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# College Credit on the Table? Advanced Placement Course and Exam Taking

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Millions of high school students who take an Advanced Placement (AP) course in one of over 30 subjects can earn college credit by performing well on the corresponding AP exam. Using data from four metro-Atlanta public school districts, we find that 15 percent of students' AP courses do not result in an AP exam. We predict that up to 32 percent of the AP courses that do not result in an AP exam would result in a score of 3 or higher, which generally commands college credit at colleges and universities across the United States. Next, we examine disparities in AP exam-taking rates by demographics and course taking patterns. Most immediately policy relevant, we find evidence consistent with the positive impact of school district exam subsidies on AP exam-taking rates. In fact, students on free and reduced-price lunch (FRL) in the districts that provide a higher subsidy to FRL students than non-FRL students are more likely to take an AP exam than their non-FRL counterparts, after controlling for demographic and academic covariates.

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**Abstract**

Millions of high school students who take an Advanced Placement (AP) course in one of over 30 subjects can earn college credit by performing well on the corresponding AP exam. Using data from four metro-Atlanta public school districts, we find that 15 percent of students' AP courses do not result in an AP exam. We predict that up to 32 percent of the AP courses that do not result in an AP exam would result in a score of 3 or higher, which generally commands college credit at colleges and universities across the United States. Next, we examine disparities in AP exam-taking rates by demographics and course taking patterns. Most immediately policy relevant, we find evidence consistent with the positive impact of school district exam subsidies on AP exam-taking rates. In fact, students on free and reduced-price lunch (FRL) in the districts that provide a higher subsidy to FRL students than non-FRL students are more likely to take an AP exam than their non-FRL counterparts, after controlling for demographic and academic covariates.

Key words: Educational Economics, Advanced Placement, High School Coursework
JEL Classification: I22, I20

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## 1. Introduction

Taking advanced college-level coursework in high school is pervasive across the United States. Among the public high school graduates in the class of 2019 nationally, 1,245,527 (38.9 percent) took at least one Advanced Placement (AP) exam, which is more than a 50 percent increase over the last ten years.[1] Between the 2002-03 and 2010-11 academic years, the number of students taking college-level courses in a dual-enrollment program increased 80 percent to 1.2 million.[2] While there are many arguments in favor of (and in opposition to) such advanced course work, one potential benefit is the ability to earn college credit while still in high school. Earning college credit while in high school is related to numerous positive collegiate outcomes, including performance in college and college graduation (Dougherty et al., 2006; Morgan and Klaric, 2007; An, 2013; Allen and Dadgar, 2012; Patterson and Ewing, 2013).

This paper addresses the simple but novel research question—do students who take Advanced Placement (AP) courses take the corresponding AP exams or are they leaving college credit on the table? For more than 30 AP courses, students can obtain college credit by performing well on the corresponding AP exam at the end of the school year. College credit through AP exams causally results in a higher probability of graduating college in four years (Smith et al., 2017). This is especially important since many college students struggle to graduate and graduate on time (Bound et al., 2010; Denning, et al., 2021). Scoring high enough on an AP exam to earn college credit also induces more advanced coursework in high school (Smith et al., 2017), more females taking upper level STEM courses in college (Gurantz, 2019), and increases the probability the student's college major will be in the AP subject (Avery, et al., 2018). Collectively, taking an AP exam and performing well substantially impacts students' trajectories through college.

There are a number of reasons students who take an AP course may not take the corresponding AP exam, which motivate our analyses. First and foremost, the costs of taking the AP exam may outweigh the benefits. The exam fees constitute a direct financial cost, which can be as high as $91. Moreover, there may be indirect costs such as time spent studying and sitting for the exam, as well as psychological costs of a high stakes exam (e.g., Banks and Smyth, 2015). All these costs, especially the exam fee, likely motivate states like Georgia to subsidize at least one AP exam for students eligible for free and reduced-priced lunch (FRL). Many Georgia school

[1] Source: College Board website. Link: https://reports.collegeboard.org/ap-program-results/class-2019-data
[2] Source: National Center for Education Statistics. Link: https://nces.ed.gov/pubs2013/2013002/tables/table_01.asp

districts, including all four we explore, go above and beyond the state subsidy by making some (or all) AP exams free for some (or all) students. On the benefit side, students may know they are likely to perform poorly on the exam, resulting in few if any benefits (i.e., college credit) and so even small costs may outweigh the benefits.

The second set of reasons students who take an AP course may not take the AP exam stems from a mountain of evidence on the behavioral and informational constraints that lead to undesirable educational outcomes on the path to and through college.[3] On the behavioral side, some students are dissuaded by small costs and procedures in the college application process, even if the benefits actually outweigh the costs, such as taking the SAT or ACT (Klasik, 2013; Hurwitz et al., 2015; Goodman, 2016; Hyman, 2017; Cook and Turner, 2019) or paying a small college application fee and writing an admission essay (Smith, et al., 2015). In this context, an exam fee or a three-hour exam may be sufficient to overlook the benefits of performing well. On the informational side, disadvantaged students may not have the same resources, peers, and schools as relatively advantaged students to help them navigate educational procedures and decisions (e.g., Bettinger, et al., 2012; Hoxby and Turner, 2013; Dillon and Smith, 2017). Here, some AP course enrollees may not know about college credit policies or how they can benefit from college credit, should they score high enough.

Using data from four metro-Atlanta public school districts from school year (SY) 2014-15 to SY 2016-17, we find that 15 percent of students' AP course enrollments do not result in an AP exam. Using a flexible model with a rich set of controls, we predict that up to 32 percent of the AP courses that do not lead to exams would receive scores of 3 or higher, generally corresponding to college credit. To our knowledge, we are the first paper to document these simple results on AP exam-taking rates. This also represents a potential actionable policy lever—incentives for students to take the AP exam—that corresponds to the massive growth in advanced coursework enrollment over the last decade.

Motivated by the previously mentioned literature, we also examine AP exam-taking rates by different student subgroups and find substantial disparities in AP exam-taking rates between traditionally disadvantaged populations and relatively advantaged students. Eighteen percent of the courses taken by students on FRL do not lead to an exam compared to 15 percent for students not on FRL. Black students take an AP course but do not take the AP exam 23 percent of the time,

[3] See Page and Scott-Clayton (2016) for a thorough review of the evidence.

compared to 10 and 13 percent for Asian students and White students, respectively. The rates are 18 and 15 percent for Hispanic and non-Hispanic students, respectively.[4]

Next, we estimate multiple linear regressions to assess whether the above unconditional statistics on AP exam taking are driven by factors correlated with FRL status and race/ethnicity or by those measures in and of themselves. We also investigate potential policy levers to increase AP exam-taking rates. We find that after adding a rich set of controls—including AP course grades—courses taken by students using FRL are 2 percentage points more likely to result in an AP exam than those taken by students not using FRL. FRL students typically have worse educational outcomes than non-FRL students, on average (e.g., Papay et al., 2015), making this an uncommon result in the literature. The districts that provide a higher AP exam subsidy for FRL students than non-FRL students drive the positive relationship, with courses taken by FRL students being 3 percentage points more likely to result in an AP exam. In the districts with high AP exam subsidies but not differentially so by FRL status, we see no difference in exam-taking rates by FRL status. Taken together and with a series of other analyses, the evidence is consistent with these AP exam subsidy policies leading to an increase in AP exam taking for FRL students. These are the very students who are targeted by the subsidies and are often subject to financial and informational constraints.

After adding a rich set controls to our regressions, we do not see substantial disparities in AP exam-taking rates between males and females[5] but we find troubling racial disparities. Courses taken by Black students are almost 4 percentage points less likely to take an AP exam compared to their White peers, even when accounting for differences in AP course grades, FRL status, and high school enrolled. We also find that courses taken by Hispanic students are almost 1.5 percentage points less likely to take the exam compared to non-Hispanic students. Our analyses do not provide evidence as to why the Black-White and Hispanic-non-Hispanic disparities persists in this context and find this to be a compelling place for further research and school intervention.

[4] Ethnicity and race are not mutually exclusive categories in these data.

[5] Furthermore, we investigate whether there is a lower AP exam-taking rate by females, especially in AP courses where female students are under-represented. We also explore if a female student being paired with female teachers leads to more AP exam-taking. We find no evidence that females are less likely to take an AP exam, even in AP courses where they are the minority. We fail to detect an effect of a female student being paired with a female teacher on the probability of taking the AP exam; we also fail to detect an effect even in AP subjects in which females are underrepresented. For brevity, we don't present these results in the paper.

Finally, we examine several other factors that potentially affect AP exam taking. First, although twelfth-grade students are the least likely grade to take an AP exam, the impact of exam subsidies appear to be largest for these students. Second, we find some evidence that taking relatively more AP courses reduces the probability of taking all AP exams. Combined, these results suggest that the timing and number of exam subsidies enter the calculus of whether to take an AP exam; policymakers and educators can take this into account if they are looking to increase taking rates.

Overall, our results highlight the fact that not all students who take AP courses take the AP exam, including some of whom we predict would score a 3 or higher and earn college credit. Although we only focus on a few potential ways to induce AP exam taking, we provide evidence consistent with a positive effect of exam subsidies on AP exams taking, thereby suggesting that students can be incentivized to take AP exams. This may be particularly important given the underlying AP exam-taking disparities, especially for Black students with similar academic credentials as their White peers. These results build on a rich literature about AP that typically focuses on AP course enrollment, spanning inequality in access and enrollment (e.g., Solórzano and Ornelas, 2002; Klopfenstein, 2004), impacts on learning (e.g., Conger et al., 2019), and impacts on college enrollment (e.g., Jackson, 2010). In an era where school districts (and researchers) are fully immersed in advanced coursework, getting students over the last hurdle to take an AP exam may be a relatively straightforward policy lever.

## 2. Data and Setting

### 2.1. Advanced Placement

Since 1955, Advanced Placement (AP) gives high school students an opportunity to take college level courses while in high school and potentially earn college credit. There are currently 38 different AP courses in seven different subject categories: History and Social Sciences, English, Science, Math and Computer Science, World Language and Culture, Arts, and AP Capstone. Each AP course is designed to cover the concepts from the corresponding introductory college level course. Schools must be accredited by the AP Course Audit to offer AP courses.

At the end of an AP course in May, students can take the corresponding AP exam, which typically lasts between two to three hours. The exam is designed by college faculty and high school

teachers to test a mastery of the subject matter at a college level. Exam scores range from 1 to 5 in integer values. The exams are only offered once a year, so retaking is rare.

Most universities provide credit for an AP exam score of 3 or above, but there is considerable variation in credit granting across colleges and AP subjects. For example, Appendix Table 1 shows that credit granting AP exam scores for the ten most popular AP courses in Georgia at some of the largest public universities in the state varied between 3 to 5; however, the modal score is a 3 and the most academically selective public institution in the state accepts mostly 4s. In lieu of college credit, some colleges use AP scores for placement in and out of certain courses.

### 2.2. Sample Overview

Our analyses consider four large metro-Atlanta districts from SY 2014-15 to SY 2016-17 using administrative, student-level data from the Metro Atlanta Policy Lab for Education (MAPLE), a collaboration between academic researchers and several Atlanta-area public school districts. We refer to these districts as Districts 1, 2, 3, and 4.[6] The data include information on student and teacher demographics; AP course-taking and course grades; and AP exam taking and scores.

To construct the sample, we begin with the high school student-course level data, which contains all courses students take in a school year after eighth grade. We restrict the course data to only AP courses as identified by course codes from the Georgia Department of Education. We do not consider AP Research or AP Seminar courses, classes that were almost never taken across our sample (e.g., AP Japanese), or AP Art courses that require a student to submit a portfolio in lieu of an exam.

Most AP courses are two semesters long and most students take both semesters, so we primarily make use of the second semester course as a marker for having taken the AP course.[7] For our main sample, we consider only students' AP courses that are most likely the terminal course in a sequence of AP courses (e.g., the first semester of a one-semester sequence or the second semester of a two-semester sequence). In particular, we include courses from students who took more than one term of a course in a year,[8] those who took a course in the final term of the

[6] We do not reveal the names of the districts for confidentiality reasons.
[7] It can also happen that, e.g., an AP subject that is typically two semesters is only offered for one semester.
[8] We also include those enrolled in a year-long term.

year (e.g., in the second semester), and those who took a course in which most students in the broad sample take only one semester.[9] We view the resulting sample as a good proxy for terminal-course takers. We run a robustness check with an alternate definition of AP course-taking where we consider a student to have taken an AP course if she took any course in a sequence.[10]

We determine that a student took the AP exam if an AP exam record exists for the student's corresponding course. We do not consider the small set of students who took an AP exam but did not take the corresponding course in that same year.[11] We also drop the few observations for which no student in a district in a year took the corresponding exam (minimum 10 observations).[12]

The school data include information on student race and ethnicity. Race is not mutually exclusive. Because most students select a mutually exclusive option, we categorize students as White, Black, Asian, or other race. The other race category includes those who select multiple races as well as American Indian and Pacific Islander. Hispanic/non-Hispanic is its own variable indicating if a student self-identifies as having Hispanic origin.[13] Additionally, we consider a student in a year as being FRL if they are ever considered eligible for either free or reduced-price lunch.

We make use of two primary samples with the above data. The first sample is at the student-year-course level (which we refer to as student-course hereafter) and includes 194,778 observations. This sample allows for multiple observations per student when they take multiple AP courses. The second sample is at the student-year level and includes 95,074 observations. It has only one observation per student per year to examine student decisions at the aggregate level.

[9] These courses are Physics C: Electricity and Magnetism; Government and Politics: Comparative, Economics: Microeconomics, and Economics: Macroeconomics. These courses appear to rarely be offered as a two-term sequence; in these cases, if a student took only the first term of this sequence, they would be included in the main sample. Other courses also appear to in some cases be offered as a one-semester course; if a student took one of these one-term courses in a term before the final term (e.g., in the first semester), they would not be included in the main sample.

[10] We also include students who did not earn high school course credit in the course.

[11] This can happen for a number of reasons such as if the student took a similar course that was not AP and wanted to try their luck on the AP exam or if the student has accumulated exam-specific knowledge in another way such as by learning a language outside of school.

[12] In particular, we drop (observations in a district-year) twice for Physics 1 and once for Physics 2 (all the same district), and twice for Government & Politics: Comparative (both for the same district). These represent approximately 1 percent of observations. In some cases, 0 students took the exam in a school in a district, potentially due to missing data; we keep these observations as long as there was at least one who took it in the district.

[13] In the summary statistics, we group and define underrepresented minorities (URM) by combining students who are at least one of Hispanic, American Indian, Black, and Pacific Islander.

This sample includes only observations in which all of a students' courses are what we consider to be terminal courses in the year.

The Appendix contains additional details on the data preparation, such as how we clean the raw data and how we treat students who transfer districts but have conflicting demographic information. All these decisions are about small subsets of students and will not impact our results.

### 2.3. Summary Statistics

Table 1 shows the summary statistics of high school students in general (column 1) and AP course takers (column 2).[14] The unit of observation is the student, regardless of how many AP exams they took. The first two columns show that there are disproportionately lower percentages of FRL, Black, and Hispanic students taking AP courses compared to their shares in the student body. The first column of Table 1 shows that around half of the high school students in our four metro-Atlanta districts are FRL eligible, are female, or are Black. Column 2 shows that students who enroll in an AP course are less likely to be FRL eligible, Black, or Hispanic (33 percent are FRL eligible, 33 percent are Black, and 13 percent are Hispanic) than the entire student body (50 percent are FRL eligible, 49 percent are Black, and 18 percent are Hispanic). Most of the AP students are from grades 11 and 12 (32 and 27 percent, respectively). In addition, most of the AP students are from districts 3 and 4 (62 percent) rather than 1 and 2 (38 percent).

The remaining columns of Table 1 are at the student-course level such that there can be multiple observations per student. It shows all AP course enrollments (column 3), AP course enrollments that do not lead to an exam (column 4), and AP course enrollments that do lead to an exam (column 5). The third column shows that 30 percent of all AP courses are taken by FRL students, 54 percent by female students, and 28 percent by Black students.

Similarly, there are stark differences between the statistics in the fourth and fifth columns, which highlight the differences between AP course enrollees who take an AP exam and those who do not.[15] Specifically, the fourth column shows that 34 percent of the AP courses that do not lead to an exam are taken by FRL students, 54 percent by female students, and 41 percent by Black students. The fifth column shows that 29 percent of the AP courses that lead to an exam are taken

[14] In Appendix Table 2, we restrict the sample to districts 1 and 2 in Panel A and to districts 3 and 4 in Panel B.
[15] T-tests indicate that the means of each variable are statistically different between exam takers and non-takers. When splitting by districts (Appendix Table 2), all are statistically different at the 10% level except Female for Districts 1 and 2 and FRL for Districts 3 and 4.

by FRL students, 55 percent by female students, and 25 percent by Black students. Twelfth graders take the highest share of total AP courses (41 percent) and the highest share of courses that do not lead to an AP exam (59 percent). Importantly, the average numeric grade in AP courses is higher for exam takers compared to non-exam takers. The average numeric grade for all AP course takers is 91.97, exam non takers is 86.11, and exam takers is 93.04. This is the first indication of positive selection into AP exam taking.

AP exam-taking behavior also varies by AP subject. Table 2 presents the number of AP course enrollments, the percent of AP courses leading to AP exam, predicted percent of AP courses leading to AP exam (adjusted for academic performance and student demographics), and average AP exam score for exam takers for different AP subjects. The AP subjects are grouped by the broad areas and sorted by the number of course takers within each category. From column 1 we see that some of the most popular AP subjects in our sample are World History and US History and they have a high unconditional probability of leading to an AP exam (92 percent and 89 percent, respectively, compared to 85 percent in the full sample; see column 2 and Figure 1). Some of the least popular subjects are foreign languages such as Chinese, Spanish and German.

From column 2, we find that the highest unconditional probability of taking an exam is for Calculus BC and Chinese (94.3 percent and 93.4 percent, respectively). Column 3 shows the probability of taking an exam conditional on academic performance and student demographics is highest for Calculus BC and Spanish Language (92.3 percent and 90.7 percent, respectively). From column 4, we see that some of the highest average AP exam scores are in Spanish Language and Calculus BC (3.8 and 3.7, respectively).

### 2.4. AP Exam Prices and Subsidies

The full price of each AP exam is approximately $90 but varies by year. "Low-income" students pay considerably less but it varies by school district. The College Board pays about $30 of all AP exams for low-income students and the state of Georgia pays the remaining balance of one AP exam for all low-income public school students.[16] The College Board defines "low-income" as a family with income below 185 percent of the national poverty level or qualified as

[16] Details as of 2020 found here: https://apcentral.collegeboard.org/ap-coordinators/exam-ordering-fees/exam-fees/federal-state-assistance

an "identified student."[17] In practice, school counselors and school administrators help find and validate subsidy eligible students.

School districts also offer varying subsidies for AP exams. During the sample period, two sample districts (Districts 1 and 2) offered unlimited free AP exams for all students.[18] In contrast, the policies of the two other districts (Districts 3 and 4) varied by the FRL status of the student: one offered two free AP exams for FRL eligible students and one for non-FRL students and another offered unlimited free AP exams for FRL-eligible students and one free AP exam for non-FRL-eligible students.[19]

## 3. Methodology

### 3.1 Predicting AP Exam Scores

We start by predicting AP exam scores for students who do not take the exams and hence have no score. As noted, we find that many AP courses do not lead to AP exams, yet this fact alone is not necessarily concerning. If a student is unlikely to perform well on the AP exam and will likely not earn college credit, then nothing is lost and, arguably, something is gained (e.g., time) by not taking the exam. However, if they are likely to score well on the exam but do not take it, they may be "leaving college credit on the table."

To predict AP exam scores, we use the student-course level sample and regress the AP exam scores of AP exam takers on a number of predictor variables, as seen below:

$$Score_{iscgt} = \alpha_0 + X_{it}\alpha_1 + \tau_t + \lambda_g + \eta_{sc} + \varepsilon_{iscgt} \quad (1)$$

where individual *i* in school *s* took AP course *c* in grade level *g* in year *t.* Each student may appear in multiple observations if they take multiple AP courses. *Score* is the integer score obtained on the AP exam. We include a vector of observed covariates *X* which includes indicators for gender,

[17] Students at a Community Eligibility Provision participant schools do not automatically qualify but need further validation such as being an "identified student." An identified student is defined by College Board as a student in foster care, in Head Start, experiencing homelessness or migrancy, or living in households that receive SNAP/Food Stamps, TANF cash assistance, or who receives the Food Distribution on Indian Reservations benefits. See details here: https://apcentral.collegeboard.org/ap-coordinators/exam-ordering-fees/exam-fees/reductions

[18] One of these districts requires all students to pay a $10 fee.

[19] See Appendix Table 3 for details.

race/ethnicity, FRL status, and course grade fixed effects.[20] We also include a set of fixed effects, including school-by-subject fixed effects ($\eta_{sc}$)—because there are different propensities to take the exam across different subjects (see Table 2) and across schools—as well as year ($\tau_t$) and grade level ($\lambda_g$) fixed effects. In addition, we include a number of interactions with subject: FRL, race, Hispanic, and female.

We obtain coefficient estimates from equation (1) using Ordinary Least Squares and apply them to all observations to obtain predicted AP exam scores. These predictions are not integers because of our linear probability model, but the continuous score can be thought of as a weighted probability of two integer scores. We also test the robustness of the result by estimating a logit model where the outcome is whether the student scores a 3 or above. This allows us to sum the predicted probabilities and determine how many students would get a 3 or higher.

Regardless of our estimation strategy, our predictions are based only on observable student characteristics. It is likely that students do not take AP exams because they believe they would perform poorly for reasons unobserved to the researchers. For example, "bad exam takers" may choose not to take the exam and this could be correlated with some of our observable characteristics. We believe that this scenario and most other scenarios are likely to bias our predicted scores of non-takers upward and thereby inflate the fraction of non-exam takers who would receive a 3 or higher. As such, our estimates should be considered an upper bound.

### 3.2. Determinants of AP Exam Taking

We estimate predictors and correlates of AP exam taking among all the AP courses by using variations of the following equation:

$$TookExam_{iscgt} = \beta_0 + X_{it}\beta_1 + \beta_2 FRL_i + \theta_c + \tau_t + \delta_{sg} + \epsilon_{iscgt} \quad (2)$$

This equation is similar to equation (1) and preserves its notation, but the outcome variable is now an indicator for whether the student took the exam corresponding to the course.[21] The sample now

[20] In other words, course grade (the grade they received in the course) bins with width 1 as opposed to width 5, which we use elsewhere.

[21] The main differences are that in equation 1, to improve predictive power, we include course grade fixed effects; school-by-subject fixed effects; and FRPL-course (subject) interactions, race-subject interactions, Hispanic-subject interactions, and female-subject interactions. In equation 2, we include course grade bins with width 5, course fixed effects, and school-grade level (ninth, tenth, etc.) fixed effects.

includes all courses, not only the courses that resulted in an exam. We estimate several variations of this equation, but in our preferred specification, *X* includes gender and race/ethnicity indicators, and course grade indicators in bins of 5. In all the variations of this model we include year ($\tau_t$) and subject ($\theta_c$) fixed effects and the preferred model includes school-by-grade ($\delta_{sg}$) fixed effect as well. We vary the sets of fixed effects to include different combinations of district, grade level, district-by-grade level, and school fixed effects to test the stability of our estimates on the other coefficients. We cluster the standard errors at the school level. We are particularly interested in $\beta_2$, which represents the percentage point difference in the probability of taking an AP exam, conditional on enrolling in the course, between FRL students and non-FRL students.

In addition to the student-course level analyses above, we also define the unit of observation to be at the student-year level in the following equation:

$$NumExam_{isgt} = \gamma_0 + X_{it}\gamma_1 + \gamma_2 FRL_i + \gamma_3 NCourse_i + \tau_t + \delta_{sg} + \varepsilon_{isgt} \quad (3)$$

Here, *NumExam* is a count variable denoting how many AP exams a student took. *NCourse* is a count variable for the number of AP courses the student took.[22] We use this model to analyze how FRL status, race, ethnicity, gender, and the number of courses relate to the number of AP exams taken, conditional on the number of AP courses. The other variables are as previously defined; course grade indicators in bins of 5 is now constructed using the average grade of each of the student's courses. The coefficients of primary interest are $\gamma_2$ and $\gamma_3$, which show the difference in the number of exams taken by FRL students and the conversion rate to exam for each additional course, respectively.

In one specification that relies on equation (3), we analyze AP exam subsidy policies by making use of the number of exams a student can take for free. We determine this based on the student's FRL status and district. In districts 1 and 2, the number of free exams is equal to the number of courses. For one district among districts 3 and 4, the number of free exams is one for non-FRL students and two for FRL students (who take at least two courses). For the other district, it is one for non-FRL students, and is equal to the number of courses for FRL students.

[22] In equation 2, we control for the subject of the course the student took. Here, we instead control for the number of courses the student took, but we do not control for the particular set of subjects the student took.

We also consider an alternative dependent variable in equation (3), an indicator of whether the student took the same number of exams as courses (*AllExam*). The intent of this analysis is to assess whether taking relatively more courses reduces the probability of taking all exams. Students may be short on time or money and have to choose from their set of AP courses. In fact, Pope and Fillmore (2015) find that the timing and order of AP exams impacts performance.

## 4. Results

### 4.1. Basic Statistics

Overall, 15 percent of AP courses do not lead to an AP exam (Figure 1).[23] We also find substantial disparities between traditionally disadvantaged populations and relatively-advantaged students. For example, 18 percent of the courses taken by FRL students do not lead to an exam but the statistic is 15 percent for non-FRL students. For Black students, 23 percent of courses do not lead to exams while for White and Asian students it is 13 percent and 10 percent, respectively. Eighteen percent of the courses taken by Hispanic students do not lead to an exam compared to 15 percent for non-Hispanic students.

We also see differential exam-taking rates by grade and district. Twenty-three percent of twelfth graders' AP courses do not lead to an AP exam, while lower grades are close to 10 percent. We later show that students who take multiple AP courses (12th graders are likely to take multiple courses) are more likely to miss some exams but they are also on the precipice of college, which may change their behavior, incentives, and information on whether they can earn college credit. They also are more likely to take multiple AP courses at the same time, which we later show negatively relates to exam taking. Students from districts 3 and 4 are more likely to be enrolled in an AP course that do not lead to exams (18 percent) compared to those from districts 1 and 2 (10 percent).

Table 3 explores the relationship between the number of AP courses taken by a student in a year and the number of AP exams taken. More than half of students take only one course in a year (column 5), and few take more than five. The second column shows that the percentage of students who take zero AP exams decreases monotonically (but not linearly) from 16.6 percent to 2 percent as the number of AP courses increases from one to five. As the number of AP courses

[23] Note that Figure 1 shows the percentage of the category that does not take the exam, while Column 4 of Table 1 shows the percentage of all non-takers who fall into each category.

increase from one to five, the percentage of students taking all the AP exams in the courses enrolled in decreases from 83.4 percent to 66.2 percent (third column): the more AP courses, the lower the probability of taking all the corresponding AP exams. Also, the mean number of exams taken increases monotonically as the number of AP courses increases (fourth column).

Combined, Table 3 shows the intuitive result that students who take more AP courses take more AP exams. However, it also shows that students taking more AP courses are less likely to take all exams. This is despite the fact that we may expect the students taking more courses to be positively selected. These unconditional statistics motivate later analyses on how the number of courses relates to the number of exams, controlling for student characteristics.

### 4.2. Predicting AP Exam Scores

On average, we find that students predicted to earn higher AP grades do earn higher grades in reality, albeit with a fair amount of dispersion.[24] Figure 2 presents box and whisker plots of predicted AP exam scores for each actual AP exam score, with the sample limited to courses that resulted in AP exams. The box represents the interquartile range, or the 25$^{th}$ through 75$^{th}$ percentiles, with the median in the middle. The whiskers are the top (bottom) percentile plus (minus) 1.5 times the interquartile range. We obtain a relatively high correlation coefficient between predicted and actual score of 0.78 and an R-squared of 0.61 from the prediction equation. The prediction performs relatively poorly in the tails but, fortunately, students predicted to score at the tails are less likely to be misclassified as scoring above/below a 3, which is the point of the exercise.

AP exam non-takers are predicted to perform less well than AP exam takers. Figure 3 plots the kernel density of predicted AP exam scores for AP exam takers and non-takers. AP exam takers have a higher predicted score (solid line) than AP exam non takers (dashed line). This is an expected result since it may not make sense to take an exam if likely to not perform well. However, this analysis is based entirely on observable characteristics, so it is possible that the true densities are further apart, depending on the role of unobservables in the decision to not take an exam.

[24] Appendix Table 4 shows the coefficients from the prediction regression (Column 4). The other columns are variations either in specification (Columns 1-3) or restricting to particular sets of districts (Columns 5 and 6). The predicted percent of those who did not take the test who pass (get a 2.5 or higher) is indicated in the row at the bottom of the table.

Table 4 catalogues the results of the prediction exercise and leads us to the result that up to 32 percent of non-exam takers could score a 3 or higher. We group the continuous predicted scores into the discrete bands of length 0.5, indicated in the first column. The second column is the count of AP courses that did not lead to exams in a given band, and the third columns shows the corresponding percent. Summing the third column for predicted AP grades of 2.5 and above, we find that 32 percent of the courses that do not lead to an AP exam would receive a 3 or higher, a score than generally corresponds to college credit. Here, we round up the scores between 2.5 and 3 to be 3. This totals 9,454 AP courses in the four school districts in three years. The more conservative approach, which is to include only students predicted to receive a 3 or higher without rounding,[25] yields a substantially smaller estimate of 17 percent. The fourth column is the total number of students with predicted (not actual) AP exam scores, regardless of whether they took the exam or not. The fifth column is the ratio of the second and fourth columns and represents the share of courses that had no exam among all courses in each predicted grade band. The decreasing nature of this ratio is consistent with students choosing not to take the exam based on their probability of not scoring well. Yet, there are still a substantial number of students at high scores who do not take the exams and potentially leave college credit on the table.

### 4.3. Determinants of AP Exam Taking

Table 5 explores the determinants of AP exam taking to investigate whether disparities by subgroup exist (after controlling for other factors) and whether any potential policies to increase AP exam taking and alleviate disparities present themselves. In column 1, we estimate equation (2) with only subject and year fixed effects and find that FRL-eligible students are 3.6 percentage points less likely to take an AP exam after taking the AP course. This negative relationship is common between measures of income and educational outcomes but in this context, it was not a foregone conclusion given that the FRL students were already enrolled in the course.

FRL status is likely correlated with race/ethnicity and other variables, so we add in a set of controls to test the stability of our initial FRL coefficient. Column 2 adds controls for sex and race/ethnicity in addition to the subject and year fixed effects in column 1. The coefficient on FRL

[25] The logit model described in section 3.1 corresponds to the conservative model. Appendix Table 5 shows the coefficients from different specifications using logit (Columns 5-8) and using OLS (Columns 1-4) when the outcome is an indicator for scoring 3 or higher. The predicted percent of those who did not take the test who pass (computed by adding up the predicted logit probabilities from all rows) is indicated in the row at the bottom of the table.

status is now statistically indistinguishable from zero but the coefficients on race and ethnicity highlight some disparities. Black and Hispanic students are 11 and 4.3 percentage points less likely to take an AP exam than White and non-Hispanic students, respectively.

We next provide evidence that students with lower AP course numeric grades are less likely to take the AP exam. Figure 4 shows the positive relationship between numeric AP course grade and the probability of taking the AP exam. Not only does this reinforce the previous analyses that some students with a low probability of performing well (as measured by course grades) are not taking the exam (see also Figure 5), but it also suggests that AP course grade is an important determinant that could be confounded with our demographic variables; thus, it is an important control variable. Another notable insight from Figure 4 is that there are more circles above the diamonds when the numeric score is lower than 70. This shows that FRL eligible students are more likely to take the AP exam even for lower AP course grades.

Adding course grade to the regressions, as in column 3 of Table 5, confirms the positive relationship between course grades and AP exam taking, even conditional on other student characteristics. Interestingly, the coefficient on FRL status is now a positive 2.1 percentage points, showing that FRL students with similar course performances as non-FRL students are more likely to take the AP exam. This motivates analyses below as to whether the subsidies that target FRL students are playing a role. The coefficients on race and ethnicity are somewhat muted relative to the previous column but the disparities remain for Black students.

We add various combinations of district, school, and grade-level fixed effects in columns 4 through 7 of Table 5, and the coefficients are mostly insensitive to our choice of fixed effects.[26] Column 7 is our preferred specification because the school-by-grade fixed effects mean we are comparing students with different characteristics (e.g., race or FRL status) but who are in the same high school and grade, which could conceivably explain the coefficients (but does not in practice). We find that FRL eligible students have a 1.9 percentage point higher probability of taking the AP exam than non-FRL students. Given the baseline prevalence of taking an AP exam is 85 percent, this amounts to a 2.24 percent increase in the probability of taking the AP exam. This is not an especially large coefficient or implied percent; however, the fact that FRL students tend to lag behind in most educational outcomes makes this coefficient stand out relative to the existing

[26] We obtain nearly identical results for the model with school fixed effects when we instead use school random effects.

literature. Also, this positive relationship between FRL status and exam taking is consistent with higher AP exam subsidies for FRL students than for non-FRL students in two of our four partner school districts. We explore this further in section 4.4.

In column 7, we see small differences in AP exam-taking rates by gender (females are 0.8 percentage points lower than males), but Black students are 3.9 percentage points less likely to take an AP exam than their White peers (in the same school and grade). While we cannot explain this result, it is worthy of future investigation. Finally, other race students have a 1.8 percentage point lower probability of taking an exam compared to their White peers, and Hispanic students have a 1.3 percentage point lower probability of taking an AP exam compared to their non-Hispanic peers.[27]

### 4.4. AP Subsidies

To explore if the positive relationship between FRL eligibility and AP exam taking (found in column 7 of Table 5) might be driven by the two school districts that provide higher AP exam subsidies for FRL students than for non-FRL students, we perform subsample analysis in Table 6. Panel A includes only districts 1 and 2—those that offer all AP exams for free to all students, regardless of their FRL status. In column 1, we obtain a large, negative, and significant coefficient on the FRL variable. However, as we add controls, especially fixed effects, we find no statistical relationship with FRL status and AP exam taking in these districts. This null effect is largely a desirable result for districts because FRL students tend to lag behind in educational outcomes.

Panel B of Table 6 only includes districts 3 and 4, the districts in which FRL students get more AP exam subsidies than non-FRL students. With a full set of controls (column 7), we show that being FRL eligible is associated with a 2.8 percentage point increase in the probability of taking the AP exam compared to non-FRL students. Taken together, Panels A and B of Table 6 show that the results in Table 5 are driven by districts 3 and 4—the very districts that provide extra financial incentives for FRL students to take the AP exams. We also note that the last two columns of the table show similar estimates for students who are predicted to receive a 3 or higher on the

[27] We do a robustness check for these results in table with an alternate definition of AP course taking. In Appendix Table 6, we define a student to have taken an AP course if she took any course in that AP course sequence in that year. The results are qualitatively the same.

AP exam with those scoring lower, so college credit is likely influenced by the district exam subsidies.

We next look deeper into the impact of AP exam subsidies by analyzing the data at the student level and looking across districts and FRL status. Table 7 shows the results of equation 3 where the outcome is the number of AP exams taken. Similar to Table 5, in column 1 we see that the coefficient on FRL is positive and statistically significant, implying that conditional on a host of variables, particularly numeric grade, FRL students take 0.025 more AP exams than non-FRL students. The coefficient is relatively small in magnitude but surprisingly non-negative.

We then explore the relationships of various demographic and academic variables with the number of AP exams taken by a student for different subsamples. To that end, we restrict the sample to various district and FRL status combinations in columns 2 through 7. We first consider districts 1 and 2, where the amount of the AP exam subsidy does not depend on FRL status and all students get all exams for free. In column 2, we cannot detect a relationship between FRL status and the number of AP exams taken. Column 5 restricts to districts 3 and 4, where the AP exam subsidy varies by FRL status. In contrast to the result for districts 1 and 2, we find that FRL students take 0.040 more AP exams compared to non-FRL students, which is consistent with the exam subsidy influencing exam taking. Further evidence in support of the positive role of subsidies is shown by comparing the coefficients on the number of courses in columns 2 and 5. We find that taking one more AP course results in 0.940 more AP exams in the districts that provide all exams for free (districts 1 and 2), while in the districts that do not, taking one more AP course results in 0.883 more AP exams.

Next, we split column 2 (districts 1 and 2) into FRL students (column 3) and non-FRL students (column 4) to further examine the role of subsidies by FRL status. Non-FRL students have a higher conversion rate of course to exam (one more course leads to 0.947 more AP exams) compared to FRL students (one more course leads to 0.900 more AP exams). Absent higher subsidies compared to non-FRL students, FRL students in districts 1 and 2 are less likely to take an AP exam, which is consistent with most literature and the negative relationship between FRL status and educational outcomes. However, we find the opposite in districts 3 and 4 in which FRL students take more exams than non-FRL students. Specifically, taking one more course leads to 0.922 more exams for FRL students, while this number is 0.859 for non-FRL students. These results are consistent with a “subsidy effect” that drives the course to exam conversion rate up,

even more so than any "FRL effect," which tends to drive the course to exam conversion rate down.

### 4.5. Timing and Number of Exams

We first consider whether the high school grad level relates to AP exam taking. High school twelfth graders, in particular, face different incentives to take an AP exam than students in lower grades. First, twelfth graders may know with more certainty if and where they will go to college and the college credit offered (or not) for an AP exam score. Second, time in high school is ending, so students only have one more opportunity to earn college credit while in high school. Our data shows that the highest share of AP courses are taken by twelfth graders but they also have the highest prevalence of not taking an exam after taking the course (23 percent compared to 10, 8, and 12 percent for grades 9, 10 and 11, respectively).

To further explore the relationship between high school grade of the student on AP exam taking, in Appendix Table 7, we split the sample into twelfth graders and those in other grades and re-estimate equation 3 (analogous to Table 7). In panel A, we see how FRL eligibility, number of courses enrolled in, and number of subsidized tests relate to the number of AP exams for non-twelfth graders. In panel B we consider the same relationships for twelfth graders. Comparing the coefficients for FRL indicator in the two panels of Appendix Table 7 reveals that the earlier results of Table 7 were driven by twelfth graders. That is, being an FRL student in twelfth grade is associated with taking more AP exams and this is driven by districts 3 and 4 where exam subsidies are higher for FRL students than for non-FRL students.

We further investigate how taking different numbers of courses relates to the probability of taking all the AP exams corresponding to those courses in Appendix Table 8. This analysis uses a variation of equation 3 but the dependent variable is a binary indicator for whether the student took all the AP exams corresponding to the set of courses in which the student enrolled. The first column of Appendix Table 8 shows that FRL students have a 1.3 percentage point higher probability of taking all the exams among her/his courses compared to non-FRL students. From columns 2 and 3, we see that the full sample results are driven by districts 3 and 4 where the AP subsidy generosity is based on FRL status. This is consistent with what we see in Table 7 and shows that an AP subsidy is associated with a higher probability of taking all the exams.

## 5. Discussion and Conclusion

We find that the practice of AP course-taking without exam taking is fairly prevalent in the four metro-Atlanta school districts that comprise our sample, with 15 percent of the AP courses not leading to an exam. We predict that up to 32 percent of the courses that do not lead to an AP exam would receive a score of 3 or higher if the exam was taken. Thus, high school students seem to be leaving credit on the table by not taking the AP exams.

In our sample of four school districts over three years, this amounts to an upper bound of 9,454 AP courses that could have turned to college credits if the AP exams were taken. In SY 2017-18, the tuition and fees faced by a four-year in-state Georgia public college student was $7,206.[28] Assuming a typical college student enrolls for 30 credits per year (10 three credit courses), one three credit college course costs $721. 9,454 successful AP exams would save students in the four districts up to $6.8 million over three years.[29] This is roughly eight times the cost of these AP exams ($0.9 million)[30] for the students or the state and school districts,[31] though it is a smaller multiple if unsuccessful exams are factored in.

AP course offerings and exam subsidies are well within the control of school districts, though budgets constrain the ability to pay for these courses and subsidies. In exploring the possible determinants of AP exam taking, we show strong evidence that districts' policies on exam subsidies seem to improve exam-taking rates. The existing policies make it no less likely that FRL students take exams than non-FRL students in the same high school with the same course grades. We also show some evidence that the timing and number of AP courses relates to the probability of taking exams, which can inform which students are at risk of not taking the exam.

Our results quantify the potential issue of not taking AP exams and highlight that this may be a relatively straightforward policy lever for schools and districts, especially because students are already taking the AP course. However, we cannot and do not quantify the benefits and costs of AP course enrollment, which is front and center of many administrators' minds. The benefits (and costs) of the course enrollment may far outweigh the benefits (and costs) of taking the exam.

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[28] Source: National Center for Education Statistics, https://nces.ed.gov/programs/digest/d18/tables/dt18_330.20.asp. Table 330.20.
[29] $721*9,454 = $6,816,334.
[30] $91*9,454 = $860,314. This assumes the previous cost of $91, which is now $94.
[31] The calculation depends on whether the student, district, state, or College Board pays the fees.

Our work also only examines policies and practices that are observable in the data. Schools and districts likely push students to take AP exams in ways unobserved to the researchers. Policies, initiatives, and intervention around AP exam taking are a fruitful area for future research.

**References**


Allen, D., & Dadgar, M. (2012). Does dual enrollment increase students' success in college? Evidence from a quasi-experimental analysis of dual enrollment in New York City. *New Directions for Higher Education*, *2012*(158), 11-19.

An, B. P. (2013). The impact of dual enrollment on college degree attainment: Do low-SES students benefit? *Educational Evaluation and Policy Analysis*, *35*(1), 57-75.

Avery, C., Gurantz, O., Hurwitz, M., & Smith, J. (2018). Shifting college majors in response to advanced placement exam scores. *Journal of Human Resources*, 53(4), 918-956.

Banks, J., & Smyth, E. (2015). 'Your whole life depends on it': academic stress and high-stakes testing in Ireland. *Journal of Youth Studies*, *18*(5), 598-616.

Bettinger, E. P., Long, B. T., Oreopoulos, P., & Sanbonmatsu, L. (2012). The role of application assistance and information in college decisions: Results from the H&R Block FAFSA experiment. *The Quarterly Journal of Economics*, *127*(3), 1205-1242.

Bound, J., Lovenheim, M. F., & Turner, S. (2010). Why have college completion rates declined? An analysis of changing student preparation and collegiate resources. *American Economic Journal: Applied Economics*, *2*(3), 129-57.

Conger, D., Kennedy, A. L., Long, M. C., & McGhee, R. (2019). The effect of advanced placement science on students' skills, confidence and stress. *Journal of Human Resources*, 0118-9298R3.

Cook, E. E., & Turner, S. (2019). Missed Exams and Lost Opportunities: Who Could Gain From Expanded College Admission Testing?. AERA Open, 5(2), 2332858419855030.

Denning, J., Eide, E., Mumford, K., Patterson, R., and Warnick, M. (2021). Why have college completion rates increased? *National Bureau of Economic Research Working Paper 28710*.

Dillon, E. W., & Smith, J. A. (2017). Determinants of the match between student ability and college quality. *Journal of Labor Economics*, *35*(1), 45-66.

Dougherty, C., Mellor, L., & Jian, S. (2006). The relationship between advanced placement and college graduation. 2005 AP Study Series, Report 1. *National Center for Educational Accountability*.

Goodman, S. (2016). Learning from the test: Raising selective college enrollment by providing information. *Review of Economics and Statistics*, *98*(4), 671-684.

Gurantz, O. (2019). How college credit in high school impacts postsecondary course-taking: the role of AP exams. *Education Finance and Policy*, 1-43.

Hoxby, C., & Turner, S. (2013). Expanding college opportunities for high-achieving, low income students. *Stanford Institute for Economic Policy Research Discussion Paper*, *12*, 014.

Hurwitz, M., Smith, J., Niu, S., & Howell, J. (2015). The Maine question: How is 4-year college enrollment affected by mandatory college entrance exams?. *Educational Evaluation and Policy Analysis*, *37*(1), 138-159.

Hyman, J. (2017). ACT for all: The effect of mandatory college entrance exams on postsecondary attainment and choice. *Education Finance and Policy*, *12*(3), 281-311.

Jackson, C. K. (2010). A little now for a lot later a look at a texas advanced placement incentive program. *Journal of Human Resources*, *45*(3), 591-639.

Klasik, D. (2013). The ACT of enrollment: The college enrollment effects of state-required college entrance exam testing. *Educational researcher*, *42*(3), 151-160.

Klopfenstein, K. (2004). Advanced Placement: Do minorities have equal opportunity?. *Economics of Education Review*, *23*(2), 115-131.

Morgan, R., & Klaric, J. (2007). AP students in college: An analysis of five-year academic Careers. Research Report No. 2007-4. *College Board*.

Page, L. C., & Scott-Clayton, J. (2016). Improving college access in the United States: Barriers and policy responses. *Economics of Education Review*, *51*, 4-22.

Papay, J. P., Murnane, R. J., & Willett, J. B. (2015). Income-based inequality in educational outcomes: Learning from state longitudinal data systems. *Educational Evaluation and Policy Analysis*, *37*(1_suppl), 29S-52S.

Patterson, B. F., & Ewing, M. (2013). Validating the use of AP exam scores for college course placement. Research Report 2013-2. *College Board*.

Pope, D. G., & Fillmore, I. (2015). The impact of time between cognitive tasks on performance: Evidence from advanced placement exams. *Economics of Education Review*, 48, 30-40.

Smith, J., Hurwitz, M., & Avery, C. (2017). Giving college credit where it is due: Advanced Placement exam scores and college outcomes. *Journal of Labor Economics*, *35*(1), 67-147.

Smith, J., Hurwitz, M., & Howell, J. (2015). Screening mechanisms and student responses in the college market. *Economics of Education Review*, *44*, 17-28.

Solórzano, D. G., & Ornelas, A. (2002). A critical race analysis of advanced placement classes: A case of educational inequality. *Journal of Latinos and Education*, *1*(4), 215-229.

## Tables

Table 1: Summary Statistics

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | Student-level | | AP Course-level | | |
| | All Students | AP Course-taking Students | Course-All | Course-No Exam | Course-Exam |
| FRL | 0.50 | 0.33 | 0.30 | 0.34 | 0.29 |
| Female | 0.49 | 0.56 | 0.54 | 0.54 | 0.55 |
| URM | 0.69 | 0.48 | 0.42 | 0.57 | 0.39 |
| Black | 0.49 | 0.33 | 0.28 | 0.41 | 0.25 |
| Asian | 0.09 | 0.17 | 0.22 | 0.14 | 0.23 |
| White | 0.31 | 0.41 | 0.42 | 0.35 | 0.44 |
| Other | 0.11 | 0.09 | 0.09 | 0.10 | 0.08 |
| Hispanic | 0.18 | 0.13 | 0.13 | 0.15 | 0.12 |
| Grade 9 | 0.29 | 0.16 | 0.09 | 0.05 | 0.09 |
| Grade 10 | 0.26 | 0.25 | 0.17 | 0.09 | 0.18 |
| Grade 11 | 0.22 | 0.32 | 0.34 | 0.26 | 0.36 |
| Grade 12 | 0.23 | 0.27 | 0.41 | 0.59 | 0.37 |
| District 1 and 2 | 0.35 | 0.38 | 0.35 | 0.23 | 0.37 |
| District 3 and 4 | 0.65 | 0.62 | 0.65 | 0.77 | 0.63 |
| Numeric Grade | | 90.54 | 91.97 | 86.11 | 93.04 |
| Exam Grade | | | | | 2.81 |
| Observations | 387,698 | 95,074 | 194,778 | 30,125 | 164,653 |

This table shows means for several populations: 1. Full Sample, which includes all students—regardless of if they took an AP exam—in grades 9-12; this column is at the student-year level. 2. The AP course-taking sample, which is at the student-year level. 3. The AP course-taking sample, which is at the student-year-course level. Columns 4 and 5 split column 3 by whether or not the course led to an exam. We ran t-tests on columns 4 and 5 of the table and find that all are statistically different at the 1 percent level (with one being significant at the 5 percent level). As such, we do not include the column of p-values.

Table 2: AP Course Subjects

| Course | (1) N | (2) % Took Exam | (3) Predicted % Took Exam | (4) Exam Grade |
|---|---|---|---|---|
| History and Social Sciences | | | | |
| World History | 20,209 | 92.0 | 86.2 | 2.7 |
| US History | 19,594 | 89.4 | 88.3 | 2.6 |
| Economics: Macroeconomics | 14,528 | 73.9 | 78.4 | 2.8 |
| Psychology | 12,438 | 85.9 | 87.7 | 3.1 |
| Human Geography | 12,184 | 90.6 | 86.5 | 2.7 |
| Government & Politics: US | 9,019 | 83.0 | 81.8 | 2.6 |
| Economics: Microeconomics | 4,343 | 76.0 | 80 | 3.2 |
| European History | 1,105 | 82.7 | 81.6 | 3.3 |
| Government & Politics: Comparative | 1,046 | 82.5 | 81.8 | 3.4 |
| English | | | | |
| English Language & Composition | 17,635 | 91.1 | 90.1 | 2.8 |
| English Literature & Composition | 12,390 | 75.5 | 81.5 | 2.6 |
| Sciences | | | | |
| Environmental Science | 10,572 | 75.5 | 77.2 | 2.6 |
| Biology | 8,572 | 88.2 | 87.5 | 2.8 |
| Physics 1 | 7,597 | 80.9 | 79.1 | 2.3 |
| Chemistry | 4,828 | 87.7 | 85.9 | 2.8 |
| Physics C – Mechanics | 1,097 | 83.9 | 85.2 | 3.9 |
| Physics C - Electricity & Magnetism | 993 | 86.2 | 86.7 | 3.6 |
| Physics 2 | 633 | 56.4 | 55.7 | 2.6 |
| Math and Computer Science | | | | |
| Calculus AB | 9,771 | 85.0 | 87.6 | 2.8 |
| Statistics | 9,717 | 79.5 | 82.5 | 2.7 |
| Calculus BC | 4,513 | 94.3 | 92.3 | 3.7 |
| Computer Science A | 3,624 | 71.1 | 69.6 | 2.8 |
| Computer Science Principles | 1,053 | 78.1 | 76.3 | 3.2 |
| World Languages and Cultures | | | | |
| Spanish Language | 3,365 | 88.9 | 90.7 | 3.8 |
| French | 1,067 | 85.4 | 88.5 | 3.1 |
| Latin | 429 | 88.1 | 87.9 | 2.6 |
| German | 338 | 88.5 | 87.5 | 3.6 |
| Spanish Literature | 278 | 83.8 | 86.5 | 2.5 |
| Chinese | 151 | 93.4 | 90.3 | 4.0 |
| Arts | | | | |
| History of Art | 923 | 92.4 | 89.7 | 3.0 |
| Music Theory | 766 | 71.7 | 73.1 | 3.1 |

Notes: This table shows summary statistics broken by AP subject where the unit of observation is a student-year-course. The first column shows the number of courses, followed by the percentage of these courses that resulted in an AP exam. The third column adjusts for FRL, female, race, Hispanic, and grade, and is the predicted exam-taking percentage for the average student along each of these characteristics. The fourth column is the average AP exam grade received conditional on taking the exam.

Table 3: AP Exam-taking Behavior

| (1) #AP Courses | (2) % Take 0 Exams | (3) % Take All Exams | (4) Mean # Exams | (5) N |
|---|---|---|---|---|
| 1 | 16.6 | 83.4 | 0.8 | 53,679 |
| 2 | 8.1 | 79.2 | 1.7 | 22,194 |
| 3 | 4.4 | 75.5 | 2.6 | 10,939 |
| 4 | 3.3 | 71.2 | 3.5 | 5,507 |
| 5 | 2.0 | 66.2 | 4.4 | 2,130 |
| 6-9 | 1.4 | 57.3 | 5.3 | 625 |

Notes: This student-year level table shows AP exam-taking behavior for students enrolled in different number of courses (denoted in column 1). Students taking 6 through 9 courses are combined. The second column shows the percentage of students in the row who take 0 exams, while the third column shows the percentage of students in the row who take all of their exams. The fourth column shows the mean number of exams taken.

Table 4: Predicted AP Exam Scores

| (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|
| Predicted AP score | Courses that did not lead to AP exam in this grade band | Courses that did not lead to AP exam in this grade band as percent of total number of courses that did not lead to an AP exam | # Total courses in this grade band irrespective of the AP exam being taken or not | Courses that did not lead to AP exam as percent of all AP courses in this grade band |
| <1 | 4151 | 13.8 | 12355 | 33.6 |
| [1, 1.5) | 4902 | 16.3 | 17408 | 28.2 |
| [1.5, 2) | 5944 | 19.7 | 23739 | 25.0 |
| [2, 2.5) | 5674 | 18.8 | 28982 | 19.6 |
| [2.5, 3) | 4509 | 15.0 | 32725 | 13.8 |
| [3, 3.5) | 2817 | 9.4 | 32298 | 8.7 |
| [3.5, 4) | 1435 | 4.8 | 25571 | 5.6 |
| [4, 4.5) | 502 | 1.7 | 14461 | 3.5 |
| >=4.5 | 191 | 0.6 | 7239 | 2.6 |
| Total | 30125 | 100.0 | 194778 | |

Notes: This is a student-course-year level table where the counts are number of individual courses. See Section 3.1 for details on the estimating equation. Actual AP scores are in integer values from 1 to 5. Our predicted AP scores are continuous and unbounded. In this table we present the predicted AP scores in buckets of 0.5 increments.

Table 5: Determinants of AP Exam Taking

| | (1) Basic | (2) Add Demographic Controls | (3) Add academic controls | (4) Add district control | (5) Add district*grade control | (6) Replace district control with school control | (7) Use school*grade control |
|---|---|---|---|---|---|---|---|
| FRL | -0.036** | 0.004 | 0.021* | 0.031*** | 0.031*** | 0.018*** | 0.019*** |
| | (0.015) | (0.012) | (0.012) | (0.010) | (0.009) | (0.005) | (0.005) |
| Female | | 0.005* | -0.008*** | -0.007** | -0.007** | -0.007*** | -0.008*** |
| | | (0.003) | (0.003) | (0.003) | (0.003) | (0.002) | (0.003) |
| Black | | -0.110*** | -0.067*** | -0.038*** | -0.037*** | -0.041*** | -0.039*** |
| | | (0.022) | (0.021) | (0.011) | (0.010) | (0.006) | (0.006) |
| Asian | | 0.020** | 0.007 | 0.013** | 0.014** | 0.003 | 0.004 |
| | | (0.010) | (0.010) | (0.006) | (0.007) | (0.004) | (0.004) |
| Other | | -0.042*** | -0.027** | -0.005 | -0.004 | -0.019*** | -0.018*** |
| | | (0.013) | (0.014) | (0.011) | (0.011) | (0.006) | (0.006) |
| Hispanic | | -0.043*** | -0.024** | -0.004 | -0.004 | -0.015*** | -0.013** |
| | | (0.010) | (0.010) | (0.010) | (0.009) | (0.006) | (0.005) |
| Grade Level = 10 | | | 0.020 | 0.047 | | 0.035 | |
| | | | (0.037) | (0.035) | | (0.029) | |
| Grade Level = 11 | | | -0.019 | -0.009 | | -0.017 | |
| | | | (0.035) | (0.033) | | (0.027) | |
| Grade Level = 12 | | | -0.085** | -0.069** | | -0.077*** | |
| | | | (0.036) | (0.034) | | (0.028) | |
| Constant | 0.909*** | 0.927*** | 0.324** | 0.327** | 0.253* | 0.297** | 0.305** |
| | (0.017) | (0.016) | (0.131) | (0.156) | (0.147) | (0.139) | (0.138) |
| Observations | 194,778 | 194,778 | 194,778 | 194,778 | 194,778 | 194,778 | 194,778 |
| R-squared | 0.038 | 0.057 | 0.110 | 0.136 | 0.145 | 0.195 | 0.222 |
| Mean of Dependent Variable | 0.845 | 0.845 | 0.845 | 0.845 | 0.845 | 0.845 | 0.845 |
| Year FE | YES | YES | YES | YES | YES | YES | YES |
| Subject FE | YES | YES | YES | YES | YES | YES | YES |
| District FE | | | | YES | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| District-Grade FE | | | | YES | | |
| School FE | | | | | YES | |
| School-Grade FE | | | | | | YES |
| Course Grade Bins | YES | YES | YES | YES | YES | YES |

Notes: Observations are at the student-course-year level. The dependent variable is a binary variable indicating if the exam was attempted. Column 1 includes subject and year fixed effects. Columns 2 adds demographic controls sex and race/ethnicity to column 1. Column 3 adds academic controls - course grade bins of a width of 5 and grade level fixed effects. Column 4 adds district fixed effects to column 3, while column 5 instead adds district by grade fixed effects. Columns 6 and 7 are corollaries to columns 4 and 5 where district is replaced by school. Standard errors are clustered at the school level. Statistical significance at the 1 percent, 5 percent, and 10 percent levels is indicated by ***, **, and *, respectively.

Table 6: Determinants of AP Exam Taking

Panel A: Districts 1 and 2 (Same Subsidy for All Students):

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|
| | Basic | Add Demographic Controls | Add academic controls | Add district control | Add district*grade control | Replace district control with school control | Use school*grade control | Pred<2.5 | Pred>=2.5 |
| FRL | -0.064*** | 0.019 | 0.028 | 0.001 | -0.001 | -0.009 | -0.009 | -0.010* | -0.009 |
| | (0.019) | (0.024) | (0.022) | (0.011) | (0.011) | (0.006) | (0.005) | (0.006) | (0.009) |
| Observations | 68,169 | 68,169 | 68,169 | 68,169 | 68,169 | 68,169 | 68,169 | 24,678 | 43,491 |
| R-squared | 0.026 | 0.066 | 0.110 | 0.167 | 0.171 | 0.250 | 0.294 | 0.321 | 0.137 |
| Mean of Dependent Variable | 0.897 | 0.897 | 0.897 | 0.897 | 0.897 | 0.897 | 0.897 | 0.794 | 0.955 |

Panel B: Districts 3 and 4 (Higher Subsidy for FRL Students than non-FRL Students):

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FRL | -0.003 | 0.019 | 0.040*** | 0.040*** | 0.040*** | 0.028*** | 0.028*** | 0.038*** | 0.030*** |
| | (0.017) | (0.013) | (0.011) | (0.011) | (0.011) | (0.006) | (0.006) | (0.007) | (0.007) |
| Observations | 126,609 | 126,609 | 126,609 | 126,609 | 126,609 | 126,609 | 126,609 | 57,806 | 68,803 |
| R-squared | 0.057 | 0.069 | 0.135 | 0.135 | 0.137 | 0.184 | 0.199 | 0.205 | 0.160 |
| Mean of Dependent Variable | 0.818 | 0.818 | 0.818 | 0.818 | 0.818 | 0.818 | 0.818 | 0.730 | 0.891 |
| Year FE | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Subject FE | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| District FE | | | | YES | | | | | |
| District-Grade FE | | | | | YES | | | | |
| School FE | | | | | | YES | | | |
| School-Grade FE | | | | | | | YES | YES | YES |
| Course Grade Bins | | | YES | YES | YES | YES | YES | YES | YES |

Notes: This table divides the sample used in table 5 into two subsamples - districts 1 and 2 in Panel A and districts 3 and 4 in Panel B. Observations are at the student-course-year level. The dependent variable is a binary variable indicating if the exam for a course enrollment was attempted; taking the value 1 if the exam was taken and 0 if not. Column 1 includes subject and year fixed effects. Columns 2 adds demographic controls sex and race/ethnicity to column 1. Column 3 adds academic controls - course grade bins of a width of 5 and grade level fixed effects. Column 4 adds district fixed effects to column 3, while

column 5 instead adds district by grade fixed effects. Columns 6 and 7 are corollaries to columns 4 and 5, where district is replaced by school. Columns 8 and 9 uses the same specification as column 7 but divides the sample into courses with a predicted score of less than 2.5 and courses with a predicted score of 2.5 and higher, respectively. Standard errors are clustered at the school level. Statistical significance at the 1 percent, 5 percent, and 10 percent levels is indicated by ***, **, and *, respectively.

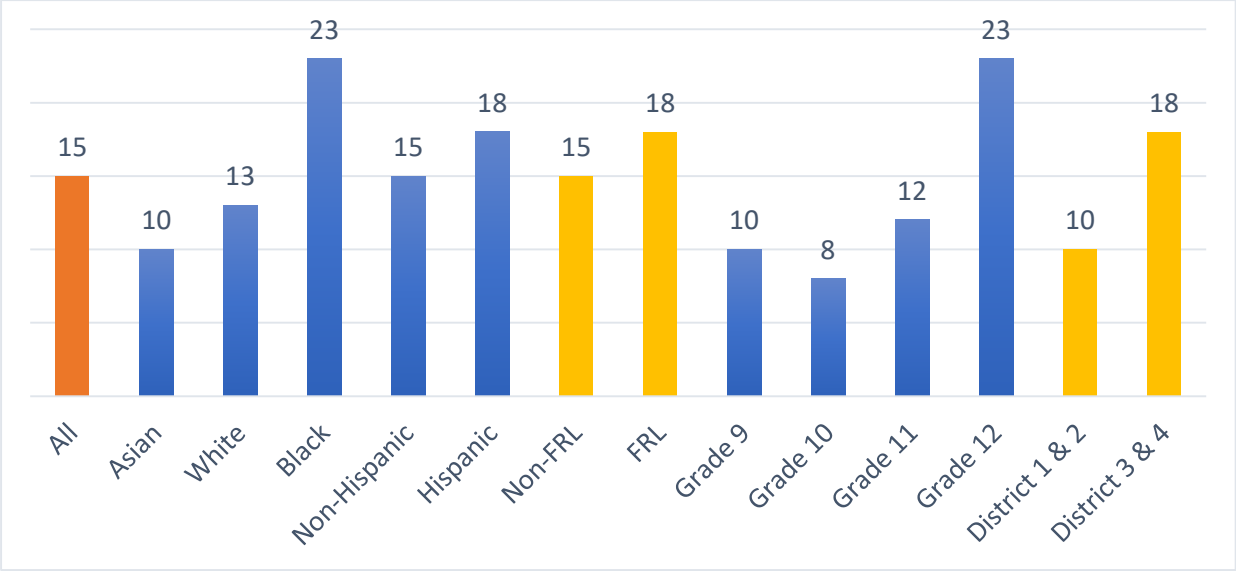
Table 7: Number of Exams Taken

| | (1) Full Sample | (2) Districts 1&2 | (3) Districts 1&2: FRL Only | (4) Districts 1&2: non-FRL Only | (5) Districts 3&4 | (6) Districts 3&4: FRL Only | (7) Districts 3&4: non-FRL Only | (8) Full Sample #Subsidised Tests |
|---|---|---|---|---|---|---|---|---|
| FRL | 0.025*** | -0.012 | | | 0.040*** | | | -0.012 |
| | (0.009) | (0.009) | | | (0.011) | | | (0.008) |
| Female | 0.000 | 0.004 | 0.012 | 0.002 | -0.001 | 0.013 | -0.011 | 0.000 |
| | (0.005) | (0.006) | (0.011) | (0.007) | (0.006) | (0.008) | (0.007) | (0.005) |
| Black | -0.046*** | -0.000 | -0.009 | 0.001 | -0.065*** | -0.032** | -0.068*** | -0.049*** |
| | (0.010) | (0.013) | (0.025) | (0.014) | (0.012) | (0.015) | (0.016) | (0.011) |
| Asian | 0.017** | 0.022* | 0.064** | 0.015 | 0.008 | 0.051*** | 0.001 | 0.012* |
| | (0.008) | (0.012) | (0.028) | (0.011) | (0.009) | (0.015) | (0.012) | (0.007) |
| Other | -0.027*** | 0.010 | 0.015 | 0.009 | -0.037*** | -0.011 | -0.054*** | -0.030*** |
| | (0.007) | (0.011) | (0.027) | (0.013) | (0.010) | (0.010) | (0.015) | (0.008) |
| Hispanic | -0.011 | 0.021* | 0.017 | 0.019* | -0.022* | -0.008 | -0.013 | -0.013 |
| | (0.009) | (0.012) | (0.024) | (0.011) | (0.012) | (0.016) | (0.016) | (0.010) |
| # Courses | 0.903*** | 0.940*** | 0.900*** | 0.947*** | 0.883*** | 0.922*** | 0.859*** | 0.860*** |
| | (0.014) | (0.018) | (0.031) | (0.016) | (0.018) | (0.018) | (0.022) | (0.020) |
| #Subsidized Tests | | | | | | | | 0.075*** |
| | | | | | | | | (0.018) |
| Observations | 95,074 | 35,834 | 7,655 | 28,179 | 59,240 | 23,393 | 35,847 | 95,074 |
| R-squared | 0.809 | 0.863 | 0.754 | 0.877 | 0.777 | 0.787 | 0.773 | 0.810 |
| Avg. Course Grade Bins | YES | YES | YES | YES | YES | YES | YES | YES |
| Mean of Dependent Variable | 1.506 | 1.584 | 1.264 | 1.671 | 1.459 | 1.381 | 1.510 | 1.506 |

Notes: Observations are at the student-year level. The dependent variable is the number of AP exams taken by the student in a year. All columns include school-grade and year fixed effects. Average course grade bins are the average grade over the courses and have a width of 5. Column 1 includes the full sample of AP course takers. Column 2 restricts the sample to districts 1 and 2, while column 3 and 4 further restricts the sample in column 2 to FRL students only and non-FRL students only, respectively. Column 5 restricts the sample to districts 3 and 4, while column 6 and 7 further restricts the sample in column 5 to FRL students only and non-FRL students only, respectively. Column 8 uses the full sample as in column 1, but controls for the number of subsidized tests. Standard errors are clustered at the school level. Statistical significance at the 1 percent, 5 percent, and 10 percent levels is indicated by ***, **, and *, respectively.

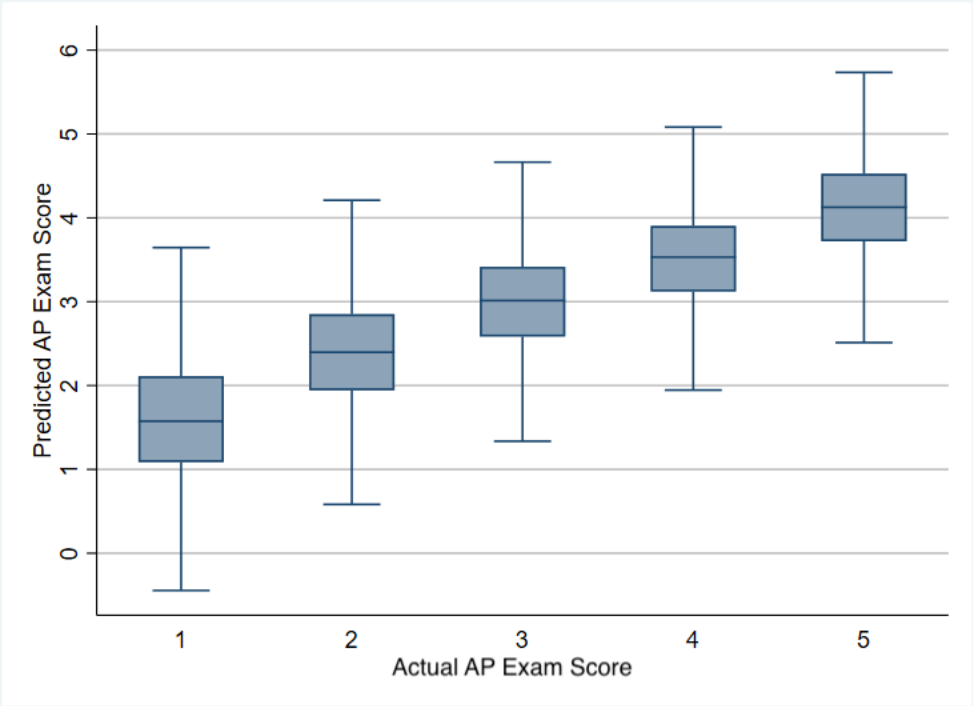
# Figures

Figure 1: Percent of AP Courses Without a Corresponding AP Exam



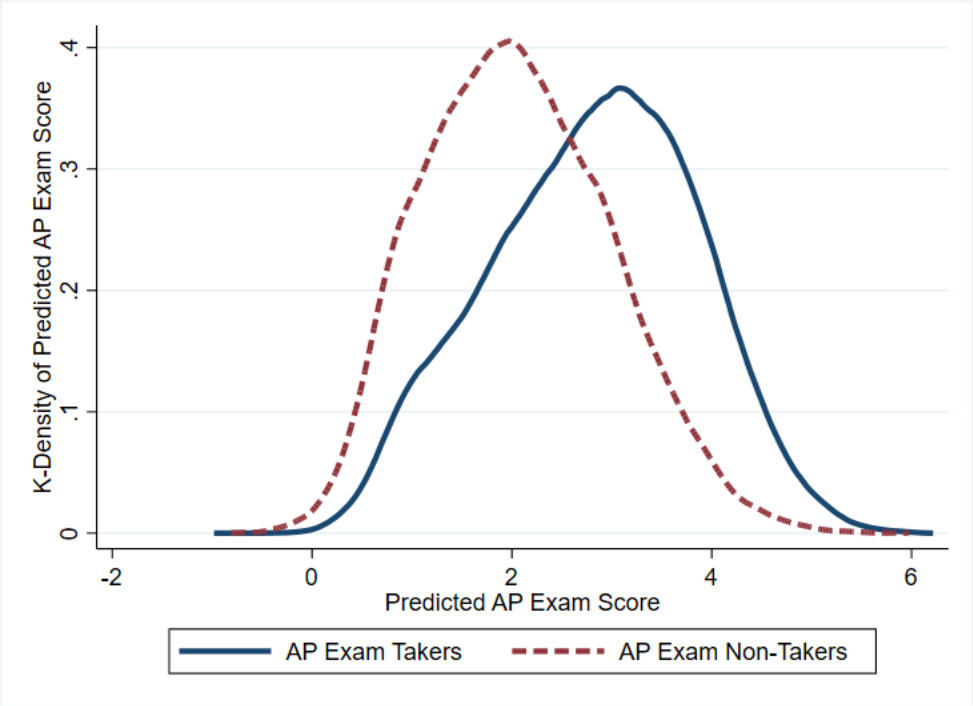

Notes: This figure shows the percent of AP courses that do not lead to an AP exam in the full sample and in subsamples by race, ethnicity and FRL status.

Figure 2: Actual and Predicted AP Exam Grade of AP Exam-Takers



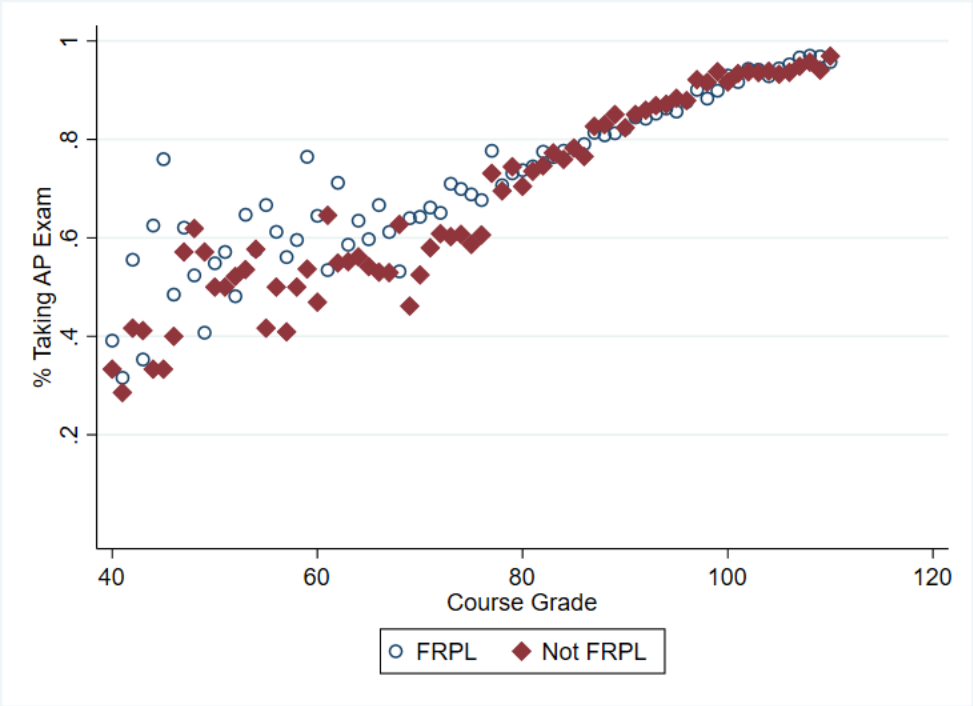

Notes: This figure shows a box and whisker plot of predicted AP exam score vs. actual AP exam score for AP exam-takers (where the unit observation is a student-year-course). The middle of the box is the median, and the edges are the interquartile range, or the 25$^{th}$ and 75$^{th}$ percentiles. The top line, or whisker, is the adjacent value, which is the 75$^{th}$ percentile plus the interquartile range multiplied by 1.5. The bottom line, or whisker, is the 25$^{th}$ percentile minus the interquartile range multiplied by 1.5 Observations beyond the whiskers, or outside values, are not displayed.

Figure 3: Predicted AP Exam Grade Distribution for Exam Takers and Non-Takers



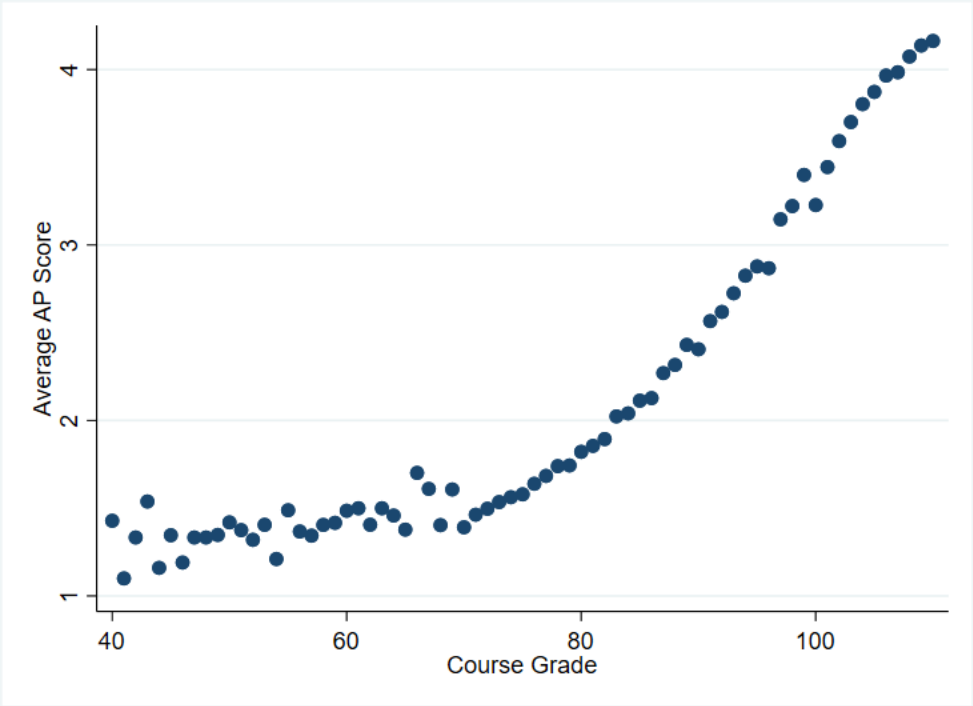

Notes: This figure shows kernel densities of predicted AP exam grade for AP exam-takers (where the unit of observation is a student-year-course) in solid and for AP Exam non-takers in dashed lines.

Figure 4: Relationship Between Course Grade and Exam Taking




Notes: This figure shows the relation between course grade (x-axis) and the percentage of student with a given course grade of at least 40 who take the corresponding AP exam (y-axis). Calculations are performed at the student-course-year level.

Figure 5: Relationship between Exam Score and Course Grade




Notes: This figure shows the relation between course grade (x-axis) and the average AP exam score (y-axis) for the corresponding AP exam for students with a given course grade of at least 40. Calculations are performed at the student-course-year level, and are conditional on the student taking the exam.

# Appendix Tables

Appendix Table 1: Credit Granting AP Exam Scores

| AP Course | Georgia State University | University of Georgia | Georgia Tech University | Kennesaw State University | Georgia Southern University | Perimeter College |
|---|---|---|---|---|---|---|
| World History | 3 | 4 | 4 | 4 | 3 | 3 |
| US History | 3 | 4 | 4 | 4 | 3 | 3 |
| English Language and Composition | 3 | 5 | 4 | 5 | 3 | 3 |
| Government and Politics: US | 3 | 4 | 4 | 4 | 3 | 3 |
| Macroeconomics | 3 | 3 | 4 | 3 | 3 | 3 |
| Psychology | 3 | 3 | 4 | 3 | 3 | 3 |
| English Literature and Composition | 4 | 3 | 4 | 5 | 5 | 3 |
| Human Geography | 3 | 5 | 4 | 3 | 3 | 3 |
| Environmental Science | 4 | 3 | 4 | 3 | 4 | 4 |
| Calculus AB | 4 | 3 | 4 | 3 | 4 | 3 |

Notes: Shows credit granting AP exam scores in major universities and colleges in Georgia for the ten most popular AP courses in our sample. Source: College Board. Link: https://apstudents.collegeboard.org/getting-credit-placement/search-policies

Appendix Table 2: Summary Statistics, Split by Districts

Panel A: Districts 1&2

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Student-level | | AP Course-level | | | |
| | Full Sample | Student | Course-All | Course-No Exam | Course-Exam | T-Test p-value |
| FRL | 0.42 | 0.21 | 0.17 | 0.25 | 0.16 | 0.00 |
| Female | 0.50 | 0.57 | 0.54 | 0.55 | 0.54 | 0.75 |
| URM | 0.69 | 0.43 | 0.36 | 0.65 | 0.33 | 0.00 |
| Black | 0.54 | 0.33 | 0.27 | 0.52 | 0.24 | 0.00 |
| Asian | 0.08 | 0.17 | 0.23 | 0.13 | 0.24 | 0.00 |
| White | 0.32 | 0.45 | 0.46 | 0.27 | 0.48 | 0.00 |
| Other | 0.06 | 0.05 | 0.05 | 0.07 | 0.04 | 0.00 |
| Hispanic | 0.14 | 0.09 | 0.08 | 0.11 | 0.07 | 0.00 |
| Grade 9 | 0.29 | 0.15 | 0.08 | 0.11 | 0.08 | 0.00 |
| Grade 10 | 0.26 | 0.22 | 0.14 | 0.10 | 0.14 | 0.00 |
| Grade 11 | 0.22 | 0.33 | 0.36 | 0.23 | 0.37 | 0.00 |
| Grade 12 | 0.23 | 0.30 | 0.42 | 0.55 | 0.40 | 0.00 |
| District 1 and 2 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | . |
| District 3 and 4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | . |
| Numeric Grade | | 90.77 | 91.98 | 85.29 | 92.75 | 0.00 |
| Exam Grade | | | | | 2.93 | |
| Observations | 135,752 | 35,834 | 68,169 | 7,024 | 61,145 | 68,169 |

Panel B: Districts 3&4

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Student-level | | AP Course-level | | | |
| | Full Sample | Student | Course-All | Course-No Exam | Course-Exam | T-Test p-value |
| FRL | 0.55 | 0.39 | 0.37 | 0.37 | 0.37 | 0.57 |
| Female | 0.49 | 0.56 | 0.54 | 0.53 | 0.55 | 0.00 |
| URM | 0.69 | 0.52 | 0.45 | 0.55 | 0.43 | 0.00 |
| Black | 0.47 | 0.33 | 0.28 | 0.37 | 0.26 | 0.00 |
| Asian | 0.09 | 0.16 | 0.21 | 0.15 | 0.22 | 0.00 |
| White | 0.31 | 0.39 | 0.40 | 0.37 | 0.41 | 0.00 |
| Other | 0.13 | 0.11 | 0.11 | 0.11 | 0.11 | 0.09 |
| Hispanic | 0.21 | 0.16 | 0.15 | 0.16 | 0.15 | 0.05 |
| Grade 9 | 0.29 | 0.16 | 0.09 | 0.04 | 0.10 | 0.00 |
| Grade 10 | 0.26 | 0.26 | 0.18 | 0.09 | 0.20 | 0.00 |
| Grade 11 | 0.22 | 0.32 | 0.33 | 0.27 | 0.34 | 0.00 |
| Grade 12 | 0.23 | 0.26 | 0.40 | 0.61 | 0.36 | 0.00 |
| District 1 and 2 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| District 3 and 4 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | |
| Numeric Grade | | 90.40 | 91.96 | 86.35 | 93.22 | 0.00 |
| Exam Grade | | | | | 2.73 | |
| Observations | 251,946 | 59,240 | 126,609 | 23,101 | 103,508 | 126,609 |

Notes: This is a version of Table 1 where the summary statistics for districts 1&2 are presented in Panel A and those from district 3&4 are presented in Panel B. This table shows means for several populations: 1. Full Sample, which includes all students—regardless of if they took an AP exam—in grades 9-12; this column is at the student-year

level. 2. The AP course-taking sample, which is at the student-year level. 3. The AP course-taking sample, which is at the student-year-course level. Columns 4 and 5 split column 3 by whether or not the course led to an exam. The 5th column shows p-values from a T-test testing if the variables are statistically different between AP course enrollees who take an AP exam and those who do not.

Appendix Table 3: AP Exam Registration Policy

| District | Enrolled Non FRL | Enrolled FRL |
|---|---|---|
| State of GA[32] | | State pays for one AP exam |
| One District among Districts 1 and 2 | District pays for all exams that are not paid by the state or federal funds | District pays for all exams that are not paid by the state or federal funds |
| The Other District among Districts 1 and 2 | District pays for all exams that are not paid by the state or federal funds | District pays for all exams that are not paid by the state or federal funds |
| One District among Districts 3 and 4 | District pays for one exam | District pays for one exam.<br>The state funds one additional exam for any course.<br>Students who are eligible for AP exam fee reduction pay roughly $53 (depending on the year) per exam if they take more than 2 exams |
| The Other District among Districts 3 and 4 | District pays for one exam. All students pay a non-refundable $10 fee. | District pays for all exams that are not paid by the state or federal funds. All students pay a non-refundable $10 fee. |

Notes: This table shows AP Exam registration policies for the state of Georgia and the districts considered in this study.

[32] See https://www.ajc.com/news/local-education/some-fear-change-exam-subsidy-slights-low-income-students/jMvPp7FznJQvZw936Jv6oM/.

Appendix Table 4: Coefficients from AP Exam Grade Prediction Regression

| VARIABLES | (1) Exam Grade | (2) Exam Grade | (3) Exam Grade | (4) Exam Grade | (5) Exam Grade Districts 1 and 2 Only | (6) Exam Grade Districts 3 and 4 Only |
|---|---|---|---|---|---|---|
| FRL | -0.115*** | -0.115*** | -0.110*** | -0.060*** | -0.057 | -0.056*** |
| | (0.006) | (0.006) | (0.006) | (0.017) | (0.038) | (0.019) |
| Female | -0.217*** | -0.216*** | -0.219*** | -0.206*** | -0.228*** | -0.196*** |
| | (0.004) | (0.004) | (0.004) | (0.013) | (0.023) | (0.015) |
| Black | -0.204*** | -0.195*** | -0.184*** | -0.138*** | -0.064 | -0.164*** |
| | (0.007) | (0.007) | (0.007) | (0.019) | (0.042) | (0.022) |
| Asian | -0.094*** | -0.115*** | -0.120*** | -0.091*** | -0.022 | -0.121*** |
| | (0.006) | (0.006) | (0.006) | (0.019) | (0.033) | (0.022) |
| Other | -0.055*** | -0.050*** | -0.048*** | -0.006 | 0.166*** | -0.058* |
| | (0.009) | (0.009) | (0.009) | (0.026) | (0.061) | (0.030) |
| Hispanic | -0.100*** | -0.094*** | -0.088*** | -0.070*** | -0.106** | -0.056** |
| | (0.008) | (0.008) | (0.008) | (0.024) | (0.048) | (0.028) |
| Grade Level = 10 | -0.040 | -0.052** | -0.056** | -0.062*** | -0.093** | -0.042 |
| | (0.025) | (0.024) | (0.024) | (0.024) | (0.041) | (0.029) |
| Grade Level = 11 | -0.203*** | -0.193*** | -0.189*** | -0.187*** | -0.185*** | -0.182*** |
| | (0.024) | (0.024) | (0.023) | (0.023) | (0.040) | (0.029) |
| Grade Level = 12 | -0.232*** | -0.204*** | -0.199*** | -0.192*** | -0.199*** | -0.176*** |
| | (0.024) | (0.023) | (0.023) | (0.023) | (0.040) | (0.028) |
| Numeric Grade | 0.068*** | | | | | |
| | (0.000) | | | | | |
| Constant | -2.317*** | 3.580*** | 3.678*** | 3.728*** | 3.340*** | 3.065*** |
| | (0.063) | (0.433) | (0.492) | (0.491) | (0.843) | (0.498) |
| Observations | 164,071 | 164,071 | 164,071 | 164,071 | 60,722 | 103,349 |
| R-squared | 0.573 | 0.595 | 0.605 | 0.608 | 0.647 | 0.582 |
| Fraction Pass | 0.337 | 0.322 | 0.315 | 0.314 | 0.277 | 0.329 |
| 5 Point Grade Bins | | Yes | | | | |
| Grade Fixed Effect | | | Yes | Yes | Yes | Yes |
| Demographics – Subject Interactions | | | | Yes | Yes | Yes |

Notes: The dependent variable is AP Exam grade. All columns include year fixed effects and school-course subject fixed effects. Standard errors (not robust or clustered) in parentheses. Statistical significance at the 1 percent, 5 percent, and 10 percent levels is indicated by ***, **, and *, respectively.

Appendix Table 5: Coefficients from Passing AP Exam Prediction Regression

| VARIABLES | (1) OLS | (2) OLS | (3) OLS | (4) OLS | (5) Logit | (6) Logit | (7) Logit | (8) Logit |
|---|---|---|---|---|---|---|---|---|
| FRL | -0.039*** | -0.040*** | -0.039*** | -0.017** | -0.256*** | -0.267*** | -0.258*** | -0.106** |
| | (0.003) | (0.003) | (0.002) | (0.007) | (0.019) | (0.019) | (0.019) | (0.053) |
| Female | -0.070*** | -0.070*** | -0.071*** | -0.071*** | -0.565*** | -0.557*** | -0.574*** | -0.549*** |
| | (0.002) | (0.002) | (0.002) | (0.005) | (0.015) | (0.015) | (0.015) | (0.041) |
| Black | -0.079*** | -0.076*** | -0.073*** | -0.073*** | -0.438*** | -0.458*** | -0.441*** | -0.378*** |
| | (0.003) | (0.003) | (0.003) | (0.008) | (0.022) | (0.022) | (0.022) | (0.059) |
| Asian | -0.049*** | -0.053*** | -0.054*** | -0.044*** | -0.341*** | -0.355*** | -0.369*** | -0.316*** |
| | (0.003) | (0.003) | (0.003) | (0.008) | (0.020) | (0.020) | (0.021) | (0.061) |
| Other | -0.025*** | -0.023*** | -0.022*** | -0.015 | -0.123*** | -0.125*** | -0.122*** | -0.077 |
| | (0.004) | (0.004) | (0.004) | (0.011) | (0.030) | (0.030) | (0.030) | (0.085) |
| Hispanic | -0.049*** | -0.048*** | -0.046*** | -0.049*** | -0.255*** | -0.258*** | -0.249*** | -0.234*** |
| | (0.003) | (0.003) | (0.003) | (0.010) | (0.026) | (0.026) | (0.026) | (0.075) |
| Grade Level = 10 | -0.021** | -0.024** | -0.025** | -0.026** | -0.190** | -0.197** | -0.208** | -0.215*** |
| | (0.010) | (0.010) | (0.010) | (0.010) | (0.080) | (0.080) | (0.081) | (0.082) |
| Grade Level = 11 | -0.066*** | -0.065*** | -0.064*** | -0.062*** | -0.523*** | -0.526*** | -0.535*** | -0.523*** |
| | (0.010) | (0.010) | (0.010) | (0.010) | (0.078) | (0.079) | (0.079) | (0.080) |
| Grade Level = 12 | -0.071*** | -0.064*** | -0.063*** | -0.060*** | -0.549*** | -0.549*** | -0.559*** | -0.540*** |
| | (0.010) | (0.010) | (0.010) | (0.010) | (0.077) | (0.077) | (0.078) | (0.079) |
| Numeric Grade | 0.021*** | | | | 0.177*** | | | |
| | (0.000) | | | | (0.001) | | | |
| Constant | -0.900*** | 0.854*** | 0.788*** | 0.815*** | -12.233*** | 2.412 | 8.219*** | 8.684*** |
| | (0.026) | (0.185) | (0.212) | (0.212) | (0.290) | (2.432) | (0.288) | (0.299) |
| Observations | 164,071 | 164,071 | 164,071 | 164,071 | 160,253 | 160,212 | 160,118 | 160,115 |
| R-squared | 0.450 | 0.460 | 0.465 | 0.468 | | | | |
| Fraction Pass | 0.308 | 0.325 | 0.321 | 0.321 | 0.318 | 0.327 | 0.325 | 0.324 |
| 5 Point Grade Bins | | Yes | | | | Yes | | |
| Grade Fixed Effect | | | Yes | Yes | | | Yes | Yes |
| Demographics – Subject Interactions | | | | Yes | | | | Yes |

Notes: Observations are at the student-course-year level. The dependent variable is a binary variable indicating if an AP exam received a 3 or above. All columns include year fixed effects and school-course subject fixed effects. Standard errors (not robust or clustered) in parentheses. Columns 1-4 use OLS. Columns 5-8

use logit. Columns 1, 2, and 3 differ in terms of how course grade is controlled for. Column 1 includes a linear control for numeric course grades, column 2 includes 5 point grade bins, and column 3 includes grade fixed effects. Column 4 includes demographics (FRL, race, Hispanic, and female) and subject interaction to column 3. Statistical significance at the 1 percent, 5 percent, and 10 percent levels is indicated by ***, **, and *, respectively.

Appendix Table 6: Determinants of AP Exam Taking, Taken Any Course in Sequence Sample

| VARIABLES | (1) Basic | (2) Add Demographic Controls | (3) Add academic controls | (4) Add district control | (5) Add district*grade control | (6) Replace district control with school control | (7) Use school*grade control |
|---|---|---|---|---|---|---|---|
| FRL | -0.047*** | -0.005 | 0.021* | 0.033*** | 0.033*** | 0.019*** | 0.020*** |
| | (0.016) | (0.013) | (0.012) | (0.010) | (0.010) | (0.005) | (0.005) |
| Female | | 0.008** | -0.012*** | -0.011*** | -0.011*** | -0.011*** | -0.011*** |
| | | (0.003) | (0.003) | (0.003) | (0.003) | (0.003) | (0.003) |
| Black | | -0.116*** | -0.058*** | -0.033*** | -0.032*** | -0.042*** | -0.040*** |
| | | (0.022) | (0.020) | (0.011) | (0.011) | (0.006) | (0.005) |
| Asian | | 0.031*** | 0.012 | 0.018*** | 0.019*** | 0.004 | 0.005 |
| | | (0.010) | (0.010) | (0.007) | (0.007) | (0.004) | (0.004) |
| Other | | -0.041*** | -0.022 | -0.000 | -0.000 | -0.017** | -0.015** |
| | | (0.014) | (0.015) | (0.013) | (0.013) | (0.007) | (0.006) |
| Hispanic | | -0.046*** | -0.019 | -0.000 | 0.000 | -0.015** | -0.012** |
| | | (0.011) | (0.011) | (0.011) | (0.011) | (0.006) | (0.005) |
| Grade Level = 10 | | | 0.014 | 0.044 | | 0.039 | |
| | | | (0.034) | (0.032) | | (0.028) | |
| Grade Level = 11 | | | -0.028 | -0.014 | | -0.017 | |
| | | | (0.034) | (0.030) | | (0.025) | |
| Grade Level = 12 | | | -0.105*** | -0.084*** | | -0.088*** | |
| | | | (0.035) | (0.031) | | (0.027) | |
| Constant | 0.876*** | 0.892*** | 0.258*** | 0.274** | 0.213** | 0.226** | 0.248** |
| | (0.019) | (0.019) | (0.091) | (0.107) | (0.100) | (0.096) | (0.094) |
| Observations | 212,935 | 212,935 | 212,935 | 212,935 | 212,935 | 212,935 | 212,935 |
| R-squared | 0.030 | 0.049 | 0.147 | 0.168 | 0.175 | 0.222 | 0.247 |
| Mean of Dependent Variable | 0.808 | 0.808 | 0.808 | 0.808 | 0.808 | 0.808 | 0.808 |
| Year FE | YES | YES | YES | YES | YES | YES | YES |
| Subject FE | YES | YES | YES | YES | YES | YES | YES |

| | | | | | | |
|---|---|---|---|---|---|---|
| District FE | | YES | | | | |
| District-Grade FE | | | YES | | | |
| School FE | | | | YES | | |
| School-Grade FE | | | | | | YES |
| Course Grade Bins | YES | YES | YES | YES | YES | YES |

Notes: Observations are at the student-course-year level. The dependent variable is a binary variable indicating if the exam for a course enrollment was attempted. The sample includes students who took any course in the AP course sequence. Column 1 includes subject and year fixed effects. Columns 2 adds demographic controls sex and race/ethnicity to column 1. Column 3 adds academic controls - course grade bins of a width of 5 and grade level fixed effects. Column 4 adds district fixed effect to column 3, while column 5 instead adds district by grade fixed effects. Columns 6 and 7 are corollaries to 4 and 5, where district is replaced by school. Standard errors are clustered at the school level. Statistical significance at the 1 percent, 5 percent, and 10 percent levels is indicated by ***, **, and *, respectively.

Appendix Table 7: Number of Exams Taken, Ninth-Eleventh Grade and Twelfth Grade Samples

Panel A: Ninth-Eleventh Grade Sample

| VARIABLES | (1) Full Sample | (2) Districts 1&2 | (3) Districts 1&2: FRL Only | (4) Districts 1&2: non-FRL Only | (5) Districts 3&4 | (6) Districts 3&4: FRL Only | (7) Districts 3&4: non-FRL Only | (8) Full Sample #Subsidised Tests |
|---|---|---|---|---|---|---|---|---|
| FRL | 0.003 | -0.004 | | | 0.006 | | | -0.014** |
| | (0.006) | (0.007) | | | (0.008) | | | (0.007) |
| # Courses | 0.951*** | 0.977*** | 0.965*** | 0.979*** | 0.939*** | 0.966*** | 0.921*** | 0.928*** |
| | (0.009) | (0.009) | (0.019) | (0.008) | (0.013) | (0.013) | (0.015) | (0.013) |
| # Subsidized Tests | | | | | | | | 0.042*** |
| | | | | | | | | (0.011) |
| Observations | 69,038 | 25,018 | 5,084 | 19,934 | 44,020 | 16,998 | 27,022 | 69,038 |
| R-squared | 0.844 | 0.886 | 0.780 | 0.901 | 0.822 | 0.817 | 0.827 | 0.844 |
| Avg. Course Grade Bins | YES | YES | | YES | YES | YES | YES | YES |
| Mean of Dependent Variable | 1.416 | 1.428 | 1.182 | 1.490 | 1.409 | 1.333 | 1.456 | 1.416 |

Panel B: Twelfth Grade Sample

| VARIABLES | (1) Full Sample | (2) Districts 1&2 | (3) Districts 1&2: FRL Only | (4) Districts 1&2: non-FRL Only | (5) Districts 3&4 | (6) Districts 3&4: FRL Only | (7) Districts 3&4: non-FRL Only | (8) Full Sample #Subsidised Tests |
|---|---|---|---|---|---|---|---|---|
| FRL | 0.080*** | -0.028 | | | 0.131*** | | | 0.001 |
| | (0.022) | (0.023) | | | (0.027) | | | (0.017) |
| # Courses | 0.853*** | 0.910*** | 0.851*** | 0.920*** | 0.817*** | 0.868*** | 0.786*** | 0.788*** |
| | (0.019) | (0.026) | (0.046) | (0.023) | (0.026) | (0.023) | (0.033) | (0.030) |
| # Subsidized Tests | | | | | | | | 0.111*** |
| | | | | | | | | (0.028) |
| Observations | 26,036 | 10,816 | 2,571 | 8,245 | 15,220 | 6,395 | 8,825 | 26,036 |
| R-squared | 0.766 | 0.827 | 0.724 | 0.837 | 0.726 | 0.754 | 0.712 | 0.768 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Avg. Course Grade Bins | YES | YES | | YES | YES | YES | YES | YES |
| Mean of Dependent Variable | 1.746 | 1.945 | 1.427 | 2.106 | 1.605 | 1.508 | 1.675 | 1.746 |

Notes: Observations are at the student-year level. The dependent variable is the number of AP exams taken by the student in a year. Panel A restricts the sample to students in grades 9-11, while Panel B restricts to students in grade 12. All columns include School-Grade and year fixed effects, and control for Asian, Black, Other, and Hispanic. Average course grade bins are the average grade over the courses and have a width of 5. Column 1 includes the full sample of AP course takers. Column 2 restricts the sample to districts 1 and 2, while column 3 and 4 further restricts the sample in column 2 to FRL students only and non-FRL students only, respectively. Column 5 restricts the sample to districts 3 and 4, while column 6 and 7 further restricts the sample in column 5 to FRL students only and non-FRL students only, respectively. Column 8 uses the full sample as in column 1, but controls for the number of subsidized tests. Standard errors are clustered at the school level. Statistical significance at the 1 percent, 5 percent, and 10 percent levels is indicated by ***, **, and *, respectively

Appendix Table 8: Took All Exams

| | (1) Full Sample | (2) Districts 1&2 | (3) Districts 3&4 |
|---|---|---|---|
| FRL | 0.013** | -0.002 | 0.019*** |
| | (0.005) | (0.007) | (0.007) |
| Female | -0.002 | 0.005 | -0.006 |
| | (0.004) | (0.004) | (0.005) |
| Black | -0.034*** | 0.003 | -0.049*** |
| | (0.007) | (0.010) | (0.007) |
| Asian | 0.003 | 0.012* | -0.004 |
| | (0.005) | (0.007) | (0.006) |
| Other | -0.024*** | 0.001 | -0.030*** |
| | (0.006) | (0.010) | (0.007) |
| Hispanic | -0.008 | 0.015 | -0.014* |
| | (0.006) | (0.009) | (0.007) |
| Took 2 Courses | -0.030*** | -0.002 | -0.046*** |
| | (0.007) | (0.009) | (0.008) |
| Took 3 Courses | -0.065*** | -0.015 | -0.094*** |
| | (0.015) | (0.014) | (0.021) |
| Took 4 Courses | -0.079*** | -0.024 | -0.109*** |
| | (0.018) | (0.016) | (0.027) |
| Took 5 Courses | -0.080*** | -0.041 | -0.102*** |
| | (0.019) | (0.025) | (0.028) |
| Took 6+ Courses | -0.144*** | -0.093*** | -0.172*** |
| | (0.040) | (0.027) | (0.053) |
| Observations | 95,074 | 35,834 | 59,240 |
| R-squared | 0.284 | 0.322 | 0.261 |
| Mean of Dependent Variable | 0.802 | 0.860 | 0.767 |

Notes: Observations are at the student-year level. The dependent variable is an indicator for the student taking the same number of exams as courses. All columns include average course grade bins of 5, School-Grade, and year fixed effects. Column 1 includes the full sample while columns 2 and 3 restrict to districts 1 & 2 and 3 & 4, respectively. Standard errors are clustered at the school level. Statistical significance at the 1 percent, 5 percent, and 10 percent levels is indicated by ***, **, and *, respectively.

## Appendix: Additional Details of the Data

*AP Test* Data

The format in which the raw AP score data arrived was not uniform across districts. Two districts provide one file per school year; such files contain test scores for students who took a test in the current year and in previous years. For these files, we only consider exams for the year of the file. We also drop the small number (far less than 1 percent) of cases for which a student-year appears multiple times in a file (which we think mainly occur due to imperfect fuzzy matching). The other two districts provided us a files that they had already cleaned; if we observe a student-year-test that appears twice, we keep the one with the higher score. For all data, if we are missing a unique identifier—which prevents us from matching to the course data—we drop these instances. Dropping these observations and the observations identified earlier in the paragraph will cause us to very slightly underestimate the percentage of students taking the corresponding AP exam.

In cases where we observe that the student took a test, but do not observe the test score (often because the test is still pending or the score has been canceled) or being coded as having a 0 score, we code the student as having taken the test, but record the score variable as missing. Thus, these individuals are not used in the first step of the prediction exercise.

*Course Data*

We first process the course data within district. In the very rare instances that a student has multiple observations for a district-year-course-term, we keep the observation that is not a transfer credit (if one is and one is not), and then break ties with the higher credits earned and then higher exam score. In some instances, students do not take semester courses (S1, S2) and take one of four 9-week terms (N1, N2, N3, N4) or year-long courses (Y1). In order to decide which observation is the terminal course (for the final sample), we create a hierarchy as follows, where we choose the observation appearing latest: N1, N2, S1, N3, N4, S2, Y1.

Not all subjects appear in all districts. Two AP courses map to the same English AP exam. We treat both courses as being the same. In some cases, the observation in the main data set is coded with a teacher denoting that it is a transfer course; they represent less than 0.1 percent of observations of the data (before restricting to the terminal course dataset), and we keep them in the data.

It is very rare that a student's course will be associated with multiple teachers. In these cases, we only consider the first-listed teacher and use his/her demographics. We construct the

teacher gender variables within district-year, but using information from three separate files. In cases of disagreement between the files, we assign them female if any are female.

*Combined Data*

When we aggregate from the student-course-year level to the student-year level, there is a very small number of cases in which variables are not constant within student-year. If a student transferred schools or districts, their demographics could vary within year. If they do, we consider the student to be female if any observation if female, other race if not all observations have the same race, Hispanic if any observation is Hispanic, and FRL if any observation is FRL. We assign them the latest-occurring school and district if unique. In the extremely rare cases of ties, we go with the school/district in which the course was not a transfer course and in the other instance the school/district that had the most number of courses. When constructing the sample for the Full Sample of Table 1 (Summary Statistics), we use all students who appear in both the demographic and course data files, keeping the observation with the highest grade in rare cases of a student appearing with multiple grades. We follow a similar process as above in cases of transfer students; if there was still a tie after the above process, we break it randomly.