily last year of enrollment at a CCC. "CSU discipline" is defined as groups of majors that share the same two first digits of the CSU major code and CSU broad major is defined as majors that share the same first three digits of the CSU major code. "CCC major discipline" is defined as majors that share the first two digits of the six-digit TOP code. "CCC broad major" is defined as majors that share the first three digits of the six-digit TOP code.

Table 2. Descriptive Statistics for CCC-CSU Transfers, by cohort, by CCC degree

	(1) **Total** mean (sd)	(2) **No CCC Degree** mean (sd)	(3) **AA/AS Only** mean (sd)	(4) **ADT Only** mean (sd)	(5) **AA/AS + ADT** mean (sd)
<u>All students in sample:</u>					
CCC Application information					
Female	0.54	0.48	0.60	0.57	0.58
	(0.50)	(0.50)	(0.49)	(0.50)	(0.49)
White	0.35	0.39	0.32	0.33	0.30
	(0.48)	(0.49)	(0.47)	(0.47)	(0.46)
African American	0.05	0.04	0.06	0.03	0.04
	(0.21)	(0.20)	(0.23)	(0.18)	(0.18)
Asian	0.18	0.22	0.15	0.16	0.15
	(0.39)	(0.42)	(0.36)	(0.36)	(0.36)
Latinx	0.33	0.27	0.38	0.38	0.42
	(0.47)	(0.44)	(0.48)	(0.49)	(0.49)
CCC Ever BOG	0.70	0.64	0.76	0.73	0.79
	(0.46)	(0.48)	(0.43)	(0.45)	(0.41)
CCC outcomes					
CCC Age at Exit	24.38	23.86	24.98	23.65	24.88
	(10.88)	(11.70)	(10.87)	(4.99)	(6.11)
Transfer Units Earned	87.03	84.07	90.33	81.78	92.37
	(27.86)	(26.02)	(29.75)	(22.10)	(28.91)
Transfer GPA	3.06	3.01	3.10	3.10	3.12
	(0.44)	(0.45)	(0.43)	(0.42)	(0.44)
CSU outcomes					
Earned BA/BS within 3 Years	0.62	0.59	0.62	0.72	0.69
	(0.49)	(0.49)	(0.48)	(0.45)	(0.46)
Number of observations	*132,894*	*60,383*	*59,700*	*8,212*	*4,599*
<u>Students who graduate w/in 3 years:</u>					
Earned Degree in Major at Entry	0.82	0.80	0.82	0.87	0.86
	(0.39)	(0.40)	(0.38)	(0.34)	(0.34)
Semesters at Degree	4.91	5.03	4.89	4.49	4.53
	(1.04)	(1.04)	(1.06)	(0.86)	(0.88)
CSU Units at Degree	72.00	70.41	64.19	66.59	70.25
	(19.36)	(19.24)	(14.79)	(17.75)	(18.97)
Grad. In 4 or Fewer Sem. (0/1)	0.38	0.32	0.39	0.57	0.55
	(0.49)	(0.47)	(0.49)	(0.49)	(0.50)
Grad. In 5 or Fewer Sem. (0/1)	0.69	0.65	0.70	0.85	0.83
	(0.46)	(0.48)	(0.46)	(0.35)	(0.38)
Grad. In 6 or Fewer Sem. (0/1)	0.93	0.91	0.93	0.99	0.99
	(0.26)	(0.29)	(0.26)	(0.12)	(0.11)
Observations	*95,199*	*42,617*	*42,933*	*6,239*	*3,410*

Note: Author's calculations from matched CCC-CSU student-level data of students who CCC transfer students who entered a CSU in 2012, 2013 or 2014. Sample includes only students who transferred to a CSU after having earned at least 60 units at a CCC. Cohort years indicate year of entry at a CSU campus, and not necessarily last year of enrollment at a CCC. BOG = Board of Governors Fee Waiver. Transfer GPA = weighted GPA from transfer-eligible courses taken at the CCC.

Table 3. Predicting ADT Receipt

Outcome: Earn ADT				
Reference:	No CCC Degree		Earn AA/AS	
Female	0.03	***	-0.007	*
	(0.003)		(0.003)	
White	-0.021	***	-0.004	
	(0.005)		(0.005)	
Black	-0.018	+	-0.033	***
	(0.008)		(0.008)	
Asian	-0.026	***	0.01	+
	(0.006)		(0.006)	
Latinx	0.023	***	0.005	
	(0.005)		(0.005)	
Receive Fin. Aid (0/1)	0.09	***	0.015	***
	(0.003)		(0.003)	
CCC Campus * Major FE	X		X	
N	73,194		72,511	
Adjusted R^2	0.262		0.277	

Notes: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001
Financial aid = State Board of Governors Fee Waiver (means tested waiver of enrollment fees). Omitted race/ethnicity category is other. Sample includes CCC transfer students who entered a CSU in 2012, 2013 or 2014. . CCC * Major FE = CCC campus-by-CSU entry major fixed effects.

Table 4. Predicting BA/BS Outcomes Using ADT Receipt as Predictor

Outcome:	*Probability of earning a Bachelor's Degree*						*Number of Enrolled Terms at Degree*					
	Model 1		Model 2		Model 3		Model 1		Model 2		Model 3	
ADT	0.124	***	0.097	***	0.041	***	-0.529	***	-0.524	***	-0.160	***
	(0.005)		(0.005)		(0.005)		(0.012)		(0.012)		(0.012)	
AA/AS	0.034	***	0.018	***	0.004		-0.145	***	-0.134	***	-0.04	***
	(0.003)		(0.003)		(0.003)		(0.008)		(0.008)		(0.007)	
Stud Char			X		X				X		X	
Major FE					X						X	
CCC Campus FE					X						X	
CCC Cohort FE					X						X	
CSU Campus FE					X						X	
CSU Cohort FE					X						X	
Major * CCC FE					X						X	
Major * CCC Cohort FE					X						X	
CCC * CCC Cohort FE					X						X	
Major * CSU FE					X						X	
CSU * CSU Cohort FE					X						X	
Major * CSU Cohort FE					X						X	
Adjusted R^2	0.005		0.053		0.163		0.023		0.029		0.381	
N	132,894		132,894		132,894		81,897		81,897		81,897	

Notes: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001 Sample includes CCC transfer students who entered a CSU in 2012, 2013 or 2014. Sample includes only students who transferred to a CSU after having earned at least 60 units at a CCC. Cohort years indicate year of entry at a CSU campus, and not necessarily last year of enrollment at a CCC. Vector of student characteristics includes: gender, year of high school graduation, race/ethnicity dummy variables, CCC GPA at transfer, and a dummy variable indicating if the student ever received the Board of Governors Fee Waiver. Major indicates student major at CSU entry. Omitted category is transferring with no CCC degree.

Table 5. Predicting BA /BS Outcomes Using ADT Availability as Predictor

Outcome:	*Probability of earning a BA*				*# of Terms at Degree*							
	Model 1: ADT Avail. In Major	Model 2: ADTs avail. In broad major	Model 3: ADT avail. In discipline	Model 4: ADT avail. In hand-coded group	Model 1: ADT Avail. In Major		Model 2: ADTs avail. In broad major		Model 3: ADT avail. In discipline		Model 4: ADT avail. In hand-coded group	
ADT Available	0.007	0.004	0.003	0.004	-0.027	*	-0.024	*	-0.025	*	-0.022	+
	(0.005)	(0.005)	(0.005)	(0.005)	(0.011)		(0.011)		(0.011)		(0.013)	
Stud Char	X	X	X	X	X		X		X		X	
Major FE	X	X	X	X	X		X		X		X	
CCC Campus FE	X	X	X	X	X		X		X		X	
CCC Cohort FE	X	X	X	X	X		X		X		X	
CSU Campus FE	X	X	X	X	X		X		X		X	
CSU Cohort FE	X	X	X	X	X		X		X		X	
Major * CCC FE	X	X	X	X	X		X		X		X	
Major * CCC Cohort FE	X	X	X	X	X		X		X		X	
CCC * CCC Cohort FE	X	X	X	X	X		X		X		X	
Major * CSU FE	X	X	X	X	X		X		X		X	
CSU * CSU Cohort FE	X	X	X	X	X		X		X		X	
Major * CSU Cohort FE	X	X	X	X	X		X		X		X	
Adjusted R^2	0.163	0.163	0.163	0.147	0.379		0.379		0.379		0.346	
N	132,894	132,894	132,894	106,852	81,897		81,897		81,897		67,330	

Notes: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001 Sample includes CCC transfer students who entered a CSU in 2012, 2013 or 2014. Sample includes only students who transferred to a CSU after having earned at least 60 units at a CCC. Cohort years indicate year of entry at a CSU campus, and not necessarily last year of enrollment at a CCC. Vector of student characteristics includes gender, year of high school graduation, race/ethnicity dummy variables, CCC GPA at transfer, and a dummy variable indicating if the student ever received the Board of Governors Fee Waiver. Major indicates student major at CSU entry. "Discipline" is defined as groups of majors that share the same two first digits of the CSU major code and "broad major" is defined as majors that share the same first three digits of the CSU major code. Hand-coded groups are groups of majors that were deemed similar by our research team.

Table 6. Not Switching Major as Mechanism for ADTs Effect on Efficiency

Outcome:	Pr(Earn Deg. In Entry Major)				# of Terms at Degree			
	Model 1		Model 2		Model 3		Model 4	
Earned ADT	0.016	***			-0.157	***		
	(0.004)				(0.012)			
Earned AA/AS	0.006	*			-0.039	***		
	(0.002)				(0.007)			
ADT Available			0.002				-0.026	*
			(0.004)				(0.011)	
Graduate with Entering Major					-0.192	***	-0.194	***
					(0.011)		(0.011)	
Stud Char	X		X		X		X	
Major FE	X		X		X		X	
CCC Campus FE	X		X		X		X	
CCC Cohort FE	X		X		X		X	
CSU Campus FE	X		X		X		X	
CSU Cohort FE	X		X		X		X	
Major * CCC FE	X		X		X		X	
Major * CCC Cohort FE	X		X		X		X	
CCC * CCC Cohort FE	X		X		X		X	
Major * CSU FE	X		X		X		X	
CSU * CSU Cohort FE	X		X		X		X	
Major * CSU Cohort FE	X		X		X		X	
Adjusted R^2	0.403		0.403		0.383		0.382	
N	95,199		95,199		81,897		81,897	

Notes: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001 Sample includes CCC transfer students who entered a CSU in 2012, 2013 or 2014 after having earned at least 60 units at a CCC and who successfully earned a BA/BS. Cohort year indicate year of entry at a CSU campus, and not necessarily last year of enrollment at a CCC. Vector of student characteristics includes gender, year of high school graduation, race/ethnicity dummy variables, CCC GPA at transfer, and a dummy variable indicating if the student ever received the Board of Governors Fee Waiver. Major indicates student major at CSU entry. Students were determined to have earned a degree in their entering CSU major if the five-digit major codes at entry and graduation matched exactly.

Table 7: Effects of ADTs on BA/BS receipt and Semesters at Graduation, by Student Subgroup

Outcome: Probability of Earning a Bachelor's Degree

	Overall Estimates	*Female Students*	*White Students*	*Black Students*	*Latinx Students*	*Asian Students*	*Students Receiving Financial Aid*	*Students with High CCC GPAs*	*Students with Low CCC GPAs*
ADT	0.041 ***	0.021 **	0.047 ***	0.102 *	0.050 ***	0.014	0.055 ***	0.02	0.046 **
	(0.005)	(0.007)	(0.009)	(0.047)	(0.010)	(0.014)	(0.006)	(0.014)	(0.018)
AA/AS	0.004	-0.007	0.008	-0.028	0.008	-0.001	0.014 ***	-0.006	0.011
	(0.003)	(0.004)	(0.005)	(0.026)	(0.006)	(0.008)	(0.004)	(0.008)	(0.010)
Stud Char	X	X	X	X	X	X	X	X	X
All FE and 2-way FE	X	X	X	X	X	X	X	X	X
Adjusted R^2	0.163	0.163	0.167	0.124	0.162	0.163	0.131	0.171	0.118
N	132,894	72,280	46,649	6,302	43,664	24,516	93,662	22,123	20,654

Outcome: Number of Enrolled Semesters at Graduation

	Overall Estimates	*Female Students*	*White Students*	*Black Students*	*Latinx Students*	*Asian Students*	*Students Receiving Financial Aid*	*Students with High CCC GPAs*	*Students with Low CCC GPAs*
ADT	-0.160 ***	-0.130 ***	-0.180 ***	0.116	-0.152 ***	-0.211 ***	-0.147 ***	-0.166 ***	-0.102 *
	(0.012)	(0.016)	(0.021)	(0.150)	(0.022)	(0.035)	(0.015)	(0.032)	(0.051)
AA/AS	-0.040 ***	-0.024 *	-0.056 ***	0.168 +	-0.031 *	-0.049 *	-0.036 ***	-0.041 *	-0.013
	(0.007)	(0.010)	(0.013)	(0.100)	(0.014)	(0.021)	(0.009)	(0.019)	(0.031)
Stud Char	X	X	X	X	X	X	X	X	X
All FE and 2-way FE	X	X	X	X	X	X	X	X	X
Adjusted R^2	0.381	0.381	0.413	0.336	0.37	0.381	0.373	0.446	0.359
N	81,897	47,431	30,197	3,251	26,682	14,635	56,399	16,335	9,394

Notes: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001 Sample includes CCC transfer students who entered a CSU in 2012, 2013 or 2014 after having earned at least 60 units at a CCC. Cohort years indicate year of entry at a CSU campus, and not necessarily last year of enrollment at a CCC. Vector of student characteristics includes: gender, year of high school graduation, race/ethnicity dummy variables, CCC GPA at transfer, and a dummy variable indicating if the student ever received the Board of Governors Fee Waiver. Vector of one- and two-way FE include all combinations of CCC, CSU, major, and cohort FE. Omitted category is transferring with no CCC degree.

Appendix A: Availability of ADTs

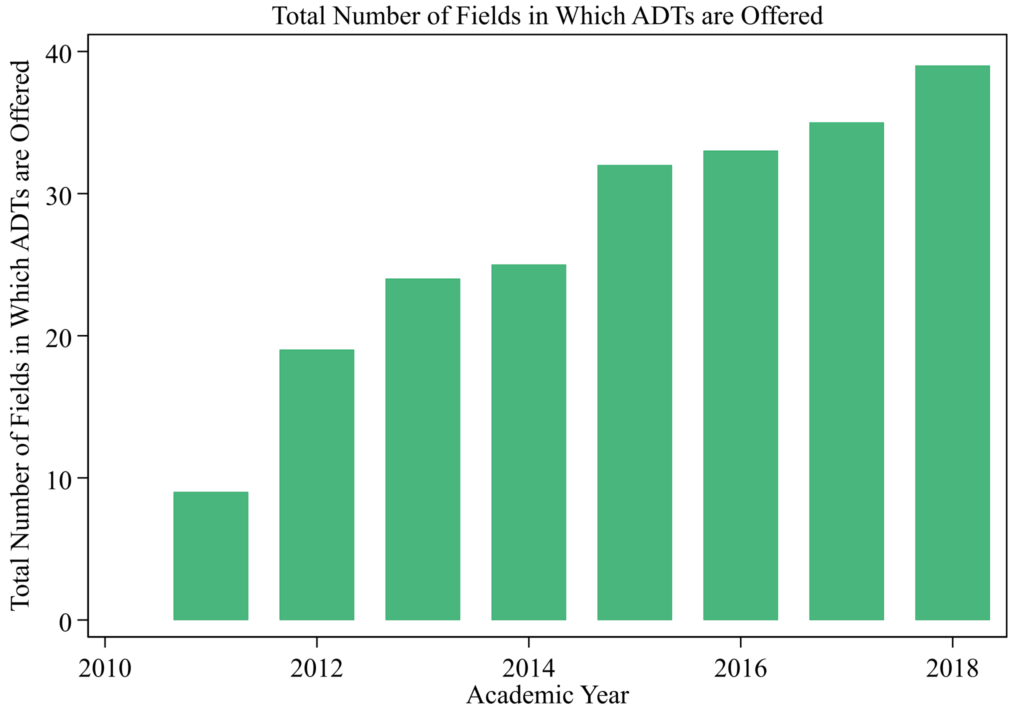

Figure A1. Total Number of Fields in Which ADTs are Offered, by Year

Notes: Authors' calculations based on CCCCO administrative data. We consider a campus to have offered an ADT in a given subject in a given year if at least one student earned an ADT that year. Thus, our counts might underestimate the actual on-the-books availability of ADTs, but capture programs that were successfully graduating students.

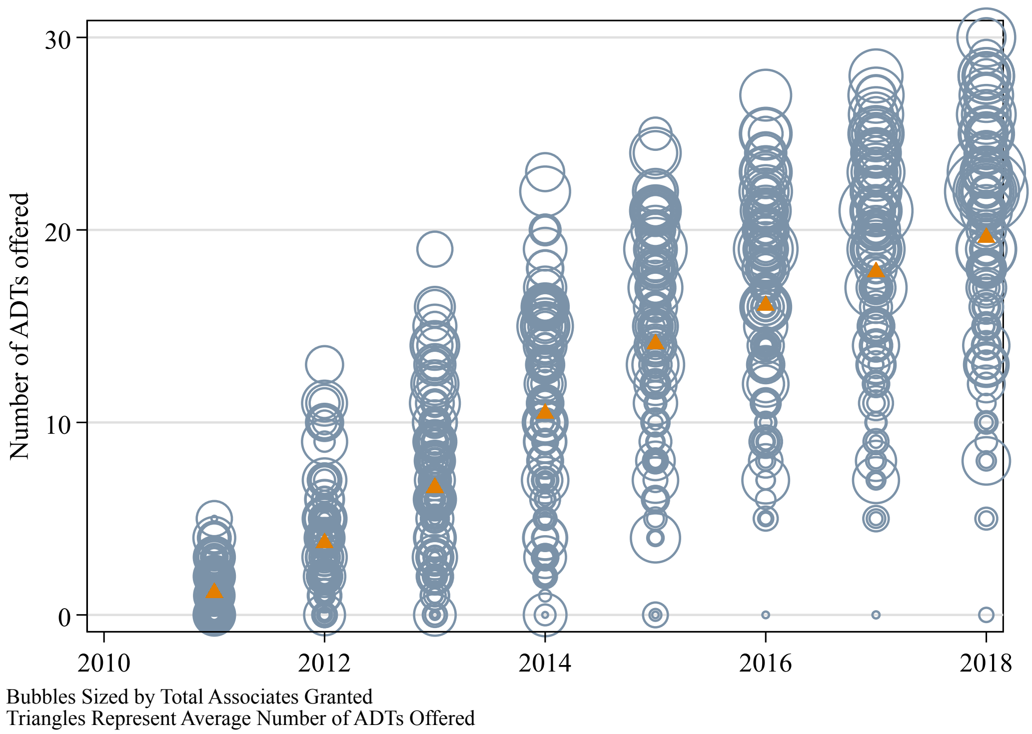

Figure A2. Number of ADTs Offered on Each CCC Campus, by Year

Notes: Authors' calculations using CCCCO administrative data. Each bubble indicates one CCC campus in one year. Bubbles are sized by the total number of associates degrees granted by a given college in a given year.

Appendix B: Robustness Check, limiting the sample to students who earned a degree at the CCC

One key issue of measurement in this paper is that we do not have recorded majors/programs of study for students who transferred to the CSU without having first earned a community college degree. In order to retain all CCC-CSU transfer students in our sample, and because we believe that the "no degree" students are a key comparison for students who earn an ADT, we use CSU entry major as our proxy for CCC major. To test the robustness of our estimates to this decision, we conduct additional analyses in which we limit the sample to students who earned a community college degree (AA/AS or ADT), as we have a measure of community college major for these students. Using this subsample, we re-estimate model (3) and include a vector of fixed effects for community college major, as well as the fully saturated set of two-way community college fixed effects (campus, major, and cohort). California Community Colleges use six-digit Taxonomy of Programs (TOP) codes to categorize majors. We use these six-digit codes as a measure of major.

Results from these analyses are presented in Appendix Table B1. These results show that students who earned an ADT, as compared to a local AA/AS, were more likely to earn a BA/BS and graduated in fewer semesters. The magnitude of these estimated effects are very similar to the ADT – AA/AS comparison in our main models.

Using this subsample of students, we also re-estimate our models that use availability of ADTs as the key predictor. In this sample, we can more accurately measure ADT availability because we know community college program of study. For this subsample of students, we re-estimate a version model (4), with ADT availability being equal to one for any student in a major-by-community college-by-exit cohort cell in which at least one student earned an ADT. We again estimate progressively conservative models by considering ADTs to be available if any student earned an ADT in increasingly large groups of majors (first three digits of the TOP code and first two digits of the TOP code).

The results from these analyses are presented in Appendix Table B2. The estimated effects of ADT availability on BA/BS receipt are quite similar to our main model (not statistically significant and very close to zero). The estimated effects of offering ADTs on efficiency (number of semesters enrolled at graduation) are also similar to the results of our main models, but they are no longer statistically significant. This could be partially explained by the smaller sample size/larger standard errors.

Table B1. Predicting BA /BS Outcomes Using ADT Receipt as Predictor, Limiting Sample to Students who Earned CCC Degree

Outcome:	*Probability of earning a Bachelors Degree*			*Number of Enrolled Terms at Degree*		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
ADT	0.091 ***	0.078 ***	0.031 ***	-0.384 ***	-0.390 ***	-0.092 ***
	(0.005)	(0.005)	(0.008)	(0.012)	(0.012)	(0.019)
Stud Char		X	X		X	X
Major FE			X			X
CCC Campus FE			X			X
CCC Cohort FE			X			X
CSU Campus FE			X			X
CSU Cohort FE			X			X
Major * CCC FE			X			X
Major * CCC Cohort FE			X			X
CCC * CCC Cohort FE			X			X
Major * CSU FE			X			X
CSU * CSU Cohort FE			X			X
Major * CSU Cohort FE			X			X
Adjusted R^2	0.005	0.048	0.165	0.022	0.027	0.382
N	72,511	72,511	72,511	46,324	46,324	46,324

Notes: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001 Sample includes CCC transfer students who entered a CSU in 2012, 2013 or 2014. Sample includes only students who transferred to a CSU after having earned an associate degree CCC. Cohort years indicate year of entry at a CSU campus, and not necessarily last year of enrollment at a CCC. Vector of student characteristics includes: gender, year of high school graduation, race/ethnicity dummy variables, CCC GPA at transfer, and a dummy variable indicating if the student ever received the Board of Governors Fee Waiver. Major indicates the six-digit Taxonomy of Programs code for the CCC degree. Omitted category is transferring with an AA or AS degree.

Table B2. Predicting BA /BS Outcomes Using ADT Availability as Predictor, Limiting Sample to Students who Earned CCC Degree

Outcome:	*Probability of earning a BA*			*# of Terms at Degree*		
	ADT Avail. In Major	ADT Avail. In 3-digit TOP	ADT Avail. In 2-digit TOP	ADT Avail. In Major	ADT Avail. In 3-digit TOP	ADT Avail. In 2-digit TOP
ADT Available	0.010	0.000	0.000	-0.056 *	-0.035	-0.016
	(0.010)	(0.009)	(0.008)	(0.024)	(0.021)	(0.020)
Stud Char	X	X	X	X	X	X
Major FE	X	X	X	X	X	X
CCC Campus FE	X	X	X	X	X	X
CCC Cohort FE	X	X	X	X	X	X
CSU Campus FE	X	X	X	X	X	X
CSU Cohort FE	X	X	X	X	X	X
Major * CCC FE	X	X	X	X	X	X
Major * CCC Cohort FE	X	X	X	X	X	X
CCC * CCC Cohort FE	X	X	X	X	X	X
Major * CSU FE	X	X	X	X	X	X
CSU * CSU Cohort FE	X	X	X	X	X	X
Major * CSU Cohort FE	X	X	X	X	X	X
Adjusted R^2	0.165	0.165	0.165	0.382	0.382	0.382
N	72,511	72,511	72,511	46,324	46,324	46,324

Notes: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001 Sample includes CCC transfer students who entered a CSU in 2012, 2013 or 2014. Sample includes only students who transferred to a CSU after having earned an associate degree CCC. Cohort years indicate year of entry at a CSU campus, and not necessarily last year of enrollment at a CCC. Vector of student characteristics includes: gender, year of high school graduation, race/ethnicity dummy variables, CCC GPA at transfer, and a dummy variable indicating if the student ever received the Board of Governors Fee Waiver. Major indicates the six-digit Taxonomy of Programs code for the CCC degree.

Appendix C: Effects on CSU Units at Graduation

Table C1. Effects on CSU Units at Graduation, ADT Receipt and ADT Availability

	Model 1		*Model 2*		*Model 3*		*Model 1* ADT Avail. In Major		*Model 2* ADTs avail. in broad major		*Model 3* ADT avail. in discipline	
ADT	-6.991	***	-6.953	***	-2.148	***						
	(0.262)		(0.263)		(0.173)							
AA/AS	-1.589	***	-1.429	***	-1.182	***						
	(0.190)		(0.195)		(0.121)							
ADT Available							-0.534	**	-0.408	*	-0.444	*
							(0.184)		(0.191)		(0.186)	
Stud Char			X		X		X		X		X	
Major FE					X		X		X		X	
CCC Campus FE					X		X		X		X	
CCC Cohort FE					X		X		X		X	
CSU Campus FE					X		X		X		X	
CSU Cohort FE					X		X		X		X	
Major * CCC FE					X		X		X		X	
Major * CCC Cohort FE					X		X		X		X	
CCC * CCC Cohort FE					X		X		X		X	
Major * CSU FE					X		X		X		X	
CSU * CSU Cohort FE					X		X		X		X	
Major * CSU Cohort FE					X		X		X		X	
R-squared	0.015		0.02		0.681		0.752		0.751		0.751	
N	46,158		46,158		46,158		46,158		46,158		46,158	

Notes: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001 Outcome (units at graduation) includes only units earned in the CSU. Sample includes CCC transfer students who entered a CSU in 2012, 2013 or 2014. Sample includes only students who transferred to a CSU after having earned at least 60 units at a CCC. Cohort years indicate year of entry at a CSU campus, and not necessarily last year of enrollment at a CCC. Vector of student characteristics includes: gender, year of high school graduation, race/ethnicity dummy variables, CCC GPA at transfer, and a dummy variable indicating if the student ever received the Board of Governors Fee Waiver. Major indicates student major at CSU entry. Omitted category in Models 1-3 is transferring with no CCC degree.

Appendix D: Subgroup Effects Using ADT Availability as Predictor

Table D1: Effects of ADTs on BA/BS receipt and Semesters at Graduation, Using ADT Availability as Predictor, by Student Subgroup

Outcome: Probability of Earning a Bachelors Degree

	Overall Estimates		*Female Students*	*White Students*	*Black Students*	*Latinx Students*		*Asian Students*	*Students Receiving Financial Aid*		*Students with High CCC GPAs*	*Students with Low CCC GPAs*
ADT Avail. in Discipline	0.007		0.003	0.002	0.04	-0.003		0.013	0.005		0.01	0.021
	(0.005)		(0.006)	(0.008)	(0.044)	(0.009)		(0.013)	(0.006)		(0.013)	(0.015)
Stud Char	X		X	X	X	X		X	X		X	X
All FE and 2-way FE	X		X	X	X	X		X	X		X	X
Adjusted R^2	0.163		0.162	0.166	0.12	0.161		0.163	0.13		0.171	0.118
N	132,894		72,280	46,649	6,302	43,664		24,516	93,662		22,123	20,654

Outcome: Number of Enrolled Semesters at Graduation

	Overall Estimates		*Female Students*	*White Students*	*Black Students*	*Latinx Students*		*Asian Students*	*Students Receiving Financial Aid*		*Students with High CCC GPAs*	*Students with Low CCC GPAs*
ADT Avail. in Discipline	-0.027	*	-0.012	-0.016	-0.027	-0.048	*	-0.009	-0.029	*	-0.030	0.000
	(0.011)		(0.015)	(0.020)	(0.200)	(0.022)		(0.034)	(0.014)		(0.031)	(0.052)
Stud Char	X		X	X	X	X		X	X		X	X
All FE and 2-way FE	X		X	X	X	X		X	X		X	X
Adjusted R^2	0.379		0.381	0.411	0.333	0.37		0.379	0.372		0.445	0.358
N	81,897		47,431	30,197	3,251	26,682		14,635	56,399		16,335	9,394

Notes: + $p<0.10$, * $p<0.05$, ** $p<0.01$, *** $p<0.001$ Sample includes CCC transfer students who entered a CSU in 2012, 2013 or 2014 after having earned at least 60 units at a CCC. Cohort years indicate year of entry at a CSU campus, and not necessarily last year of enrollment at a CCC. Vector of student characteristics includes: gender, year of high school graduation, race/ethnicity dummy variables, CCC GPA at transfer, and a dummy variable indicating if the student ever received the Board of Governors Fee Waiver. Vector of one- and two-way FE include all combinations of CCC, CSU, major, and cohort FE. "ADT Avail. in Discipline" is equal to 1 if any student from a given CCC who graduated in a given year and entered a CSU discipline (defined by first two digits of CSU major code) had earned an ADT.

Appendix E: Effects of ADT on Transfer

The main analyses in this paper focus on the effects of the ADT on baccalaureate degree attainment and efficiency, conditional on transfer to the CSU. The full effect of the ADT on baccalaureate outcomes for students who start at a community college must also account for the effects of the ADT on transfer rates from the community college to the CSU. Without account for this stage, the results underestimate the true effect of ADTs on overall BA/BS production. In the main body of the paper, we rely on past work (Baker, 2016; Shaat, 2020) as a benchmark for the effects of the ADT on transfer rates. Both of these papers rely on aggregate data and thus cannot examine subgroup effects. Additionally, the Baker (2016) paper relies on data from only the first three years of ADT implementation, and the Shaat paper (2020) uses a comparison group that might not fully account for overall trends in transfer. In this appendix we replicate the findings from these two papers using four cohorts of student-level data.

We examine the effects of ADT on transfer from the CCC to four-year institutions. The sample is limited to students who first entered the CCC between in the fall term between 2011 and 2015 and who demonstrate intent to transfer (defined as completing at least 12 units and attempting a transfer level math or English course in their first four years).[18] We look at both transfer to any four-year institution and also look at the probability of transfer to the CSU in particular, conditional on transfer.

We estimate a series of models, with the main coefficient of interest being the number of ADTs offered at each CCC in the student's first year of attendance in defined categories (zero, 1-3, 4-10, 11+).[19] We estimate a series of models adding controls for student characteristics, CCC campus fixed effects, and CCC cohort fixed effects. These models thus control for anything unique about a given campus (including proximity to CSUs, overall transfer rate, advising

[18] There are a number of ways to measure "transfer intention" among community college students. In our analyses we tested two other definitions (stated transfer intent, completing at least 30 units within the first two years). The results, available upon request, are consistent across definitions. We chose this definition – completing at least 12 units and attempting a transfer level math or English course in their first four years – as it aligns with the California Community Colleges Chancellor's Office's "transfer cohort" definition.

[19] Our results are generally robust to a number of definitions of our variable of interest – number of ADTs available at a given CCC in a given year – including using a continuous measure and differently sized categories.

services, etc.), as well as anything that is unique about a give cohort of students (including trends in CSU admissions, tuition policies, etc.).

The results from these analyses are presented in Appendix Table E1. The estimated effects of ADT availability on transfer are positive. As shown in Model 5, which controls for a vector of student characteristics, CCC campus fixed effects, and CCC cohort fixed effects, we estimate that offering 1-3 ADTs is associated with a 0.9 percentage points increase in the probability that a transfer-intending student will transfer to a four-year college. The estimated effects were similar for offering 4-10 or 11+ ADTs. The results for CSU transfer (relative to transfer to UC, in-state private or out-of-state) were also positive.

We also look at the effects of ADT availability on transfer by subgroup (presented in Appendix Table E2). The results are positive across all subgroups, with large significant effects in particular for female students and students receiving a CCC fee waiver.

Table E1: Effects of ADTs Transfer. Panel A: Effects on Overall Transfer

	Model 1		*Model 2*		*Model 3*		*Model 4*		*Model 5*	
Low ADT	0		0.003		0.012	***	0.012	***	0.009	***
	(0.002)		(0.002)		(0.002)		(0.002)		(0.003)	
Medium ADTs	0.02	***	0.021	***	0.016	***	0.016	***	0.011	**
	(0.002)		(0.002)		(0.002)		(0.002)		(0.003)	
High ADTs	0.03	***	0.028	***	0.012	***	0.012	***	0.01	*
	(0.002)		(0.002)		(0.003)		(0.003)		(0.004)	
Stud Char			X				X		X	
CCC Campus FE					X		X		X	
CCC Cohort FE									X	
R-squared	0.001		0.022		0.021		0.037		0.037	
N	547,831		543,264		547,831		543,264		543,264	

Panel B: Effects on Transfer to the CSU, conditional on transfer

	Model 1		*Model 2*		*Model 3*		*Model 4*		*Model 5*	
Low ADT	0.036	***	0.029	***	0.01	+	0.006		0.009	
	(0.005)		(0.005)		(0.006)		(0.006)		(0.006)	
Medium ADTs	0.036	***	0.028	***	0.01	+	0.005		0.015	+
	(0.004)		(0.004)		(0.006)		(0.006)		(0.008)	
High ADTs	0.062	***	0.055	***	0.008		0.001		0.023	*
	(0.005)		(0.005)		(0.006)		(0.006)		(0.010)	
Stud Char			X				X		X	
CCC Campus FE					X		X		X	
CCC Cohort FE									X	
R-squared	0.001		0.022		0.021		0.037		0.037	
N	547,831		543,264		547,831		543,264		543,264	

Notes: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001 Sample includes CCC students who first entered the CCC in 2011, 2012, 2013 or 2014 and earned at least 12 units and attempted a transfer-level math or English course in their first four years. Vector of student characteristics includes: gender, race/ethnicity dummy variables, and a dummy variable indicating if the student ever received the Board of Governors Fee Waiver. "Low ADTs" is equal to one if the CCC offered 1-3 ADTs, “Medium ADTs” is equal to one if the CCC offered 4-10 ADTs and “High ADTs” is equal to one if the CCC offered 11 or more ADTs in a student’s first year.

Table E2: Effects of ADTs on Transfer, by Student Subgroup

	Overall Estimates	*Female Students*	*White Students*	*Black Students*	*Latinx Students*	*Asian Students*	*Students Receiving Financial Aid*
	Outcome: Probability of Transferring to a Four-Year University						
Low ADT	0.009 ***	0.012 **	0.013 *	0.007	0.005	0.014	0.008 *
	(0.003)	(0.004)	(0.005)	(0.011)	(0.004)	(0.010)	(0.003)
Medium ADTs	0.011 **	0.011 *	0.012 +	0.009	0.006	0.007	0.008 *
	(0.003)	(0.005)	(0.007)	(0.014)	(0.005)	(0.013)	(0.004)
High ADTs	0.01 *	0.012 *	0.01	0.004	0	0.007	0.007
	(0.004)	(0.006)	(0.008)	(0.018)	(0.006)	(0.015)	(0.005)
R-squared	0.001	0.032	0.032	0.027	0.019	0.048	0.032
N	547,831	282,781	152,238	26,133	248,660	56,589	392,141
	Outcome: Probability of Transferring to CSU, Conditional on Transfer						
	Overall Estimates	*Female Students*	*White Students*	*Black Students*	*Latinx Students*	*Asian Students*	*Students Receiving Financial Aid*
Low ADT	0.036 ***	0.017 +	0.005	0.026	0.012	0.002	0.007
	(0.005)	(0.009)	(0.010)	(0.025)	(0.011)	(0.020)	(0.008)
Medium ADTs	0.036 ***	0.025 *	0.009	0.074 *	0.02	-0.004	0.012
	(0.004)	(0.011)	(0.012)	(0.032)	(0.013)	(0.025)	(0.010)
High ADTs	0.062 ***	0.027 *	0.028 +	0.077 +	0.018	0.001	0.019
	(0.005)	(0.013)	(0.016)	(0.041)	(0.016)	(0.031)	(0.012)
R-squared	0.001	0.074	0.058	0.05	0.051	0.081	0.063
N	143,180	76,591	52126	6,707	49,691	17,919	92,484

Notes: + p<0.10, * p<0.05, ** p<0.01, *** p<0.001 Sample includes CCC students who first entered the CCC in 2011, 2012, 2013 or 2014 and earned at least 12 units and attempted a transfer-level math or English course in their first four years. These models include CCC fixed effects, CCC cohort fixed effects and a vector of student characteristics including gender, race/ethnicity dummy variables, age and a dummy variable indicating if the student ever received the Board of Governors Fee Waiver. "Low ADTs" is equal to one if the CCC offered 1-3 ADTs, "Medium ADTs" is equal to one if the CCC offered 4-10 ADTs and "High ADTs" is equal to one if the CCC offered 11 or more ADTs in a student's first year.