

# An NCPR Working Paper

## Determinants of Students' Success

### The Role of Advanced Placement and Dual Enrollment Programs

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## **Abstract**

Advanced Placement (AP) and Dual Enrollment (DE) are two programs that allow high school students to earn college credits. The recent growth of these programs has been unprecedented. However, there is little evidence that compares how they fare in terms of improving college access and success. Using data from two cohorts of all high school students in Florida and controlling for schools' and students' characteristics (including prior achievement), this study examines the relative power of AP and DE in predicting students' college access and success. The study finds that both AP and DE are strongly associated with positive outcomes, but the enrollment outcomes are not the same for both programs. DE students are more likely than AP students to go to college after high school, but they are less likely to first enroll in a four-year college. Despite this difference in initial enrollment, the difference between DE and AP in terms of bachelor's degree attainment is much smaller and not statistically significant for some model specifications. In addition, the effect of DE is driven by courses taken at the local community college campus; there is no effect for DE courses taken at the high school.



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# 1. Introduction

*[Advanced Placement is] the best for kids. ... How long are you going to wait to do the right thing? I can't wait. Every time we have another graduating class, and we haven't given them the courses they need to be prepared for [college], we haven't done what we needed to do. ... This isn't a guinea pig deal. ... This is a way to really open up the pathways for all students to be successful.*

Florida's Hillsborough superintendent, MaryEllen Elia, after signing a \$3.6-million-a-year three-year partnership with the College Board (The EXCEerator program) to expand Advanced Placement (Matus, 2009)

Advanced Placement (AP) and Dual Enrollment (DE) are two programs that allow high school students to take college-level courses and earn college credits. The recent growth of these programs has been unprecedented. While there are no national data on the number of students taking AP courses, the number of AP exam-takers increased from 537,428 in 1995 to over 1.3 million in 2005 (College Board, 2008). Over the same period, part-time enrollment of under-the-age-of-18 students at public two-year colleges — presumably mostly comprised of DE students — more than doubled, while overall high school enrollment growth was only about 19 percent (National Center for Education Statistics [NCES] 1998, 2006, 2008). Today, it is estimated that about 67 percent of all public high schools offer AP courses and 71 percent offer DE courses (Waits, Setzer, & Lewis, 2005). Yet, despite the fact that AP and DE are the two largest acceleration programs in the nation, there is little to no evidence on how the programs fare in terms of increasing college access and success.

AP programs differ from DE programs in a number of ways. An important distinction concerns the curriculum they employ. DE students take a course with an actual college syllabus (either at their high school or at a college campus), and they receive college credit when they pass it. AP courses are taught using a standardized curriculum intended to be college level, and students can receive college credit only by taking an optional exam. While AP and DE programs are often regarded as close equivalents, there is disagreement over whether they provide equally effective college preparatory experiences. Proponents of AP programs argue that AP is more beneficial to students than DE because it provides smaller class sizes than college courses, more class hours, continual monitoring of progress, and a standardized curriculum that serves as a benchmark for the quality of the course. Conversely, proponents of DE argue that DE courses are real college courses (rather than college-level courses) and therefore may better prepare students for college by exposing

them to a more authentic college experience. Based on these different perceptions, and given the lack of empirical evidence directly comparing both programs, educators and policymakers often have strong feelings about which program “is the best for kids” or the “right thing to do.” Thus, it is not uncommon for state or local policies to treat these programs differently. Notably, many districts and universities assign more weight to AP than to DE courses when calculating students’ GPAs to determine high school rankings or college admissions and course placements.

While both programs were initially limited to academically advanced students, they are increasingly serving a wider student population, including middle- and even low-achieving students. Several states now subsidize AP exam fees for low-income students or have AP incentive programs specifically targeted to schools predominantly serving minorities or low-income students. In addition, private-led initiatives, such as the Bill and Melinda Gates Foundation’s Early College Initiative, are increasingly funding DE programs in high-poverty areas. Despite concerted efforts to increase participation among traditionally underrepresented students, the distributional consequences of participation remain largely unexplored.

This paper investigates the extent to which participation in AP and DE programs is associated with students’ likelihood of enrolling in college, first enrolling in a four-year college, and then obtaining a bachelor’s degree. In addition, it assesses whether the relative apparent effects of these programs depend on students’ minority status and academic ability. In order to compare the programs fairly, I focus on DE academic (not vocational) course participation, which counts toward college degree requirements, and on AP course participation (not AP exam taking) since not all AP students take the AP exams.

The main challenge in isolating the effects of the programs is that it is likely that AP and DE students are highly motivated and, therefore, may have better outcomes than non-AP/DE students in the absence of participation. In addition, students themselves often choose which of these two programs to take, and schools may have different eligibility criteria for enrollment in each program. I address these selection problems in two ways. First, I use a detailed administrative dataset to control for a large set of individual background characteristics — including pre-participation standardized scores in reading and math and schools’ fixed effects. Second, I exploit differences in the regional supply of AP and DE programs to assess the sensitivity of the results to situations where students are faced with constraint choices: (a) schools where no AP is offered, and (b) AP- and DE-dominant districts where there is empirical evidence that one program is strictly preferred. While these procedures cannot credibly circumvent the selection problem, taken together they provide a careful attempt to understand how AP and DE relate to students’ college outcomes.

Using data from two cohorts of all public high school students in Florida, the study finds that both AP and DE course-taking are significantly related to students' likelihood of college enrollment after high school, enrollment in a four-year institution, and attainment of a bachelor's degree. However, the programs are not equal predictors of students' success. While DE students enroll in college at a higher rate than observationally similar AP students, they enroll in four-year institutions at a lower rate. Having DE credits is associated with a 12 and 7 percentage point increase in the rate of college enrollment and in the rate of four-year college enrollment, respectively, relative to not taking DE/AP credits. This compares with a 6 and 18 percentage point increase in these same rates associated with having AP credits. Importantly, this large difference in students' initial enrollment in four-year colleges does not translate into bachelor's degree attainment, where the AP advantage over DE is at most 4 percentage points and not consistently statistically significant across model specifications. For all outcomes, students who combine both DE and AP courses fare better than those who only participate in one program, suggesting important complementarities between them. Notably, the effect of DE applies only to students who took courses at the local community college campus; there is no effect for students who took DE courses at the high school.

The DE–AP college enrollment gap, while negligible for students with very low ability, is fairly constant for students along most of the ability distribution. The relative advantage of AP students in four-year college enrollment increases as students' ability increases: high-ability students with AP credits get an extra edge in college admissions relative to those with DE credits. Last, the study found no evidence that the predictive power of the programs differs for minorities and non-minorities in terms of college enrollment or degree attainment. However, AP non-minority students are more likely to enroll in four-year colleges than their AP minority counterparts.

The paper is organized as follows. The next section provides a brief summary of the prior research on DE and AP programs. Section 3 describes the AP and DE programs in Florida. Section 4 presents the study data. Section 5 provides a profile AP and DE participants in Florida. Section 6 describes the methodological approach. Section 7 presents the results. Conclusions from the study are presented in Section 8.



## 2. Prior Literature

A substantial body of the AP literature focuses on students who take and/or pass an AP exam and not on students who take an AP course. This focus provides a limited view of the impact of AP since a large fraction of AP course-takers do not take AP examinations (Commission on the Future of the Advanced Placement Program [CFAP], 2001). A few recent studies have contributed to our understanding of the effect of simply taking an AP course, controlling for a wide range of students' characteristics and/or other rigorous high school curriculum (Dougherty, Mellor, & Jian, 2005; Geiser & Santelice, 2004; Klopfenstein & Thomas, 2009). This non-experimental evidence suggests that both taking AP courses and passing AP exams are associated with college success, though when carefully controlling for students' preparation, the effects of just passing an AP course tend to be small in magnitude, often insignificant, or limited to selected AP subject areas.

Jackson (2009, 2010) has provided the only quasi-experimental evidence on the causal impact of AP. Using a difference-in-difference estimation strategy, the researcher exploited Texas' variation in the timing of schools' implementation of AP cash incentives that reward students and teachers for good performance on AP exams. Despite the fact that AP incentives did not have an effect on high school graduation rates or on the number of students taking college placement tests, incentives were found to significantly improve performance on college placement tests and increase college enrollment. Incentives also positively affected college GPA, student retention, and minority students' college graduation. While these findings provide credible causal evidence on AP, it remains unclear whether the benefits might extend to regular non-incentivized AP programs.

A number of studies have documented the impact of DE programs while controlling for characteristics that are likely correlated with both participation and students' outcomes. DE participation has been found to be positively associated with nearly every educational outcome studied (e.g., Karp, Calcagno, Hughes, Jeong, & Bailey, 2007; Kim, 2006; Swanson, 2008). While the studies controlled for many relevant potential confounders, there is still the concern that DE students might be different from non-DE students in ways not captured by administrative data. In a previous study (Speroni, 2011), I provided the first quasi-experimental attempt to examine the impact of DE programs. I used a regression-discontinuity design that exploits plausible exogenous variation in DE participation generated by a Florida statute that requires high school students to have a minimum academic standing in order to participate. Results suggest that simply taking a DE course does not have significant impact on college access or success. However, taking one rigorous DE college course — college algebra — has sizeable effects on college enrollment and degree attainment.

The empirical evidence directly comparing AP and DE is remarkably scarce. The few studies that compared both participant groups provide inconclusive evidence at best. Hargrove, Godin, & Dodd (2008) found that AP course-takers have a statistically significant advantage compared with DE students in terms of college GPA and credits earned, though the difference between the two is small in magnitude. Other studies found that DE course-takers have a higher probability of being retained in college or of obtaining a bachelor's degree than AP course-takers (Eimers & Mullen, 2003; O'Brien & Nelson, 2004). While suggestive, none of the studies provide compelling evidence of the superiority of one program over the other, given the lack of sufficient control variables in their analyses and, as pointed by Jackson (2009), given the likely bias incurred by looking at college outcomes for only college attendees. Furthermore, there is still a limited understanding in this literature of the types of students that these programs serve.

This study contributes to this strand of literature by providing a thorough descriptive analysis of students who choose AP, DE, or both, using data from the state of Florida. Owing to the completeness of the data, I was able to control for a rich set of high school pre-AP/DE measures of students' abilities and other characteristics. In addition, I used the full cohort of high school students as the target population of these programs, thus avoiding the particular sample selection bias mentioned before. Like Jackson's research (2009), the data came from a state that provides cash incentives for AP exam performance, and results might not generalize to AP programs more broadly.

### **3. Advanced Placement and Dual Enrollment Program in Florida**

AP, a long-established program sponsored by the College Board, and DE, a more recent grassroots program involving close interaction between the high school and college, constitute the two largest acceleration mechanisms in Florida.<sup>1</sup> The “acceleration” designation describes a core characteristic of the programs: They allow students to accrue college credits while still in high school. While AP courses were offered in 55 districts in 2001 (around the period studied in this paper), all 67 districts in Florida had an agreement with the local community college to offer DE.

#### **Program Component Differences**

Despite the fact that AP and DE can be conceptually regarded as close high school equivalents for earning college credits, the programs differ in a number of ways. Table 1 provides a comparison of the programs in Florida. As opposed to AP, DE students take an actual college course with a college syllabus and immediately receive the college credit when they successfully meet the requirements of the course; they do not take an additional standardized end-of-course exam. DE students in Florida are also granted a high school credit that counts toward the requirements for graduation: a type of DE arrangement called “Dual Credit.” DE in Florida is almost exclusively sponsored by the local two-year community college, and the courses can be taken at the high school campus (depending on availability) or directly at the college campus. Regardless of location, all DE courses are taught by teachers who meet the certification requirements, based on accreditation standards, of a college faculty member.

AP courses are different from DE courses in that they are high school courses that follow a standardized curriculum intended to be college level and are taught by a regular high school teacher who might have received non-mandatory College Board training. In order to get college credits for the course, AP students are required to take an optional exam (administered once a year by the College Board); postsecondary institutions have the discretion to set their own policies for granting college credits or advanced placement into higher level courses. Most commonly, students with a score of 3 or higher on a 5-point scale exam are given college credit.

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<sup>1</sup> Other acceleration programs include the International Baccalaureate (IB), the Advanced International Certificate of Education (AICE), and the Credit by Examination Program (CLEP).

DE students have a broader scope of curricular options than AP students. With the exception of physical education and remedial (pre-college) courses, which are excluded from Florida's DE program, students can take any course in the college catalog provided they meet the course prerequisites. Conversely, the AP program offers about 30 courses in selected subject areas, with school-level offerings varying considerably across schools. A common criticism of DE is the lack of a uniform quality standard across colleges (e.g., Johnstone & Del Genio, 2001). Concern about quality is not unique to DE, however (e.g., Klopfenstein, 2004). Despite having an standardized curriculum, policymakers have questioned AP course quality given the generally low pass rate on AP exams and anecdotal evidence of schools' designating regular honor courses as "AP" to signal better instruction.<sup>2</sup>

Unlike AP, the requirements for participation in DE in Florida are established by the state. To be eligible for DE, students are required to have a minimum 3.0 un-weighted high school GPA and to pass the appropriate section of the College Placement Test (CPT). While all students need to take the CPT for DE enrollment, a common practice is to require students to pass the math (English) section of the CPT for enrollment in math (English) courses, just as required for regular community college students. Districts are allowed to set their own eligibility requirement for participation in AP.

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<sup>2</sup> To address AP quality concerns, the College Board is currently conducting an audit, though results from it are not yet available. In 1999, the National Alliance of Concurrent Enrollment Partnerships (NACEP) was created to serve as a national accrediting organism for DE programs. However, none of Florida's colleges belong to NACEP.



**Table 1**

**Advanced Placement and Dual Enrollment Program Comparison in Florida**

<b>Program Factor</b>	<b>Advanced Placement</b>	<b>Dual Enrollment</b>
Course experience	<i>Level of instruction:</i> high school course intended to be college-level	<i>Level of instruction:</i> college course
	<i>Location:</i> offered at the high school or through Florida Virtual School	<i>Location:</i> college or high school campus
	<i>Content:</i> about 30 AP courses in selected subject areas; course offerings vary by school	<i>Content:</i> any course in the college catalog with the exception of remedial (pre-college) courses and physical education
Instructor qualifications	Public school teacher requirements Non-mandatory College Board training	SACS college faculty requirements (master’s degree and 18 graduate credit hours in subject field)
High school credit	Passing grade in the course	Passing grade in the course
College credit & transferability	Only for students with a satisfactory score on the AP exam	Passing grade in the course
	Credit (or advanced placement into higher-level courses) policies vary by postsecondary institution	Credit transferable to any public postsecondary institution in Florida (facilitated by the Statewide Course Numbering System)
Requirements for participation	No statewide requirements; districts set their own eligibility criteria	3.0 unweighted GPA Pass appropriate sections of the College Placement Test (CPT) Additional requirements as specified in the agreement between the district and the local community college
Grade weighting & accountability	AP and DE courses have the same weight in GPA calculations, college admissions in state public institutions (since 2006) and state scholarships	Same as AP
	Exam participation and performance is awarded by the state accountability system (since 2009)	Course participation and performance is awarded by the state accountability system (since 2009)
Course financing (public school)	State pays for AP (as part of HS curriculum), and books AP exam fee reimbursement for all students AP exam incentives: district & teacher bonus for each student scoring 3 or higher on exam	State pays for tuition, fees, and books State pays both college and district for each student (i.e., “double-dipping” formula)

SOURCE: Adapted from the Florida Department of Education, Comparison of Florida’s Articulated Acceleration Programs (<http://www.fldoe.org/articulation>).

NOTES: Dual enrollment requirements are those for the Academic Dual Enrollment Program (as opposed to Vocational Dual Enrollment). A college course is considered academic if it counts toward the state requirements for an associate degree.

While traditionally AP courses have received more weight than DE courses in GPA calculations, beginning in 2006, Florida's districts and colleges were required by law to weight AP and DE the same. The current high school accountability system also incorporates both programs, though only performance on the AP exam (and not simply taking an AP course) is rewarded. It is important to note that these two legislative mandates were not in effect for the 2000 and 2001 cohort analyzed in this study. Florida offers a fully funded AP and DE program where the state pays for tuition; books; and, in the case of AP, exam fees for all students. In addition, Florida has a generous AP performance-based incentive program whereby districts and teachers receive a financial bonus for each student scoring 3 or higher on an AP exam.

### **Program Cost Differences per College Credit Earned**

Despite Florida's DE "double-dipping" funding formula, which pays both the high school and the college for each student, DE has proven to be a cost-saving strategy for the state. As with any other acceleration mechanism, DE saves tax payers money by reducing the number of courses and time it takes for a student to get a postsecondary degree. But DE is more cost effective than AP because of the following: (a) the rate at which course participants earn college credits is considerably higher in DE than in AP (Office of Program Policy Analysis and Government Accountability [OPPAGA], 2006a), (b) DE courses are almost exclusively offered by the relatively low-cost local community college, and (c) AP has an additional performance-based incentive funding (OPPAGA, 2006b). A recent report from the Florida legislature concluded that: "The incentive funding paid for each credit hour earned by passing an AP exam cost nearly twice what it would have cost for students to earn the same credits by passing the course at a Florida community college or university" (OPPAGA 2006a, p. 4).

## 4. Study Data

This study used detailed student-level administrative records obtained from the Florida Department of Education that include all public school students in the 2000-01 and 2001-02 high school graduating cohort: a total of 229,828 students. The dataset contains transcript information on all the courses taken in both high school and college (up to 2006), with unique identifiers for AP and DE courses, as well as the location where the DE course was taught (high school or college campus). The data also include demographic characteristics such as age, gender, race/ethnicity, English language proficiency, and free lunch eligibility, as well as 8th and 10th grade state standardized test scores (FCAT) and high school and postsecondary degree attainment.

I complemented Florida state postsecondary records with National Student Clearinghouse data, which track enrollment of students at out-of-state colleges or private institutions. An important limitation of this dataset is that the National Student Clearinghouse records only cover college enrollment; they do not indicate degree attainment for students who enrolled in a private or out-of-Florida college. Insofar as AP or DE students are systematically more likely to enroll in a private college or outside the state, the estimates of a program on attainment of a bachelor's degree would be downward biased. Lastly, districts' characteristics, such as median income and urbanicity, were obtained from the 2000 Common Core Data and Census.



## 5. Profile of Advanced Placement and Dual Enrollment Students

### Student Similarities and Differences

Table 2 shows students' descriptive characteristics by program participation. The study focuses on participation in the 11th or 12th grade, when most students participate in acceleration programs.<sup>3</sup> Students labeled on the table as *DE Only* or *AP Only* participate exclusively in one program, whereas *DE & AP* students combine both types of courses. For comparison purposes, the table also depicts students who do not participate in any acceleration program. AP is the largest acceleration mechanism in Florida, with almost 19 percent of the students participating, followed by DE with about 13 percent. Most of acceleration students only participate in one of the programs; less than 6 percent of the students combine both an AP and a DE experience.<sup>4</sup>

While the gender composition of DE and AP participants is similar, the AP program serves almost twice the proportion of Black and Hispanic students than DE (36 percent versus 19 percent), reflecting AP program's concerted efforts over the last decades to reach traditionally underrepresented minority students (Klopfenstein, 2004). Both programs attract students from a similar socioeconomic background (proxied by free or reduced price lunch eligibility), though students who choose to participate in both AP and DE are relatively more affluent.

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<sup>3</sup> AP/DE course participation exclusively before the 11th grade is very rare: less than 4 percent of the AP/DE students.

<sup>4</sup> These statistics exclude a small share of students who combine AP/DE with IB courses. The corresponding statistics including IB students are: 20.5 percent AP, 13.8 percent DE, and 6.0 percent for AP and DE.

**Table 2**  
**Descriptive Statistics by Student Subgroup**

Variable	All	Sub-Samples			
	Students	DE Only	AP Only	DE & AP	None
<b>Participation rate</b>	100%	7.7%	13.1%	5.7%	71.0%
<b>Student characteristics</b>					
Female	0.51	0.63	0.57	0.62	0.48
White	0.56	0.78	0.59	0.78	0.50
Minority (Black or Hispanic)	0.41	0.19	0.36	0.17	0.48
Asian or Pacific Islander	0.02	0.02	0.04	0.05	0.01
Limited English proficiency	0.03	0.01	0.03	0.00	0.04
Economically disadvantaged	0.43	0.26	0.28	0.17	0.50
FCAT reading score, 10th grade	304 (46)	325 (31)	334 (35)	346 (28)	289 (43)
FCAT math score, 10th grade	314 (46)	334 (29)	344 (34)	357 (27)	299 (43)
FCAT reading z-score, 10th grade ( <i>school-level residuals</i> )	0.00 (0.87)	0.33 (0.68)	0.52 (0.73)	0.72 (0.64)	-0.21 (0.83)
FCAT math z-score, 10th grade ( <i>school-level residuals</i> )	0.00 (0.86)	0.31 (0.63)	0.52 (0.71)	0.73 (0.63)	-0.22 (0.82)
Unweighted high school GPA, 10th grade	2.60 (0.73)	3.12 (0.53)	3.11 (0.56)	3.43 (0.43)	2.37 (0.66)
<b>DE course location</b>					
Percent DE courses at both community college & high school campuses		58.2%	<i>n/a</i>	62.3%	<i>n/a</i>
Percent DE courses at community college campus only		36.8%	<i>n/a</i>	33.2%	<i>n/a</i>
Percent DE courses at high school campus only		5.1%	<i>n/a</i>	4.5%	<i>n/a</i>
<b>Outcomes</b>					
HS diploma	0.81	0.95	0.97	0.99	0.75
HS diploma (any type)	0.91	0.97	0.98	0.99	0.88
PSE enrollment after HS (in or out of state)	0.62	0.85	0.86	0.93	0.51
<b>Outcomes conditional on college going (in or out of state)</b>					
PSE enrollment at 4-year institution	0.39	0.44	0.68	0.77	0.22
Persistence to second term	0.76	0.83	0.83	0.84	0.72
Persistence to second year	0.73	0.80	0.86	0.90	0.63
<b>Outcomes conditional on college going in state public system</b>					
Remedial reading enrollment	0.23	0.09	0.07	0.01	0.35
Remedial English enrollment	0.18	0.06	0.05	0.01	0.27
Remedial math enrollment	0.33	0.17	0.12	0.04	0.47
Associate degree (within 5 years)	0.19	0.34	0.20	0.24	0.16
Bachelor's degree (within 5 years)	0.20	0.29	0.37	0.52	0.08
Freshman college GPA (first 30 credits, including AP/DE courses)	2.43 (1.03)	2.82 (0.75)	2.78 (0.88)	3.13 (0.69)	2.14 (1.05)
Cumulative college GPA (including AP/DE courses)	2.40 (1.01)	2.75 (0.73)	2.76 (0.85)	3.05 (0.67)	2.12 (1.03)
<b>Observations</b>	229,828	17,746	30,033	13,042	163,236
%	100%	7.7%	13.1%	5.7%	71.0%

NOTES: Standard deviations for continuous variables are in parentheses.

*DE Only* (or *AP Only*) denotes students who participate in the Dual Enrollment (or Advanced Placement) academic program exclusively during the 11th or 12th grade, excluding students who combine either program with International Baccalaureate (IB).

*AP & DE* denotes students who take both AP and DE courses. *None* denotes students who do not participate in either of AP, DE, or IB programs.

Participation rates do not sum to 100 because IB students are excluded from the subsamples.

There is systematic sorting of students into AP and DE by academic ability. Specifically, AP-only participants have substantially better academic preparation than their DE counterparts, as measured by their 10th grade scores on Florida’s standardized exam (FCAT), though students who combine both programs are among the most able. AP students have, on average, scores 9 and 10 points higher in reading and math, respectively: roughly a 0.3 standard deviation gap in academic background. Residuals from a school-level fixed effect regression on the scores (normalized at the grade-cohort level), indicate that AP and DE students’ differences in ability do not purely reflect sorting of students into schools with different course offerings, but also a persistent sorting of students within schools. Interestingly, the AP–DE achievement gap using the 10th grade cumulative GPA is small and not consistent with that reflected by the FCAT scores, highlighting the importance of using standardized measures for making comparisons.

Most DE students have a DE experience that combines courses taken at the high school and at the college campus (58 percent), though some take DE exclusively at the college campus (37 percent). Only a small percentage of the students take DE only at the high school campus (5 percent). To the extent that part of the returns to DE is attributed to familiarizing students with college life or exposing them to college peers, at equal quality of instruction at different locations, DE courses taken at the college campus would be preferred.

With the exception of college enrollment and early college persistence, where both DE and AP students have similar rates, mean college outcomes across programs correlate closely with measures of academic achievement prior to participation. AP-only students have a relative advantage in terms of four-year college enrollment and bachelor’s degree attainment, and have a higher GPA in college than DE-only students, but students combining both AP and DE take the lead.

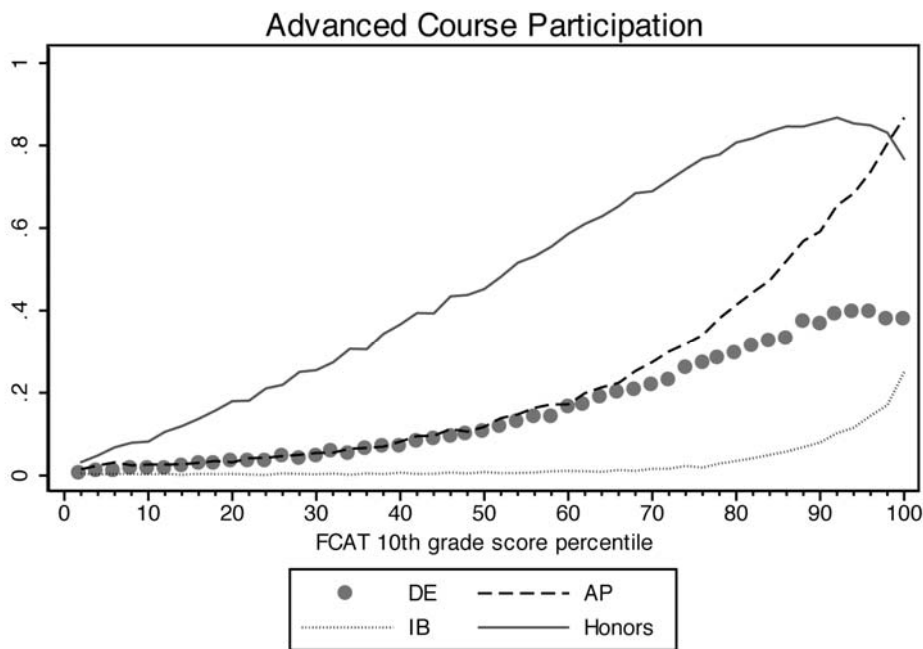
## **Participation by Academic Ability and Districts’ Preferences**

Figure 1 provides a visual description of statewide participation in advanced courses (AP, DE, International Baccalaureate [IB], and Honors) as a function of 10th grade score percentiles (calculated based on the average math and reading FCAT scores). As expected, participation across advanced high school courses monotonically increases with students’ academic ability. While participation in AP and DE remains relatively low among students below the state’s median academic performance, it increases rapidly for higher-level achievers. Students of all ability levels have access to Honors courses — advanced courses that are not college level. Participation in IB, an alternative acceleration program, is very low (only 2.5 percent of students statewide) and restricted to students at the very top of the academic distribution.

While both AP and DE programs are available in most Florida school districts, there is a considerable difference in students' program choice across districts. To illustrate this, Figure 2 plots AP and DE participation in "DE-dominant" and "AP-dominant" districts. I define a district as AP- or DE-dominant if the participation rate in one program exceeds that of the other program by at least 40 percentage points among students in the top quartile of the state FCAT score distribution (Appendix Table A.1 shows the participation rate for all districts). As shown in the top panel, students' choices of AP versus DE in DE-dominant districts are the mirror opposite of those in AP-dominant districts. These diverse experiences among students of similar academic ability across districts are largely explained by the differences in student composition. The bottom panel displays residuals from participation regressions that control for a rich set of characteristics known to be correlated with programs' choice (variables listed in the figure's note). Notably, while most of the variation in participation across AP- and DE-dominant districts is explained by the characteristics of the students they serve and districts' enrollment, there is still some unexplained variation in participation, particularly among students in top quartile of the academic ability. This variation provides suggestive evidence of districts' preferences to favor one program instead of the other.

**Figure 1**

**Statewide Participation in Advanced Courses by 10th Grade Score**

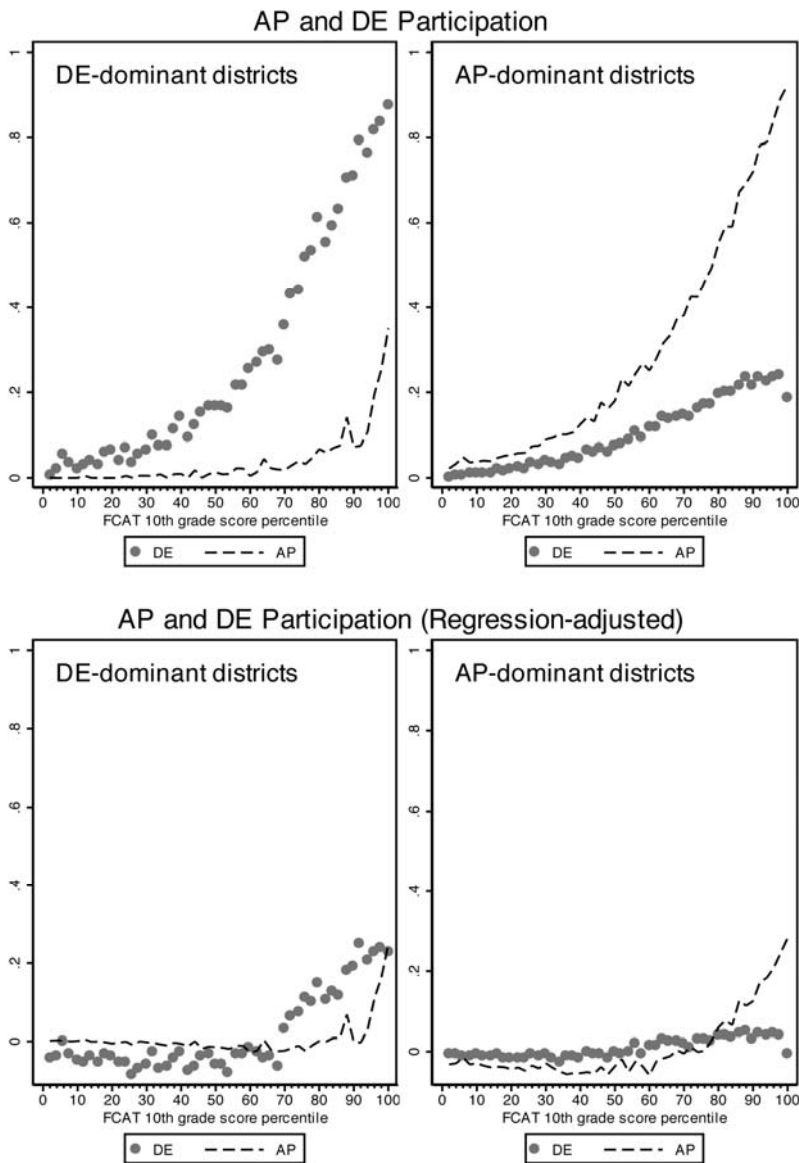


NOTES: Participation is defined as taking at least one advanced course either in 11th or 12th grade.



**Figure 2**

**Advanced Placement and Dual Enrollment Participation in Selected Districts**



NOTES: Samples are AP-dominant districts (N = 6) and DE-dominant districts (N = 20). AP(DE)-dominant districts are those where AP(DE) participation rate among students in the top quartile of the FCAT 10th grade (reading and math mean) score distribution is higher than that of DE(AP) by at least 40 percentage points. Top panel displays raw participation rates by FCAT 10th percentile score, broken down by district type. Bottom panel plots residuals from participation regressions that control for gender, race/ethnicity dummies, English learner and free or reduced price lunch status, participation in honors program, total attempted credits by 10th grade, high school characteristics (race/ethnicity, English learners, low SES, FCAT 10th grade scores, and total enrollment), districts' median income and urbanicity, and cohort fixed effects.



## 6. Methodological Approach

### Relative Predictive Effect of AP and DE

To measure the relative predictive effect of AP versus DE, I followed a regression specification of the form:

$$Y_{is} = \alpha + \gamma AP_{is} + \theta DE_{is} + \delta AP * DE_{is} + \beta X_{is} + \varepsilon_{is} \quad (1)$$

where  $i$  is the student in school  $s$ ,  $AP/DE/AP*DE$  are indicators whether the student takes an AP course, DE, or both in the junior or senior high school year,  $X_{is}$  is a vector of covariates including students' gender, race, free/reduced price lunch status, cohort year, 8th and 10th grade standardized scores, 10th grade GPA, high school and districts demographics, and  $\varepsilon_{is}$  is an idiosyncratic error term. In order to account for an obvious potential confounding factor, students' endogenous sorting across schools, an additional specification includes high school fixed effects.<sup>5,6</sup> I formally tested whether the coefficients for AP and DE are statistically different. The basic specification in equation (1) is extended to assess whether the returns to DE vary depending on the course location by interacting the participation dummy with an indicator for whether students have a DE experience at the college campus, at the high school campus, and an interaction term for both locations. Standard errors allow for clustering at the district-level and are robust to heteroskedasticity.

Even after controlling for a rich set of covariates and measures of academic preparation prior to participation, there is still the concern that unobserved differences between AP and DE students within the same school may be driving the results. After all,

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<sup>5</sup> The FCAT 8th grade exam was first administered for the 2001 cohort. Regressions set missing scores to zero for the 2000 cohort and include a dummy for missing values. One particular AP course type, AP Studio Art portfolios, does not necessarily involve actual instruction time. Students get the credits by submitting art projects at the end of the year following detailed guidelines. Since only 1.2 percent of AP students would only take this type of AP course, I included them in the analysis. Admittedly, there is likely important heterogeneity in the returns to different courses within each program (e.g., Klopfenstein & Thomas, 2009; Speroni, 2011). However, disaggregating the analysis by course subject area is challenging in a non-experimental setting due the multicollinearity problem that arises because most students take multiple acceleration courses (Camara & Michaelides, 2005).

<sup>6</sup> While the dichotomous nature of the outcomes calls for a logit or probit model, nonlinear models with fixed effects suffer from the incidental parameters problem (see Greene 2003, p. 697, for an econometric discussion of the problem). A particular type of nonlinear model, the conditional logit, can accommodate fixed effects but requires making assumptions about the magnitude of the fixed effects to calculate the marginal effects of interest. For consistency, I report ordinary least squares estimates for all models, though logit estimates for models without high school fixed effects (available upon request) indicate programs' differences of comparable magnitude — within 0.1 to 2 percentage point difference in college-going and bachelor's degree attainment and about 5 percentage point smaller difference in four-year enrollment.

the determinants of students' program choice are largely unknown, schools' might have participation criteria systematically more selective for one program than the other, or counselors might endogenously encourage participation in a particular program based on perceived differences among their students.

In an attempt to alleviate concerns about omitted variable bias, I provided a second set of analyses that exploit schools' variation in the supply of the programs. In the spirit of Rosenbaum (1987), I utilized the fact that a student may be a control group either because the program was not offered or because it was offered but declined. For example, not all schools offer the AP program or strongly promote participation, and in those that do only a small share of students elect to participate. Thus, these two groups of students provide two natural control groups that can be used to assess whether the model proposed in specification (1) sufficiently captures selection into the programs or, in Rosenbaum's terms, whether selection into the treatment is ignorable conditional on the vector  $X_{is}$ .

I implemented Rosenbaum's idea in two separate analyses. In the first analysis, I assessed the impact of DE in situations where students have no choice of AP by estimating equation (1) in the subsample of schools where no student takes any AP course.<sup>7</sup> Even in situations where students have access to both programs, as shown in Section 5, AP- and DE-dominant districts might favor one program at the expense of the other, effectively limiting the choice set of high-ability students. The second analysis takes advantage of these potentially idiosyncratic preferences by comparing outcomes of "high-ability" students (top quartile of the 10th grade FCAT score distribution) versus "medium-to-low-ability" in an AP-dominant versus DE-dominant district (districts identified in Section 5). While high-ability students might be different than the rest and AP-dominant districts might be different than DE-dominant, this difference-in-difference framework assumes that high-ability students (i.e., potential AP/DE takers) are not different across districts conditional on all the characteristics included in the model. Using data from the subsample of districts where one program strictly dominates the other, the comparison is given by the coefficient  $\gamma$  in the following regression:

$$Y_{isd} = \alpha + \theta HA_{isd} + \gamma HA_{isd} * AP\_dominant_{sd} + \sum_d \pi_d D_{is}^d + \beta X_{isd} + \varepsilon_{isd} \quad (2)$$

where  $HA_{isd}$  is an indicator that student  $i$  in school  $s$  in district  $d$  is a high-ability student,  $HA_{isd} * AP\_dominant_{sd}$  is the interaction term between high-ability and an AP-dominant dummy, and  $D_{is}^d$  is an indicator for whether the student  $i$  attends a school  $s$  located in

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<sup>7</sup> The parallel analysis for measuring the effect of AP is not feasible since all districts and virtually every school have DE students.

district  $d$ .<sup>8</sup> Since not all high-ability students participate in an acceleration program and if they do, not all participate in the district “favored” program, this analysis provides an *intent-to-treat* effect of promoting one program. Even though these point estimates are not directly comparable with the other models, consistency with statewide analyses using specification (1) provides some robustness that the covariates in the models are capturing students’ selection into the program relatively well.

It is important to emphasize that, to the extent that students’ participation is driven by unobserved factors, the result would only speak to the predictive power of participation and *cannot* be interpreted as causal estimates of the program. Exploiting variation in participation in scenarios of constraint choice provides an exercise to advance our understanding of the potential impact of these programs but does not represent a quasi-experimental analytical exercise.<sup>9</sup>

## **Heterogeneity of the Effect by Students’ Minority Status and Ability**

In order to gauge whether the predictive effect of the programs vary by students’ subgroups, I estimated (1) separately for minority (Black and Hispanic) and non-minority students. Lastly, to examine whether the relative effectiveness of AP and DE programs varies with respect to students’ academic preparation, I classified students by their pre-participation test score quartile (and decile) using the 10th grade FCAT average math and reading scores. I then estimated a version of (1) in which the AP and DE indicator is interacted with dummies for quartiles (and deciles) of students’ initial ability. For simplicity, I omitted the DE\*AP interaction term.

## **A Methodological Consideration for the Effect on Bachelor’s Degree Attainment**

Ideally, we would be interested in measuring the effect of AP/DE on students’ probability of going to college and then, conditional on college attendance, the effect of the programs on the probability of finishing college. However, to the extent that AP/DE has an effect on college-going, disentangling both effects is methodologically challenging even in a randomized setting. For a randomized study to uncover the causal effect of AP/DE on

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<sup>8</sup> Using district fixed effects is virtually analogous to including a dummy for AP-dominant district.

<sup>9</sup> Since a college’s location was determined long before the advent of (and for reasons unrelated to) DE programs, and students in Florida are only allowed to take the program sponsored by the local community college, a high school’s distance from the college might provide, in theory, a source of plausible exogenous inducement to participation. Unfortunately, distance to college does not strongly predict DE participation in these data and an instrumental variable approach is not feasible.

college success once in college (i.e., conditional on college access) it would have to be the case that all students (both randomized in and out of each program in high school) are forced to go to college — an experiment practically unfeasible. To avoid the sample selection bias derived from looking at college outcomes for only college attendees, when measuring the effect of AP/DE on bachelor's degree attainment, I used the entire sample of high school students in the analyses and assigned an outcome of zero for students who do not go to college. This effect should be interpreted as an overall effect of the programs that captures both changes in the composition of college goers as well as improvements in college readiness conditional on college-going.

## 7. Results

### **Predictive Effect of Advanced Placement and Dual Enrollment on College Outcomes**

Table 3 presents the main regression results. The first column of each outcome shows the results, controlling for the full set of covariates; the second column adds school fixed effects, and the third column breaks down the effect of DE by location of the course (high school or college). The remaining columns present the analyses using different sample restrictions. Overall, there are significant positive relationships between both AP and DE participation and students' likelihood of enrolling in college after high school, first enrolling in a four-year institution, and obtaining a bachelor's degree. There are, however, apparent differences in outcomes between students with AP credits and those with DE credits when compared to those with no AP or DE credits.

After controlling for students' and schools' characteristics, including preexisting measures of academic ability, DE students are more likely than AP students to go to college, but are less likely to enroll in a four-year college. Adding high school fixed effects to account for endogenous migrations (such as families with high value for education moving to areas with a strong program) do not materially change the point estimates. In both outcomes, I rejected the hypothesis that the coefficients on AP and DE are the same. The programs differ by about 6 percentage points for college enrollment and almost double, to 12 percentage points, for four-year enrollment (columns 1 and 6). Naturally, these differences between the programs might reflect a tendency of students who have already decided to go to college or to a two-year college to prefer DE as well as status quo ante admission practices in selective four-year colleges to favor AP students. The results on bachelor's degree attainment mirror that of four-year enrollment with a relative advantage of the AP program, though the AP-DE gap is considerably smaller (ranging from 0.2 to 4 percentage points depending on specification, columns 11 through 13) and only statistically significant when dropping students for whom degree attainment is missing due to out-of-state or private college enrollment.

**Table 3**

**Regression of Student Outcomes on Dual Enrollment and Advanced Placement Participation**

	College Enrollment					Four-Year College Enrollment					Bachelor's Degree						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	
Mean dependent variable (SD)	0.62 (0.49)					0.24 (0.43)					0.12 (0.32)						
<b>AP</b>	0.058 (0.006)**	0.052 (0.007)**	0.059 (0.006)**			0.184 (0.012)**	0.176 (0.012)**	0.185 (0.013)**			0.084 (0.006)**	0.079 (0.005)**	0.105 (0.006)**	0.085 (0.006)**			
<b>DE</b>	0.119 (0.007)**	0.113 (0.007)**		0.119 (0.025)**		0.065 (0.014)**	0.073 (0.013)**		-1.307 (0.937)	0.092 (0.017)**	0.072 (0.011)**	0.077 (0.011)**	0.068 (0.011)**		0.089 (0.016)**		
DE in college campus			0.112 (0.010)**					0.051 (0.017)**						0.054 (0.018)**			
DE in high school campus			0.025 (0.023)					-0.011 (0.030)						0.006 (0.016)			
DE in college & high school			-0.003 (0.025)					0.042 (0.033)						0.033 (0.021)			
<b>AP &amp; DE</b>	-0.093 (0.008)**	-0.086 (0.008)**	-0.095 (0.008)**			-0.038 (0.010)**	-0.041 (0.009)**	-0.040 (0.010)**			-0.007 (0.010)	-0.007 (0.010)	0.006 (0.010)	-0.009 (0.010)			
High ability* AP-dominant district				-0.077 (0.027)**						0.163 (0.038)**						0.012 (0.014)	
High ability				0.022 (0.026)						-0.083 (0.036)**						0.033 (0.014)**	
Difference AP – DE	-0.061	-0.061				0.119	0.103				0.012	0.002	0.037				
F-test AP = DE [p-value]	[0.00]	[0.00]				[0.00]	[0.00]				[0.37]	[0.86]	[0.00]				
High school fixed effects		√					√					√					
District fixed effects					√					√						√	
Dropping students enrolled in private/out-state college													√				
Dropping schools that offer AP				√					√						√		
AP- & DE-dominant districts only					√					√						√	
R-squared	0.27	0.28	0.27	0.34	0.25	0.40	0.41	0.40	0.19	0.39	0.23	0.24	0.29	0.23	0.22	0.22	
Observations	229,828	229,828	229,828	13,250	95,286	229,828	229,828	229,828	229,828	13,250	95,286	229,828	229,828	211,753	229,828	13,250	95,286

NOTES: \* significant at 5%; \*\* significant at 1%.

Robust standard errors (in parenthesis) correct for clustering at the district level.

AP (DE) are indicators of students' participation in Advanced Placement (Dual Enrollment) during the junior or senior high school year.

All specifications include dummy variables for gender, race, English learner, free/reduced price lunch status, and cohort. In addition, regressions control for total 10th grade attempted credits, a quadratic polynomial in pre-program participation math and reading scores (8th and 10th grade FCAT) and cumulative 10th grade high school GPA, and an indicator for 10th grade GPA eligibility for DE participation. High school characteristics include race, English Learner, low SES, FCAT scores, and a quadratic polynomial in total enrollment. District characteristics include median-income and urbanicity.



Since both AP and DE main effects are included in the model, a negative coefficient for the interaction term does not imply that combining both programs lowers the likelihood of college access or success. Rather, results indicate that taking both AP and DE courses is associated with better outcomes than taking solely one of the programs, but the magnitude is smaller than the sum of the individual program effects (particularly in college enrollment and enrollment type). This group of students is mostly composed of those who exhaust the AP courses available at the high school and turn to DE for even higher level courses offered at the college.

### **Dual Enrollment Effect by Location of Course**

Interestingly, DE students who take DE courses exclusively at the local high school perform no differently from high school students who do not participate in either AP or DE (column 3, 8, and 14). In addition, students who combine DE courses at both high school and college locations appear to derive no benefit from those courses taken at the high school (i.e., point estimates on both DE in the high school and DE in both locations are small and statistically insignificant across all outcomes). This correlation is consistent with lower quality of DE high school courses (which are often taught by high school teachers) and/or with important returns to giving students a firsthand experience of the college environment, expectations, and peers. While I cannot rule out endogenous selection of students into different locations, with highly motivated or unobservable “better” students choosing a DE experience directly at the college campus, the regressions control for a rich set of student characteristics.

### **Sensitivity Analyses Exploiting Constraint of the Program Supply**

In order to assess the robustness of the results, I complemented the statewide analyses with a second estimation strategy that exploits regional differences in programs’ offerings to measure the effect in situations where students do not have much choice of program. Results from this exercise are broadly consistent with the more precise estimates constructed using the larger sample, supporting the notion that much of the selection into the programs is being captured by the covariates included in the model. Across outcomes, the point estimates for DE-taking in schools where no AP is offered are very similar to those estimated using all schools, and highly significant despite the reduction in sample size. The last columns for each outcome show the results using specification (2) on the subsample of AP- and DE-dominant districts. High-ability students in a district where the most popular program is AP (i.e., AP-dominant), enroll in college at a lower rate than high-ability students in a DE-dominant school (column 5) but are more likely to enroll in a four-year institution (column 10). Also consistent with statewide results, the effect of promoting AP among high-ability students on bachelor’s degree attainment is very small (0.008) and

not significant compared with promoting DE (column 16). Even though this approach ameliorates concerns about students self-selecting into one program as opposed to the other, it still assumes that schools' encouragement of one particular program is exogenous (of their students' characteristics), that the effect of program does not vary across districts, and that students do not sort themselves in different schools. Thus, results speak of a correlation which does not necessarily imply causation.

## **Effect Heterogeneity**

### **Effect by Minority Status**

Table 4 demonstrates the extent to which the relative predictive effectiveness of an AP and DE experience depends on students' minority status (Black/Hispanic versus other races/ethnicities). For reference, the first columns for each outcome restate the main results in Table 3 columns 1, 6, and 11. Results indicate that AP and DE minority students are equally likely to go to college than observationally similar non-minority participants—point estimates for both subgroups are virtually identical (columns 2 and 3). In contrast, non-minority AP students are almost twice as likely to enroll in a four-year institution than AP minorities (about a 10-percentage point difference in rate, columns 5 and 6), suggesting that AP, by itself, is not enough to close the race/ethnicity gap in college aspirations, applications, or admissions. These large differences by minority status in AP students' likelihood of enrolling in a four-year college do not translate into bachelor's degree attainment: The race/ethnicity gap in bachelor's degree attainment is less than 4 percentage points compared with a 10 percentage point gap in four-year enrollment. Minority AP students, despite being disproportionately more likely to initially enroll at a community college, are able to transfer to a four-year college and graduate with a bachelor's degree at higher rates than minorities who do not participate in any acceleration program.

**Table 4**

**Heterogeneity of Dual Enrollment and Advanced Placement Effect by Students' Minority Status**

	College Enrollment			Four-Year College Enrollment			Bachelor's Degree		
	All	Minority	Non-Minority	All	Minority	Non-Minority	All	Minority	Non-Minority
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
<b>Course type</b>									
AP	0.058 (0.006)**	0.058 (0.006)**	0.059 (0.007)**	0.184 (0.012)**	0.122 (0.011)**	0.215 (0.009)**	0.084 (0.006)**	0.062 (0.005)**	0.098 (0.007)**
DE	0.119 (0.007)**	0.117 (0.007)**	0.117 (0.008)**	0.065 (0.014)**	0.087 (0.015)**	0.071 (0.014)**	0.072 (0.011)**	0.061 (0.008)**	0.076 (0.012)**
AP & DE	-0.093 (0.008)**	-0.106 (0.015)**	-0.091 (0.009)**	-0.038 (0.010)**	-0.041 (0.014)**	-0.056 (0.012)**	-0.007 (0.010)	0.001 (0.017)	-0.018 (0.014)
Difference AP – DE	-0.061	-0.059	-0.058	0.12	0.04	0.14	0.012	0.001	0.022
F-test AP = DE [p-value]	[0.00]	[0.00]	[0.00]	[0.00]	[0.05]	[0.00]	[0.37]	[0.91]	[0.10]
R-squared	0.27	0.24	0.28	0.40	0.35	0.42	0.23	0.19	0.23
Observations	229,828	94,913	134,915	229,828	94,913	134,915	229,828	94,913	134,915

NOTES: \* significant at 5%; \*\* significant at 1%.

Robust standard errors (in parenthesis) correct for clustering at the district level.

AP (DE) are indicators of students' participation in Advanced Placement (Dual Enrollment) during the junior or senior high school year.

Regression controls for additional covariates as described in the text.

### **Effect by Student Ability**

Table 5 assesses non-linearities in the AP and DE programs impact with respect to students' quartile of initial ability. Figure 3 displays a more nuanced analysis by students' decile. Both sets of results indicate important heterogeneity in the impact of the programs on college enrollment and enrollment type though not in bachelor's degree. AP and DE participants at the bottom of the ability distribution (quartile 1 in Table 5 and decile 1 and 2 in Figure 3) are equally likely to enroll in college. However, middle- to high-ability DE participants are significantly more likely to do so, with a DE-AP gap fairly stable at around 6 percentage points. In terms of four-year enrollment, the AP effect increases with ability while the DE effect remains constant. The difference between the two programs is small and statistically insignificant for students at the lower levels of ability, but becomes large and significant for above-median students. In other words, students who were academically successful prior to participation drive the advantage of AP relative to DE in four-year enrollment. Lastly, I cannot reject the hypothesis that the difference between AP and DE in students' likelihood of obtaining a bachelor's degree is statistically significant at conventional levels along the distribution of ability.

**Table 5**  
**Heterogeneity of Dual Enrollment and Advanced Placement Effect**  
**by Quartiles of Students' Prior Scores**

	Quartiles of 10th Grade FCAT Test Score			
	(1)	(2)	(3)	(4)
<b><u>College enrollment</u></b>				
AP	0.093 (0.016)**	0.061 (0.009)**	0.037 (0.007)**	-0.009 (0.008)
DE	0.111 (0.017)**	0.128 (0.011)**	0.089 (0.007)**	0.044 (0.006)**
<hr style="border-top: 1px dashed black;"/>				
Difference AP – DE	-0.018	-0.067	-0.052	-0.053
F test AP = DE	[0.51]	[0.00]	[0.00]	[0.00]
[p-value]				
<hr style="border-top: 1px dashed black;"/>				
<b><u>Four-year college enrollment</u></b>				
AP	0.019 (0.016)	0.069 (0.009)**	0.176 (0.010)**	0.212 (0.013)**
DE	0.048 (0.014)**	0.044 (0.012)**	0.063 (0.016)**	0.036 (0.011)**
<hr style="border-top: 1px dashed black;"/>				
Difference AP – DE	-0.029	0.025	0.113	0.176
F test AP = DE	[0.30]	[0.18]	[0.00]	[0.00]
[p-value]				
<hr style="border-top: 1px dashed black;"/>				
<b><u>Bachelor's degree</u></b>				
AP	0.000 (0.005)	0.031 (0.005)**	0.077 (0.007)**	0.103 (0.009)**
DE	0.010 (0.005)*	0.024 (0.007)**	0.070 (0.012)**	0.082 (0.009)**
<hr style="border-top: 1px dashed black;"/>				
Difference AP – DE	-0.01	0.007	0.007	0.021
F test AP = DE	[0.09]	[0.39]	[0.67]	[0.16]
[p-value]				
Observations	48,692	48,683	48,687	48,670

NOTES: \* significant at 5%; \*\* significant at 1%.

Robust standard errors (in parenthesis) correct for clustering at the district level.

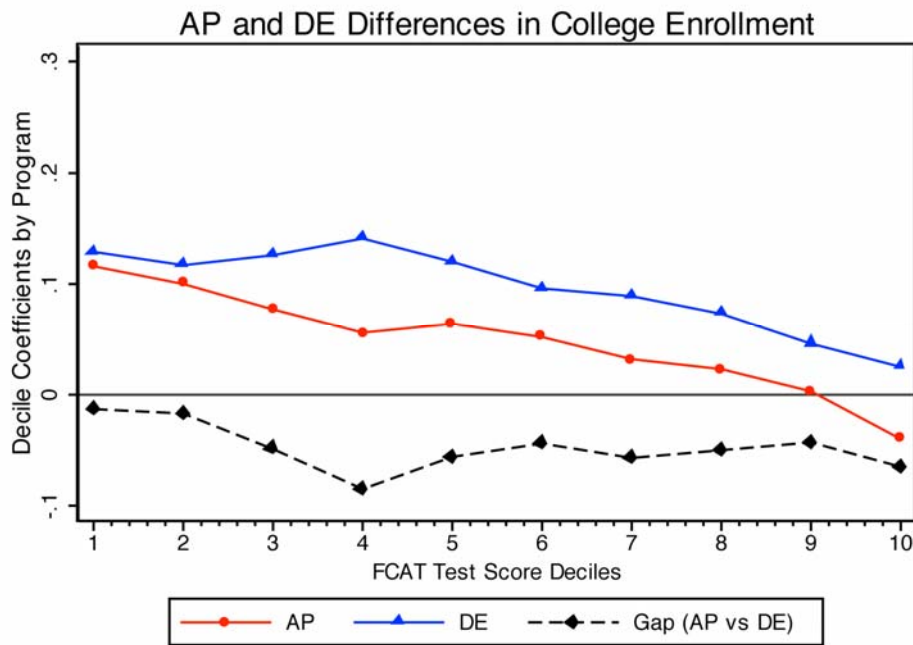
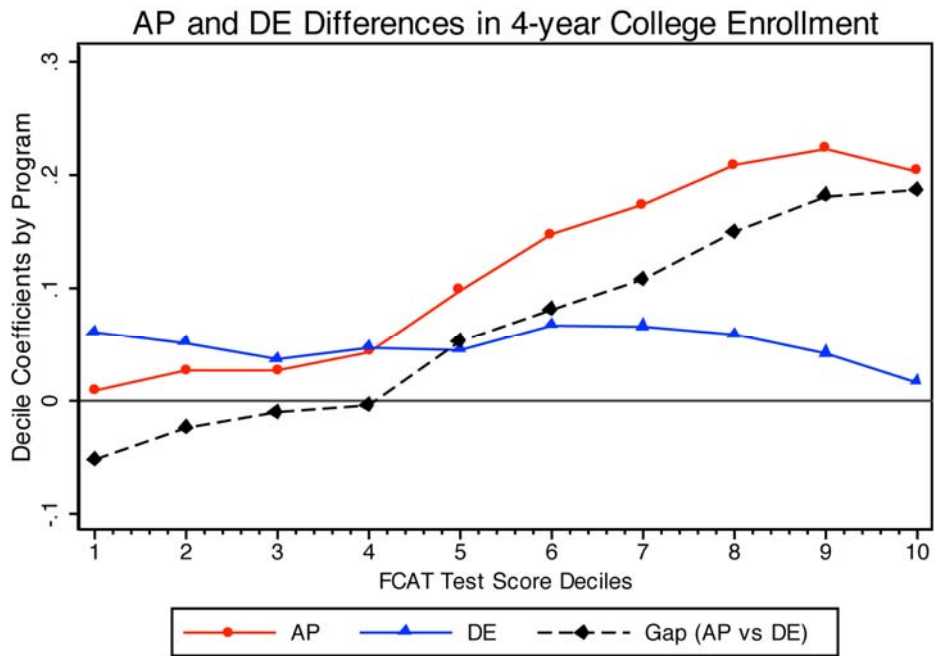
AP (DE) are indicators of students' participation in Advanced Placement (Dual Enrollment) during the junior or senior high school year.

Quartiles are defined based on the statewide distribution of the mean FCAT score 10th grade score in reading and math.

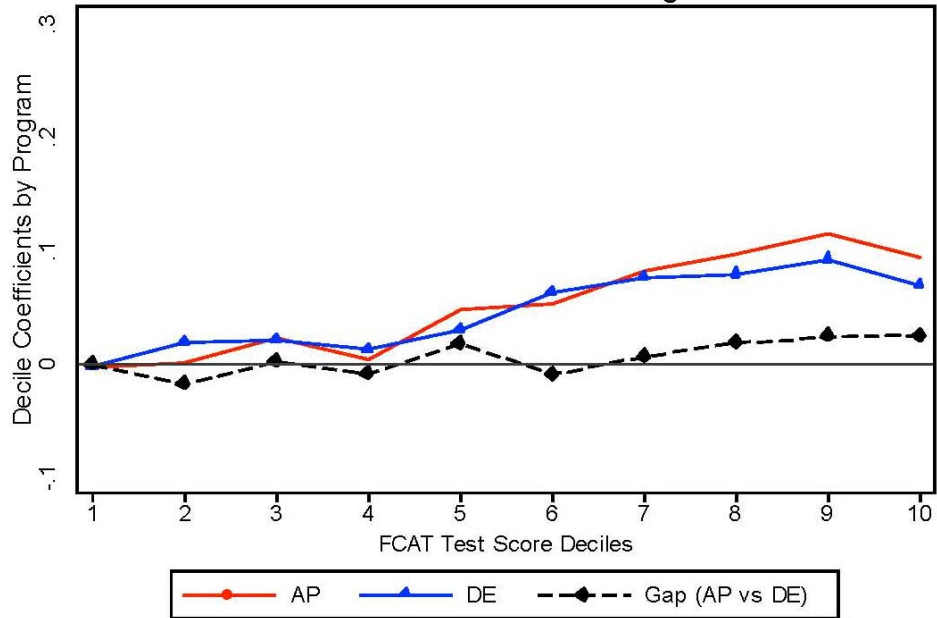
Regression controls for additional covariates as described in the text.

Figure 3

Heterogeneity of the Effect of Advanced Placement and Dual Enrollment by Students' Ability



### AP and DE Differences in Bachelor Degree Attainment



NOTES: Solid lines plot the regression-adjusted coefficients for FCAT 10th grade (reading and math mean) score deciles dummies interacted with AP and DE participation on the outcome as the dependent variable. Regression controls for same covariates as in Table 3. The dashed line is the difference between the AP and DE coefficients.





## 8. Conclusion

This study used Florida's statewide data for two cohorts of high school students to assess the relative power of Advanced Placement (AP) and Dual Enrollment (DE) course experiences for predicting students' success. Basing identification of the effects on statistical controls for previous achievement and school and family characteristics, results indicated that both AP and DE are strongly associated with college access and degree attainment, though there are important differences in outcomes across programs. While DE students are, on average, more likely to go to college after high school, AP students are more likely to first enroll in a four-year institution. Despite this difference in initial enrollment, the difference between DE and AP in terms of bachelor's degree attainment is much smaller and not robust to model specifications. Taken together, these results suggest a relative underrepresentation of DE students at four-year colleges. This has important implications for college admission practices that are unduly influenced by AP participation and for policies addressing factors other than academic readiness that affect DE students' ability-college undermatch.

While DE participation is associated with positive outcomes, this effect is seen only for students who took DE courses at the community college; DE participation had no effect for students who took courses at the high school. In light of current concerns about high schools' ability to deliver college-level instruction and the lack of a standardized curriculum in DE courses, the results might call for increased quality control for DE college credits earned at high school campuses. Future (quasi-)experimental research should further investigate the relationship between DE course location and educational outcomes to establish causality.

AP and DE programs have become a prominent feature of the high school education system and their growth is expected to continue. AP participation is increasingly being used by selective colleges for screening highly motivated and able students in their admission process (Breland, Maxey, Genand, Cumming, & Trapani, 2002). Amidst budgetary deficits, state governments are turning to these programs as a mean of shortening the time and decreasing the number of credits needed for students to get through the education pipeline. At the same time, there is a growing perception that both programs are effective interventions for improving educational outcomes not only for high-ability students but also for middle- or even low-achievers. As these programs continue to expand, it is important to increase our knowledge about which students choose to participate in each program, how their choice affects their educational prospects, and whether high-stakes policies that treat these programs differently are justified.



## Appendix A: Participation Rates by District

**Table A.1**

**Participation Rate in AP or DE for High Ability Students  
(Top Quartile of the FCAT 10th Grade score) by District**

	Students in Top Quartile of FCAT 10th Grade Score Distribution	Advanced Placement Participation rate (%)	Dual Enrollment Participation rate (%)	Absolute Difference AP versus DE Participation Rate	AP (DE) Dominant District
District 1 <sup>a</sup>	53	0.0	81.1	81.1	DE-dominant
District 2	86	0.0	79.1	79.1	DE-dominant
District 3	70	1.4	78.6	77.1	DE-dominant
District 4	56	1.8	76.8	75.0	DE-dominant
District 5	22	0.0	72.7	72.7	DE-dominant
District 6	57	3.5	75.4	71.9	DE-dominant
District 7	21	0.0	71.4	71.4	DE-dominant
District 8	50	0.0	68.0	68.0	DE-dominant
District 9	94	0.0	66.0	66.0	DE-dominant
District 10	216	18.1	83.8	65.7	DE-dominant
District 11	192	0.5	64.1	63.5	DE-dominant
District 12	107	0.0	62.6	62.6	DE-dominant
District 13	5,129	71.4	12.6	58.7	AP-dominant
District 14	53	0.0	56.6	56.6	DE-dominant
District 15	112	4.5	58.0	53.6	DE-dominant
District 16	94	3.2	54.3	51.1	DE-dominant
District 17	1,238	69.3	20.0	49.3	AP-dominant
District 18	108	23.1	72.2	49.1	DE-dominant
District 19	37	0.0	48.6	48.6	DE-dominant
District 20	21	19.0	66.7	47.6	DE-dominant
District 21	2,393	77.6	30.4	47.2	AP-dominant
District 22	436	20.2	65.1	45.0	DE-dominant
District 23	1,646	57.8	14.2	43.6	AP-dominant
District 24	1,138	63.9	21.5	42.4	AP-dominant
District 25	400	17.0	58.5	41.5	DE-dominant
District 26	4,423	68.4	28.2	40.3	AP-dominant
District 27	3,048	61.8	23.4	38.5	
District 28	668	47.2	85.3	38.2	
District 29	92	31.5	69.6	38.0	
District 30	5,132	59.1	21.8	37.3	
District 31	70	42.9	80.0	37.1	
District 32	73	50.7	13.7	37.0	
District 33	188	17.6	53.2	35.6	
District 34	117	10.3	43.6	33.3	
District 35	1,154	77.4	44.6	32.8	
District 36	32	21.9	53.1	31.3	
District 37	37	0.0	29.7	29.7	
District 38	803	59.8	32.0	27.8	
District 39	97	21.6	47.4	25.8	
District 40	4,160	61.0	37.0	23.9	

	Students in Top Quartile of FCAT 10th Grade Score Distribution	Advanced Placement Participation rate (%)	Dual Enrollment Participation rate (%)	Absolute Difference AP versus DE Participation Rate	AP (DE) Dominant District
District 41	592	48.8	72.3	23.5	
District 42	969	43.9	20.5	23.3	
District 43	620	43.4	65.6	22.3	
District 44	1,582	50.6	28.8	21.7	
District 45	893	52.9	31.4	21.5	
District 46	1,342	54.6	33.8	20.9	
District 47	815	49.7	70.1	20.4	
District 48	185	43.2	23.2	20.0	
District 49	10	80.0	60.0	20.0	
District 50	119	55.5	37.0	18.5	
District 51	66	60.6	78.8	18.2	
District 52	1,386	59.7	43.6	16.2	
District 53	132	47.0	62.9	15.9	
District 54	534	37.8	53.2	15.4	
District 55	510	47.6	32.7	14.9	
District 56	74	36.5	50.0	13.5	
District 57	108	76.9	63.9	13.0	
District 58	427	44.3	56.9	12.6	
District 59	192	58.3	69.3	10.9	
District 60	560	48.2	37.3	10.9	
District 61	274	44.5	34.7	9.9	
District 62	662	50.3	41.1	9.2	
District 63	23	47.8	39.1	8.7	
District 64	994	53.1	44.7	8.5	
District 65	574	48.8	55.1	6.3	
District 66	581	47.2	53.4	6.2	
District 67	2,469	54.8	53.0	1.8	
State average	50,616	57.6	34.5	23.1	

NOTES: To preserve confidentiality, districts are identified with fictional identification numbers.

Participation rates are based on 2000 and 2001 high school senior cohorts in the top quartile of the statewide FCAT 10th grade (reading and math mean) score distribution. Participation is defined as taking at least one AP or DE academic course either in 11th or 12th grade.

<sup>a</sup>Districts 1–26 are districts with an at least 40-percentage point difference in their AP and DE participation rates.

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