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Can state policies reduce racial disparities in the time–to–degree? Examining the interconnected role of statewide articulation agreements with dual enrollment

Abstract

As more students, particularly those from racially minoritized backgrounds, struggle to complete the baccalaureate within the conventional four years, it has become increasingly important to consider ways to improve student trajectories through higher education. Although dual enrollment has become a popular option to improve the time-to-degree, this benefit hinges upon credit acceptance by the colleges where participants eventually matriculate. Statewide articulation agreements are a promising solution to facilitate the transfer of credits across institutions, but there is little research investigating the effects of these policies on dual enrollment students. Using data from Georgia, this study used a difference-in-differences approach to estimate effects of the state's 2012 statewide articulation agreement on the rate of on-time degree completion for students who took dual enrollment coursework at two-year colleges. In this investigation, we particularly emphasize differences by race in addition to differential impacts by dual enrollment course type. We find that rates of four-year degree completion rates are positively affected by the policy, but the results vary by race because Black students who participate in dual enrollment are found to complete fewer transferable courses. Across racial groups, however, students who completed more transferable courses for dual enrollment have a higher probability of graduating on time.

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Introduction

In addition to *whether* bachelor's degree attainment occurs, *when* students complete their degree program is equally important. Since the 1970s, "on-time" college attainment rates have fallen as the average time-to-degree extended beyond the traditional four years (Bound et al., 2012). Among bachelor's degree earners in the 2014–2015 school year, the average time-to-degree was 5.7 elapsed years (Shapiro et al., 2016). Although the proportion of full-time undergraduates finishing within six years (150% of the normal time-to-degree) has increased—rising from 55% of students in 1996 to 64% in 2014—completion rates for some groups, particularly Black students, have remained far below 50% nationwide (de Brey et al., 2021). Research estimating the total time-to-degree among baccalaureate earners shows that Black students take eight elapsed years to graduate: more than 20 months longer than their White peers, on average (National Center for Education Statistics, 2021). Taken together, the descriptive evidence suggests that attaining a bachelor's degree is taking far longer for many students than intended, especially those from racially minoritized backgrounds.

More attention has been paid in recent years to the extended timing of bachelor's degree completion and persistent racial disparities, given the potential implications on students' direct and opportunity costs. These concerns are particularly salient for students who have taken out student loans to finance their pursuit of higher education, as enrolling for additional terms may require a larger investment to cover costs. Extending the time-to-degree also delays entry into the labor market, where students can begin paying off the loans. Research also shows that the extent to which student debt is exacerbated by the timing of postsecondary pursuits varies by race (Baum, 2019). Indeed, disparities occur partially because Black students are more likely to experience challenges in transitioning seamlessly through higher education (Boylan, 2020; DesJardins et al., 2002; Eller & DiPrete, 2018; Mabel & Britton, 2018). Thus, the timing of degree completion is an especially important issue for Black students, who are more likely to take on student debt and also more likely to borrow higher amounts (Addo et al., 2016).

Notwithstanding the value of other potential interventions, one way to improve the time-to-degree is by improving early access to college-level coursework for high school students. Although there are multiple accelerated learning programs such as Advanced Placement (AP) and International Baccalaureate (IB), dual enrollment (DE) has emerged as a popular mechanism to accelerate the time-to-degree because it allows for high school students to receive credit at both the secondary and postsecondary levels simultaneously (Karp et al., 2008). While there is variation across contexts in program delivery, dual enrollment is generally structured to provide access to college-level coursework for high school students, which can be offered either on a college campus or at local high schools. It is estimated that dual enrollment programs are now offered in nearly 70% of high schools nationwide, and approximately 33% of high school students have taken some amount of coursework in the program (Spencer & Maldonaldo, 2021). The popularity of the program has been garnered, in part, because of research consistently demonstrating that participants of the program have better postsecondary outcomes relative to nonparticipants (An & Taylor, 2019). Given these results, many believe that expanding access to dual enrollment may help to improve disparities in the timing of degree completion.

Notably, however, the potential postsecondary success associated with dual enrollment may depend considerably on credit acceptance. Taylor and colleagues (2022) observe that

> Whereas DE policies can be well-intended to shorten the number of credits and time needed for a college student to complete their postsecondary credential, the influence of DE participation on postsecondary affordability is built upon the assumption that the DE credits earned are transferable toward their postsecondary degree plan. (p. 62)

Indeed, many colleges and universities will not always accept credits for college-level coursework taken at another institution, leaving many students, particularly those who transfer, in the precarious predicament of losing credits (Spencer, 2022). Students who participate in dual enrollment at two-year colleges and later matriculate to four-year institutions may be especially at risk of losing the credits earned from dual enrollment courses given the differences between the two sectors, which have different curricular standards and course numbering systems. Thus, while dual enrollment may be a promising opportunity to gain early postsecondary credits, program participants may similarly experience credit loss unless they enroll as a first-year student at the same institution where they completed coursework for the program in high school. To address the issue of credit loss, many states have introduced statewide articulation agreements to ensure that students are able to preserve credits when transferring between public institutions. But while there are numerous studies estimating the effects of these policies among students transferring from community colleges (Baker, 2016; Boatman & Soliz, 2018; LaSota & Zumeta, 2016; Roksa & Keith, 2008; Worsham et al., 2021a, 2021b), it is unclear if these policies may facilitate early credit acceptance and, thus, on-time degree completion for dual enrollment participants.

In this research, we address this gap in the literature by analyzing the effectiveness of a statewide articulation agreement in Georgia. Using administrative data for four-year college students in the state, we use multiple techniques, including a quasi-experimental approach that consists of comparing the outcomes of those who participated in dual enrollment at two-year colleges before and after the introduction of an articulation policy. We find that when credits for dual enrollment were accepted, these students have a higher probability of timely bachelor's degree completion. However, our results show that the articulation policy impact is specifically associated with the completion of coursework in which the credits are guaranteed to be accepted across all public institutions.

Understanding the interconnected effectiveness of articulation agreements and dual enrollment is especially important for two reasons. First, while there is a growing body of literature regarding access to dual enrollment and its effects (An & Taylor, 2019), we know far less about the mechanisms driving positive student outcomes, which we hypothesize is related to credit acceptance. Second, because high school students are more likely to participate in dual enrollment at two-year colleges rather than four-year institutions (Fink et al., 2017), knowing whether articulation agreements can address and improve the transferability of dual enrollment course credits will be critical if positive student outcomes are conditional on credit acceptance. Our results provide evidence suggesting that articulation agreements can improve the timing of degree completion for dual enrollment students who do not enroll in colleges where they participated in the program; but we also find that there are important limitations of the policy impact for racially minoritized students.

Theory and literature

Facilitating academic momentum through dual enrollment

This research draws heavily upon the theory of academic momentum, which suggests that undergraduate students who move quickly through their academic programs are more likely to persist to degree completion (Adelman, 2006). Academic momentum can be defined largely according to students' initial course-taking and early progress, which affects degree attainment irrespective of student background and academic preparation (Attewell et al., 2012; Martin et al., 2013). In other words, a key function of academic momentum pertains to the speed of credit hour accumulation. Attewell and colleagues (2012) theorize that several mechanisms may explain the effects of academic momentum on improved postsecondary outcomes: students who take additional courses may have greater opportunities for academic engagement (Tinto, 1993), and they may also experience higher self-efficacy and academic self-concept (Bandura, 1997).

Notably, differences in academic momentum by race are also related to disparate outcomes in subsequent degree completion. Several studies demonstrate that, relative to their White peers, Black students are more likely to delay college entry (Rowan-Kenyon, 2007) and/or enroll with below average course loads (Attewell et al., 2012; Attewell & Monaghan, 2016). Attewell and Monaghan (2016) found that attempting at least 15 credits in the first semester is associated with a higher probability of degree completion; however, the proportion of Black students who attempt at least 15 credits in their first semester is lower than the proportion who start the semester registered for fewer courses. In response to these challenges, various initiatives have been introduced in recent years to enhance academic momentum, such as encouraging college students to enroll in 30 credit hours in their first year (e.g., "15 to Finish" campaigns), and facilitating opportunities for students to enroll in summer coursework (Attewell et al., 2012; Wang et al., 2015).

In addition to credit accumulation in the typical college years, there is growing evidence of postsecondary success for programs that facilitate earning college-level credits in high school. Specifically, Evans (2019) found that the number of credits earned and later accepted for AP coursework in high school is associated with positive postsecondary outcomes. This finding suggests the importance of precollege credit accumulation in facilitating the academic momentum needed for future success in higher education. Although dual enrollment is unique relative to other advanced curricular opportunities, the literature similarly shows that students who participate also benefit relative to nonparticipants because these programs create a pathway for early exposure to higher education, increased academic preparation, and early college credit accumulation (Karp & Hughes, 2008). Notably, many studies have found that dual enrollment participation is positively associated with academic preparedness, college persistence, credit accumulation, and degree completion (An, 2013a; An & Taylor, 2015; Andrews, 2004; Allen & Dadgar, 2012; Cowen & Goldhaber, 2015; Giani et al., 2014; Medvide & Blustein, 2010; Taylor, 2015; Wang et al., 2015), particularly for students from marginalized backgrounds (An, 2013b; Barnett, 2017; Blankenberger et al., 2017). Given these findings, some scholars posit that early academic momentum mediates the effect of dual enrollment on postsecondary outcomes (Wang et al., 2015).

Credit acceptance and the role of articulation policies

Most studies have not parsed the nuanced relationship between credit acceptance as an underlying mechanism for the positive effect of dual enrollment on degree completion. But like AP, in which exam scores and the policies of each individual college determine whether credits are awarded, credit acceptance for dual enrollment is also conditional. Indeed, the credits for college-level coursework are not guaranteed to transfer across institutions with different curricular standards, course numbering systems, and degree requirements (Cohen et al., 2014). Although dual enrollment participants are not formally engaged in transferring between colleges, they may similarly need to ensure that the credits earned at one institution will be accepted at another. Thus, preventing the loss of credits earned for college-level coursework may be especially important for students who complete courses for dual enrollment at an institution other than the one where they eventually matriculate for their postsecondary degree program.

In the literature pertaining to college transfer, credit loss commonly occurs when a student's receiving institution does not accept the credits earned from college-level coursework at their previous institution. According to a report from the National Center for Education Statistics, community college students lose 8.2 credits on average when transferring to four-year public colleges, but nearly one in every five are unable to successfully transfer any credits (Simone, 2014). Additional research shows that Black students are disproportionately more likely to experience the loss of credits relative to White students, thus demonstrating the risk often varies by race (Giani, 2019). The implications for credit loss are considerable, given evidence that the odds of degree completion for students who successfully transferred with most or all their credits were 2.5 times greater than for those who transferred with less than half of their credits (Monaghan & Attewell, 2015). Recent evidence further shows that, in addition to threatening the probability of degree completion, the loss of credits can further exacerbate student loan debt burdens (Spencer, 2022).

To address the issue of credit loss, articulation agreements are intended to ensure that the credits for college-level courses are accepted when a student transfers to a new college or university. While bilateral articulation is common between two institutions, statewide articulation policies are comprehensive arrangements that mandate collaboration among all public institutions within a state to guarantee the acceptance of course credits (Roksa & Keith, 2008). In some studies that evaluate the effectiveness of statewide articulation agreements, scholars have found that students affected by these arrangements are more likely to transfer seamlessly and experience improved post-transfer outcomes (Boatman & Soliz, 2018; Worsham et al., 2021a; Spencer, 2021). Despite some positive findings associated with these policies, some scholars have questioned whether articulation agreements do enough to address racial disparities in college completion (Chase, 2014). Furthermore, aside from one recently published study (Spencer, 2021), much of the research on these policies has focused on vertical transfer pathways from two- to four-year institutions. But no studies, to our knowledge, have expanded research on articulation agreements to address whether they also positively impact dual enrollment participants.

Conceptualization of the study

Our study investigates the following research question: (1) *Does the introduction of a statewide articulation agreement improve the probability of on-time degree completion for four-year college students who previously participated in dual enrollment at two-year colleges, and to what extent does the policy effect vary by race?* To this end, we examine whether there are differences in the effect of dual enrollment according to whether the credits associated with dual enrollment coursework are accepted by the four-year institutions where students later matriculate. In other words, because the credits for coursework taken at a two-year college are not guaranteed to transfer to four-year colleges and universities, we can examine whether the impact of a statewide articulation agreement will increase credit acceptance—and thus, academic momentum—which may, in turn, improve degree completion.

In this effort, our study explores the interconnected relationship between dual enrollment and articulation in Georgia as a case study. Public higher education in Georgia mainly consists of institutions in two systems: four-year colleges and universities in the University System of Georgia (USG) and two-year colleges in the Technical College System of Georgia (TCSG). In 2012, the state's Board of Regents approved a statewide articulation agreement, referred to as the Complete College Georgia Articulation Agreement, which was introduced to help facilitate credit acceptance for students who transfer from TCSG to USG institutions (USG Academic Affairs Division, 2023; USG Board of Regents, 2023). Because of the agreement, many courses taught at TCSG colleges—in the core curriculum, Areas A–F—would become transferable to USG institutions for credit. The core curriculum represents 60 credit hours, of which 42 pertain to general education coursework in foundational academic subjects (A–E) and 18

for prerequisites in a chosen major of study (Area F). Table 1 presents the coursework offered at TCSG institutions deemed eligible for transfer under the 2012 articulation agreement, which includes only general education subjects.

Notably, many of the eligible courses outlined by the articulation agreement are commonly completed by dual enrollment participants. Although students in Georgia may enroll in college-level courses across multiple postsecondary institutions, including some private postsecondary institutions, dual enrollment occurs across institutions in the state's public higher education systems. Much of the growth for dual enrollment has also occurred at the state's 22 technical colleges that offer workforce certificate programs and associate degrees (Griffin & McGuire, 2018; Lee & Owens, 2019). Higher participation rates at TCSG colleges may be due, in part, to less stringent academic requirements for participating in dual enrollment relative to USG institutions.

Since the cross-system agreement guarantees credit acceptance for students who participated in dual enrollment at TCSG schools and later enrolled at USG four-year colleges and universities, these students may have experienced considerable postsecondary benefits following the policy introduction that only dual enrollment participants at USG institutions were previously afforded. If the articulation agreement helps to preserve the transfer of credit hours earned for college-level coursework taken at TCSG institutions, students who later enroll at USG colleges and universities would benefit from academic momentum afforded by early credit accumulation. But because the articulation agreement was introduced in January of 2012, only USG first-year students who enroll after the Fall 2012 semester would be affected if they completed the eligible dual enrollment coursework at TSCG institutions before graduating from high school. Theoretically, the articulation agreement would allow treated students of all backgrounds to bypass some degree requirements and improve the timing of bachelor's degree completion, but we hypothesize that a boost in academic momentum would be especially beneficial for Black students, who are found to have a longer time-to-degree relative to their White peers.

Research design

Data and sample

We make use of administrative data derive from Georgia's Academic and Workforce Analysis and Research Data System (GA•AWARDS), which are provided by the Governor's Office of Student Achievement. The data available for this study concerns students from Georgia enrolled at public secondary and postsecondary institutions in the state from 2007–2020. Student-level information includes demographic characteristics, the schools and colleges attended, the terms of enrollment at each institution, coursework attempted and completed each term, grades, graduation status, and degree attainment. Using these data, we generate a sample to facilitate our investigation of changes across cohorts of students over time. Specifically, we focus on Georgia residents who enrolled for the first time at a USG institution as first-year students between the 2008–2009 and 2015–2016 school years and who also participated in dual enrollment during their years in high school. We broadly define dual enrollment participation as engagement in any postsecondary course-taking while still enrolled in high school. We also restrict our sample to students who were observed to take early college-level coursework at only a TCSG or USG institution, but not both. The full analytic sample includes 25,337 students from the 2008 through 2015 USG first-year student cohorts.

Measures

Because our study is principally interested in on-time degree completion, our dependent variable of interest is a dichotomous indicator of bachelor's degree completion. This measure is coded as 1 if a student graduates within four years from the initial entry point as a first-time student (100% of time) and it is coded as 0 otherwise. The primary independent variables for this study are introduced below in our discussion of the analytic approach, but our study also employs several measures as covariates. Following the literature, we employ several covariates to account for student background and academic achievement factors associated with timely degree completion. Specifically, the covariates include a continuous measure of cumulative high school GPA and dichotomous indicators for gender, race/ethnicity, and income status, which is based on free/reduced-price lunch status in high school.

Methods

Difference-in-differences

The goal of this study is to determine whether the 2012 statewide articulation agreement in Georgia improves rates of on-time bachelor's degree completion, but to estimate whether changes in degree completion can be attributed to the articulation policy, the most challenging task concerns the identification of treated students and the comparison of their outcomes to a suitable counterfactual. Absent randomization, there are numerous observed and unobserved differences between treated and untreated students that preclude a clear understanding of the policy's causal effect (Murnane & Willett, 2011). We employ a difference-in-differences (DID) approach to address this concern for our primary analysis.

Using this quasi-experimental research design, we compare the outcomes of USG first-year students over time before and after the 2012 policy is introduced. Thus, students in the USG first-year student cohorts of 2008 through 2011 are included in the pre-policy group, in order to compare them with those who enrolled in subsequent years. Notably, the DID approach depends on observing the outcomes for two sets of dual enrollment participants: the first includes students who participated in dual enrollment at TCSG institutions in high school, and thus are eligible to be treated by the 2012 articulation policy, and the second includes USG first-year students who participated in dual enrollment in high school at USG institutions. With this approach, our first difference estimates a change in degree completion rates among dual enrollment participants from TCSG schools, which are then adjusted using a second difference of dual enrollment participants from USG colleges. Students who participated dual enrollment programs at USG institutions and then attended college at a USG institution will have the credits they earned in high school accepted automatically because they are within the same system. By accounting for a comparison group of students unaffected by the policy, this strategy will account for "secular trends" that impacted all dual enrollment program participants in the state.

The basic DID specification can be expressed as follows:

$$Y_{ijt} = \beta_0 + \beta_1(TCSG_i \times POLICY_t) + X_{ijt} + \sigma_j + \delta_t + \varepsilon_{ijt} \quad (1)$$

where Y_{ijt} represents the outcome of interest for individual i who enrolled as a first-year student in year t and completed dual enrollment coursework at college j. The random error is represented by ε_{ijt}. Additionally, σ_j represents dual enrollment college fixed effects—controlling for unobserved differences between students according to the institutions where dual enrollment courses were completed—and δ_t represents freshman cohort year fixed effects, which controls for unobserved differences over time (e.g., state-level policies affecting dual enrollment). Also, X_i is a vector of student covariates.

The dichotomous variable, *TCSG,* is coded as 1 if the student participated in dual enrollment at a TCSG college and coded 0 if dual enrollment occurred at a USG college. *POLICY* is a dichotomous variable indicating whether a student matriculated to college as a first-year student in the school years following the introduction of the 2012 articulation policy. Therefore, β_1 is our parameter of interest for the interaction term $(TCSG_i \times POLICY_t)$, which estimates the average difference in degree completion among all students who completed dual enrollment coursework at TCSG colleges and later enrolled at USG colleges after the 2012 articulation policy introduction. Standard errors for all models are clustered at the dual enrollment-college level.

We also replicate the analysis by racial subgroups to answer the second research question. In other words, we examine the effects for Black and White students separately by replicating Equation 1 using conditioned samples of each group. Although dual enrollment participation in Georgia has increased among all racial/ethnic groups in recent years, those from racial backgrounds other than White (54%) and Black (29%) remain a relatively small proportion of dual enrollment participants. For this reason, we do not replicate the analysis for other racial/ethnic groups, given the considerably smaller sample sizes.

Alternative specifications and robustness checks

In addition to the standard DID models, we employ an event study approach to estimate effects for each year by adding leads and lags to equation (1). The key identifying assumption in our DID analysis is that rates of degree completion between USG first-year students who participated in dual enrollment at TCSG colleges and those who participated in dual enrollment at USG colleges are similar preceding the policy and would have remained so if the articulation agreement was not introduced in 2012. The event-study approach facilitates a way to empirically examine the parallel trends assumption. If the estimated treatment effects for years before the 2012 policy are significantly different from zero, we cannot conclude that there is evidence in support of the parallel trends assumption. Moreover, the event study also allows us to understand whether the treatment effects in post-policy years are heterogeneous.

Several issues threaten the validity of our estimates of the policy effect, however. First, the sample includes all TCSG DE participants, so estimates from the main analysis may overstate the policy effects. Because students in Georgia are allowed to take dual enrollment courses in multiple fields of study, including career and technical education programs, not every student in the TCSG DE group was treated by the 2012 policy (see Table 1). We address this limitation by re-estimating Equation 1 using a sample that is further conditioned to include only dual enrollment participants who completed at least one course in a subject treated by the articulation agreement, including courses commonly required for general education requirements (n=16,869). Using this more narrowly defined sample, we can compare the outcomes of students who engaged in similar course-taking and those who were directly treated by the policy.

Second, although our DID analysis facilitates the ability to produce estimates for all TCSG dual enrollment participants, it precludes a direct estimation of the policy effect for those actually treated. For this reason, our DID estimates may be confounded by the inclusion of students who did not complete coursework deemed transferable by the policy in 2012.

To reconcile these limitations, we also employ additional regression models to estimate the relationship between our degree completion outcomes and the number of credit hours earned for dual enrollment coursework treated by the articulation policy.

For this analysis, we further reduce the sample to include only the post-policy TCSG DE students: those who completed dual enrollment coursework at TCSG institutions and enrolled as first-year students at USG institutions following the policy introduction in 2012 (n = 7,019). Using OLS regression, the model can be specified as follows:

$$Y_{ijtg} = \alpha_0 + \alpha_1 TreatedHrs_{ijtg} + \alpha_2 UntreatedHrs_{ijtg} + X_{ijtg} + \sigma_j + \delta_t + \omega_g + \varepsilon_{ijt} \quad (2)$$

where, in addition to the aforementioned variables, ω_g represents cohort year college fixed effects. Adding these fixed effects allows us to constrain estimates to students who participated in dual enrollment and later enrolled at the same USG institution. We also control for $TreatedHrs_{ijtg}$ and $UntreatedHrs_{ijtg}$. Respectively, these capture the number of credit hours earned for dual enrollment coursework that was treated by the 2012 articulation agreement—and would therefore be transferable—in addition to the number of credits associated with dual enrollment coursework that was not treated. Here, α_1 is the parameter of interest and indicates the relationship between credits earned for treated dual enrollment coursework with degree completion, net of other factors. Like our DID analysis, the OLS results are also similarly replicated using conditioned samples by race.

There are some limitations to the regression-based approach. It does not account for all unobserved factors that determine the self-selection of whether a student participates in dual enrollment, where they do so, or what types of coursework they would attempt. For this reason, we are unable to make causal inferences regarding the effect of credit hours associated with specific types of courses. But because the richness of our administrative data allows us to account for variation in dual enrollment engagement across multiple contexts, this modeling strategy nicely complements our DID analysis by facilitating a more nuanced understanding of how the articulation agreement affects degree completion.

Findings

Table 2 presents descriptive statistics of dual enrollment participants who later enrolled at a four-year public institution in Georgia. The first column shows the characteristics for the full analytic sample, and in subsequent columns, we disaggregate characteristics of the sample according to the sector in which dual enrollment courses were taken. The table shows that most students in the sample identify as White, female, and completed a total of four dual enrollment courses in high school, on average. A larger proportion of students in the group who completed coursework at TCSG colleges are Black and come from low-income backgrounds. Because USG colleges and universities have more stringent admissions criteria for DE, students from historically marginalized backgrounds may have been more likely to participate in the program at TCSG institutions, which have fewer requirements for dual enrollment. There are also some course-taking differences between the groups, as only 32% of the TCSG DE students completed some dual enrollment coursework in a general education subject relative to the majority of those in the USG DE group (98%).

We now turn to a descriptive examination of degree completion trends in Figure 1, which facilitates a visual inspection of the assumption pertaining to parallel trends for USG first-year students who participated in dual enrollment at TCSG institutions compared to those who participated in dual enrollment at USG institutions. Henceforth, we will refer to the primary population of interest as the TCSG DE group, and the comparison is referred to as the USG DE group. Figure 1 shows that the rates of timely degree completion for TCSG DE participants are much lower relative to USG DE participants each year. Nonetheless, time trends before the policy introduction in 2012 were relatively similar between the two groups. There is a clear and rather substantial change in the trend for the TCSG DE group after 2012, however, which narrows the gap in degree completion between the two groups. More specifically, the rate of four-year degree completion for TCSG DE participants increased by more than 10 percentage points between the 2011 and 2015 cohorts, with a steady and positive change in each successive year.

The descriptive results nicely foreshadow the results from our DID analysis. Using the specification presented in Equation 1, Table 3 presents estimates from a series of models for the full sample in columns 1 and 2. Each column presents our estimated effects of the articulation policy introduction for the TCSG DE students who later enrolled at USG institutions. All models control for college and cohort year fixed effects. We first show results from a reduced form of the model excluding covariates, followed by the full model estimates. The first column indicates that, on average, the new policy increased four-year bachelor's degree completion rates by 8 percentage points. The magnitude of the effect decreases, however, after accounting for our exogenous covariates, but it is still positive and statistically significant.

We also produce estimates of heterogeneous effects across subgroups by race in the subsequent columns of Table 3. We juxtapose the DID estimates for conditioned samples of White students in columns 3 and 4, with the estimates for only Black students in columns 5 and 6. The subgroup analysis results show that increases in degree completion are largely concentrated among students identifying as White. Net of other factors, degree completion among White students increases by approximately 6 percentage points, on average. Among Black students, the estimate of the policy effect is positive and statistically significant at the 10 percent level of significance in column 5, but this estimate is no longer statistically different from zero after accounting for other demographic characteristics and high school GPA.

In Figures 2 and 3, we show the results from our event study, which extends the DID analysis by examining differences in the treatment effect for each year preceding and following the 2012 policy introduction. By estimating leads and lags of the policy effect, we can empirically test for the presence of confounding trends in the pre-policy years and determine whether the effect varies in the post-policy years. In this effort, we present point estimates for each year with 95% confidence intervals. Figure 2 presents the event study for the full sample and shows that the point estimates are mostly negative and not statistically different from zero at the 5 percent level prior to 2012; therefore, we conclude that the treatment effect estimates are not affected by pre-policy trends. Additionally, the policy is related to a positive and statistically significant increase in four-year degree completion for first-year students first enrolling in 2013 and each subsequent year. Figure 3 presents results by race and shows a similar trend, but only for results pertaining to White students in Panel A. In contrast, column B shows that there is a positive difference in degree completion among Black students in the years following the policy introduction, but these estimates are not significant.

Table 4 presents the results from our DID analysis with the modified analytic sample: including only dual enrollment participants who completed at least one course in a general education subject that was treated by the articulation agreement. The results presented in the table show that the main policy effect for the full sample remains positive and statistically significant, which suggests that the estimates are robust to our sample definition. Net of other factors, the results show that four-year degree completion increased by 6.6 percentage points following the policy introduction. The event study analysis in Figure 4 further nuances the results, demonstrating that only estimates for the 2013 and 2015 cohorts are positive and statistically different from zero. We also provide the results by race in columns 3–6 in Table 4 and for the corresponding event-study results in Figure 5, which are mostly consistent with the results using the full sample and show that statistically significant differences are only found among White students.

We now turn to our analysis pertaining to the completion of specific types of dual enrollment courses. To facilitate this component of our study, we produce estimates of the relationship between credit hours earned for treated and untreated dual enrollment coursework. To do so, we use a restricted sample of students who participated in dual enrollment at TCSG institutions and later enrolled at a USG college after the policy introduction in 2012. For these models, we control for fixed effects of students' first-year college, the institution where dual enrollment courses were completed, cohort year fixed effects, and covariates. Although the regression-based approach controls for several factors associated with degree completion, it does not account for many other confounding factors, which preclude the ability to make causal inferences. Nonetheless, because our DID analysis is unable to directly estimate effects for only students treated by the articulation agreement, it is important to determine whether the observed changes in degree completion can be attributed to the group of students who are hypothesized to benefit.

Before presenting the results from our regression analysis, we begin with a descriptive examination of credit accumulation related to dual enrollment courses for the sample. Given the differences between groups from our DID analysis, we also further examine variation by race here. Figure 6 shows the distributions of earned credits for treated and untreated dual enrollment courses for all students and for the subgroups. Among all students, participants earned 7.9 credit hours in untreated coursework, on average, but only 33% of students earned at least some amount of credits from treated coursework. Among those with some credits earned from treated coursework, the mean number of credits for these courses was 6.7. Earned credits vary between groups, however, as Black students earn more credits in untreated rather than treated coursework compared to White students, on average. Notably, the percentage of students who earned any course credits in treated coursework was lower among Black (22%) students relative to White students (42%).

Table 5 presents the results from our regression analyses, comparing reduced-form estimates without controls or fixed effects, followed by estimates from the full model. The results are similar across models presented in the table. As hypothesized, we do not find that credits for untreated coursework have a relationship with the outcomes that is statistically different from zero. However, the results show

that the number of credits earned for treated dual enrollment coursework has a positive and statistically significant relationship with the probability of degree completion. After controlling for other factors, our full sample estimate suggests that earning 6.7 credits for treated dual enrollment coursework—the mean for students who earned any amount—is associated with a higher probability of attaining a bachelor's degree by approximately 9 percentage points, on average. Notably, we find that this relationship is consistent across racial subgroups. Figure 7 also suggests that treated coursework is especially important for Black students as the associated probability of graduating is slightly higher than for White students who earned a similar number of credit hours for dual enrollment coursework at two-year colleges.

Summary and implications

Although dual enrollment is often touted as a promising pathway to improve timely degree completion, more research is needed to understand the mechanisms that facilitate positive student outcomes and the ways in which these programs can be improved to reduce racial disparities. Our study provides a much-needed exploration into these gaps in the literature by focusing on the importance of the credits accepted for dual enrollment (DE) coursework and the role of articulation agreements in this effort. In our analysis, we exploit the introduction of a statewide articulation agreement in Georgia to examine its effects on dual enrollment participants. By introducing an articulation agreement in 2012, many students who completed college-level coursework for dual enrollment at two-year technical colleges in Georgia could earn credits that would be accepted at USG colleges and universities if the students chose to later enroll at these institutions. As such, these students would benefit from academic momentum attributed to early credit accumulation and have a higher probability of graduating on time. Following the implementation of the 2012 articulation agreement, we found a substantial increase in completion rates among students who participated in dual enrollment at two-year colleges. This finding demonstrates that dual enrollment participation is most likely to have a positive effect on postsecondary outcomes when the credits are accepted by the institution where a student enrolls to pursue a bachelor's degree.

Notably, our findings suggest that articulation agreements between advanced high school curricula and postsecondary institutions can be a meaningful tool for increasing postsecondary outcomes. Although prior studies of articulation agreements have largely focused on vertical transfer among postsecondary students going from a two-year to a four-year institution (Baker, 2016; Boatman & Soliz, 2018; LaSota & Zumeta, 2016; Roksa & Keith, 2008; Worsham et al., 2021a, 2021b), articulation agreements can also build momentum for dual enrollment participants by protecting the credits for college-level coursework earned in high school (Wang et al., 2015). However, our findings also suggest that the benefits associated with the articulation agreement are conditional. Although our difference-in-difference analysis shows that the policy increased rates of degree completion, on average, we found that the policy effect was not statistically significant across all subgroups as the results appear to be driven largely by White students.

While it is possible that the effects of this policy are experienced differently by race, we suggest an alternative explanation. In looking at the trends in course enrollment, we find that, on average, Black students earn more credits in untreated rather than treated coursework compared to other students. Put another way, Black students earn half as many credits in treated coursework relative to White students. It makes sense, for this reason, that rates of degree completion for Black students in post-policy years were not statistically different from rates in pre-policy years. The insignificant subgroup findings are also likely a function of broader educational inequities as they relate to access to meaningful early postsecondary course opportunities (Liu et al., 2020; Pretlow & Wathington, 2014; Struhl & Vargas, 2012; Xu et al., 2021). Nonetheless, it is noteworthy that among both Black and White students, those who completed the treated coursework were more likely to graduate on time.

Given these findings, informing and engaging students, particularly those from marginalized backgrounds, is vital when implementing a policy that requires students to opt in. Students will require guidance in selecting the courses that will be most helpful in meeting their postsecondary goals. Students may also require additional support to engage in dual enrollment programs: traveling to a local postsecondary institution, financial support for tuition costs, and academic support either from their high school or the postsecondary institution. These opportunities must also be widely and easily accessible, so high schools may require increased capacity to offer changes or additional coursework, and supply the needed support. Considering the findings of this study, future quantitative research in the areas of dual enrollment and other early postsecondary opportunities should consider the transfer of credits earned when studying the effects of these courses on postsecondary outcomes. Additionally, future research, especially qualitative research, could be useful in further understanding how students make sense of and navigate their high school coursework opportunities, their awareness of how credits may or may not transfer, and how this coursework impacts their postsecondary ambitions.

As states continue to consider strengthening early postsecondary educational opportunities, it is imperative that policymakers think about how different systems and institutions connect. Taken together, our study demonstrates that dual enrollment participation alone may be insufficient to help students realize postsecondary success and reduce racial disparities in the timing of degree completion. We argue that with effective articulation agreements, dual enrollment may present an opportunity to build academic momentum, but more work is needed to ensure that students from racially minoritized backgrounds can complete coursework for dual enrollment that will ensure their subsequent postsecondary success if they choose to enroll at a four-year college or university.

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Table 1. 2012 Statewide Articulation Agreement coursework

USG Core Curriculum Area	TCSG Course
Area A1: Communication Skills	English Composition I (ENGL 1101) English Composition II (ENGL 1102)
Area A2: Quantitative Skills	Calculus (MATH 1131) College Algebra (MATH 1111) Math Modeling: Intro (MATH 1101) Pre–Calculus (MATH 1113) Quantitative Skills & Reasoning (MATH 1103)
Area C: Humanities, Fine Arts, & Ethics	American Literature (ENGL 2130) Art Appreciation (ARTS 1101) Biology Introduction II (BIOL 1112/BIOL 1112L) Humanities (Intro) (HUMN 1101) Public Speaking (SPCH 1101)
Area D: Natural Sciences, Math, & Technology	Biology Introduction I (BIOL 1111/BIOL 1111L) Calculus (MATH 1131) Chemistry I (Intro) (CHEM 1511/CHEM 1511L) Chemistry II (Intro) (CHEM 1152/CHEM 1152L) Physics I (Intro) (PHYS 1111/PHYS 1111L) Physics II (Intro) (PHYS 1112/PHYS 1112L) Statistics (Intro) (MATH 1127)
Area E: Social Sciences	American Government (POLS 1101) Economics (Macro) (ECON 2105) Economics (Micro) (ECON 2106) Economics (Principles) (ECON 1101) Psychology (Intro) (PSYC 1101) Sociology (Intro) (SOCI 1101) US History I (HIST 2111) US History II (HIST 2112) World History I (HIST 1111) World History II (HIST 1112)

Note. The articulation agreement was effective in January 2012. The TCSG courses eligible for transfer do not meet the criteria for all USG Core Curriculum areas, particularly Area F (Lower-Division Major Requirements). Public Speaking (SPCH 1101) also meets the criteria for Area B (Institutional Options). Derived from: https://www.usg.edu/academic_affairs_handbook/assets/academic_affairs_handbook/docs/TCSGUSGTransfer.pdf

Table 2. Sample characteristics

	Full Sample		TCSG DE		USG DE	
	M	SD	M	SD	M	SD
Student Characteristics						
Female	0.624	(0.484)	0.673	(0.469)	0.581	(0.493)
White	0.642	(0.479)	0.537	(0.499)	0.735	(0.441)
Black	0.241	(0.428)	0.374	(0.484)	0.124	(0.329)
Hispanic	0.044	(0.204)	0.055	(0.227)	0.034	(0.180)
Asian	0.062	(0.241)	0.023	(0.149)	0.096	(0.295)
Multiracial	0.018	(0.134)	0.017	(0.129)	0.019	(0.137)
Other Race/Ethnicity	0.012	(0.111)	0.013	(0.112)	0.012	(0.109)
High School GPA	3.332	(0.656)	3.123	(0.702)	3.517	(0.550)
Low-income status	0.380	(0.485)	0.554	(0.497)	0.226	(0.418)
Dual Enrollment Indicators						
Total Number of DE Courses Taken	4.071	(3.038)	3.902	(2.583)	4.221	(3.383)
Total DE Credit Hours Attempted	11.89	(8.387)	11.64	(7.473)	12.11	(9.114)
Total DE Credit Hours Earned	10.98	(8.023)	10.31	(7.056)	11.57	(8.748)
Completed Courses in Gen. Ed. Subjects	0.666	(0.472)	0.316	(0.465)	0.976	(0.154)
n	25,337		11,896		13,441	

Note. TCSG DE represents USG first-year students from 2008–2015 who participated in dual enrollment at two-year colleges in the Technical College System of Georgia. USG DE represents USG first-year students who participated in dual enrollment at four-year colleges in the University System of Georgia. Gen. Ed.= General Education. Low-income status is based on free or reduced-price lunch status in high school. High School GPA is used to determine Georgia's HOPE scholarship eligibility.

Table 3. Statewide Articulation Agreement effect on degree completion

			By Race Subgroup			
	Full Sample		White		Black	
	(1)	(2)	(3)	(4)	(5)	(6)
TCSG × POLICY	0.080***	0.055***	0.085***	0.058***	0.069~	0.046
	(0.014)	(0.015)	(0.019)	(0.020)	(0.037)	(0.035)
Controls	No	Yes	No	Yes	No	Yes
DE College FE	Yes	Yes	Yes	Yes	Yes	Yes
Cohort Year FE	Yes	Yes	Yes	Yes	Yes	Yes
n	25,337	25,337	16,275	16,275	6,109	6,109

Note. Standard errors are clustered at the DE college level and are presented in parentheses. The covariates for models in columns 1 and 2 include HS GPA, gender, race/ethnicity, and income status, and the covariates for the models in columns 3–6 exclude race/ethnicity. FE= fixed effects. TCSG=Technical College System of Georgia, USG=University System of Georgia. TCSG × POLICY is an indicator for whether the student participated in DE at a TCSG college and enrolled in college after the policy introduction in 2012. The sample includes students enrolled at four-year public college in Georgia who participated in dual enrollment at a TCSG or USG institution in high school.dents enrolled at four-year public college in Georgia who participated in dual enrollment at a TCSG or USG institution in high school.
~p < .10. *p < .05. **p < .01. ***p < .001

Table 4. Statewide Articulation Agreement effect on degree completion, among participants of dual enrollment coursework in general education subjects

	Full Sample		By Race Subgroup			
			White		Black	
	(1)	(2)	(3)	(4)	(5)	(6)
TCSG × POLICY	0.066*	0.063*	0.074*	0.078**	0.072	0.051
	(0.026)	(0.025)	(0.032)	(0.029)	(0.059)	(0.057)
Controls	No	Yes	No	Yes	No	Yes
DE College FE	Yes	Yes	Yes	Yes	Yes	Yes
Cohort Year FE	Yes	Yes	Yes	Yes	Yes	Yes
n	16,869	16,869	12,281	12,281	2,417	2,417

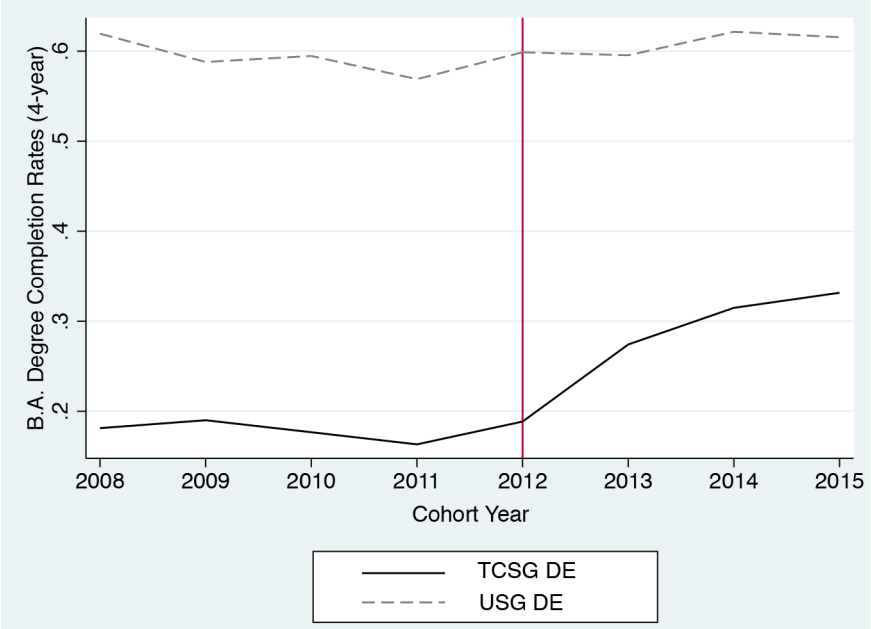
Note. Standard errors are clustered at the DE college level and are presented in parentheses. The covariates for models in columns 1 and 2 include HS GPA, gender, race/ethnicity, and income status, and the covariates for the models in columns 3–6 exclude race/ethnicity. FE= fixed effects. TCSG=Technical College System of Georgia, USG=University System of Georgia. TCSG × POLICY is an indicator for whether the student participated in DE at a TCSG college and enrolled in college after the policy introduction in 2012. The sample includes students enrolled at four-year public colleges in Georgia who participated in dual enrollment at a TCSG or USG institution in high school and completed DE coursework in a general education subject area.
~p < .10. *p < .05. **p < .01. ***p < .001

Table 5. OLS regression estimates of dual enrollment course-taking with degree completion

	All Students	Black	White
Treated Credit Hours	0.013***	0.018***	0.012***
	(0.002)	(0.004)	(0.003)
Untreated Credit Hours	-0.001	-0.001	0.000
	(0.001)	(0.002)	(0.001)
Controls	Yes	Yes	Yes
DE College FE	Yes	Yes	Yes
Freshman Yr. College FE	Yes	Yes	Yes
Cohort Year FE	Yes	Yes	Yes
n	7,019	2,405	3,876

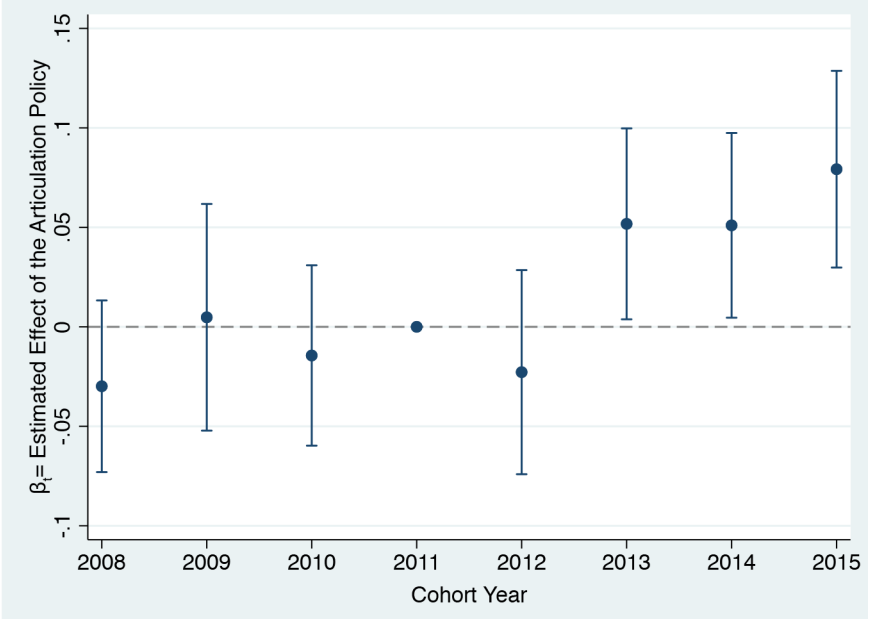
Note. Standard errors are clustered at the DE college level and are presented in parentheses. Covariates include HS GPA and gender; race/ethnicity is added as a control in estimates by income status subgroups; income status is added as a control in estimates by race/ethnicity subgroups. FE= fixed effects. The sample includes students enrolled at four-year public colleges in Georgia in 2012–2015 who participated in dual enrollment at a TCSG institution in high school. Treated Credit Hours= the total number of credit hours earned for general education coursework deemed transferable by the 2012 articulation policy.
~p < .10. *p < .05. **p < .01. ***p < .001

Figure 1. Bachelor's degree completion rates over time, by dual enrollment institutional level



Note. Trends for TCSG DE represent the rates of four-year degree completion among USG first-year students who participated in dual enrollment at two-year colleges in the Technical College System of Georgia. USG DE represents the rates of degree completion among USG first-year students who participated in dual enrollment at four-year colleges in the University System of Georgia.

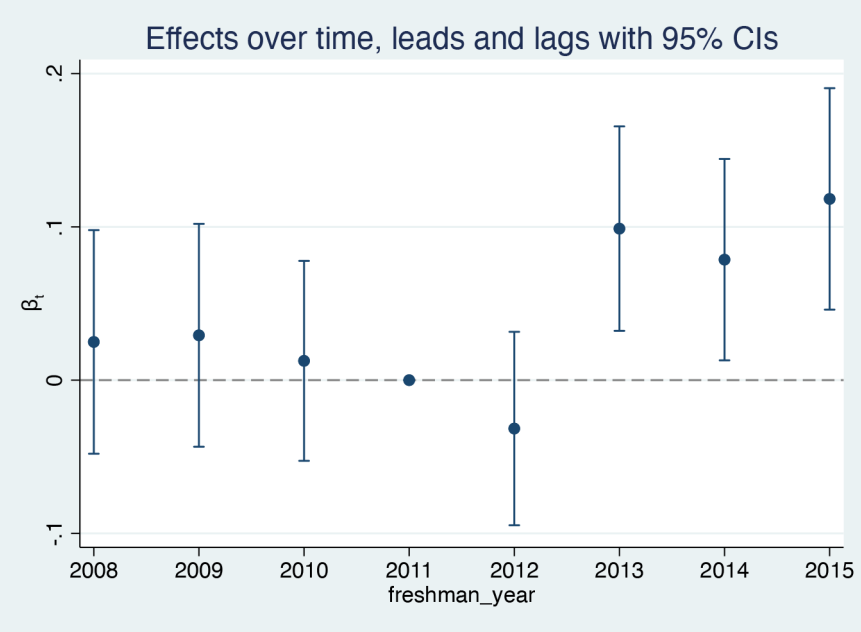
Figure 2. Event-study analysis of the articulation policy effect on degree completion among dual enrollment participants



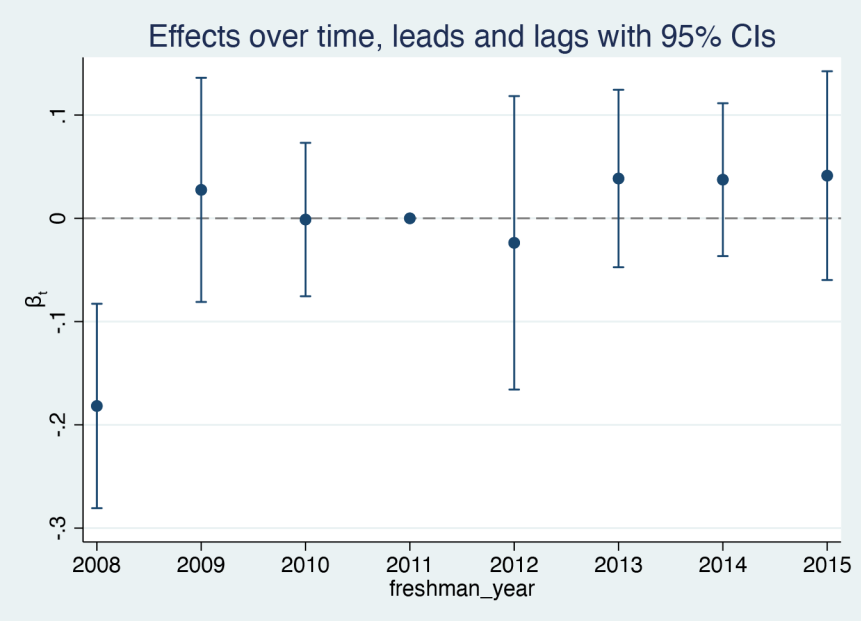
Note. Reported are the leads and lags of the articulation policy effect among TCSG first-year students who participated in dual enrollment and later enrolled at four-year colleges in the University System of Georgia. Point estimates are presented for each cohort year with 95% confidence intervals. Standard errors are clustered at the DE college level. Each model controls for covariates (HS GPA, gender, race/ethnicity, and income status) and DE college fixed effects. The sample includes students enrolled at four-year public colleges in Georgia who participated in dual enrollment at a TCSG or USG institution in high school.

Figure 3. Event-study analysis of the articulation policy effect on degree completion among dual enrollment participants, by race

Panel A. White Students

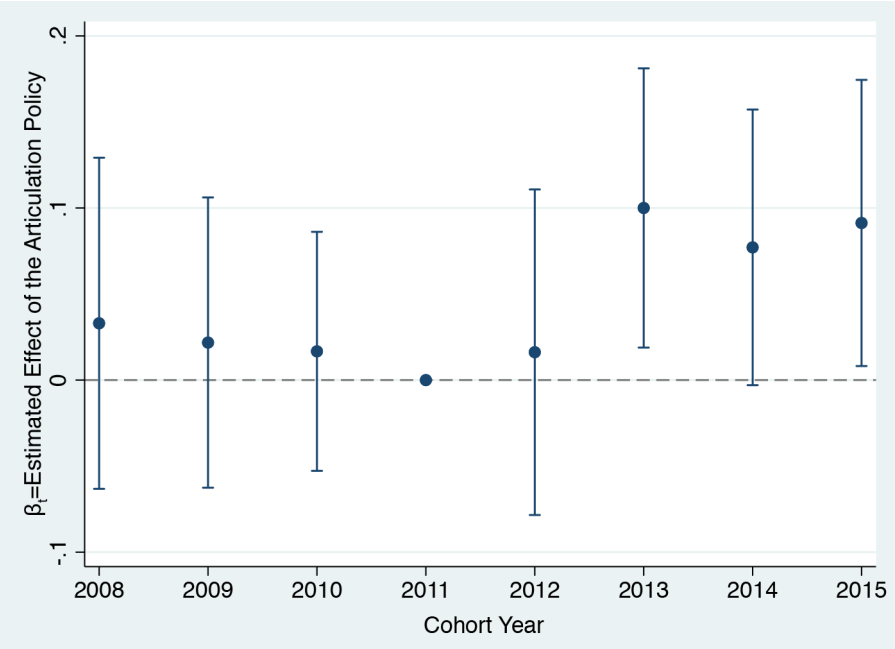


Panel B. Black Students



Note. Reported are the leads and lags of the articulation policy effect among TCSG first-year students who participated in dual enrollment and later enrolled at four-year colleges in the University System of Georgia. Point estimates are presented for each cohort year with 95% confidence intervals. Standard errors are clustered at the DE college level. Each model controls for covariates (HS GPA, gender, and income status) and DE college fixed effects. The sample includes students enrolled at four-year public college in Georgia who participated in dual enrollment at a TCSG or USG institution in high school.

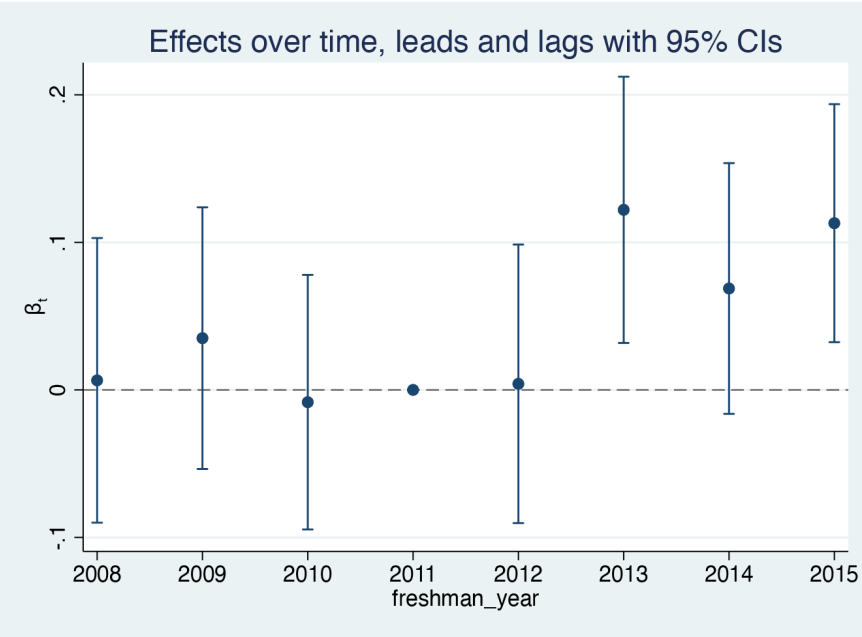
Figure 4. Event-study analysis of the articulation policy effect on degree completion among participants of dual enrollment coursework in general education subjects



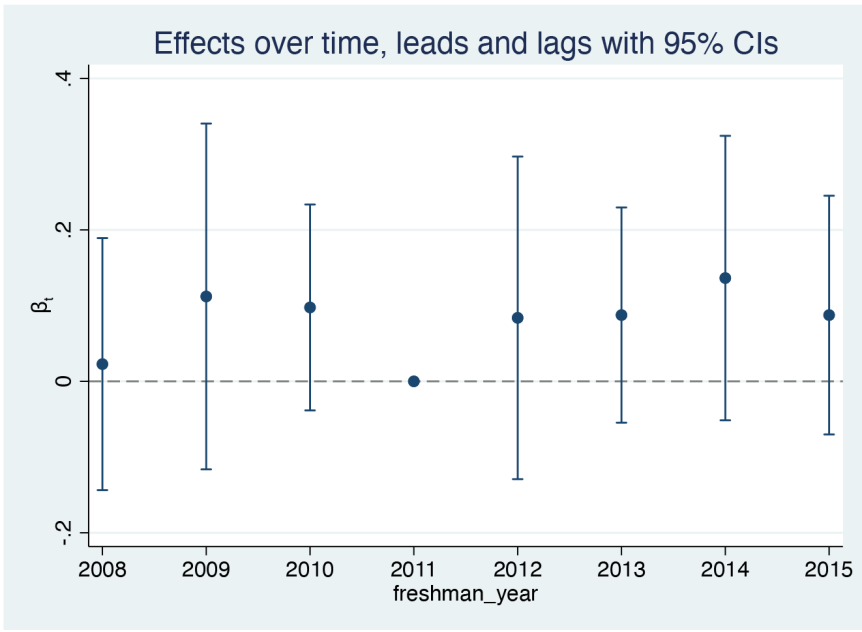
Note. Reported are the leads and lags of the articulation policy effect among TCSG first-year students who participated in dual enrollment and later enrolled at four-year colleges in the University System of Georgia. Point estimates are presented for each cohort year with 95% confidence intervals. Standard errors are clustered at the DE college level. Each model controls for covariates (HS GPA, gender, race/ethnicity, and income status) and DE college fixed effects. The sample includes students enrolled at four-year public colleges in Georgia who participated in dual enrollment at a TCSG or USG institution in high school and completed DE coursework in a general education subject area.

Figure 5. Event-study analysis of the articulation policy effect on degree completion among participants of dual enrollment coursework in general education subjects, by race

Panel A. White Students



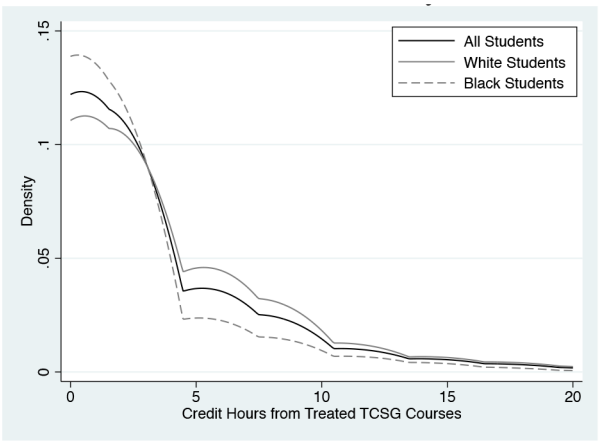
Panel B. Black Students



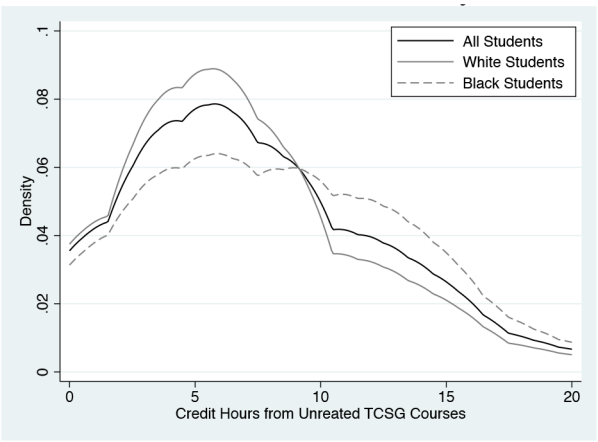
Note. Reported are the leads and lags of the articulation policy effect among TCSG first-year students who participated in dual enrollment and later enrolled at four-year colleges in the University System of Georgia. Point estimates are presented for each cohort year with 95% confidence intervals. Standard errors are clustered at the DE college level. Each model controls for covariates (HS GPA, gender, and income status) and DE college fixed effects. The sample includes students enrolled at four-year public colleges in Georgia who participated in dual enrollment at a TCSG or USG institution in high school.

Figure 6. Kernel density distributions of credit hours earned for dual enrollment courses among participants at two-year institutions (2012–2015 cohorts)

Panel A. Treated Credit Hours, by Race

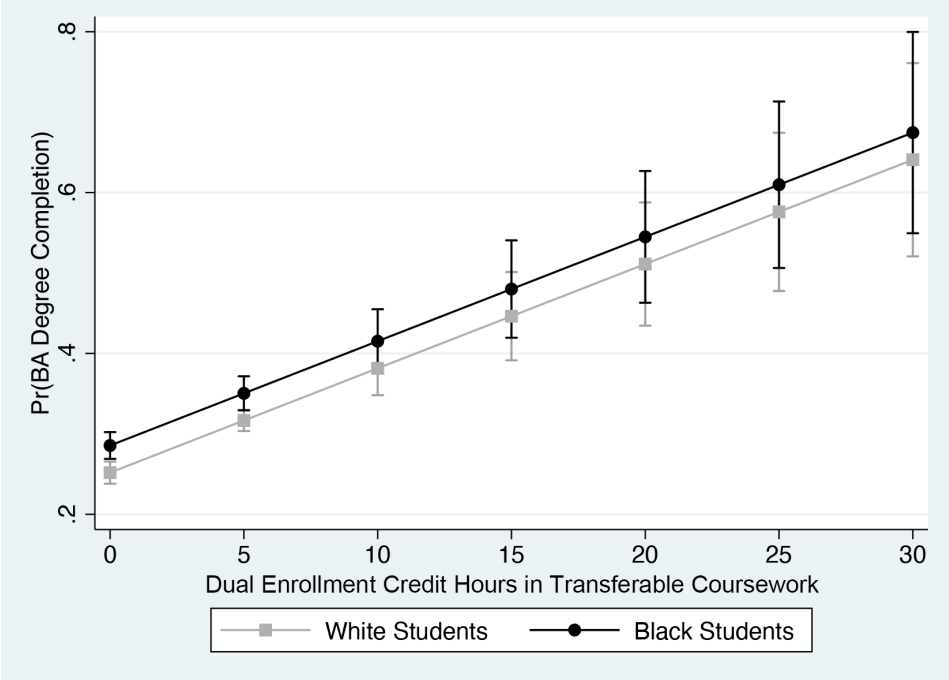


Panel B. Untreated Credit Hours, by Race



Note. The sample includes students enrolled at four-year public colleges in Georgia in 2012–2015 who participated in dual enrollment at a TCSG institution in high school.

Figure 7. Credit hours earned for dual enrollment courses and the predicted probability of bachelor's degree completion among participants at two-year colleges (2012–2015 cohorts), by race



Note. Presented at average marginal effects with 95% confidence intervals derived from regression models of all the reduced sample that includes students enrolled at four-year public college in Georgia in 2012–2015 who participated in dual enrollment at a TCSG institution in high school (n = 7,019). Point estimates are presented by race, for students identifying as White or Black, and capture the relationship between bachelor's degree completion and the number of dual enrollment credit hours earned in transferable coursework treated by the articulation agreement.

About the authors

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