# Boosting Dual Enrollment Participation by Simplifying Access for High School Students

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August 2025

**Abstract**

Despite the promise of dual enrollment to expand college access, racial disparities in participation persist, and limited research examines policies designed to reduce access barriers. Using statewide student-level data from 2013–14 to 2021–22 and difference-in-differences approaches, I estimate the causal impact of College and Career Access Pathways (CCAP) partnerships, which aimed to reduce barriers by offering college courses on high school campuses, during the school day, exclusively for high school students, and tuition-free (structured dual enrollment). CCAPs increased structured dual enrollment participation by 0.8 to 1.8 percentage points—a 42% to 95% increase over pre-policy levels—but did not affect independent dual enrollment (courses students enroll in individually). Effects were consistent across racial groups but not larger for underrepresented students.

*Keywords:* Dual enrollment, Administrative Burden Theory, college and career readiness, educational access and opportunity

## Introduction

Dual enrollment, which enables students to take college courses for credit while in high school, has emerged as an important strategy for expanding college access, particularly for students historically underrepresented in higher education or not traditionally college-bound.[1] Dual enrollment is associated with a host of positive outcomes, including high school graduation, college degree attainment, and labor market outcomes (Allen & Dadgar, 2012; An & Taylor, 2019; Britton et al., 2019; Henneberger et al., 2020; Hughes et al., 2012). Yet, studies consistently show unequal access to dual enrollment opportunities, with persistent disparities by race (Anderson, 2024; Dykeman et al., 2024; Friedmann et al., 2024; Shivji & Wilson, 2019; Xu et al., 2021).

Several states have implemented policies aimed at increasing access and reducing barriers to dual enrollment participation. In California, Assembly Bill 288 (AB 288), enacted in 2016, authorized and promoted the formation of College and Career Access Pathways (CCAP) partnerships between K-12 and community college districts. These partnerships allowed for a form of *structured dual enrollment*, characterized by college courses offered on high school campuses during the regular school day, composed entirely of high school students, with college enrollment fees waived. This stands in contrast to *independent dual enrollment*, where students individually pursue college courses on college campuses in classes with college students.[2] An explicit purpose of AB 288 was to increase dual enrollment access for students from groups underrepresented in higher education and students who might not already be college-bound.

Although dual enrollment participation has increased over time, limited research exists on whether policies like CCAP effectively reshape access and address structural barriers (Hemelt & Swiderski, 2022; Miller et al., 2018). Additionally, no studies, to my knowledge, have explored the causal impact of policies that provide for structured dual enrollment classes composed solely of high school students, outside of Early and Middle College High Schools.

This study addresses these gaps in the literature by investigating the following research questions:

1. Does attending a high school in a district with a College and Career Access Pathways partnership (reducing the barriers to accessing dual enrollment by offering courses on a high school campus exclusively for high school students) increase the likelihood of dual enrollment participation?
2. Does having a CCAP partnership increase dual enrollment participation for underrepresented students in higher education—Black, Latine, Native, and Pacific Islander—thereby meeting one of the key objectives of AB 288?[3]
3. Which types of dual enrollment courses (i.e., career-focused versus academic-focused) and subjects (e.g., Biological sciences, Education, Health) have had the most prominent change during this time period?[4]

To answer the first research question, I leverage the staggered implementation of these CCAP agreements across California and employ a difference-in-differences (DiD) approach with three specifications. First, I apply a *two-way fixed-effects* (TWFE) difference-in-differences model with district and time fixed effects to estimate the overall (pooled) impact of CCAPs. Next, I use an *event study* design with district and year fixed effects, which differs from TWFE in that it provides dynamic estimates of CCAP impacts for each year post-implementation, rather than a single pooled estimate. Finally, to address potential biases of the TWFE and event study estimates that can arise with staggered treatment timing and heterogeneous treatment effects (Callaway & Sant'Anna, 2021; Goodman-Bacon, 2021; Sun & Abraham, 2021), I employ the

Callaway and Sant'Anna (2021) DiD estimator. To answer the second research question, I estimate the models for each racial/ethnic group separately using all three specifications.[5] For the third research question, I compare participation by dual enrollment type (i.e., academic vs. CTE) and field of study before and after the enactment of AB 288. I address each of these questions separately for both structured and independent dual enrollment participation.

This study finds that attending a school with a CCAP partnership increases the likelihood that a student participates in structured dual enrollment by 0.8 to 1.8 percentage points, representing a 42% to 95% increase relative to the pre-AB 288 structured dual enrollment rate of 1.9%. In contrast, independent dual enrollment showed no growth as a result of CCAPs. Students of all races/ethnicities experienced an increase in the likelihood of dual enrollment participation due to CCAPs, yet the policy did not disproportionately benefit underrepresented students, thus maintaining existing participation gaps. This finding is noteworthy given AB 288's explicit emphasis on increasing dual enrollment participation for underrepresented students in higher education. The policy also shaped enrollment patterns across subject areas, with career-focused dual enrollment participation growing more than academic-focused dual enrollment participation. The fields of *Humanities* and *Social Sciences* saw the largest growth in enrollments in both structured and independent dual enrollment. *Health* also saw the third largest total growth in enrollments in structured dual enrollment subjects, whereas *Mathematics* showed the third greatest growth in independent dual enrollment.

This paper makes an essential contribution to the growing body of literature on dual enrollment as well as research on racial and socioeconomic equity in college access. Specifically, this study offers the opportunity to evaluate how formal college district-K-12 district partnerships can expand and reduce barriers to access to dual enrollment—particularly valuable given the well-documented benefits of participation and the need for evidence on scalable approaches to increasing participation.

## Prior Literature

### Benefits of Dual Enrollment Participation

Dual enrollment has consistently shown positive impacts across multiple student outcomes. For example, studies have documented that dual enrollment participation is associated with increased high school graduation rates (Karp et al., 2007; Lee et al., 2022). Additionally, dual enrollment has been shown to increase college enrollment, though findings are mixed regarding effects on two-year versus four-year attendance. Henneberger et al. (2020) found that dual enrollment increased two-year college enrollment by 20 percentage points immediately after high school but had no effect on four-year enrollment in that first year. Conversely, Lee et al. (2022) found that dual enrollment students were more likely to choose four-year institutions over two-year institutions by 5.6 percentage points. These varying findings may reflect differences in program implementation, regional contexts, or student populations studied. Additionally, dual enrollment has been shown to be associated with better academic performance in college (Kirby et al., 2023), greater college persistence (Lee et al., 2022), shorter time to degree completion (Allen & Dadgar, 2012), higher degree attainment rates (An, 2013), and improved labor market outcomes (Henneberger et al., 2020). Particularly noteworthy are findings that dual enrollment can have especially strong positive effects for historically underrepresented students, with Lee et al. (2022) documenting particularly strong graduation rate improvements for Black, Asian, and Latine students, and An (2013) highlighting greater benefits for low-income students in college degree attainment. While these benefits are well-established, less is known about how policy interventions affect dual enrollment participation patterns, particularly for historically underrepresented students.

## Dual Enrollment Course Structure and Educational Outcomes

Importantly for this study, which focuses on a dual enrollment expansion policy for structured dual enrollment, Ryu et al. (2024) examined dual enrollment features that predict greater postsecondary outcomes. They found that courses offered on high school campuses were associated with higher pass rates and course grades compared to those offered on college campuses. Specifically, college-campus courses resulted in a 1.1 percentage point decrease in course grade and a 0.9 percentage point decrease in the likelihood of passing for academic dual enrollment courses. For career and technical education (CTE) courses, location on a college campus led to a 5.5 percentage point decrease in course grade. Additionally, Ryu et al. (2024) found that dual enrollment students had lower course grades and were less likely to pass courses that included both high school and college students, compared to classes composed exclusively of high school students. Beyond location and class composition, course content also matters: Giani et al. (2014) further noted that dual enrollment in core academic subjects was more predictive of positive postsecondary outcomes than dual enrollment in electives, suggesting that both course content and delivery format influence effectiveness.

## Administrative Burden Theory and Dual Enrollment Access

While the benefits of dual enrollment are well-documented, understanding why some students participate while others do not requires examining the barriers to access. *Administrative Burden Theory* can provide a useful framework for analyzing these barriers. This theory identifies three general types of costs that can impede program participation: learning costs (time and effort required to learn about a program), compliance costs (time, effort, and resources required to participate), and psychological costs (stress and stigma associated with navigating bureaucratic systems) (Moynihan et al., 2015). While not specific to dual enrollment, these concepts help explain barriers that disproportionately affect students of color (Ray et al., 2023). Understanding how these administrative burdens manifest in dual enrollment contexts provides insight into why participation gaps persist and how policy interventions might address them.

**Barriers to Equitable Dual Enrollment Participation**

Despite growth in dual enrollment participation nationally, access and participation vary significantly across student subgroups. According to the High School Longitudinal Study of 2009, White and Asian students had higher participation rates (both at 38%) compared to Black (27%) and Latine students (30%) (NCES, 2019). Xu, Solanki, and Fink (2021) found that districts with larger populations of Black and Latine students demonstrated greater inequalities in dual enrollment access, though these racial gaps were smaller than those in Advanced Placement enrollment.

The greatest barrier to dual enrollment participation is whether a school offers any dual enrollment courses at all (Spencer & Maldonado, 2021), and schools with higher proportions of White students are more likely to offer dual enrollment opportunities, as observed in Tennessee's Statewide Dual-Credit program (Hemelt & Swiderski, 2022). Additionally, districts with higher proportions of Black students show larger participation gaps between White students and students of color (Xu et al., 2021). This uneven distribution of dual enrollment opportunities means that students' access to structured dual enrollment depends, in large part, on the racial composition of their school and district, reflecting systemic inequalities in educational opportunities.

Even when dual enrollment is available, institutional requirements for participation may further exacerbate these inequities. Marken et al. (2013) found that nationwide, 60% of programs require a minimum GPA, 45% require passing a college placement test, 43% require a minimum score on a standardized test, and 41% require a letter of recommendation. While these requirements aim to maintain academic rigor, they may inadvertently restrict access for students who would benefit most from college exposure.

Research suggests that disparities may also stem from additional factors beyond program availability and formal requirements. Anderson (2023) finds suggestive evidence that explicit racial bias—as measured by two questions in the Race Implicit Association Test (IAT)—can explain some of the disparities in dual enrollment participation between White and Black students. These multiple, intersecting barriers—from basic program availability to institutional requirements to potential bias—create significant administrative burdens that disproportionately affect students of color.

**Policy Approaches to Reducing Dual Enrollment Barriers**

Research on policies that reduce dual enrollment access barriers in other states provides insights into how California's CCAP partnerships might also impact enrollment patterns. In Texas, House Bill 505 eliminated limits on the number of dual enrollment courses students could take and allowed 9th and 10th graders to participate. Miller et al. (2018) found moderate increases in participation following implementation, with 9th-grade participation rates doubling from 1.0% to 2.1% and 10th-grade rates rising from 2.7% to 4.3%. Tennessee's Statewide Dual Credit program similarly reduced barriers by offering college-level courses in high schools that were free to students and had no GPA requirements. Hemelt and Swiderski (2022) found that this program increased the proportion of students enrolling in dual enrollment courses across all academic achievement levels, with career and technical education courses experiencing the largest growth in enrollments.

Financial barriers also appear to be a factor in participation. Xu et al. (2021) found that dual enrollment participation disparities between White and Black students were lower (by four percentage points) in states that require tuition-free or reduced-tuition dual enrollment. Additionally, when Washington made dual enrollment courses free for students through its College in High School program, participation increased by approximately 10,000 students (Deng, 2024).

## California Policy Context

### Access and Participation in Dual Enrollment in California

As of 2022, 22% of California high school graduates participate in dual enrollment (Dykeman et al., 2024). Participation rates reflect national patterns of inequity: Asian students have the highest participation rate (31%), followed by White (26%), Latine (19%), and Black students (17%) (Dykeman et al., 2024).

Despite the widespread presence of structured dual enrollment programs in California – approximately 70% of schools offer structured opportunities (Kurlaender et al., 2021) – equitable access remains a challenge. Roughly 74% of high school graduates attended schools where only five percent of the student body took dual enrollment courses, and 22% attended schools with no structured dual enrollment offerings at all (Kurlaender et al., 2021). Schools with the highest dual enrollment participation rates tend to have significantly smaller student populations (70 students per cohort) compared to the average school (252 students per cohort) (Mathais, 2022).

Historically, most students in California accessed dual enrollment courses through independent enrollment (75% in the 2020 cohort) rather than structured program enrollment

(Kurlaender et al., 2021; Rodriguez et al., 2023). Kurlaender et al. (2021) reported that 12% of dual enrollment participants from the 2016 high school graduation class took courses composed solely of high school students, and Rodriguez et al. (2023) found that by 2019-20, 24% of dual enrollment participants participated in dual enrollment through CCAP programs. Both independent and structured dual enrollment rates are increasing, with structured/CCAP participation growing at a faster rate (Kurlaender et al., 2021; Rodriguez et al., 2023). Whether this growth can be attributed to AB 288 is a key motivation for the present study.

Research indicates smaller racial participation gaps in structured programs compared to independently sought dual enrollment (Kurlaender et al., 2021). Rodriguez et al. (2023) found that participants in structured dual enrollment more closely resemble the general student population than those in independent programs. While CCAP participants have better academic outcomes in college than non-dual enrollment students, they generally have lower academic outcomes than other dual enrollment students (Rodriguez et al., 2023), likely reflecting differences in self-selection.

**Assembly Bill 288: College and Career Access Pathways Act**

Acknowledging both the benefits of dual enrollment and the fact that it had historically been primarily accessed by higher-achieving students, the California Legislature enacted AB 288 in 2016, authorizing and promoting the formation of College and Career Access Pathways (CCAP) partnerships between community college districts and K-12 school districts. These partnerships aim to develop "seamless pathways from high school to community college for career and technical education or preparation for transfer, improving high school graduation rates, or helping high school pupils achieve college and career readiness" (AB 288: CCAP Partnerships, 2015, Section 2). Importantly, the bill explicitly charged districts to expand dual enrollment opportunities "for students who may not already be college bound or who are underrepresented in higher education" (Education Code section 76004).

CCAP partnership agreements address several logistical and cost barriers to accessing dual enrollment. They allow colleges to offer courses exclusively for high school students on high school campuses during regular school hours and exempt students from paying enrollment fees. These formalized (i.e., structured) dual enrollment programs extend beyond the traditional model where students independently enroll in college courses directly through community colleges.

Given the administrative burdens that create barriers to dual enrollment participation, CCAP partnerships can address several of them by eliminating fees, offering courses on high school campuses during regular school hours, and allowing students to take courses exclusively with their high school peers. This approach reduces learning costs by eliminating the need for students to independently research and navigate the college enrollment process. It also reduces compliance costs by removing fees and the logistical challenges of traveling to college campuses outside of the school day. Misaligned schedules between high schools and community colleges have been found to be a meaningful barrier in accessing dual enrollment, with more than half of dual enrollment survey respondents in California citing this as an obstacle to participating (Engage R+D and the Career Ladders Project, 2023). Additionally, by allowing students to take courses exclusively with their high school peers in familiar settings, CCAP partnerships may reduce psychological costs associated with navigating unfamiliar college environments or feeling out of place among traditional college students.

# Data and Methods

## Data

To address this study's research questions, I use student-level administrative data on the census of California's 11th- and 12th-graders between the 2013–14 and 2021–22 school years. The analytic sample includes students from all California traditional public school districts (i.e., Local Education Agencies [LEAs]) that operate high schools. I exclude charter schools because they function as independent LEAs and have separate CCAP agreements from the districts in which they receive their charters. I focus on 11th- and 12th-grade students because these are the grades in which dual enrollment participation is most common (Friedmann et al., 2024). This approach is consistent with other studies that limit their samples to 11th- and 12th-grade students (Edmunds et al., 2024) or to 12th-grade only (Henneberger et al., 2020). Individual student-level data come from a restricted administrative dataset provided by the California Department of Education (CDE), which includes information on race, gender, socioeconomic status, and school, and the California Community Colleges Chancellor's Office (CCCCO), which contains course subject, course type, and grade received.

Because California lacks a unique statewide student identifier to link K–12 and community college records, I rely on a crosswalk developed in prior work (Dykeman et al., 2024; Boochever et al., 2025). This method matches students across the CDE and CCCCO datasets using a combination of last name, first name, date of birth, high school, and gender. The process incorporates both deterministic and fuzzy matching techniques to account for inconsistencies in how names are recorded. Students who appear in both datasets—meaning they were enrolled in both systems concurrently—are considered dual enrollment students.

To obtain the year of implementation for each district's CCAP agreement, I coded information from all CCAP agreements that I received from CDE or that were publicly available and able to be opened. I supplemented this dataset with publicly available information about each high school, including its locale and enrollment size. As of the 2021–22 school year, 247 of the 502 non-elementary school districts—49%—had a CCAP agreement in place, and 571,553 11th- and 12th-grade students (69%) were enrolled in a school within a district with a CCAP agreement with a CCAP agreement. Table 1 shows the distribution of the year each district first implemented a CCAP agreement and the corresponding student enrollment in those districts. The data begins in the 2015–16 school year, which was the first year such agreements were formally authorized under California state law (AB 288). While some districts may have offered former dual enrollment opportunities before this law, 2015–16 marks the beginning of the formal CCAP policy framework.

**Table 1**

*Initial CCAP Implementation and District Enrollment*

| The year CCAP was signed into effect | Number of First CCAPs signed that year | Enrollment in districts adopting CCAPs | Share of students in districts adopting CCAPs (%) |
|---|---|---|---|
| 2015-16 | 6 | 15,152 | 0.9 |
| 2016-17 | 39 | 319,476 | 19.0 |
| 2017-18 | 31 | 137,689 | 8.2 |
| 2018-19 | 62 | 362,326 | 21.6 |
| 2019-20 | 54 | 191,194 | 11.3 |
| 2020-21 | 41 | 104,744 | 6.2 |
| 2021-22 | 14 | 37,387 | 2.2 |
| Total | 247 | | |

*Note*. Charter school CCAPs are excluded from this table, as I excluded them from this study. The number of first CCAPs signed that year represent "unique" CCAP agreements; these are all the first agreements between a particular community college district and a K-12 school district (i.e., this table does not include renewal agreements). Enrollment in districts adopting CCAPs represents the number of students enrolled in districts during the year their district first adopted a CCAP. Share of students in districts adopting CCAPs represents the proportion of students enrolled in districts that adopted CCAPs that year.

Table 2 presents the sample of schools included in this analysis, comparing those in districts that have ever had a CCAP to those that have not. While difference-in-differences analyses do not require these groups to be demographically similar, understanding their differences may provide insight into the generalizability of CCAP's potential impact if non-CCAP districts were to adopt a CCAP.

**Table 2**

*Comparison of CCAP and Non-CCAP Districts' Demographics in 2014–15*

| | Non-CCAP | CCAP |
|---|---|---|
| Average number of schools per district | 3.3 | 5.5 |
| Average number of students per district | 1,070 | 2,377 |
| Dual enrollment participation (%) | 5.2 | 6.4 |
| Socioeconomically disadvantaged students (%) | 47.3 | 51.5 |
| Black (%) | 6.1 | 5.8 |
| Latine (%) | 46.3 | 53.1 |
| White (%) | 31.3 | 23.7 |
| Asian (%) | 8.7 | 10.2 |
| 11th grade ELA proficiency (%) | 57.2 | 56.3 |
| College-going rate (%) | 56.4 | 64.3 |
| Total number of districts | 233 | 241 |
| Total number of students | 249,221 | 572,937 |

*Note.* Table 2 compares 2014–15 demographic characteristics between districts that implemented a CCAP agreement at any point between 2016 and 2022 and those that never implemented a CCAP. The average number of schools includes any school serving 11th and 12th graders, and the average number of students refers specifically to 11th- and 12th-grade enrollment. Consistent with the sample used in this study, charter schools are excluded from this table. ELA proficiency is defined as scoring Met or Exceeded Standards on the 11th-grade SBAC assessment. The college-going rate measures the proportion of public high school completers who enrolled in postsecondary institutions within 12 months of high school completion.

The proportion of students participating in dual enrollment (both structured and independent) increased steadily from 2013–14 to 2021–22, although independent dual enrollment growth has leveled off in recent years. Structured dual enrollment (blue line) started lower—at 1.5% in 2013–14—but reached 7.2% by 2021–22, while independent dual enrollment (orange line) grew from 3.0% to 6.7% over the same period. Structured dual enrollment saw a dip in participation in 2020–21, when most California public high school students were learning remotely due to the COVID-19 pandemic; interestingly, independent dual enrollment did not experience a similar decline. Overall, structured dual enrollment nearly quintupled during the study period.

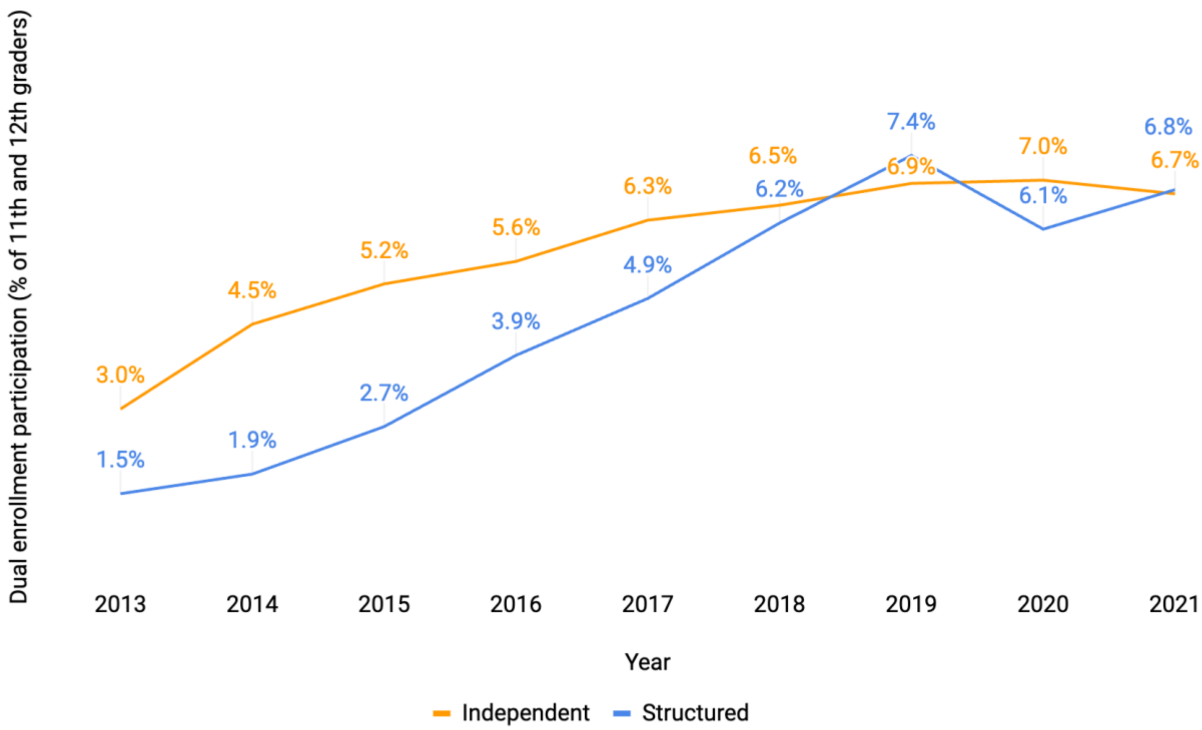
Additional descriptive analyses suggest that CCAP implementation may have contributed to this growth. Prior to a district adopting a CCAP, only 30% of schools had more than 0.5% of students participating in structured dual enrollment. After adoption, that share doubled to 60%. Among schools with any structured dual enrollment participation post-CCAP, an average of 11.4% of students are enrolled in structured dual enrollment.

**Measures**

This study leverages a policy change – AB 288, which allowed K-12 districts and community college districts to enter into CCAP partnerships to offer dual enrollment courses on high school campuses for high school students. I examine the impact of this change to identify the effect of CCAPs on student participation in dual enrollment. While I focus on structured dual enrollment since that type of dual enrollment is the focus of AB 288 and CCAPs, it is also possible that through CCAPs increasing students' exposure to structured dual enrollment, students may have been more inspired to seek out more dual enrollment courses on their own. As a result, I also estimate separate models for independent dual enrollment.

**Figure 1**

*Independent and structured dual enrollment participation, 2013-14 – 2021-22*




*Note.* Figure shows the percentage of 11th- and 12th-grade students participating in dual enrollment over time. The blue line for structured dual enrollment refers to students participating in dual enrollment through formal CCAP agreements between K-12 districts and community college districts. The orange line for independent dual enrollment refers to students enrolled in community college courses outside of formal partnership agreements.

For structured dual enrollment participation, I create a variable where participation equals "1" if the student takes at least one dual enrollment class composed of 95% of high school students that year and "0" otherwise (which I consider an independent dual enrollment course).[7] To examine how dual enrollment changed across course types and subjects, I define course types as either CTE or academic, which I determine by using a CCCCO indicator that identifies if a course was a vocational course. In defining course subjects, I use the two-digit code discipline code that the CCCCO uses to categorize dual enrollment courses.[8] There are 24 disciplines (indicated by the first two digits), which I refer to as dual enrollment “subjects". Although additional discipline code digits identify 270 sub-disciplines, I do not use these in my study (CCCCO, 2023).

## Analytic Approach

My goal is to estimate the causal effect of districts adopting CCAP partnerships on dual enrollment participation—overall and by student race/ethnicity. But potential selection issues exist, where some districts might choose to enter into a CCAP for some confounding reason that also increases dual enrollment participation but is not due to the CCAP agreement itself. Additionally, other concurrent policies and events like the COVID-19 pandemic could affect dual enrollment participation, potentially confounding estimates of CCAP's impact. I attend to these through multiple identification strategies.

### *Difference-in-Differences Two-Way Fixed Effects Model*

The TWFE model for the impact of CCAP partnership on dual enrollment participation, which I estimate separately for structured and independent dual enrollment using ordinary least squares, takes the form:

$$Y_{isdt} = \beta_0 + \beta_1 CCAP_{isdt} + \theta SchoolChar_{sd} + \eta StuChar_{isd} + \delta_d + \gamma_t + \varepsilon_{isdt} \qquad (1)$$

Where $Y_{isdt}$ is a binary variable indicating whether or not student *i* in school *s* in district *d* participated in dual enrollment in year *t* (estimated separately for structured and independent dual enrollment). The treatment variable $CCAP_{isdt}$ indicates whether or not the student was enrolled in a school in a district that had a CCAP agreement in place that year, taking a value of 1 if there was a CCAP agreement in place for that district *d* in year *t* and 0 if not. This means that

$\beta_1$ , the coefficient of interest, captures the increased likelihood of participating in dual enrollment (measured in percentage points), as a result of attending a school in a district with a CCAP agreement. I include fixed effects for year $\gamma_t$and district $\delta_d$ to control for any variations across time or across districts that may affect dual enrollment participation.

In DiD models the underpinning assumption is that there would be parallel trends in dual enrollment participation in the treatment (schools in districts with CCAPs) and control groups (schools in districts without CCAPs). This means that the different baseline values of dual enrollment participation do not matter in this method, and generally speaking, adding covariates is not necessary. However, it is becoming increasingly common to include controls while using this method to mitigate bias from confounding variables that may influence the outcome (dual enrollment participation) or be correlated with treatment assignment. If adding covariates changes the DiD estimate for having a CCAP, this suggests that the controls were correlated with CCAP adoption and that observed characteristics were differentially changing between groups. This, in turn, raises the possibility that unobserved characteristics may also be evolving differently over time, potentially violating the parallel trends assumption. In this case, adding covariates does not substantially change the DiD estimate. Adding controls can also improve the precision of this study's estimates. To avoid including controls that might be affected by the variable of interest (CCAP), and to ensure the covariates are predetermined and fixed, all school-level and district-level controls are from the period before CCAPs came into existence (2014-15).

$SchoolChar_s$ represents the controls for school characteristics (log of school size, average number of Advanced Placement (AP) courses per student, percent of the school that is socioeconomically disadvantaged (SED), percent of the school that is Black, and percent of the school that is Latine). The log of school size controls for differences in dual enrollment opportunities that may vary by school size, while school-level average number of Advanced Placement (AP) courses per student accounts for a potential substitution effect by students enrolling in AP versus dual enrollment college courses. Controls for school composition include the proportion that is socioeconomically disadvantaged, the proportion who are Black, and the proportion who are Latine, given the research on the relationship between school composition and dual enrollment participation (Xu et al., 2021).

$StudentChar_i$ represents the controls for student characteristics: socioeconomic disadvantaged status (SED) and dummy variables for each ethnoracial group, where not-SED and White are the omitted variables. I include these student-level controls given the research on differences in dual enrollment participation by socioeconomic status and ethnoracial group. The estimates of the control coefficients are represented by $\theta$ for school-level controls and $\eta$ for student-level controls. Under the parallel trends assumption, the controls and fixed effects allow $\beta_1$ to be interpreted as the causal effect of CCAP partnerships.

***Event Study Model***

The event study model takes the form:

$$Y_{isdt} = \beta_0 + \sum_{k=-4}^{-2} \mu_k (Lead\ k)_{isdt} + \sum_{j=0}^{4} \rho_j (Lag\ j)_{isdt} + \theta SchoolChar_{sd} + \eta StuChar_{isd} + \delta_d + \gamma_t + \varepsilon_{isdt} \quad (3)$$

where $Y_{idt}$ represents whether student *i* participated in dual enrollment at school *s*, in district *d*, during time *t*. The key variables of interest are the lead and lag indicators, which capture the number of years until or since CCAP implementation. The year before CCAP implementation (*t* - 1) serves as the reference year and is omitted. The lead terms (*k*) include the 4, 3, and 2 years before CCAP implementation and estimate pre-treatment trends. Each $\mu_k$ coefficient represents the difference in dual enrollment participation between that pre-treatment year and the reference year. The lag terms ($j$) include the year of CCAP implementation (year 0) and 1, 2, and 3 years after implementation. Each $\rho_j$ represents the estimated effect of CCAPs in that post-treatment year relative to the reference year. School characteristics ( $SchoolChar_{sd}$), student characteristics ( $StuChar_{isd}$), district fixed effects ($\delta_d$) and time fixed effects ($\gamma_t$) are included as described above.

This model allows us to test the parallel trends assumption by examining whether the gap in dual enrollment participation between districts that adopt a CCAP and those that do not or have not yet adopted is stable in the years prior to CCAP implementation (Clarke & Tapia-Schythe, 2021). Specifically, whether pre-treatment differences between treated and not-yet-treated districts differ significantly from the reference year. Significant lead coefficients would suggest that participation was already trending differently across groups, raising concerns about whether observed increases can be causally attributed to CCAP adoption. The parallel trends assumption appears to hold for independent dual enrollment outcomes; pre-treatment patterns for structured dual enrollment are more nuanced, however, and discussed in the findings section.

***Difference-in-Differences Callaway & Sant'Anna (2021) Estimator***

Recent developments in econometrics offer alternatives to TWFE models, particularly when treatment effects have the potential to be heterogeneous (Callaway & Sant'Anna, 2021; Goodman-Bacon, 2021; Sun & Abraham, 2021). Specifically, the Callaway and Sant'Anna (2021) (CS) estimator, a version of DiD that is robust to biases that can arise with staggered implementation designs when there are heterogeneous treatment effects. This estimator calculates the "group-time average treatment effect" (Callaway & Sant'Anna, 2021) and improves upon traditional DiD estimators by incorporating propensity score weights based on the likelihood of treatment at a given time, conditional on pre-treatment covariates. These weights are applied to both treated groups and comparison groups that are untreated in a given period—whether because they will be treated later or never treated at all. The CS estimator relies on conditional parallel trends assumptions, where the control/comparison groups are selected based on whether they are likely to satisfy the parallel trends assumption. Unlike the TWFE or event study models, which rely on direct control variables, CS uses these variables to generate propensity score weights. For controls, I use the proportion of Black students, the proportion of Latine students, and the proportion of SED students with a weight for district size. CS avoids the issue of negative weighting that can arise in the TWFE model due to the issue of "forbidden comparisons" (i.e., comparing treated districts with previously treated districts rather than only untreated districts).[9]

I implement the CS estimator with the *csdid* package in Stata (Rios-Avila et al., 2021). The estimator's algorithm conducts the analysis at the unit of treatment level (i.e., the district level). This means that instead of modeling the individual likelihood of participating in dual enrollment, the outcome measures the proportion of students within a district who participated in structured or independent dual enrollment as a result of CCAPs.

### ***Heterogeneous Effects of CCAP Partnerships***

To assess whether CCAPs had a greater effect on increasing dual enrollment participation for students underrepresented in higher education, I estimate each model – TWFE, event study, CA – separately for each ethnoracial group. The results are consistent across models, so I use the TWFE model for the subgroup analysis. I include the CS and event study estimates in Appendix B. I then conduct a t-test between the *CCAP* coefficients in each separate model by ethnoracial group in both the structured and independent dual enrollment models to examine if there is statistically significant heterogeneity in the impact of CCAPs across races.

### *Change in Course Types and Subject Offerings*

To analyze the change in course offerings over this period, I calculate the percent change in the number of enrollments in academic- and CTE-dual enrollment courses between the 2014 graduating cohort (pre-AB 288) and the 2022 graduating cohort (post-AB 288). I conduct this analysis separately for structured and independent dual enrollment participation.

I apply a similar approach to examine the shift in subject areas, calculating the percent change in enrollment across each of the 24 subject areas before and after AB 288. I conducted this analysis by structured and independent dual enrollment. By measuring percent change, I capture both the absolute growth in course enrollments, as well as the relative expansion of specific subject areas.

To assess the validity of the identifying assumption, in Appendix A, I examine whether observable student characteristics—specifically race and socioeconomic disadvantage (SED) status—change with the onset of CCAP implementation. I do this by regressing each time-varying characteristic on the CCAP indicator, controlling for year and district fixed effects, and clustering standard errors at the district level. I find no statistically significant changes in student composition following CCAP adoption, which supports the assumption that treated and untreated districts followed similar trends in observables. However, this analysis does not rule out the possibility that unobserved characteristics were also changing in ways that could bias the estimated treatment effect.

## Findings

### Dual Enrollment Participation

Turning to the first research question on the effects of CCAPs on dual enrollment participation, Table 3 presents the regression results for structured dual enrollment (Panel A) and independent dual enrollment (Panel B). Each panel includes four sets of estimates: the TWFE estimates (column 1) can be compared to the pooled CS estimates (column 2), while the event study estimates (column 3) can be compared to the year-by-year CS estimates (column 4). The table only includes the parameters of interest—the impact of CCAP (TWFE and Pooled CS), and the association between lag/lead years and dual enrollment participation (event study and year-by-year CS). The full tables with the covariates are provided in Appendix C.

For structured dual enrollment (Panel A), all four models indicate a positive and statistically significant impact of CCAPs on participation. The TWFE model reveals that having a CCAP leads to a 1.8 percentage point increase in the likelihood of participating in a structured dual enrollment course in 11th and 12th grade. Given that the pre-CCAP level of structured dual enrollment was 1.9%, this represents a roughly 95% increase in participation. To further interpret the magnitude of the estimated 1.8 percentage points, if districts without a CCAP agreement made a CCAP agreement, we might expect to see an increase in structured dual enrollment participation of approximately 8,113 students (0.018 multiplied by the 450,726 11th- and 12th-grade students in districts without a CCAP partnership as of 2022).[10] The CS estimator corroborates the positive and statistically significant TWFE results, with a smaller coefficient of 0.8 percentage points. Since these findings are at the district level, the interpretation is that a district entering a CCAP agreement yields a 0.8 percentage point increase in the proportion of students taking a structured dual enrollment course.

**Table 3**

*Effects of CCAP on Dual Enrollment Participation*

| | | | | |
|---|---|---|---|---|
| Panel A: Structured Dual Enrollment | | | | |
| Lag 0 | | | 0.010***<br>(0.003) | 0.004***<br>(0.001) |
| Lag 1 | | | 0.014***<br>(0.004) | 0.006***<br>(0.002) |

| | | | | |
|---|---|---|---|---|
| Lag 2 | | | 0.023***<br>(0.006) | 0.010***<br>(0.003) |
| Lag 3 | | | 0.025***<br>(0.009) | 0.012***<br>(0.004) |
| Lead 4 | | | -0.003<br>(0.006) | -0.003<br>(0.002) |
| Lead 3 | | | -0.007**<br>(0.004) | -0.004**<br>(0.002) |
| Lead 2 | | | -0.005**<br>(0.003) | -0.002**<br>(0.001) |
| Observations | 7,239,799 | 4,249 | 7,239,799 | 4,249 |

| Panel B: Independent Dual Enrollment | | | | |
|---|---|---|---|---|
| Lag 0 | | | 0.002<br>(0.001) | 0.001<br>(0.001) |
| Lag 1 | | | 0.004*<br>(0.002) | 0.001<br>(0.001) |
| Lag 2 | | | 0.001<br>(0.003) | -0.001<br>(0.002) |
| Lag 3 | | | 0.001<br>(0.006) | -0.000<br>(0.003) |
| Lead 4 | | | 0.002<br>(0.004) | 0.002<br>(0.002) |
| Lead 3 | | | 0.004***<br>(0.002) | 0.002*<br>(0.001) |
| Lead 2 | | | 0.002<br>(0.002) | 0.001<br>(0.001) |
| Observations | 7,239,799 | 4,249 | 7,239,799 | 4,249 |

*Note.* Standard errors in parentheses, clustered at the district level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
TWFE shows estimates from the two-way fixed effects difference-in-differences (DiD) estimator; CS shows estimates from the Callaway and Sant'Anna (2021) estimator; and Event Study shows estimates from an event study specification. The CS estimate for *Has CCAP* reflects the average group-time treatment effect (ATT) across post-treatment periods and is comparable to the *Has CCAP* estimate from the TWFE model. Lag and Lead coefficients from CS can also be interpreted similarly to those in the event study model.

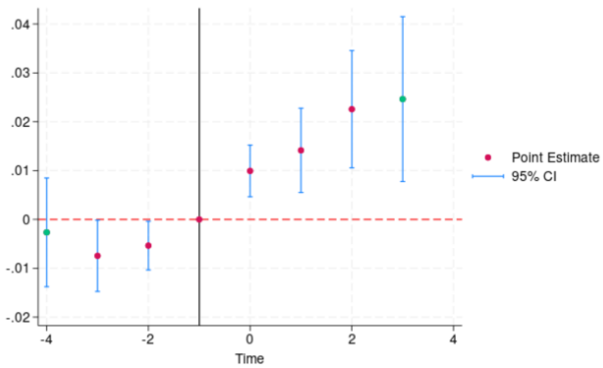
The structured dual enrollment event study model (column 3) shows a 1.0 percentage point increase in the likelihood of structured dual enrollment participation in the year of CCAP implementation, followed by a 1.4 percentage point increase in the following year. The CS estimates, while similar to the event study, yield slightly attenuated effects of 0.4 and 0.6 percentage points, respectively. Figure 2 visualizes the year-by-year impact of CCAP implementation relative to the year before a district adopted a CCAP agreement, comparing estimates from both the event study and the year-by-year CS model. Both graphs in Figure 2 demonstrate a positive impact of CCAP implementation on structured dual enrollment participation, as indicated by the bars consistently falling above zero on the y-axis in post-implementation years (Time 0 onwards). The participation rate increases the longer a district has a CCAP in place. However, the confidence intervals widen over time due to fewer observations in later years, reflecting the limited number of post-CCAP implementation years available for analysis.

In the fourth year before CCAP implementation, the coefficient for structured dual enrollment participation is not statistically significantly more negative than in the reference period. However, it is significantly lower two and three years prior to CCAP introduction in both the event study and year-by-year CS models. This suggests that dual enrollment was already expanding in districts even before CCAP implementation, indicating that other factors may have contributed to the growth in participation. Descriptive evidence from Figure 1 supports this, showing that dual enrollment was already on the rise prior to AB-288 being enacted in 2016, the first year a district could enter into a CCAP agreement. However, when the pre-CCAP implementation effects are averaged, there is no statistically significant relationship between the pre-CCAP implementation time period and structured dual enrollment participation.

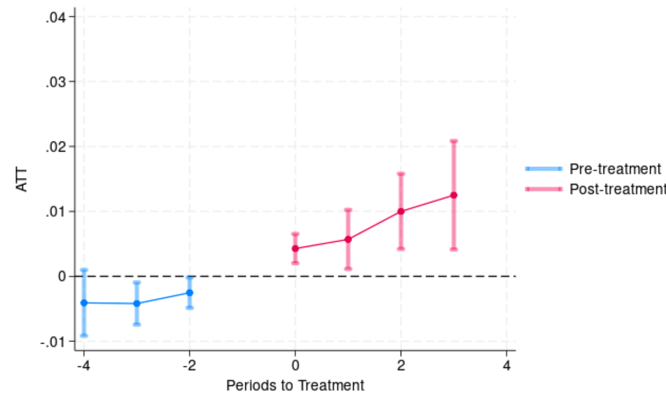
**Figure 2**

*Effect of Dual Enrollment Expansion on Structured Dual Enrollment Participation*

(A) Event Study




(B) Callaway & Sant'Anna (2021)




*Note.* Time 0 is the year the CCAP was implemented. Time -1 is the comparison year.

These mixed findings in the pre-trends highlight the complexity of attributing dual enrollment growth solely to CCAPs. While CCAPs appear to have accelerated structured dual enrollment participation overall, it remains unclear whether this growth would have occurred regardless of CCAPs, or if their implementation uniquely drove the increase. Notably, the negative pre-treatment coefficients suggest that CCAP districts had lower dual enrollment rates relative to comparison districts. Therefore, the positive effects observed post-implementation may be conservative – underestimating the true impact of CCAPs – since treated districts appear to have started from a lower baseline.

This interpretation is particularly relevant given that COVID-19 occurred within three years of most CCAP agreements being signed (62 in 2018-19, 54 in 2019-20, and 41 in 2020-21– comprising 64% of initial CCAPs, as shown in Table 1), which led to a drop in dual enrollment participation statewide (as shown in Figure 1). While the findings suggest that CCAPs may have contributed to notable increases in participation, the lack of a clear counterfactual limits our ability to fully disentangle their effects from broader trends. However, the negative pre-treatment differences suggest that the estimated effects may, if anything, understate the true impact of CCAPs. I discuss this further in the Discussion/Conclusion section.

For independent dual enrollment, I find no evidence that CCAPs increased participation (Table 3, Panel B). Both the TWFE (column 1) and pooled CS (column 2) estimates show no significant effect (0.0, not statistically significant). The event study model does indicate a small, moderately statistically significant effect ($p<0.1$) in the year following CCAP implementation, with a 0.4 percentage point increase in the likelihood of participation. However, this effect does not persist in subsequent years. Notably—and somewhat counterintuitively—three years before CCAP implementation (Lead 3), the likelihood of independent dual enrollment participation is higher than in the reference year. Given that all other estimates are not statistically significant, I interpret this result with caution. These findings are illustrated in Figure 3.

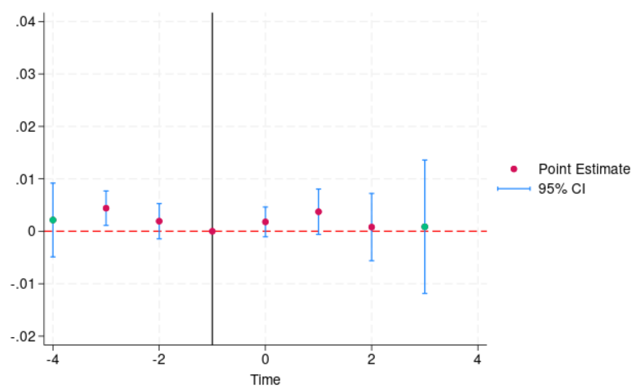
**Participation by Ethnoracial Group**

Turning to research question 2—*Does having a CCAP partnership increase dual enrollment participation for minoritized students in higher education, thereby meeting the intended goal of AB 288?*—I find that easing dual enrollment restrictions— by way of having a CCAP— increases dual enrollment participation across students of all races/ethnicities. CCAPs did not, however, disproportionately increase dual enrollment participation for students underrepresented in higher education.

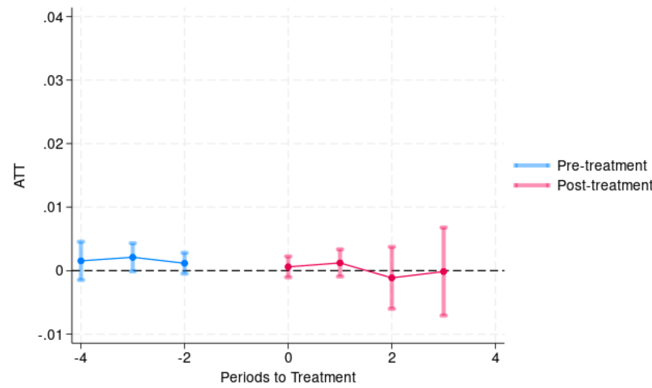
**Figure 3**

*Effect of Dual Enrollment Expansion on Independent Dual Enrollment Participation*

(A) Event Study




(B) Callaway & Sant'Anna (2021)




*Note.* Time 0 is the year the CCAP was implemented. Time -1 is the comparison year.

Table 4 shows the results from estimating the TWFE model (1) separately for each race for the structured (panel A) and independent (panel B) dual enrollment outcome.[11] CCAPs increased the likelihood of structured dual enrollment participation across all races/ethnicities by 0.7 percentage points (Native) to 2.9 percentage points (Pacific Islander). With the exception of Native students, all estimates are statistically significant. And of those races/ethnicities, all students except for Latine students had a greater than 2 percentage point increase in the likelihood of participating in structured dual enrollment as a result of CCAPs. Pacific Islander, Asian American, White, and Filipino students had the greatest increases in likelihood with a 2.9, 2.5, 2.4, and 2.5 percentage point increase in the likelihood of structured dual enrollment participation, respectively, as a result of attending a school with a CCAP. Latine students had a 1.3 percentage point increase in the likelihood of participation. These findings are similar to the estimates from the CS estimator (Appendix B).

Table 5 shows results from a series of t-tests between each ethnoracial group's CCAP coefficient, which tells us if any of the races/ethnicities had a statistically greater increase in the likelihood of structured dual enrollment (panel A) and independent (panel B) participation above other races/ethnicities. Despite the slight range in CCAP estimates by ethnoracial group, with the exception of Native and Pacific Islander students, no ethnoracial group pairs were statistically significantly different from one another. When using the CS estimator (Appendix B), no ethnoracial group pairs – not even Native and Pacific Islander students – were statistically significantly different.

Table 4, panel B presents the analysis for estimating the impact of CCAPs on the independent dual enrollment outcome for each ethnoracial group. As discussed, our findings indicate that CCAPs did not significantly affect independent dual enrollment participation overall. Additionally, the table shows no meaningful variation in the impact of CCAPs across different ethnoracial groups.

**Table 4**

*TWFE of the Effect of CCAP on Structured Dual Enrollment Participation, by Ethnoracial Group*

Panel A: Structured Dual Enrollment

| Independent Variable | Black (1) | Latine (2) | Asian (3) | Filipino (4) | Pacific Islander (5) | White (6) | Native (7) |
|---|---|---|---|---|---|---|---|
| Has CCAP | 0.021***<br>(0.005) | 0.013**<br>(0.006) | 0.025***<br>(0.007) | 0.025*<br>(0.013) | 0.029***<br>(0.007) | 0.024***<br>(0.007) | 0.007<br>(0.007) |
| Observations | 381,288 | 3,810,823 | 732,822 | 228,214 | 37,182 | 1,741,376 | 35,236 |

Panel B: Independent Dual Enrollment

| Independent Variable | Black (1) | Latine (2) | Asian (3) | Filipino (4) | Pacific Islander (5) | White (6) | Native (7) |
|---|---|---|---|---|---|---|---|
| Has CCAP | -0.003<br>(0.004) | -0.003<br>(0.002) | 0.008<br>(0.005) | -0.006<br>(0.006) | -0.003<br>(0.004) | 0.006<br>(0.004) | -0.004<br>(0.006) |
| Observations | 381,288 | 3,810,823 | 732,822 | 228,214 | 37,182 | 1,741,376 | 35,236 |

*Note*. Each column represents a separate regression model in which the outcome is independent dual enrollment participation for the ethnoracial group specified in the column header. Covariates are included but not shown; estimates available upon request. Standard errors in parentheses, clustered at the district level.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

**Table 5**

*Significance Test Between Structured Dual Enrollment CCAP Estimates Across Races/Ethnicities*

Panel A: Structured Dual Enrollment

| | Latine | Asian | Filipino | Pacific Islander | White | Native |
|---|---|---|---|---|---|---|
| Black | 1.02 | -0.46 | -0.29 | -0.93 | -0.35 | 1.63 |
| Latine | | -1.30 | -0.84 | -1.74 | -1.19 | 0.64 |
| Asian | | | 0.00 | -0.40 | 0.10 | 1.82 |
| Filipino | | | | -0.27 | 0.07 | 1.22 |
| Pacific Islander | | | | | 0.51 | 2.22** |
| White | | | | | | 1.72 |

Panel B: Independent Dual Enrollment

| | Latine | Asian | Filipino | Pacific Islander | White | Native |
|---|---|---|---|---|---|---|
| Black | 0.00 | -1.72 | 0.42 | 0.18 | -1.59 | 0.14 |
| Latine | | -2.04** | 0.47 | 0.22 | -2.01** | 0.16 |
| Asian | | | 1.79 | 1.87 | 0.31 | 1.54 |
| Filipino | | | | -0.28 | -1.66 | -0.24 |
| Pacific Islander | | | | | -1.77 | 0.00 |
| White | | | | | | 1.39 |

*Note.* ** $p < 0.05$. The number in each cell represents the t-statistic of the significance between the two races' estimates. At a significance level of 0.05, any absolute value greater than 1.96 would be considered significant.

**Course types**

During the period when CCAPs accelerated structured dual enrollment participation, both academic and CTE dual enrollment grew substantially. However, CTE dual enrollment outpaced academic dual enrollment in growth across both structured and independent dual enrollment. Table 6 shows the total number of enrollments and the percent change in both CTE and academic dual enrollment across structured and independent dual enrollment from 2013–14 (pre-AB 288) to 2021–22 (the most recent year of available post-AB 288 data).

**Table 6**

*Change in Structured and Independent Dual Enrollment by Type, 2013-14 to 2021-22*

| | Structured | | | Independent | | |
|---|---|---|---|---|---|---|
| | 2013-14 | 2021-22 | Percent change | 2013-14 | 2021-22 | Percent change |
| Academic | 11,699 | 69,679 | 496% | 38,174 | 97,612 | 156% |
| CTE | 2,990 | 36,233 | 1,112% | 8,343 | 22,035 | 164% |

*Note.* Table shows the number of dual enrollment course enrollments across structured and independent dual enrollment in 2013–14 and 2021–22 and the percent change between these years. Enrollments are at the course level; individual students may be counted more than once if they enrolled in multiple dual enrollment courses.

The growth in dual enrollment participation varied significantly across subject areas. Tables 7 highlights the change in subject-specific dual enrollment from 2013–14 to 2021–22 for structured and independent dual enrollment, respectively. Table 7, panel A reveals notable expansions in *Humanities*; *Health*; *Engineering & Industrial Technologies*; and *Education* —all of which saw substantial gains in both the number of enrollments and growth rates in structured dual enrollment. Although *Agriculture & Natural Resources* and *Environmental Sciences & Technologies* had smaller total enrollments in 2013–14 (with *Environmental Sciences & Technologies* having none), they showed some of the largest percentage increases, along with *Health*.  In terms of total structured enrollment gains, *Humanities* added the most enrollments, followed by *Social Sciences* and *Health*.

In independent dual enrollment (Table 7, panel B), *Social Sciences*, *Information Technology, Psychology*, *Business and Management*, and *Physical Sciences* all ranked among the top 10 for both total enrollment growth and percent increase. This suggests that these subjects experienced both broad uptake as well as accelerating interest. *Social Sciences* and *Humanities* saw some of the largest gains in total enrollments, with *Mathematics* close behind. Meanwhile, *Environmental Sciences & Technologies*, *Information Technology*, and *Social Sciences* had the

**Table 7**

*Change in Dual Enrollments by Course Subject, 2013-14 to 2021-22*

Panel A: Structured Dual Enrollment

| Subject | 2013-14 | 2021-22 | Enrollment Change | Percent Change |
|---|---|---|---|---|
| Environmental Sciences and Technologies | 0 | 465 | 465 | * |
| Agriculture and Natural Resources | 58 | 3,609 | 3,551 | 6,122% |
| Health | 300 | 6,265 | 5,965 | 1,988% |
| Foreign Language | 211 | 3,481 | 3,270 | 1,550% |
| Humanities (Letters) | 1,122 | 18,182 | 17,060 | 1,520% |
| Biological Sciences | 161 | 2,302 | 2,141 | 1,330% |
| Engineering and Industrial Technologies | 329 | 4,049 | 3,720 | 1,131% |
| Education | 334 | 3,991 | 3,657 | 1,095% |
| Information Technology | 207 | 2,329 | 2,122 | 1,025% |
| Family and Consumer Sciences | 415 | 4,518 | 4,103 | 989% |
| Media and Communications | 230 | 2,441 | 2,211 | 961% |
| Business and Management | 578 | 5,274 | 4,696 | 812% |
| Physical Sciences | 156 | 1,405 | 1,249 | 801% |
| Psychology | 621 | 4,010 | 3,389 | 546% |
| Social Sciences | 2,682 | 17,104 | 14,422 | 538% |
| Public and Protective Services | 747 | 4,052 | 3,305 | 442% |
| Mathematics | 1,322 | 6,998 | 5,676 | 429% |
| Fine and Applied Arts | 1,697 | 6,550 | 4,853 | 286% |
| Architecture and Related Technologies | 90 | 233 | 143 | 159% |
| Interdisciplinary Studies | 3,391 | 8,558 | 5,167 | 152% |

Panel B: Independent Dual Enrollment

| Subject | 2013-14 | 2021-22 | Enrollment Change | Percent Change |
| --- | --- | --- | --- | --- |
| Environmental Sciences and Technologies | 90 | 414 | 324 | 360% |
| Information Technology | 1,045 | 4,698 | 3,653 | 350% |
| Social Sciences | 6,320 | 23,709 | 17,389 | 275% |
| Media and Communications | 771 | 2,857 | 2,086 | 271% |
| Health | 736 | 2,545 | 1,809 | 246% |
| Biological Sciences | 995 | 3,222 | 2,227 | 224% |
| Psychology | 2,458 | 7,510 | 5,052 | 206% |
| Law | 48 | 146 | 98 | 204% |
| Business and Management | 1,600 | 4,527 | 2,927 | 183% |
| Physical Sciences | 1,667 | 4,644 | 2,977 | 179% |
| Architecture and Related Technologies | 53 | 144 | 91 | 172% |
| Humanities (Letters) | 5,994 | 16,182 | 10,188 | 170% |
| Library Science | 118 | 308 | 190 | 161% |
| Mathematics | 5,130 | 12,979 | 7,849 | 153% |
| Foreign Language | 2,730 | 6,210 | 3,480 | 127% |
| Family and Consumer Sciences | 1,352 | 2,816 | 1,464 | 108% |
| Agriculture and Natural Resources | 185 | 379 | 194 | 105% |
| Fine and Applied Arts | 4,954 | 9,930 | 4,976 | 100% |
| Engineering and Industrial Technologies | 1,219 | 2,075 | 856 | 70% |
| Education | 4,595 | 7,709 | 3,114 | 68% |
| Public and Protective Services | 1,463 | 2,229 | 766 | 52% |
| Interdisciplinary Studies | 2,931 | 4,374 | 1,443 | 49% |

*Note.* This does not include any subject with 50 or fewer students participating in 2021-22 highest percentage increases, reflecting patterns seen in structured dual enrollment and pointing to rising student interest and demand in technology-related fields.

## Discussion & Conclusion

California's College and Career Access Pathways (CCAP) partnership highlights how structured policy interventions can meaningfully expand dual enrollment access, as evidenced by statistically significant increases in structured dual enrollment participation. This is one of the first studies (and the first in California) to analyze the causal impact of a statewide policy that allows students to take college courses exclusively with high school peers, finding that CCAPs increased in the likelihood of participating in structured dual enrollment by 0.8 to 1.8 percentage points, depending on the estimation strategy. This represents a 42% to 95% increase in pre-AB 288 structured dual enrollment levels, which translates to an additional 3,606 to 8,113 students who could access important dual enrollment courses. Perhaps unsurprisingly, these results were not reflected in independent dual enrollment, meaning CCAPs did not lead to an increase in students seeking out dual enrollment opportunities on their own.

CCAPs lead to an increase in structured enrollment overall as well as across all ethnoracial groups. In one sense, this achieves the explicit legislative goal of increasing dual enrollment access for students who are underrepresented in higher education. However, CCAP did not disproportionately benefit underrepresented students, and thus highlights that removing structural barriers may be insufficient, albeit necessary, for achieving equity in dual enrollment participation.

The dramatic growth in career and technical education (CTE) dual enrollment—which increased 1,112% compared to 496% for academic courses in structured programs—signals an increase in career-focused educational opportunities. This pattern aligns with Boochever et al.'s (2025) finding that dual enrollment is a key avenue for students accessing CTE. This means that dual enrollment has the potential to serve both college preparation as well as career readiness goals. The substantial growth in *Health*, *Engineering & Industrial Technologies*, and *Education* fields reflects an alignment with high-demand, high-wage sectors in line with California's Golden State Pathways initiative (California Education Code - 53021, 2022).

While the effects of CCAP implementation are statistically significant, they may be smaller than policymakers anticipated. One potential reason for the more modest results is the COVID-19 pandemic, which occurred after the initial CCAP agreements were signed. Notably, 77% (191) of the first CCAPs were implemented before the 2021-22 school year, when schools were shut down, and structured dual enrollment participation dropped, as shown in Figure 1. There were no post-CCAP implementation years for analysis for districts that signed CCAP agreements during the 2021-22 school year. It is likely that we would see greater effects in the absence of COVID-19 and with additional years of data. Interestingly, independent dual enrollment did not decline during the pandemic, suggesting that many students proactively sought learning opportunities on their own.

The smaller-than-expected effects of CCAPs may also stem from a lack of information. Students and families may not be aware that taking a dual enrollment course at their high school is an option, even if their district has an active CCAP. Recent research highlights the importance of information from counselors in shaping educational choices (Cohodes et al., 2023).[12] Additionally, administrative barriers to dual enrollment that CCAPs do not address may still restrict access, particularly for students who have traditionally lacked opportunities to participate in dual enrollment, in line with Administrative Burden Theory.[13] For example, Engage R+D and the Career Ladders Project (2023) found that 20% of dual enrollment survey respondents in California reported not enrolling in dual enrollment courses because their application was lost or they did not enter a Social Security number.[14]

An important consideration is whether the observed increase in structured dual enrollment participation under CCAP generalizes to other efforts to ease access to dual enrollment. Because policies like CCAP vary in their design and implementation, it remains unclear which specific features contributed to increased participation. Future research could investigate which components—such as offering courses on high school campuses, integration into the regular school day, cost-free access, the social environment of taking classes with high school peers, instruction by high school teachers, or a combination of these factors—were most influential. Moreover, while CCAPs increased participation among racially underrepresented students, it remains unclear whether they also increased participation among students who are not traditionally college-bound. Future studies could examine the relative impact of different CCAP features and explore whether these programs broaden participation among students who may not be considered "college-bound", for example, students with low academic performance.

Assessing the full impact of expanding access to structured dual enrollment necessitates examining whether CCAPs led to broader postsecondary and workforce success—including enrollment in two- and four-year colleges, persistence, GPA, degree attainment, employment, and earnings. Understanding these long-term outcomes is essential for determining whether the observed increases in participation translate into the educational and economic benefits that motivate dual enrollment policy. Future research in this area would greatly contribute to the literature.

The growth in enrollment in fields like *Health*, *Engineering & Industrial Technologies*, and *Education* suggests that dual enrollment programs are aligning with high-demand workforce areas. These trends matter in part because they reflect the priorities of California's Golden State Pathways Program, designed to link high school pathways with high-growth, high-wage, or high-skill areas like technology, health care, and education (California Education Code - 53021, 2022). This alignment suggests that dual enrollment can serve multiple policy goals simultaneously: increasing college access while supporting career readiness.

This study also supports existing evidence that reducing administrative burdens and simplifying access to dual enrollment programs is associated with increased participation (Hemelt & Swiderski, 2022; Miller et al., 2018). Recent legislative efforts like AB 30, which streamlined guardian approval and high school recommendation processes, represent steps toward further reducing barriers for student participation. These types of policy interventions may help expand access and promote equity at a time when college enrollment rates are declining.

California's CCAP program represents a meaningful step toward expanding dual enrollment access, with the potential to serve thousands of additional students if adopted more widely. As momentum behind dual enrollment grows, the findings underscore the potential value—and limitations—of continued efforts to ease access, address inequalities, and reduce structural barriers to participation in programs linked to improved postsecondary outcomes.

## Acknowledgements

This research was conducted through partnership agreements between the California Education Lab at the University of California, Davis and the California Department of Education and the California Community Colleges Chancellor's Office (Michal Kurlaender, principal investigator). Research activities were funded by the Institute of Education Sciences, U.S. Department of Education, through Grant R305A210217 to the Regents of the University of California, the College Futures Foundation and the Stuart Foundation. I am grateful to my colleagues Michal Kurlaender, Paco Martorell, Heather Rose, Betsey Friedmann, and Sherrie Reed for their guidance and collaboration, and to Jonathan Isler and Colby Franklin at the California Department of Education, as well as John Hetts, Valerie Lundy-Wagner, and Erik Cooper at the Chancellor's Office, for their expertise and partnership. The findings and conclusions are my own and do not necessarily reflect the views of the funders, including the U.S. Department of Education, or the agencies providing data.

## Endnotes

1. Dual enrollment is sometimes referred to as concurrent enrollment (where a student enrolls in college courses while in high school) to distinguish from dual credit dual enrollment, where a student receives high school credit for their college course. For the purposes of this study, I refer to any college course a student takes while still in high school as a dual enrollment course, whether or not the student receives high school credit for it.
2. This has also been referred to as the "à la carte" model of dual enrollment (Ryu et al., 2024)
3. There is no unified definition of underrepresented minority, but many universities include Black, Latine, and Native (California State University Chico, 2019; Stanford University, n.d.) and some additionally include groups like Pacific Islanders (Stanford University, n.d.). I use "Latine" as a gender-inclusive term for Latina/o students (Méndez, 2023). Individuals also self-identify as – and studies also use – "Hispanic", "Latina/o", or "Latinx".
4. Career-focused dual enrollment (also known as career and technical education-focused dual enrollment ) are dual enrollment courses that are directly aligned to career industries (e.g., information technology, nursing, etc), whereas academic-dual enrollment courses are courses that are intended as college-preparatory courses. While this is a slight misnomer – career-focused dual enrollment is also academic and often requires college, this distinction exists in the data and in other studies (e.g., Hemelt & Swiderski, 2022; Ryu et al., 2024).

5. Since all estimators yield a similar pattern of results, I present the subgroup findings using the TWFE estimator for ease of interpretation, as it provides a single average treatment effect that is more straightforward to communicate. Subgroup results from the event study and Callaway and Sant'Anna (CS) models are available in Appendix B.
6. Of the universe of 552 CCAPs I received from CDE or were publicly available and able to open, 84 were for charter schools and 221 were CCAP renewals.
7. Kurlaender et al. (2021) take a similar approach when measuring HS-Only (structured) dual enrollment, except they use 100% as their benchmark for the proportion of high school students enrolled in community college dual enrollment courses at their schools. I use 95%, rather than 100%, as the proportion of dually enrolled students who are high school students to allow for misidentification of a high school student.
8. The Taxonomy of Programs (TOP) codes are California-specific codes, similar to the national Integrated Postsecondary Education Data System's Classification of Instructional Programs (CIP) code.
9. "Forbidden comparisons" is a term coined by Borusyak et al. (2024) in an earlier working paper version of their paper.
10. This is a rough calculation and does not take into account that the baseline characteristics of CCAP and never-CCAP schools differ, as shown in Table 2.
11. As with Table 3, Table 4 only displays the results for the variable of interest. Full tables with covariates available upon request.
12. This research shows the significant impact of information interventions, specifically counselor-delivered education interventions in students choosing high schools in New York City.

13. AB 30 attempted to address these barriers by reducing the application burden for CCAP dual enrollment by only requiring the student to document guardian approval and a high school recommendation once for all the years they participate in CCAP dual enrollment.
14. The reluctance to provide a Social Security number may reflect concerns related to documentation status.

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# Appendix A

*Identifying Assumption Test*

**Table A1**

*Regression of Ethnoracial Group and SED on Policy Variable*

| | Black | Native | Asian | Filipino | Pacific Islander | White | Latine | Multiracial | SED |
|---|---|---|---|---|---|---|---|---|---|
| Has CCAP | 0.001 | 0.000 | -0.002 | -0.001 | 0.000 | 0.004 | -0.003 | 0.000 | 0.000 |
| | (0.001) | (0.000) | (0.002) | (0.001) | (0.000) | (0.003) | (0.003) | (0.001) | (0.005) |
| Constant | 0.052*** | 0.005*** | 0.102*** | 0.032*** | 0.005*** | 0.239*** | 0.527*** | 0.030*** | 0.487*** |
| | (0.000) | (0.000) | (0.001) | (0.000) | (0.000) | (0.001) | (0.001) | (0.000) | (0.002) |
| Observations | 7,244,496 | 7,244,496 | 7,244,496 | 7,244,496 | 7,244,496 | 7,244,496 | 7,244,496 | 7,244,496 | 7,244,496 |
| $R^2$ | 0.055 | 0.046 | 0.171 | 0.038 | 0.005 | 0.201 | 0.223 | 0.019 | 0.188 |

*Note*. This table presents results from regressions of student demographic characteristics on the CCAP indicator to test for changes in observable characteristics following CCAP implementation. Each column represents a separate regression with the specified demographic variable as the dependent variable. All regressions include year and district fixed effects. Standard errors are clustered at the district level and shown in parentheses. * p < 0.10, ** p < 0.05, *** p < 0.01

## Appendix B

*Effects of CCAP on Structured Dual Enrollment Participation by Ethnoracial Group Using Event Study and Callaway & Sant'Anna Estimators*

### Table B1

*Effects of CCAP on Structured Dual Enrollment Participation by Ethnoracial Group using Event Study*

| | Black<br>(1) | Latine<br>(2) | Asian<br>(3) | Filipino<br>(4) | Pacific Islander<br>(5) | White<br>(6) | Native<br>(7) |
|---|---|---|---|---|---|---|---|
| lag0 | 0.012***<br>(0.003) | 0.008**<br>(0.003) | 0.019***<br>(0.004) | 0.014**<br>(0.006) | 0.011<br>(0.008) | 0.011***<br>(0.004) | 0.00<br>(0.009) |
| lag1 | 0.018**<br>(0.007) | 0.010*<br>(0.005) | 0.029***<br>(0.006) | 0.023**<br>(0.011) | 0.032***<br>(0.009) | 0.020***<br>(0.006) | 0.003<br>(0.009) |
| lag2 | 0.020***<br>(0.007) | 0.011<br>(0.007) | 0.041***<br>(0.009) | 0.030*<br>(0.016) | 0.038**<br>(0.016) | 0.031***<br>(0.008) | 0.014<br>(0.012) |
| lag3 | 0.011<br>(0.009 | 0.006<br>(0.012) | 0.050***<br>(0.009) | 0.028<br>(0.022) | 0.039**<br>(0.017) | 0.040***<br>(0.011) | 0.006<br>(0.015) |
| Observations | 381,301 | 3,813,910 | 732,825 | 228,215 | 37,197 | 1,741,381 | 35,255 |

*Note.* This table presents results from separate regressions by ethnoracial group examining the effects of CCAP on structured dual enrollment participation using an event study methodology. Each column represents results for the specified ethnoracial group. Standard errors are clustered at the district level and shown in parentheses. All regressions include year and district fixed effects and the full set of covariates shown in Table C1. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

**Table B2**

*Effects of CCAP on Structured Dual Enrollment Participation by Ethnoracial Group using Callaway & Sant'Anna Estimator*

| | Black<br>(1) | Latine<br>(2) | Asian<br>(3) | Filipino<br>(4) | Pacific Islander<br>(5) | White<br>(6) | Native<br>(7) |
|---|---|---|---|---|---|---|---|
| Has CCAP | 0.020***<br>(0.005) | 0.017***<br>(0.005) | 0.016***<br>(0.007) | 0.018*<br>(0.010) | 0.011<br>(0.012) | 0.015***<br>(0.005) | 0.007<br>(0.011) |
| Observations | 4,249 | 4,249 | 4,249 | 4,249 | 4,249 | 4,249 | 4,249 |

*Note.* This table presents results from separate regressions by ethnoracial group examining the effects of CCAP on structured dual enrollment participation using Callaway & Sant'Anna estimator methodology. Each column represents results for the specified ethnoracial group. Standard errors are clustered at the district level and shown in parentheses.
* p < 0.10, ** p < 0.05, *** p < 0.01

**Table B3**

*Effects of CCAP on Independent Dual Enrollment Participation by Ethnoracial Group using Event Study*

| | Black<br>(1) | Latine<br>(2) | Asian<br>(3) | Filipino<br>(4) | Pacific Islander<br>(5) | White<br>(6) | Native<br>(7) |
|---|---|---|---|---|---|---|---|
| lag0 | 0.001<br>(0.003) | 0.001<br>(0.001) | 0.006**<br>(0.003) | 0.002<br>(0.004) | -0.007<br>(0.005) | 0.002<br>(0.003) | -0.005<br>(0.007) |
| lag1 | 0.002<br>(0.005) | 0.001<br>(0.002) | 0.009**<br>(0.005) | 0.004<br>(0.008) | 0.003<br>(0.007) | 0.008**<br>(0.004) | 0.006<br>(0.008) |
| lag2 | -0.006<br>(0.005) | -0.004<br>(0.003) | 0.014**<br>(0.006) | -0.003<br>(0.006) | -0.006<br>(0.007) | 0.009**<br>(0.004) | 0.002<br>(0.010) |
| lag3 | -0.010*<br>(0.005) | -0.007<br>(0.006) | 0.023**<br>(0.009) | -0.004<br>(0.007) | -0.004<br>(0.009) | 0.014**<br>(0.007) | -0.003<br>(0.012) |
| Observations | 381,301 | 3,813,910 | 732,825 | 228,215 | 37,197 | 1,741,381 | 35,255 |

*Note.* This table presents results from separate regressions by ethnoracial group examining the effects of CCAP on independent dual enrollment participation using event study estimator methodology. Each column represents results for the specified ethnoracial group. Standard errors are clustered at the district level and shown in parentheses. All regressions include year and district fixed effects and the full set of covariates shown in Table C1. * p < 0.10, ** p < 0.05, *** p < 0.01

**Table B4**

*Effects of CCAP on Independent Dual Enrollment Participation by Ethnoracial Group using Callaway & Sant'Anna Estimator*

| | Black (1) | Latine (2) | Asian (3) | Filipino (4) | Pacific Islander (5) | White (6) | Native (7) |
|---|---|---|---|---|---|---|---|
| Has CCAP | 0.020*** | 0.017*** | 0.016*** | 0.018* | 0.011 | 0.015*** | 0.007 |
| | (0.005) | (0.005) | (0.007) | (0.010) | (0.012) | (0.005) | (0.011) |
| Observations | 4,249 | 4,249 | 4,249 | 4,249 | 4,249 | 4,249 | 4,249 |

*Note:* This table presents results from separate regressions by ethnoracial group examining the effects of CCAP on independent dual enrollment participation using the Callaway & Sant'Anna estimator methodology. Each column represents results for the specified ethnoracial group. Standard errors are clustered at the district level and shown in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

# Appendix C

**Table C1**

*Effects of CCAP on Dual Enrollment Participation (All Covariates Included)*

Panel A: Structured Dual Enrollment

| | | | | |
|---|---|---|---|---|
| Lag 0 | | | 0.010*** | 0.004*** |
| | | | (0.003) | (0.001) |
| Lag 1 | | | 0.014*** | 0.006*** |
| | | | (0.004) | (0.002) |
| Lag 2 | | | 0.023*** | 0.010*** |
| | | | (0.006) | (0.003) |
| Lag 3 | | | 0.025*** | 0.012*** |
| | | | (0.009) | (0.004) |
| Lead 4 | | | -0.003 | -0.004 |
| | | | (0.006) | (0.003) |
| Lead 3 | | | -0.007** | -0.004** |
| | | | (0.004) | (0.002) |
| Lead 2 | | | -0.005** | -0.002** |
| | | | (0.003) | (0.001) |
| School size (log) | 0.012*** | | 0.012*** | |
| | (0.002) | | (0.002) | |
| Avg. # of APs | 0.000*** | | 0.000*** | |
| | (0.000) | | (0.000) | |
| % SED | 0.001 | | 0.000 | |
| | (0.014) | | (0.014) | |
| %Latine | -0.007 | | -0.007 | |
| | (0.018) | | (0.018) | |
| %Black | -0.099*** | | -0.099*** | |
| | (0.029) | | (0.029) | |
| Student SED | -0.004*** | | -0.004*** | |
| | (0.001) | | (0.001) | |
| Black | -0.005*** | | -0.005*** | |
| | (0.002) | | (0.002) | |
| Latine | -0.002 | | -0.002 | |
| | (0.002) | | (0.002) | |
| Filipino | 0.007*** | | 0.007*** | |
| | (0.002) | | (0.002) | |
| Pacific Islander | -0.004** | | -0.004** | |
| | (0.002) | | (0.002) | |
| Multiracial | -0.002 | | -0.002 | |
| | (0.001) | | (0.001) | |
| Native | -0.008*** | | -0.008*** | |
| | (0.002) | | (0.002) | |
| Asian | 0.008*** | | 0.008*** | |
| | (0.002) | | (0.002) | |
| Constant | -0.022 | | -0.021 | |
| | (0.014) | | (0.023) | |
| Observations | 7,239,799 | 4,249 | 7,239,799 | 4,249 |

Panel B: Independent Dual Enrollment

| | | | | |
|---|---|---|---|---|
| Lag 0 | | | 0.002 | 0.000 |
| | | | (0.001) | (0.000) |
| Lag 1 | | | 0.004* | 0.001 |
| | | | (0.002) | (0.001) |
| Lag 2 | | | 0.001 | -0.001 |
| | | | (0.003) | (0.002) |
| Lag 3 | | | 0.001 | -0.000 |
| | | | (0.006) | (0.003) |
| Lead 4 | | | 0.002 | 0.002 |
| | | | (0.004) | (0.002) |
| Lead 3 | | | 0.004*** | 0.002* |
| | | | (0.002) | (0.001) |
| Lead 2 | | | 0.002 | 0.001 |
| | | | (0.002) | (0.001) |
| School size (log) | 0.007*** | | 0.007*** | |
| | (0.003) | | (0.003) | |
| Avg. # of APs | -0.001*** | | -0.001*** | |
| | (0.000) | | (0.000) | |
| % SED | -0.038 | | -0.038 | |
| | (0.030) | | (0.030) | |
| %Latine | -0.076* | | -0.076* | |
| | (0.046) | | (0.046) | |
| %Black | -0.102*** | | -0.102*** | |
| | (0.028) | | (0.029) | |
| Student SED | -0.013*** | | -0.013*** | |
| | (0.001) | | (0.001) | |
| Black | -0.010*** | | -0.010*** | |
| | (0.002) | | (0.002 | |
| Latine | -0.013*** | | -0.013*** | |
| | (0.002) | | (0.002) | |
| Filipino | -0.004 | | -0.004 | |
| | (0.003) | | (0.003) | |
| Pacific Islander | -0.009*** | | -0.009*** | |
| | (0.003) | | (0.003) | |
| Multiracial | 0.00 | | 0.000 | |
| | (0.002) | | (0.002) | |
| Native | -0.013*** | | -0.013*** | |
| | (0.003) | | (0.003) | |
| Asian | 0.045*** | | 0.045*** | |
| | (0.005) | | (0.005) | |
| Constant | 0.110*** | | 0.097*** | |
| | (0.015) | | (0.018) | |
| Observations | 7,239,799 | 4,249 | 7,239,799 | 4,249 |

*Note*. This table displays the full regression results, including all covariates used in the model specification for both structured dual enrollment (Panel A) and independent dual enrollment (Panel B). TWFE and event study models include district and year fixed effects (not shown). Standard errors are clustered at the district level and shown in parentheses.

* p < 0.10, ** p < 0.05, *** p < 0.01