The AP Arms Race:

Is Grade-Weighting to Blame?

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ABSTRACT

High school class rank is heavily considered in college admissions decisions and takes on particular importance in states with percent plans. When calculating class rank, most high schools give additional weight to grades earned in College Board Advanced Placement (AP) courses. Proponents argue that students will take only easy classes in the absence of grade weights. In a strategic environment like that generated by percent plans, additional weight for AP classes can potentially create an arms race where students take more AP classes than they optimally would. I model how AP grade weighting combined with a percent plan can create overconsumption of AP courses. Then I estimate the responsiveness of AP course-taking to grade weights in a broad cross section of schools and among the subsample of schools that change their weighting procedures over time. I find that grade weighting is not the primary factor driving AP course-taking and that low income students are only marginally less responsive to increases in the AP grade weight than other students. Dual credit courses, which are typically also weighted, provide accelerated learning access for students attending schools without robust AP programs and do not crowd out AP participation.

High school class rank is one of the most, if not the most, strongly considered admissions criteria of colleges and universities (Breland et al 2002, Hawkins and Clinedinst 2006). Class rank takes on particular importance in Texas, Florida, and California which employ percent plans that automatically admit students in the top X percent of each high school's graduating class to one or more of the state's public universities. When calculating class rank, most high schools give additional weight to grades earned in College Board Advanced Placement (AP) courses above and beyond what can be earned in other classes. Despite the importance of grade-weighting in assigning class rank, no states have established state-wide grade-weighting policies (ECS 2010). Some districts set a uniform weighting policy, but in Texas, the vast majority of high schools determine their own method.

Grade weighting is not a new phenomenon; as early as the 1970s, grade weighting was implemented in about one-third of American high schools, although the differential weighting occurred primarily between academic and non-academic classes rather than between college-level and all other classes (Siegel & Anderson, 1991). More recently, grade weighting has grown in tandem with accelerated learning opportunities like AP, International Baccalaureate, and dual credit. Despite its long history, there is no common or best practice weighting system, so each district and even each individual high school generates their own ad hoc method (Siegel & Anderson, 1991; Manzo, 1998). In their evaluation of student performance in college science courses, Sadler and Tai (2007a, 2007b) suggest adding half a point (on a four-point scale) for honors courses, one point for AP courses, and two points for students passing an AP exam. However, this recommendation is based on the performance of former AP science students when re-taking the comparable introductory course in college, a rationale that is far afield from the typical concern that students will minimize risk and effort by taking only easy classes in the absence of grade weights.

Proponents of grade weighting argue that rational students will minimize risk and effort by taking only easy classes in the absence of grade weights. However, consideration of AP participation in college admissions provides a substantial external incentive for students to participate in such courses regardless of grade weights used by the high school. The college admissions environment has become increasingly competitive in recent decades, and one of the ways students distinguish themselves is by participation in the AP Program (Bound, Hershbein and Long, 2009). Thus, whether the additional incentive of grade weighting is necessary to induce students to participate in AP courses remains an open empirical question.

In a strategic environment like that generated by percent plans, additional weight for AP classes can potentially create an arms race for high achieving students. Students take more AP classes than they optimally would in order to maintain their class rank among peers who are similarly vying for a spot in the top X percent. Strategic behavior will be more acute the greater the AP weight, and anecdotal evidence suggests that many schools employ weights that are large enough to induce such behavior. In one well-done study of AP in California high schools, AP teachers "expressed a concern that students took too many AP courses at one time and often were less interested in engaging in the intellectual work of the course than in earning an extra grade point average" (Furry and Hecsh 2001 p. 40). To the extent that it causes students to take "too many" AP courses, grade weighting may be one cause of overstressed high school students who enter college exhausted and burned out (Hu 2008).

From an equity standpoint, excessive grade-weighting may inflate demand for AP courses among high SES white students so much that students who are already underrepresented are further crowded out: Klopfenstein (2004b) shows that black, Hispanic and low income students participate in AP classes at very low rates, even after accounting for academic preparation. It may also be that black, Hispanic, and low income students, who would often be the first in their families to attend college, do not have the information and institutional savvy to understand the importance of AP-taking for securing a spot in the top X percent at many high schools. Tyson, Darity, and Castellino (2005) quote a black female high school student saying "As far as the honors class, don't take it unless you absolutely have to. I wouldn't advise that. It's not-- it will bring your grade point average down, just taking it will bring anybody's grade point average down." (590).

The first objective of this paper is to describe the variation in grade weighting procedures across Texas public high schools. Then, using a labor/leisure framework, I explain how AP grade weighting combined with a percent plan can create an arms race and overconsumption of AP courses. After establishing the theoretical foundations of the problem, I estimate the responsiveness of AP course-taking to grade weights in a broad cross section of schools and then among the subsample of schools that change their weighting procedures. The latter approach is carefully designed to eliminate external and internal threats to the validity of the findings. Throughout, I pay close attention to whether student responsiveness to AP grade weights differs for traditionally underrepresented students due to their potential unfamiliarity with the value of AP course-taking and class rank in college admissions.

GRADE-WEIGHTING IN TEXAS

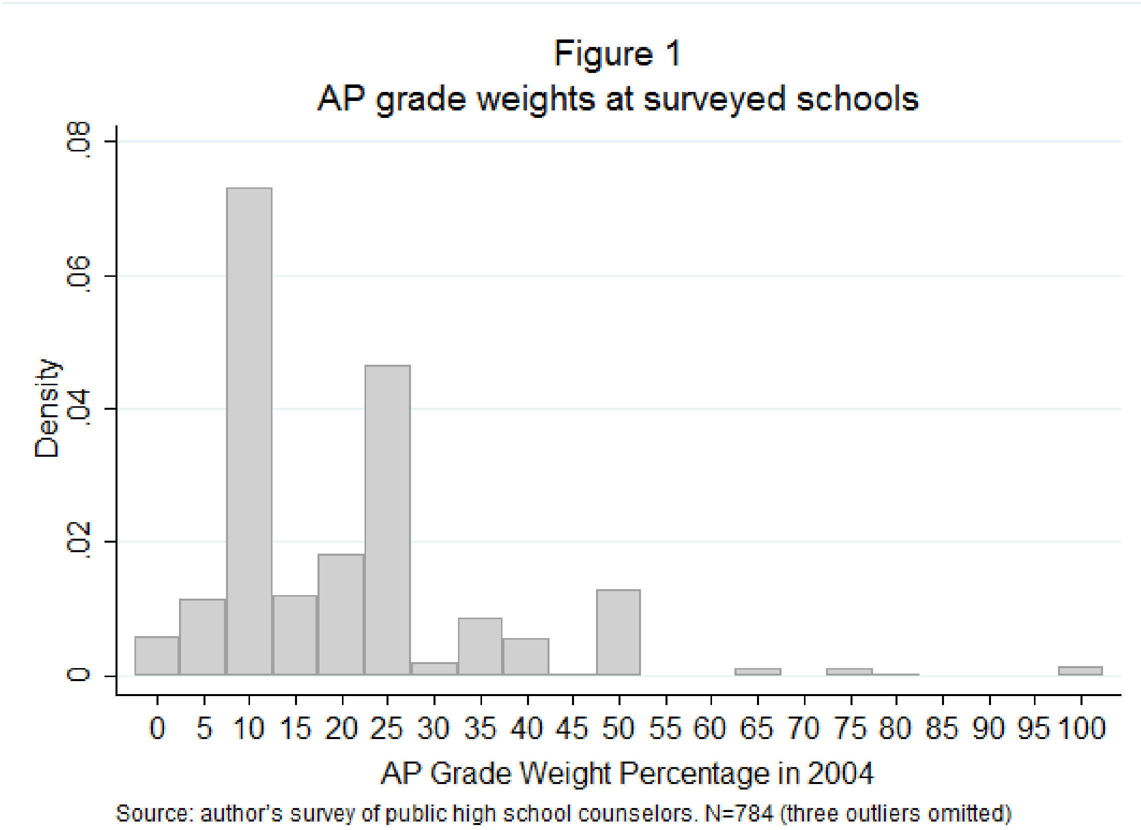
No agency collects information about school grading policies, so I surveyed counselors at over 900 public four-year high schools in Texas regarding the policies in place during the 2003-04 academic year (hereafter the "AP survey"). The telephone survey targeted large, four-year high schools that are most likely to offer AP, and fewer than ten schools, once contacted, refused to participate in the survey.

The survey confirmed that weighting practices are widespread and varied. Of the 911 schools surveyed, 793 offered an AP Program and 787 had complete survey information on grade-weighting practices. Of these 787 schools, just 2.5 percent offered no additional weight for grades in AP courses. Because schools use a variety of baseline scales and weighting techniques, I standardize the weights as the percentage increase in grade points a student earns for an A in an AP course relative to an A in a standard (non-honors and non-remedial) course. Thus, a ten point weight on a 100 point scale and a one point weight on a ten point scale generate the equivalent ten percent weight. Figure 1 displays a histogram of the percentage weights for 784 schools where three outlier schools with weights of 225, 300, and 550 percent are excluded from the plot for formatting purposes. The histogram shows that the two most common weights are ten percent (usually ten points on a 100 point scale) and 25 percent (usually one point on a four point scale). The mean weight is 21 percent with a standard deviation of 15.[1]

Advanced Placement classes are the most frequently weighted courses, although complements (Pre-AP or honors courses) and substitutes (International Baccalaureate or dual credit courses) for AP are also commonly weighted. Weights on grades earned in Pre-AP or dual credit classes vary, with most schools weighting them the same as AP classes and others weighting them less.[2] A handful of schools only provide weight for AP grades if students take and/or score well on the AP exam, but this policy is difficult to enforce because AP exams are

[1] With the three outliers omitted. With the outliers included, the mean is 22 and standard deviation 26. When interpreting the results later in the paper, I use the mean and standard deviation from the sample without the three outliers.
[2] Manzo 1998 discusses the perverse effect of having different weights for different accelerated-learning options.

not graded until the summer after seniors have graduated. Many high schools only weight AP grades in the four core subject areas of English, science, social studies, and mathematics.



In May 2007, House Bill 3851 authorized the Texas Higher Education Coordinating Board (THECB) to design and implement a standard method of calculating GPA for the purpose of simplifying postsecondary admissions procedures and distributing merit-based aid (THECB, 2008a).[3] The Commissioner convened the Uniform GPA Advisory Committee (UGAC),

[3] HB 3851 required that high schools submit transcripts to postsecondary institutions using the standardized GPA formula; this information is used for the admission of students who are not eligible under the ten percent plan. The bill did not require standardization of the process by which schools determine class rank, the issue of primary concern here.

comprised of stakeholders from both higher education and K-12 organizations, to design the uniform GPA formula.

In September 2008, the THECB held an open forum for public comment on the UGAC's formula. Attendees included AP teachers, music teachers, career and technology education teachers, a College Board regional vice president, a representative of the American Federation of Teachers legislative counsel, and a member of a school district Board of Trustees. The most frequent complaint was that the proposed GPA formula allowed extra weight for grades in AP, IB, and dual credit, but not for honors or Pre-AP courses. As one teacher put it, "Students care more about their GPA than they do about being college-ready," and if honors and Pre-AP courses aren't weighted, students won't take them. The teacher continues, "…without proper preparatory classes students would lack the confidence, the pre-requisites, and the work ethic to succeed [in AP courses]- even if they could be convinced to try" (THECB, 2008b). The claim of many in the room that day, presented without empirical justification, was that students' preparedness for college depends critically on the weighting of not only AP grades, but also of Pre-AP and honors course grades. In the end, competing demands from various interest groups proved intractable and the legislature rescinded the THECB's authority to establish a uniform GPA in 2009.

THEORY

There is a strong theoretical basis for the belief that AP grade weights will increase AP course participation. In this section, I use a labor/leisure model to display the potential incentive effects.

First, suppose student x chooses the optimal combination of two goods, GPA (GPA_x) and leisure (l_x). Utility is increasing in GPA because the probability of admission at competitive institutions is increasing in GPA. GPA is a function of time spent studying for non-

AP classes (q_x), time spent studying for AP classes (p_x), and an exogenously determined AP grade-weight, $w > 0$.

$$U_x = f(GPA_x(q_x, p_x, APCred_x \mid w), l_x)$$

Assuming the only available course types are AP and non-remedial, non-AP courses, then grade point average is calculated as

$$GPA_x = \frac{(RegPts_x)(RegCred_x) + (1 + w)(APPts_x)(APCred_x)}{TotCred_x}$$

where $RegPts_x$ are the grade points earned in non-AP classes and $APPts_x$ are grade points earned in AP classes. Assuming $TotCred = RegCred + APCred = 1$ and recognizing that study time converts to grade points differently for AP and non-AP courses,

$$GPA_x = h(q_x)(1 - APCred(p_x)) + (1 + w)g(p_x)APCred(p_x)$$

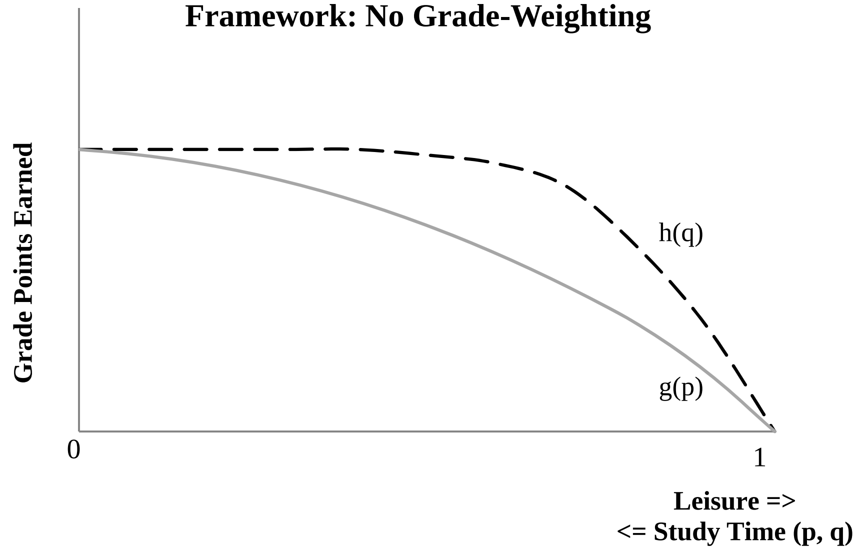
where $h(q_x)$ is the production function transforming study time to grade points for a non-AP class, and $g(p_x)$ is the production function transforming study time to grade points for an AP class. Therefore, utility can be rewritten as

(1) $$U_x = f\big(h(q_x)\big(1 - APCred(p_x)\big) + (1 + w)g(p_x)APCred(p_x), l_x\big)$$

Figure 2 displays the production functions $g(p_x)$ and $h(q_x)$ in a labor/leisure framework analogous to the household production function where families must allocate time between market production, household production, and leisure (Bryant 1990). The quantity of leisure time is read from left to right, and time spent studying is read from right to left. The total amount of time is normalized to one ($l_x + q_x + p_x = 1$).

The returns to study time in terms of grade points are positive and diminishing in both AP and non-AP classes. Because AP classes are harder than non-AP classes, $h(\cdot) \geq g(\cdot)\ \forall\ p, q$, and more effort is necessary to achieve the highest possible score in an AP class than in a non-AP class. The relationship between $h'(e)$ and $g'(e)$ depends on the particulars of the student and the school. The student modeled in Figure 2 reaches the highest possible grade in a non-AP class by

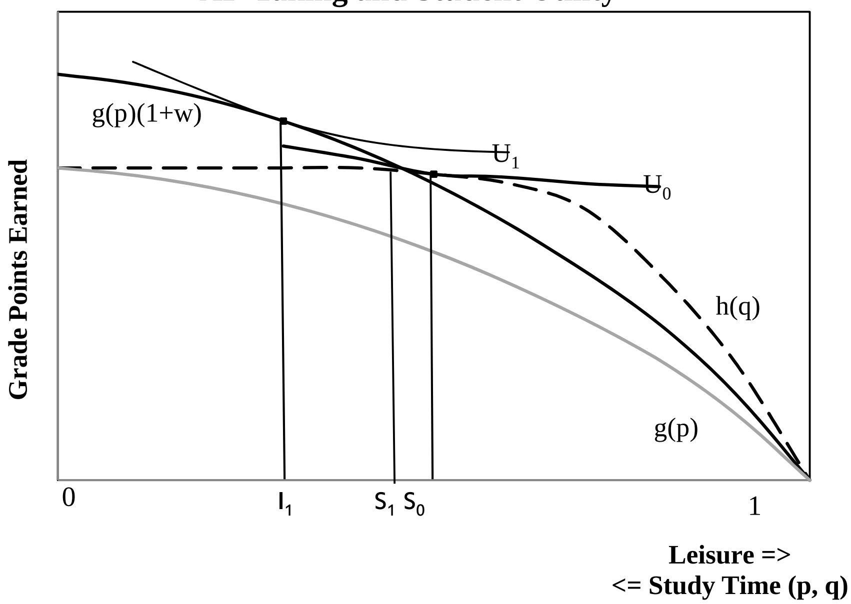
Figure 2
GPA Production Functions in a Labor/Leisure Framework: No Grade-Weighting



utilizing slightly over 50 percent of his available study time, where after the return to additional studying is zero. With enough effort, this student is capable of achieving the highest possible grade in AP class; some students would be able to do so with a lower level of effort, but others might not be able to earn the highest possible score even by devoting 100 percent of their effort.

Because utility is greater to the northeast, no utility-maximizing student would enroll in an AP class given the production functions $g(p_x)$ and $h(q_x)$ in the absence of other rewards. To address this concern, many high schools weight grades earned in AP courses more heavily than grades in other courses. Doing so rotates the production function for AP classes upward to $g(p_x)(1 + w)$ in Figure 3. Consequently, students with preferences similar to those portrayed by the indifference curves in Figure 3 can achieve a higher utility level (U_1) under grade weighting than without it (U_0). Students for whom grade-weighting increases utility enroll in AP

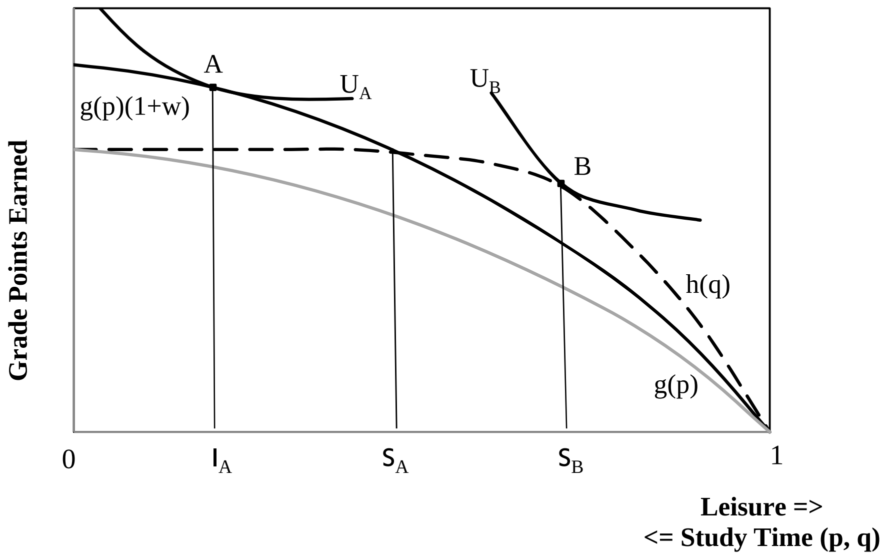
Figure 3
Grade-Weighting Increases
AP-Taking and Student Utility



courses because, with the weight, the marginal return to effort in an AP course exceeds that in a non-AP course. The degree of the shift depends on the magnitude of the weight. The student depicted in Figure 3 spends $(1 - S_0)$ time studying for non-AP classes and S_0 time in leisure in the absence of a grade weight; with an AP grade-weight, she spends l_1 time in leisure, $S_1 - l_1$ time studying for AP classes, and $(1 - S_1)$ time studying for non-AP classes.

Figure 4 displays the equilibrium allocation of time devoted to AP and non-AP classes for two students with different preferences given AP grade weight w. Student 1 has a preference for leisure over grade points and relatively steep indifference curves. Utility is maximized at point A where the north-east most indifference curve is tangent to the GPA "budget constraint." For this student, the grade weight is not large enough to outweigh the greater difficulty of an AP class, so he enrolls in no AP classes. He spends S_1 percent of his time in leisure and

Figure 4
Two Possible Student Outcomes in Equilibrium



$1 - S_1 = q_1$ percent of his time studying for his non-AP classes ($p_1 = 0$). Student 2, on the other hand, has a relatively strong preference for grade points, and the grade weight provides enough incentive to cause her to enroll in AP. She spends just l_2 time on leisure, $1 - S_2 = q_2$ time studying for non-AP classes, and $S_2 - l_2 = p_2$ time studying for AP classes.

The missing link between the labor/leisure model in figures 2-4 and the utility function specified in equation (1) is that study time does not translate directly to AP credit hours. This problem is easily remedied by imposing the constraint that the proportion of study time spent on AP classes equal the proportion of credits taken that are AP.

$$\frac{p_x}{p_x + q_x} = \frac{APCred_x}{TotCred_x}$$

Holding GPA production functions and preferences constant, a larger grade weight results in the marginal return to an AP class exceeding that in a non-AP class for more students. Theoretically, this suggests that as the grade weight increases, more students will take their first AP course, and students who were already taking AP courses will take more of them.

Later in the paper, I test empirically whether students respond to the weighting incentive in these expected ways. I am particularly interested in whether low income, black, and Hispanic students, whose parents are least likely to have attended college, are more or less responsive to differences in the grade weight than their higher SES white peers.

The arms race and percent plans

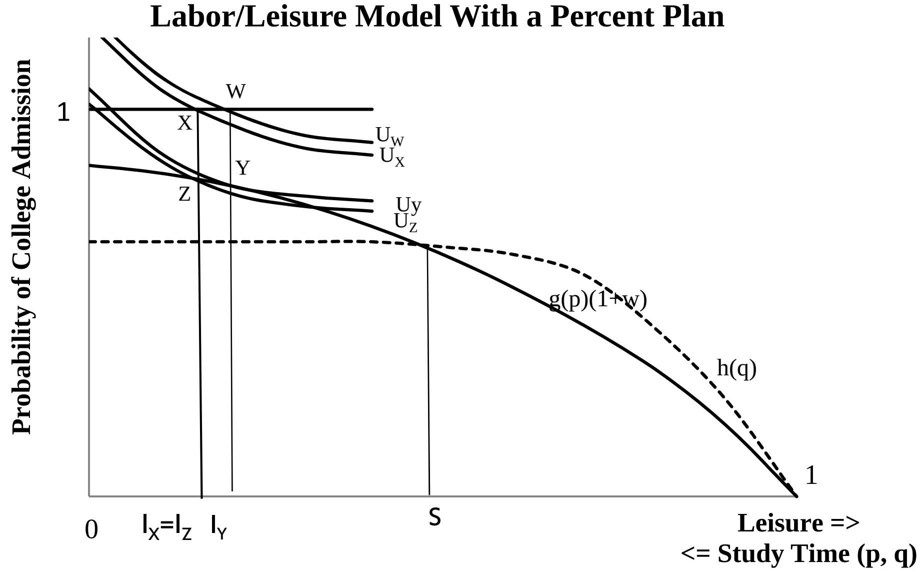
While grade-weighting by itself theoretically has a positive effect on AP course-taking, the combination of grade-weighting with state “percent plans” (legislation that awards preferential college admission to the top X percent of a high school graduating class) provides additional incentive to enroll in AP, perhaps even beyond the optimal levels depicted in Figure 4. Assume there are two students at a high school, and the one with the higher GPA upon graduation will obtain guaranteed admission to the in-state public university of her choice while the other must undergo the competitive application process. If the students have the same GPA, a coin toss determines the benefit recipient.[4] Suppose that the two students have identical grade-point production functions and preferences, and they do not collude. The probability student 1 wins the coin toss is θ.

Figure 5 displays the budget constraints and preferences of two identical students who have a strong enough preference for GPA that they enroll in some AP courses. Outcomes with higher probabilities of admission put students on higher indifference curves. Given that the first

[4] The Texas Higher Education Coordinating Board, which implements the percent plan, requires that schools select no more than 10 percent of graduating students to be eligible for automatic admission. If there are ties, the school devises a mechanism for differentiating students. The key point is that there is some element of uncertainty involved in which student obtains admission under a tie.

student knows that the second student maximizes utility at point Y, the first student knows that all she has to do is take ε more units of AP coursework (which in reality, of course, are delivered in discrete units) and she will obtain college admission with probability one. She decreases her leisure from $l_y\ to\ l_x$, increasing her AP-taking with the intention of achieving U_x. However, student 2 follows the same strategy in pursuit of Ux, so they end up with a GPA-tie and a coin toss. The expected utility of this outcome is $U_x + (1-\theta)U_z$ for student 1, which will be less than $U_x$under reasonable assumptions. While the added AP course marginally increases the probability of success in the competitive admissions process, the marginal benefit of this return is less than the marginal cost of the leisure foregone to earn the extra grade points in the course, and utility declines. No separating equilibrium is achieved and both students end up taking more AP classes than they would have in the absence of a percent plan.

Figure 5
Labor/Leisure Model With a Percent Plan



U_x is achievable with certainty when a student takes an AP course but the other student does not. U_w, while greater than U_x, cannot be obtained with certainty: it is only reached by the student who wins the coin toss when neither student enrolls in the marginal AP credit. When student 1 does not enroll in the marginal AP course but student 2 does, student 1 achieves utility U_y. If both enroll in the marginal AP course, the expected utility for student 1 is $\theta U_x + (1-\theta)U_z$. The expected utility for student 1 when there is a tie because both students take no more AP is $\theta U_w + (1-\theta)U_y$. For preferences flat enough that students enroll in AP, an epsilon-sized increase in AP credits, and values of theta away from the extremes, these outcomes can be summarized in the equations below for student 1 and student 2, respectively.

(2) $$U_x \succ \theta U_w + (1-\theta)U_y \succ \theta U_x + (1-\theta)U_z \succ U_y$$

(3) $$U_x \succ (1-\theta)U_w + \theta U_y \succ (1-\theta)U_x + \theta U_z \succ U_y$$

When $\theta = 0.5$, the outcomes in equations (2) and (3) are identical and can be displayed as $A \succ B \succ C \succ D$. Figure 6 shows the strategies (no more AP, one more AP) and outcomes (A, B, C, D) under a simultaneous-move prisoner's dilemma game. The single Nash Equilibrium is (One more AP, One more AP) because each student knows that not taking AP leaves him vulnerable to the least desirable outcome, D. Consequently, each player chooses to take one more AP, and both are worse off than if neither had taken one more AP class. When both choose AP, the signaling value of AP is lost and, for better or worse, students enroll in more AP classes.

Figure 6

Payoffs When Two Students Vie for Class Rank Under AP Grade-Weighting, $A \succ B \succ C \succ D$

		Student 2	
		No More AP	One more AP
Student 1	No More AP	B / B	D / A
	One More AP	A / D	C / C

METHODOLOGY AND DATA

I use restricted-use data from the University of Texas at Dallas Education Research Center (UTD-ERC) and my AP survey to test the predictions of the model as outlined in the previous section. The UTD-ERC data provide student-level information on demographic and course-taking behavior as well as information about the schools themselves, including the number and type of AP courses offered. The survey includes information about what type of weighting system, if any, the school employed in the 2003-04 academic year, what changes have occurred in their grade-weighting practices since 2000, whether the school also weights pre-AP or honors courses, and whether the school weights dual credit courses.

The magnitude of the AP grade weight and whether the school changed its weighting scheme are not strongly correlated with school demographic and achievement characteristics. Table 1 reports estimates of a simple linear regression predicting the magnitude of the grade weight (column 1) and a logit predicting whether a school changed its grade weight (column 2) as a function of contemporaneous (column 1) or prior (column 2) school-level demographic and achievement characteristics.[5] Of the eleven predictors considered, only the percent students black and percent students limited English proficient (LEP) are significant predictors of the size of the AP grade weight. Both coefficients are positive and small: a one standard deviation increase in the percentage of students who are black (12 points) predicts a 1.8 point increase in grade weight (effect size of 0.12) while a one standard deviation increase in LEP students (5 points) predicts a 1.4 point increase (effect size of 0.09).

The positive signs for percent black and percent LEP are the opposite of expected if one assumes that schools with higher proportions of college-bound students implement higher grade weights. The positive signs are more consistent with the assumption that schools with low AP participation rates adopt higher grade weights in an attempt to increase participation, but the more direct indicator of school wide AP participation, the percent of students taking advanced courses, does not predict the magnitude of the grade weight. This suggests that schools have either achieved their optimal participation rate, however they define it, or that schools with low AP participation rates do not systematically employ higher weights. The only significant predictor of whether a school changes their grade weight is rural location. Being in a rural location increases the predicted probability that a school will change its grade weight by less than one percentage point on average.

Because many high schools only weight AP grades in the four core subject areas, the analyses that follow consider AP course-taking only in the subjects of science, mathematics,

[5] Results from regressions omitting three extreme values larger than 100 percent. With the three extreme values included, the mean is 22 percent with a standard deviation of 27.

English, and social studies. The AP science category used throughout this paper includes Biology, Environmental Science, Chemistry, Physics B, and Physics C, AP math includes Calculus AB, Calculus BC, and Statistics, and AP English includes English Language and English Literature. The AP social studies category includes Microeconomics, Macroeconomics, U.S. Government and Politics, Comparative Government and Politics, U.S. History, European History, Psychology, Human Geography, and World History.

Cross sectional analysis

As a first step in this study, I examine cross sectional differences in grade-weighting practices using the full sample of eleventh and twelfth graders attending the 741 schools in Texas that offer core AP courses, didn't recently change their weighting policy, and have complete data on grade-weighting practices, school characteristics, and enrolled students. Theory indicates the need for two sets of regressions, the first to test the prediction that greater weights induce more students to enroll in AP at all, and the second to test whether greater weights induce students to enroll in more AP credits when they do take AP. The former approach can be modeled with AP-taking as a dichotomous outcome and the latter with AP-taking as a discrete count. Just as labor force entry is of unique interest to policy makers who might also be interested in hours worked, so might entry into the AP Program be unique from the choice of the number of courses to take among existing participants. However, in part because the majority of AP students take three or fewer core AP classes per year, estimates from the count models are remarkably similar to those from the logit models. Consequently, only the logit results are reported here.

The probability that a student enrolls in one or more AP classes during the 2003-04 academic year is predicted as a function of student demographics (grade, sex, race, low income, English proficiency, at risk of dropping out), prior academic achievement (tenth grade math and reading test scores,[6] highest math course passed by end of tenth grade[7]), campus characteristics (total enrollment, percent low income, rural location), the college-going culture of the school (number of AP courses offered, percent graduating with the recommended diploma, presence of an IB, dual credit, or AVID program), and grade-weighting practices (AP, honors, and dual credit grade weights). Because grade weights are at the school level, it is not possible to estimate the impact of the weights in the presence of campus fixed effects in the cross-sectional model. However, variances are adjusted by clustering on campus. Descriptive statistics for these variables, disaggregated by race, are presented in Table 2.[8]

The predicted effect of honors course weighting is negative if AP and Pre-AP/honors courses are substitutes and positive if they are complements. I use the terms "honors" and "Pre-AP" interchangeably because many schools indicated in the AP survey that they had recently changed the label of their honors courses to Pre-AP (and sometimes to AP). Also in the AP survey, 44 percent of schools offering Pre-AP classes indicated that they prohibit seniors from

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[6] Test scores are standardized by test and year. Texas changed from the TAAS test to the TAKS test in 2003, so twelfth-graders in 2004 took the TAAS exit test in tenth grade while eleventh-graders in 2004 took the TAKS tenth grade tests. Only the subset of components from the TAKS reading test that align with those in the TAAS reading test are included in the reading variable used here.

[7] Because of the linear nature of math course progression, highest math taken in tenth grade and AP math are simultaneously determined. Hence, highest math taken in tenth grade is omitted from the AP any core and AP math regressions but included in all other subjects.

[8] The N of schools in Table 2 is below that in Figure 1 because schools are dropped if they didn't offer any AP courses in the core subjects in 2004, if they didn't serve 11th or 12th graders, and if they didn't have complete data for any students on any of the variables of interest.

participating, with three-quarters of these schools further limiting Pre-AP access to students in the ninth and tenth grades. The limitation of Pre-AP participation to underclassmen suggests a complementarity between Pre-AP and AP courses in about half of schools that offer Pre-AP and the potential for a substitution of Pre-AP for AP courses in the other half of schools.

Dual credit courses are typically seen as good substitutes for AP with AP the more challenging option. Colleges require a passing score on the standardized AP exam before they confer college credit for AP experience, but dual credit course credits are portable, especially among public institutions, as long as the student earns a passing course grade. If dual credit and AP courses serve as substitutes, then weighting dual credit and AP grades equivalently might lead to decreased AP-taking in schools that offer both. As a result of this concern, some schools give grades in dual credit courses some additional weight but less than that conferred for AP courses. Florida prohibits grade-weighting schemes that weight dual credit course grades less heavily than other accelerated learning options, such as AP, but not such prohibition exists in Texas (ECS 2010).

The International Baccalaureate (IB) program is a secondary education model developed in the 1960s to prepare children of foreign diplomats for admission to competitive universities around the world (Mathews & Hill 2005). IB is a comprehensive program while AP offers single discrete courses, so the two programs are imperfect substitutes. Time constraints make it difficult for an IB student to also participate in the AP Program, so when grades in both are weighted equally, enrollment choice will be largely driven by student preferences. Every school surveyed that offered both AP and IB programs assigned the grades earned in the two programs equivalent weight, so I anticipate that the presence of an IB program on campus will have a small but negative impact on AP-taking. AVID, which provides the curriculum for an elective course that is designed specifically to support the AP course-taking of students without prior experience in rigorous courses, is a complement to AP, so the presence of an AVID program is expected to increase AP course-taking.

Longitudinal analysis

Although the survey was primarily cross-sectional, it did inquire about how long schools had used their current weighting policy, and if counselors indicated a recent change, additional information was collected about prior weighting policies. In the end, 34 schools had utilized a different weighting method in the recent past, 29 of which made changes that affected upperclassmen between 2002 and 2004 and had complete information about the change in the survey. The longitudinal data provide multiple sources of variation that can aid in the identification of a grade-weighting effect. Some schools increased their grade weight while others decreased it, changes were implemented in different years, and some schools implemented their weight changes cold turkey, where the new weighting system applied immediately to students in all grades, and others phased the change in with an incoming freshmen class. Thus, schools that phased in weight changes with 2002 graduates first introduced the policy change when those graduates were freshmen in 1999.

I employ a difference-in-differences approach to evaluate the course-taking behavior of students at the subsample of schools that changed their weighting schemes. Not only are students at weight-changing schools compared to one another, but they are also compared to students at observationally similar schools that did not employ weight changes over the same period. The control group, chosen via propensity score matching, plays a vitally important role in isolating the independent effect of grade weights on AP course-taking during a period of AP Program growth (Klopfenstein 2004a).

The longitudinal sample is confined to eleventh and twelfth graders who attend schools where changes in weighting schemes first impacted upperclassmen between 2002 and 2004 or one of 107 well-matched comparison schools that did not change their grade weight. 2001 serves as a baseline year. Table 3 displays average campus characteristics separately for schools that increased and decreased their grade weight as well as for the matched control group. The average grade weight among schools in the control group is comparable to that in the larger sample at just under 21 percent. Schools that increased their grade weight had below-average starting weights, and those that decreased the weight had above-average starting weights. This pattern of regression toward the mean is not universal, however. One school with a grade weight of 225 percent in 2004 is included in the change analysis because it had previously increased its AP weight from 150 percent.

In this difference-in-differences design, juniors and seniors are considered the year before and the first year after a change in the AP grade weight to determine whether they take more AP courses in the year when the AP grade weight is higher as theory would predict. Figure 7 describes the comparison groups before and after the weight change separately in the cases of cold turkey and phase-in schools. If t is the first year under the new weighting system and $t-1$ the last year under the old weighting system in a cold turkey school, juniors in year t will be compared with juniors in $t-1$, and seniors in t compared with seniors in $t-1$. In this case, the seniors in t are from the same cohort as the juniors in $t-1$. For phase-in schools implementing a weight change with seniors graduating in year t, seniors in year t are compared with seniors in year $t-1$, and juniors in year $t-1$ are compared with juniors in $t-2$. Thus, the same two cohorts of students are compared, once as juniors and once as seniors. Schools that do not change their grade weights serve as the control group and help to disaggregate changes in course-taking behavior that are part of a larger trend of increased AP participation from changes in course-taking behavior that are due to changes in the magnitude of the grade weight.

Figure 7

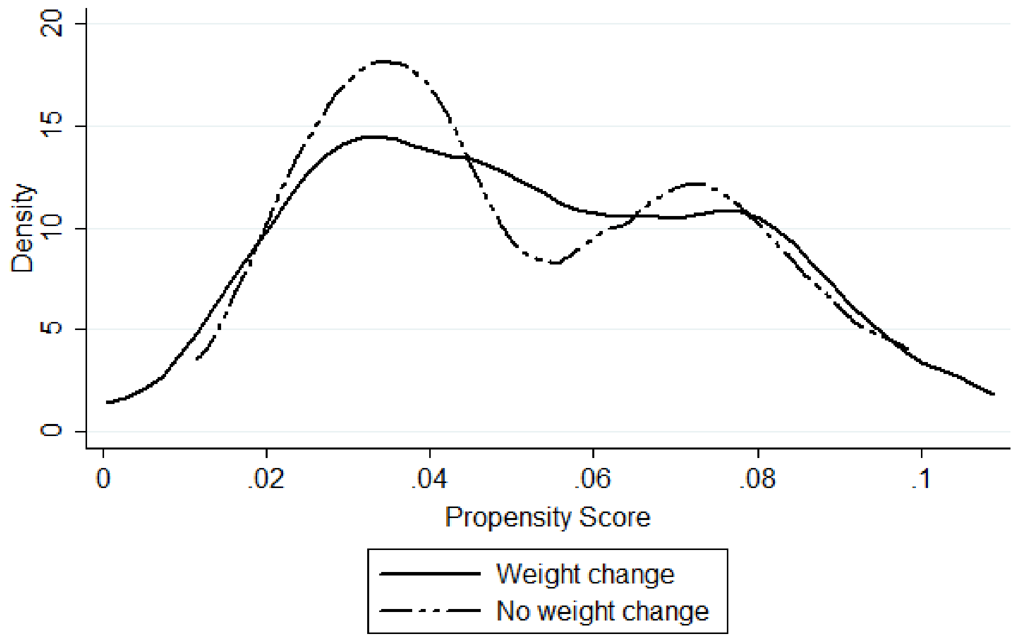
Group comparisons for cold turkey vs. phase in weight changes

	comparison of juniors	comparison of seniors
cold turkey in year t	jr_{t-1} $vs.$ jr_{t}	sr_{t-1} $vs.$ sr_t
phased in with seniors graduating in year t	jr_{t-2} $vs.$ jr_{t-1}	sr_{t-1} $vs.$ sr_t

In the sample, there are approximately 83,000 students observed once (including seniors in the first year of analysis and juniors in the last year of analysis). Of the 80,000 observed twice, 2,645 are repeaters who are, by definition, captured in the at risk variable; all others are observed in both 11th and 12th grades. When a student appears in both eleventh and twelfth grade, student-level descriptive statistics reported in Table 4 maintain both observations due to the fact that all but the prior achievement variables are time-varying. Table 4 presents descriptive statistics by race at the student-by-grade level for the longitudinal sample, including students from the comparison pool chosen as described below.

To select comparison schools from the 741 surveyed schools that experienced no changes in AP weight between 2002 and 2004, I use k-nearest neighbor propensity score matching with replacement. The propensity score logit predicting a weight change between 2002 and 2004 was based on 1999 school-level pre-treatment demographic and achievement characteristics. I use 1999 characteristics because the schools that phased in weight changes with 2002 graduates established their weighting policy when those graduates were freshmen in 1999. Variables included in the propensity score logit include the percent of students who are low income, receiving special education services, limited English proficient, black, or Hispanic; school size; percent of teachers in their first year of teaching; number of core AP courses offered and the percent of students taking advanced courses; and the percent of graduates earning the recommended high school diploma. Table 5 presents campus-level descriptives for treatment and

Figure 8
Propensity scores by weight change status



comparison schools on the variables used in the matching process and shows that match quality is quite good. The fourth column in Table 5 compares the means for the treatment and comparison schools on the matching variables; all are within one-fifth of a (pooled) standard deviation of each other and most are within one-tenth of a standard deviation. The kernel density plots of the propensity score distributions in Figure 8 confirm match quality.

The probability that a student will take an AP course in a given year is modeled using a logit as specified below, where time $t \in [2001, 2004]$, $s = school,$ and $i = student$.

$$\Pr(AP_{tsi} = 1) = \beta_0 year_t + \beta_1 apweight_{ts} + \beta_2 school_{ts} + \beta_3 school_s$$
$$+\beta_4 student_i + \beta_5 student_{ti} + \epsilon_{tsi}$$

$Year_t$ is a vector of year dummies, and $apweight_{ts}$ is a matrix of AP grade weights at school s in year t, $school_{ts}$ consists of other school characteristics that vary over time, including the number of core AP courses taught, total school enrollment, the percentage of students eligible for free or reduced lunch, and whether the school has an AVID or IB program.[9] $School_s$ is a single time-invariant school characteristics, rural location. $Student_i$ is a vector of time-invariant student characteristics, including sex, race, tenth grade math and reading scores, and highest math taken by the end of tenth grade. This vector also includes a series of variables indicating whether a student was ever (between 1996 and 2004) eligible for free or reduced price lunch or designated Limited English Proficient. $Student_{ti}$ contains the time-varying student characteristics grade and at risk of dropping out, which is triggered if a student is retained in grade, is failing two or more classes, becomes a parent, is homeless, or experiences a number of other challenges.

I also estimate a series of fixed effect logit models on the subsample of schools that changed their weight over time. These models are problematic for a couple of reasons. First, in the absence of control schools, the rapid overall growth in AP participation over this time period

[9] The question about longevity of the 2003-04 weighting system was originally collected to ensure appropriate identification of student cohorts for analysis, so information about changes in weights for Pre-AP and dual credit courses was not collected. Hence, weighting policies for other types of courses appear only in the cross-sectional models.

may lead to estimates being confounded by spurious correlation. Second, the incidental parameter problem necessitates the estimation of conditional fixed effect logit, ala Hausman, Hall, and Griliches (1984), but these models universally failed to converge due to quasi-complete separation in the sample. Hence, I estimate the unconditional logit fixed effect models while acknowledging the potential for bias.

RESULTS

Table 6 presents the results of logit regressions for enrolling in any core AP course, as well as separate estimates for AP science, math, English, and social studies course-taking for black, Hispanic, and white students. Wald tests of the null hypothesis that the coefficients on weighting-related variables (including interactions between grade-weight and ethnicity) are the same for Asian, black, Hispanic, and white students indicate that Asians respond differently than students from other races to grade weighting incentives, so results for Asian students are estimated separately and presented in Table 7. Additional Wald tests confirm that student responsiveness to differential grade weighting is the same by gender and economic disadvantage once group-specific intercepts are included.

For all races, an increase in grade weight does not increase AP course-taking in math and science, two subjects with explicitly defined prerequisites. Regardless of the grade weight, students who have not taken Pre-calculus cannot (or at least should not) take calculus, and students who have not had the high school level biology, chemistry, or physics course are not adequately prepared for AP biology, chemistry, or physics. There is also no increase in AP English-taking in response to increased grade weights, which has the less explicit but no less important prerequisites of being able to read critically and write clearly. These results suggest that, by and large, the students who are eligible to take AP courses in math, science, and English are doing so regardless of the grade weight. The results are qualitatively the same in count models predicting the number of AP courses taken.

The only action in response to increased grade weights is in AP social studies. Because the marginal effects from a logit model depend on the values of all the independent variables, I calculate the marginal effect of a change in the grade weight as the difference between the average predicted probability of AP-taking when the grade weight is half a standard deviation above the mean from that when the grade weight is half a standard deviation below. Recall that the mean grade weight is 21 and standard deviation 15. For effects unique to a subgroup of students, I calculate the difference in the average predicted probabilities of participation only for students in that subgroup. This yields between-group differences driven in part by differences in coefficient estimates and in part by differences in observable characteristics between groups.

Computed this way, increasing the grade weight by one standard deviation, from 13.5 to 28.5 percent, increases the average probability of taking an AP social studies course from 55.9 to 56.2 percent for black, Hispanic, and white students who are not low income. This already small effect is attenuated for low income students who experience a statistically significant but trivial increase in the probability of AP participation from 53.8 to 53.9 percent. Grade weights increase the AP social studies-taking of Asian students in the cross-sectional sample, though not for the economically disadvantaged, but this result is not robust to small changes in model specification. While the results from the cross-sectional models are generally consistent with theory and provide some evidence that traditionally underrepresented students are less responsive to grade weight incentives, they indicate that the practical effect of grade weighting is trivial. These results, as well as those that follow, hold when the three outlier schools are omitted from the analysis.

The difference-in-difference estimates relate a similar story. From the results in Table 8, I calculate that a one-standard deviation increase in the AP grade weight increases the probability that a black, Hispanic, or white student will take an AP social studies course from 55.9 to 56.0 percent, with an even smaller effect for low income students. An increase in grade weight of one standard deviation increases the probability of enrolling in an AP math class by 4/100 of one percent for black, Hispanic, and white students. The math and social studies results combined are substantial enough to come through in the aggregate analysis for all core AP courses, with a one standard deviation increase in grade weight associated with an increase in the probability of core course-taking from 58.8 to 59.0 percent for students who are not low income and from 55.4 to 55.6 for students who are low income. The difference-in-difference results for Asians are displayed in Table 9. A one standard deviation increase in grade weight increases the probability of AP science course-taking from 54.5 percent to 54.7 percent, but there are no other statistically significant effects.

Conditional campus fixed effect logits estimated on the subsample of schools that changed their grade weight failed to locate a maximum due to quasi-complete separation in the sample (Hausman, Hall, & Griliches 1984, Allison 2008, Heinze & Schemper 2002).[10] Estimates from a standard fixed effect logit are potentially biased due to the incidental parameter problem, but the magnitude of any bias appears to be small as the estimates, not reported here, are essentially identical to those from the cross-sectional and difference-in-difference models

[10] Quasi-complete separation in this case was a function of multiple dichotomous and continuous variables and was impossible to isolate. Even in the simple fixed effect logit specification, prior TAKS reading scores display evidence of quasi-complete separation in the sample and are necessarily omitted.

(Neyman & Scott, 1948; Lancaster, 2000). In the black, Hispanic, and white unconditional logit model with campus fixed effects, there are statistically significant but similarly trivial effects for social studies that also come through in the model for taking any AP course, where the positive effect is largely offset for economically disadvantaged students. Grade weighting is not a significant predictor in any of the other models for students of any race.

The data provide some interesting evidence about the relationship between AP-taking and related programs. AP and IB programs are indeed largely substitutes, as the presence of an IB program reduces AP course-taking in all core subjects except for math. In the case of math, there is some evidence of complementarities from the longitudinal analysis on the Asian sample. There is little evidence, however, that dual credit opportunities crowd out AP participation. In the longitudinal sample, there is some evidence that Asian students take dual credit rather than AP given the choice: the average predicted probability that an Asian student will take an AP course reduces from 65.8 to 64.2 in the presence of dual credit, slightly more than a two percent reduction. The AP-taking of the other groups studied is unresponsive to the availability of dual credit courses, regardless of whether grades in dual credit courses are weighted. This finding is likely driven by two factors. First, when both AP and dual credit courses are offered, courses can be simultaneously designated AP and dual credit. In 2004, five percent of all AP courses taken were eligible for dual credit. Second, consistent with Klopfenstein (2010), the dual credit and AP program largely serve different populations, with dual credit providing accelerated learning opportunities for students in rural and small schools that don’t have the infrastructure to support a broad scale AP program. Thus, students take dual credit courses when the comparable AP course is not offered at their high school. This finding should assuage concerns among some AP advocates who fear that dual credit courses present an inviting, less rigorous alternative for students who don't want to take the AP exam.

Given that honors and pre-AP courses serve very different functions in different schools, it is not surprising that the marginal effect of weighting grades in these courses is zero. It is possible that the positive effect of honors grade weights in schools where honors courses are a complement for AP is offset by the negative effect of honors grade weights in schools where honors and AP courses are substitutes. However, it seems more likely that weighting honors course grades has little to no impact on course-taking, just as in the case of AP grade weighting itself. For Asian students, honors grade weights increase the probability of AP science-taking by one percentage point from 52.0 to 52.9 percent but decrease the probability of AP English- and social studies-taking by one and two percentage points, respectively (calculated from results in Table 7). The negative result in the social studies model is counterintuitive given that Asian students increase enrollment in AP social studies courses in response to increases in the AP grade weight, but the marginal effects are all quite small.

Providing student support for rigorous coursework via AVID increases the probability of taking a core-subject AP course by slightly more than one full percentage point (from 56.9 to 58.1 percent) for black, Hispanic, and white students, although AVID only impacts participation in AP English and social studies. There is evidence of a similarly sized effect from the difference-in-difference models for Asian AVID students enrolling in AP science classes.

CONCLUSIONS

Despite conventional wisdom to the contrary, grade weighting is not the primary factor driving students to increase their AP course-taking. Moreover, a lack of institutional knowledge about the importance of grade-weighting does not have a practically significant adverse impact on students with low historical participation rates in AP, although low income students are marginally less responsive to increases in the AP grade weight than others. The minimal connection between AP grade weights and course-taking behavior may explain why schools tinker with their weights, making changes in the hopes of finding the sweet spot that elicits the desired student AP-taking rates. The results presented here suggest that there is no sweet spot and that schools should look elsewhere for ways to increase participation in rigorous courses.

This paper also explicitly maps out the relationship between AP and other programs. Specifically, I find that dual credit and AP are largely complements rather than substitutes. AP advocates frequently express concern that students with the choice of either program will opt for the arguably easier option of dual credit, but such behavior is not apparent in the data. The IB program is indeed a substitute for AP, except perhaps in math, and individual school policies determine whether Pre-AP and honors courses are complements or substitutes.

The primary lesson in this study is that other rewards to AP-taking, including earning college credit and advantages in the college admissions process, are strong enough to induce student participation without the additional incentive of grade-weighting. Also, if the primary competition is at the very top of the distribution among students seeking to become class valedictorian, then the magnitude of the weight matters less than the existence of any weight at all.

My initial interest in this research was driven by a desire to identify the "optimal" AP grade weight, defined as the weight that incentivizes students by equating the probability of getting 4.0 grade points in an AP class with that of getting 4.0 grade points in a non-AP class for the average student within a school. Based on the theory developed here, the optimal AP grade weight is potentially different for every school because student interests and abilities vary widely. However, the finding that there is little link between higher weights and AP course-taking behavior indicates a much easier answer: “all weights are equally ineffective” at increasing AP course participation.

Even so, there are potential benefits to grade weighting. Weighting can reduce ceiling effects by spreading out the GPA distribution at the high end, and it can insure that AP-participating students have an advantage in class rank calculations. Even a small AP weight can insure that if two students have both earned straight A’s, one with and the other without AP, the AP-taker gets ranked higher. This is different from the argument that without grade-weighting, there would be no AP-taker, a claim that is not borne out by the data. However, from a sociological perspective, weighting can be thought of as a “goody” that administrators dole out to favored groups. To the extent that AP access is restricted, either explicitly or implicitly via prior academic preparation, weighting exacerbates educational inequities by insuring that the “goodies” go to the most advantaged students. In a world where AP weighting is as prevalent as it is in Texas, it becomes even more urgent that black, Hispanic, and low income kids be prepared for and given the opportunity to engage with rigorous course work like AP.

During the public hearing about the proposed GPA, one school district board of trustees member echoed others’ concerns when he commented, “Not allowing those extra points for these courses [Gifted and Talented, pre-AP, and Honors courses] will dissuade many students from ever heading down the path of a more challenging curriculum to being with.” But his most telling remark followed: “Of course, students at the very top of the class will likely keep taking GT, honors, and pre-AP courses even without the extra points for those courses” (THECB, 2008b). Turns out, it isn’t just the high-achieving students. At the end of the day, grade weights are not so much an incentive as a reward.

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Table 1
Campus-level predictors of AP grade weight and weight change

	AP weight in 2004[a] (2004 predictors)	Changed weight between 2002 and 2004[b] (2001 predictors)
# AP core course offerings	0.19	0.10
	(0.78)	(1.08)
Enrollment	0.00	0.00
	(0.38)	(0.59)
Percent students black	0.15***	-0.02
	(3.40)	(1.06)
Percent students Hispanic	-0.04	-0.01
	(0.99)	(0.61)
Percent students economic	-0.07	-0.01
disadvantage	(1.42)	(0.36)
Percent students limited English	0.27**	0.02
Proficient	(2.39)	(0.46)
Percent students special education	0.15	0.07
	(0.98)	(1.22)
Percent teachers in first year	0.01	0.02
	(0.05)	(0.46)
Percent students taking advanced	-0.10	-0.05
courses	(1.28)	(1.55)
Percent graduating with	0.02	-0.01
recommended diploma	(0.47)	(1.19)
Rural school	-1.34	1.17*
	(0.81)	(1.78)
N	759	735

Absolute *t* statistics in parentheses
Source: UT Dallas Education Research Center data, 2001-2004 and author's AP survey
* p<0.10, ** p<0.05, *** p<0.01
[a] OLS regression predicting the magnitude of the 2004 grade weight.
[b] Logistic regression predicting whether a school changed weight between 2002 and 2004.

Table 2
Descriptive statistics for 11th and 12th grade students at cross-sectional sample of schools, 2004

	Asian	Black	Hispanic	White
Took any core AP	0.531	0.222	0.223	0.348
Took AP science	0.187	0.0350	0.0363	0.0701
Took AP math	0.240	0.0440	0.0497	0.0980
Took AP English	0.295	0.149	0.144	0.217
Took AP social studies	0.352	0.136	0.135	0.206
Sem any AP core	4.09	3.08	3.05	3.31
| AP core>0	(2.28)	(1.69)	(1.69)	(1.83)
Sem AP sci	2.18	2.01	2.01	2.04
| AP sci>0	(0.75)	(0.64)	(0.65)	(0.58)
Sem AP math	2.13	1.92	1.96	1.98
| AP math>0	(0.73)	(0.54)	(0.62)	(0.56)
Sem AP Eng	1.94	1.92	1.88	1.95
| AP Eng>0	(0.26)	(0.29)	(0.44)	(0.26)
Sem AP soc stud	1.98	1.81	1.80	1.90
| AP soc stud>0	(0.72)	(0.58)	(0.59)	(0.67)
AP weight percent	25.81	25.47	22.69	22.08
	(16.79)	(16.33)	(39.28)	(16.09)
Honors courses weighted	0.966	0.969	0.971	0.961
Dual credit courses weighted	0.586	0.555	0.625	0.615
Percent graduating with	68.71	66.35	69.95	64.64
rec. diploma	(13.78)	(14.44)	(14.59)	(15.07)
Percent economic	24.57	42.59	55.72	25.24
disadvantage	(18.71)	(21.18)	(25.42)	(15.96)
# AP core course	11.28	9.250	8.985	9.590
offerings	(3.661)	(3.600)	(3.357)	(3.910)
# AP science course	2.973	2.246	2.085	2.438
offerings	(1.255)	(1.355)	(1.308)	(1.272)
# AP math course	2.539	1.882	1.824	1.950
offerings	(0.722)	(0.880)	(0.850)	(0.924)
# AP English course	1.629	1.722	1.773	1.722
offerings	(0.734)	(0.642)	(0.573)	(0.618)
# AP social studies	4.143	3.400	3.303	3.480
course offerings	(2.081)	(1.854)	(1.661)	(2.069)
Enrollment	2349.4	1860.3	1846.4	1791.5
	(771.6)	(917.3)	(826.1)	(948.1)
School offers AVID	0.0968	0.141	0.150	0.0633

School offers IB	0.120	0.0613	0.0565	0.0695
School offers dual credit	0.935	0.933	0.953	0.957
Rural school	0.0484	0.155	0.215	0.345
Grade 12	0.478	0.483	0.481	0.490
Female	0.489	0.555	0.520	0.503
Economically disadvantaged	0.669	0.824	0.878	0.423
Limited English proficient	0.339	0.0112	0.424	0.00614
At risk	0.309	0.567	0.575	0.298
Tenth grade test score: Math (Z)	0.729 (0.814)	-0.197 (0.876)	-0.0786 (0.880)	0.440 (0.796)
Tenth grade test score: Reading (Z)	0.322 (0.832)	-0.0820 (0.859)	-0.106 (0.956)	0.408 (0.643)
Math in grade 10: Geometry	0.431	0.753	0.681	0.598
Math in grade 10: Algebra 2 or higher	0.547	0.179	0.251	0.362
N students (schools)	10246 (454)	36619 (619)	98621 (733)	140952 (729)

Source: UT Dallas Education Research Center data, 2002-2004 and AP survey.
Standard deviations in parentheses. For dummy variables, mean is the fraction of the sample reporting a one.

Table 3

Average characteristics for schools that changed grade weight between 2002 and 2004[1]

	No weight change	Increased Weight	Decreased Weight
Average weight before change	20.5	14.8	37.8
	(13.6)	(33.5)	(24.2)
Percent graduating with rec. diploma	65.9	64.0	61.5
	(14.3)	(8.5)	(14.3)
Percent economically disadvantaged	36.1	35.9	32.3
	(21.7)	(20.4)	(16.3)
Percent black	7.5	7.3	12.4
	(9.0)	(8.4)	(14.5)
Percent Hispanic	29.9	30.6	20.3
	(26.7)	(23.9)	(22.7)
# AP core course offerings	7.2	6.6	6.1
	(3.8)	(3.7)	(3.3)
Enrollment	1130	1170	908
	(845)	(847)	(623)
Advanced course-taking	19.2	19.2	17.3
	(7.6)	(5.5)	(2.8)
N	107	19	10

Source: UTD-ERC data and author counselor survey, 2004.

Standard deviations in parentheses.

[1] Campus characteristics as of 2004.

Table 4
Descriptives for students in the weight change analysis

	Asian	Black	Hispanic	White
Took Any Core AP	0.564	0.169	0.183	0.320
Took AP Science	0.181	0.0272	0.0319	0.0689
Took AP Math	0.289	0.0329	0.0395	0.0879
Took AP English	0.269	0.106	0.118	0.198
Took AP Social Studies	0.391	0.0891	0.105	0.184
Sem any AP core	4.02	2.85	3.04	3.30
| AP core>0	(2.20)	(1.55)	(1.68)	(1.82)
Sem AP sci	2.12	1.98	1.91	2.05
| AP sci>0	(0.76)	(0.50)	(0.47)	(0.55)
Sem AP math	2.12	1.96	1.91	2.00
| AP math>0	(0.76)	(0.67)	(0.67)	(0.63)
Sem AP Eng	1.90	1.90	1.89	1.94
| AP Eng>0	(0.33)	(0.33)	(0.36)	(0.27)
Sem AP soc stud	1.97	1.82	1.89	1.91
| AP soc stud>0	(0.73)	(0.55)	(0.57)	(0.65)
AP weight percent	24.28	31.06	20.42	23.84
	(22.49)	(38.16)	(19.73)	(27.25)
Percent graduating with	61.01	57.58	63.15	60.22
rec. diploma	(22.76)	(18.05)	(17.74)	(18.12)
Percent economic	20.88	33.58	46.30	21.80
disadvantage	(15.34)	(16.35)	(25.56)	(14.57)
# AP core course	11.04	9.193	8.776	9.117
offerings	(2.783)	(3.210)	(3.186)	(3.564)
# AP science course	2.606	2.168	1.975	2.280
offerings	(0.925)	(1.107)	(1.076)	(1.138)
# AP math course	2.379	1.834	1.782	1.829
offerings	(0.744)	(0.843)	(0.845)	(0.886)

# AP English course offerings	1.587 (0.786)	1.701 (0.676)	1.651 (0.683)	1.664 (0.689)
# AP social studies course offerings	4.332 (1.694)	3.384 (1.698)	3.252 (1.704)	3.225 (1.890)
Enrollment	2318.5 (752.0)	1831.1 (726.5)	1815.0 (722.3)	1630.9 (767.9)
School offers AVID	0.0843	0.0804	0.0669	0.0590
School offers IB	0.168	0.157	0.0467	0.0544
School offers dual credit	0.534	0.570	0.672	0.636
Rural school	0.140	0.332	0.237	0.417
Grade 12	0.474	0.462	0.465	0.476
Female	0.495	0.540	0.521	0.507
Economically disadvantaged	0.872	0.917	0.946	0.789
Limited English proficient	0.246	0.0107	0.370	0.00314
At risk	0.234	0.494	0.548	0.252
Tenth grade test score: Math (Z)	0.645 (0.709)	-0.128 (0.914)	-0.0661 (0.921)	0.430 (0.701)
Tenth grade test score: Reading (Z)	0.281 (0.845)	-0.0542 (0.873)	-0.154 (0.983)	0.403 (0.617)
Math in grade 10: Geometry	0.398	0.713	0.657	0.591
Math in grade 10: Algebra 2 or higher	0.569	0.179	0.237	0.352
N students (schools)	5979 (112)	15845 (122)	56893 (135)	131649 (136)

Source: UT Dallas Education Research Center data, 2002-2004 and AP survey.
Standard deviations in parentheses. For dummy variables, mean is the fraction of the sample reporting a one.

Table 5
Descriptives of treatment and comparison schools

variable	treatment	control	pooled sd	abs(diff)/sd
# AP core course offerings	6.39	6.43	3.29	0.01
Enrollment	986.82	928.13	737.16	0.08
Percent black	8.32	8.70	11.62	0.03
Percent Hispanic	21.79	21.22	22.40	0.03
Percent economic disadvantage	27.84	28.48	17.78	0.04
Percent limited English proficient	3.33	3.08	6.20	0.04
Percent special education	14.90	14.45	4.22	0.11
Percent first year teachers	6.25	5.95	4.54	0.07
Percent advanced coursetaking	18.64	19.06	6.85	0.06
Percent graduating with rec. diploma	35.24	34.32	22.30	0.04

Table 6
Logit Regressions Predicting AP-Taking for White, Black, and Hispanic Students

	Took any core AP	Took AP science	Took AP math	Took AP English	Took AP social studies
AP weight percent/100	0.02	-0.27	-0.14	-0.12	0.57**
	(0.12)	(1.18)	(0.70)	(0.46)	(2.42)
AP weight/100 *black	-0.16	0.13	-0.34	0.25	-0.21
	(0.62)	(0.28)	(1.09)	(0.85)	(0.64)
AP weight/100 *Hispanic	0.05	0.26	0.09	0.26	-0.17
	(0.31)	(1.16)	(0.50)	(1.12)	(0.78)
AP weight/100 *disadvantaged	-0.05	0.07	-0.19*	-0.09	-0.21***
	(0.52)	(0.82)	(1.79)	(0.94)	(2.85)
Honors courses weighted	0.00	0.04	0.15	-0.02	-0.03
	(0.01)	(0.35)	(0.98)	(0.14)	(0.20)
Dual credit courses weighted	-0.06	0.03	-0.07	-0.05	-0.09
	(0.90)	(0.41)	(1.00)	(0.64)	(1.21)
Fraction graduating with rec. diploma	0.77***	0.10	0.95***	0.65**	0.67***
	(3.80)	(0.34)	(3.88)	(2.49)	(2.61)
Percent economic disadvantage	0.02***	0.01***	0.01***	0.02***	0.01***
	(11.36)	(4.47)	(5.25)	(9.14)	(7.22)
# AP subject-area course offerings	0.10***	0.34***	0.42***	1.02***	0.19***
	(6.62)	(7.92)	(7.39)	(9.18)	(6.82)
Enrollment (in 1000s)	-0.41***	-1.28***	-0.23	-0.18	-0.22
	(3.32)	(9.32)	(1.40)	(1.38)	(1.44)
Enrollment^2 (in 1000s)	0.03	0.20***	0.03	-0.01	0.01
	(1.36)	(6.01)	(1.08)	(0.22)	(0.23)
School offers AVID	0.35***	-0.16	0.16	0.38***	0.34**
	(2.98)	(1.41)	(1.31)	(2.96)	(2.53)
School offers IB	-0.28**	-0.50***	-0.24	-0.42***	-0.00
	(2.11)	(3.06)	(1.33)	(3.24)	(0.03)
School offers dual credit	-0.06	-0.15	-0.15	-0.21	-0.12
	(0.39)	(1.00)	(0.77)	(1.14)	(0.74)
Rural school	-0.13	-0.11	-0.12	-0.17	-0.15
	(1.38)	(1.19)	(1.23)	(1.58)	(1.41)

Grade 12	0.03 (0.70)	1.39*** (17.16)	2.20*** (25.49)	-0.35*** (8.11)	-0.19*** (3.66)
Female	0.44*** (30.18)	0.03 (1.22)	-0.10*** (5.36)	0.61*** (33.48)	0.27*** (16.18)
Economically disadvantaged	-0.20*** (7.17)	-0.07** (2.16)	-0.41*** (11.65)	-0.09*** (2.93)	-0.04 (1.50)
Limited English proficient	-0.24*** (4.62)	-0.00 (0.05)	-0.47*** (7.40)	-0.26*** (4.75)	-0.11 (1.54)
At risk	-0.63*** (20.35)	-0.60*** (13.17)	-1.71*** (30.09)	-0.61*** (16.01)	-0.51*** (13.54)
Black	0.15 (1.56)	0.07 (0.37)	-0.51*** (5.10)	0.16 (1.53)	0.16 (1.38)
Hispanic	-0.23*** (4.16)	-0.14** (1.98)	-0.39*** (6.51)	-0.31*** (4.50)	-0.20*** (3.12)
Tenth grade test score: Math (Z)	0.98*** (45.91)	0.91*** (16.33)		0.56*** (20.26)	0.58*** (23.44)
Tenth grade test score: Reading (Z)	1.04*** (34.58)	0.69*** (14.94)		1.07*** (30.98)	0.87*** (27.21)
Math in grade 10: Geometry		0.44 (1.55)		0.84*** (10.30)	0.84*** (9.15)
Math in grade 10: Algebra 2 or higher		1.38*** (4.79)		1.80*** (19.78)	1.64*** (16.02)
N all students (schools)	279150 (741)	246229 (567)	272175 (680)	252009 (639)	250207 (558)
N white (schools)	142327 (729)	129239 (559)	138458 (671)	128185 (627)	125371 (547)
N black (schools)	37099 (621)	32208 (494)	36351 (586)	32757 (545)	33251 (488)
N Hispanic (schools)	99724 (733)	84782 (563)	97366 (675)	91067 (632)	91585 (556)

Absolute *t* statistics in parentheses
Source: UT Dallas Education Research Center data, 2002-2004
* p<0.10, ** p<0.05, *** p<0.01
[1] Due to quasi-complete separation in the AP math sample, prior test scores are omitted from this regression to achieve convergence.

Table 7
Logit Regressions Predicting AP-Taking for Asian Students

	Took Any Core AP	Took AP Science	Took AP Math	Took AP English	Took AP Social Studies
AP weight percent/100	-0.27 (0.66)	0.20 (0.47)	0.18 (0.48)	-0.20 (0.40)	0.72* (1.82)
AP weight/100 *disadvantaged	0.19 (0.61)	-0.19 (0.47)	-0.22 (0.60)	0.45 (0.91)	-0.57* (1.67)
Honors courses weighted	-0.34** (2.46)	0.44** (2.29)	0.06 (0.27)	-0.33** (2.25)	-0.56*** (4.75)
Dual credit courses weighted	0.05 (0.45)	-0.07 (0.52)	0.01 (0.04)	-0.00 (0.02)	0.18 (1.54)
Fraction graduating with rec. diploma	1.16*** (3.03)	1.13** (2.35)	1.34*** (2.63)	0.87* (1.79)	0.43 (1.05)
Percent economic disadvantage	0.02*** (8.54)	0.01*** (3.74)	0.01*** (4.37)	0.02*** (5.55)	0.02*** (5.24)
# AP core course offerings	0.10*** (4.16)	0.08 (1.21)	0.25*** (2.62)	1.45*** (6.17)	0.19*** (4.52)
Enrollment (in 1000s)	-0.25 (0.82)	-0.41 (1.02)	0.04 (0.17)	0.33 (0.84)	-0.21 (0.59)
Enrollment^2 (in 1000s)	0.04 (0.70)	0.06 (0.82)	0.00 (0.02)	-0.09 (1.31)	0.05 (0.71)
School offers AVID	-0.41 (1.47)	-0.53 (1.37)	-0.27 (1.34)	0.17 (0.82)	-0.04 (0.16)
School offers IB	-0.68*** (3.21)	-0.63** (2.40)	-0.42 (1.60)	-0.99*** (6.01)	-0.44*** (3.06)
School offers dual credit	-0.35 (1.10)	-0.16 (0.74)	-0.13 (0.41)	-0.05 (0.16)	-0.33 (1.28)
Rural school	-0.09 (0.44)	-0.25 (1.10)	-0.08 (0.44)	-0.01 (0.06)	-0.09 (0.44)
Grade 12	0.96*** (8.65)	2.03*** (12.33)	4.02*** (17.84)	0.12 (1.25)	0.16* (1.88)

Female	0.41***	0.04	0.02	0.50***	0.18***
	(6.88)	(0.61)	(0.44)	(7.61)	(3.38)
Economically disadvantaged	-0.20**	0.02	0.01	-0.27**	0.06
	(2.02)	(0.14)	(0.12)	(2.15)	(0.58)
Limited English proficient	-0.19***	0.11	-0.03	-0.44***	-0.12
	(2.85)	(1.17)	(0.39)	(5.22)	(1.60)
At risk	-0.73***	-0.47***	-0.61***	-0.55***	-0.41***
	(9.41)	(2.95)	(5.89)	(5.35)	(4.37)
Tenth grade test score: Math (Z)	1.22***	1.14***	2.50***	0.56***	0.69***
	(19.40)	(9.20)	(17.56)	(7.67)	(10.64)
Tenth grade test score: Reading (Z)	0.73***	0.42***	0.14*	1.09***	0.76***
	(10.37)	(4.77)	(1.69)	(11.82)	(9.30)
Math in grade 10: Geometry		0.82		0.41	0.79**
		(1.18)		(1.02)	(2.11)
Math in grade 10: Algebra 2 or higher		2.16***		1.42***	1.59***
		(3.09)		(3.61)	(4.20)
N students (schools)	10290	10058	10235	8681	9110
	(456)	(384)	(439)	(410)	(407)

Absolute *t* statistics in parentheses
Source: UT Dallas Education Research Center data, 2002-2004
* p<0.10, ** p<0.05, *** p<0.01

Table 8
Difference in Difference Logits Predicting AP-Taking for White, Black, and Hispanic Students

	Took any core AP	Took AP science	Took AP math	Took AP English	Took AP social studies
AP Weight Percent/100	0.33***	0.21	0.24*	0.01	0.33***
	(2.81)	(1.22)	(1.94)	(0.08)	(3.29)
AP weight/100 *black	-0.18	0.02	-0.05	-0.28	-0.03
	(1.22)	(0.16)	(0.64)	(1.34)	(0.27)
AP weight/100 *Hispanic	-0.31	-0.46	-0.05	-0.61	-0.34
	(0.88)	(0.86)	(0.22)	(0.97)	(0.63)
AP weight/100 *disadvantaged	-0.25***	0.05	-0.09	-0.09	-0.26***
	(3.19)	(0.54)	(0.84)	(0.54)	(2.59)
Fraction graduating with rec. diploma	0.76***	0.41	0.61*	1.03**	0.14
	(2.69)	(1.27)	(1.67)	(2.39)	(0.45)
Percent economic disadvantage	0.02***	0.02***	0.01***	0.02***	0.01***
	(6.53)	(5.27)	(2.80)	(3.79)	(3.78)
# AP subject-area course offerings	0.12***	0.51***	0.47***	0.90***	0.29***
	(5.77)	(7.39)	(5.15)	(4.07)	(6.96)
Enrollment (in 1000s)	-0.47*	-1.05***	-0.98***	-0.18	-0.18
	(1.78)	(3.32)	(4.66)	(0.40)	(0.62)
Enrollment^2 (in 1000s)	0.06	0.15	0.23***	0.05	-0.01
	(0.83)	(1.51)	(3.72)	(0.35)	(0.13)
School offers AVID	0.50***	0.23	0.16	0.45**	0.54***
	(2.91)	(1.63)	(0.85)	(2.37)	(3.21)
School offers IB	-0.15	-0.51***	0.09	-0.20	-0.16
	(0.87)	(3.41)	(0.57)	(0.90)	(0.67)
School offers dual credit	-0.05	0.07	0.09	-0.14	-0.09
	(0.51)	(0.59)	(0.67)	(0.90)	(0.75)
Rural school	-0.03	0.16	-0.16	-0.07	-0.00
	(0.27)	(0.92)	(1.13)	(0.31)	(0.00)
Grade 12	0.12**	0.94***	2.80***	-0.32***	-0.17**
	(2.34)	(8.73)	(14.79)	(5.43)	(2.20)

Female	0.49***	0.06	-0.01	0.70***	0.25***
	(20.08)	(1.41)	(0.43)	(24.71)	(10.54)
Economically disadvantaged	-0.09*	-0.10*	-0.24***	-0.05	0.03
	(1.87)	(1.69)	(3.41)	(0.74)	(0.51)
Limited English proficient	-0.50***	0.29***	0.01	-0.57***	0.01
	(5.41)	(2.90)	(0.12)	(4.83)	(0.11)
At risk	-0.86***	-0.62***	-0.82***	-0.79***	-0.59***
	(9.63)	(9.19)	(10.99)	(6.47)	(5.23)
Black	-0.18	-0.11	-0.10	-0.10	-0.23***
	(1.32)	(1.32)	(1.00)	(0.63)	(3.08)
Hispanic	-0.13	-0.08	-0.08	-0.09	-0.06
	(1.04)	(0.52)	(0.72)	(0.50)	(0.41)
Tenth grade test score: Math (Z)	1.77***	1.16***	2.68***	1.27***	0.77***
	(24.29)	(14.81)	(29.56)	(15.28)	(12.88)
Tenth grade test score: Reading (Z)[1]		1.01***	1.14***		1.29***
		(18.41)	(17.54)		(21.54)
Math in grade 10: Geometry		1.18***		1.06***	1.00***
		(7.79)		(11.72)	(11.21)
Math in grade 10: Algebra 2 or higher		2.13***		1.94***	1.74***
		(10.99)		(15.10)	(14.13)
N all students (schools)	204387	185412	197989	179081	185756
	(136)	(123)	(134)	(126)	(112)
N white (schools)	131649	120142	127163	115099	118280
	(136)	(123)	(134)	(126)	(112)
N black (schools)	15845	14276	15439	13883	15043
	(122)	(111)	(120)	(112)	(103)
N Hispanic (schools)	56893	50994	55387	50099	52433
	(135)	(122)	(133)	(125)	(110)

Absolute *t* statistics in parentheses
Source: UT Dallas Education Research Center data, 2002-2004
* p<0.10, ** p<0.05, *** p<0.01
[1] Due to quasi-complete separation in the any core AP and AP English samples, prior reading test scores are omitted from these regressions to achieve convergence.

Table 9
Difference-in-Difference Logits Predicting AP-Taking for Asian Students

	Took Any Core AP	Took AP Science	Took AP Math	Took AP English	Took AP Social Studies
AP weight percent/100	-0.11 (0.39)	0.48* (1.90)	-0.23 (0.84)	-0.60 (1.00)	0.13 (0.44)
AP weight/100 *disadvantaged	0.35 (0.90)	0.04 (0.13)	0.57 (1.39)	0.21 (0.43)	-0.04 (0.09)
Fraction graduating with rec. diploma	0.61 (1.53)	0.27 (0.85)	0.41 (1.27)	1.63*** (5.01)	-0.46 (1.47)
Percent economic disadvantage	0.01*** (2.68)	0.00 (0.74)	0.01 (0.97)	0.02*** (2.73)	0.02*** (3.49)
# AP core course offerings	0.11*** (3.33)	0.50*** (4.47)	0.35* (1.89)	1.22** (2.57)	0.20*** (3.03)
Enrollment (in 1000s)	0.03 (0.07)	0.31 (0.61)	0.18 (0.25)	1.31* (1.81)	0.14 (0.19)
Enrollment^2 (in 1000s)	-0.01 (0.08)	-0.15 (1.15)	0.01 (0.04)	-0.36* (1.95)	0.01 (0.09)
School offers AVID	0.16 (0.90)	0.24* (1.93)	-0.09 (0.47)	0.20 (0.94)	0.38* (1.89)
School offers IB	0.08 (0.28)	0.29 (0.80)	0.24 (1.06)	-0.74* (1.94)	-0.42 (1.53)
School offers dual credit	-0.27** (2.23)	-0.17 (1.02)	-0.38 (1.48)	-0.09 (0.45)	-0.46*** (3.29)
Rural school	0.03 (0.14)	0.32 (1.02)	-0.12 (0.46)	0.09 (0.27)	0.33 (1.29)
Grade 12	0.64*** (4.94)	0.98*** (2.76)	2.31*** (7.81)	-0.27*** (2.82)	0.13 (0.74)
Female	0.57*** (8.43)	0.07 (0.85)	0.11 (1.63)	0.66*** (7.13)	0.35*** (5.46)
Economically disadvantaged	-0.29* (1.86)	-0.20 (1.21)	-0.33* (1.74)	-0.38** (2.07)	-0.08 (0.47)

Limited English proficient	-0.30***	0.01	-0.06	-0.75***	-0.25***
	(3.19)	(0.04)	(0.60)	(6.77)	(2.77)
At risk	-0.63***	-0.74***	-0.62***	-0.38**	-0.51***
	(6.33)	(4.88)	(6.52)	(2.10)	(5.63)
Tenth grade test score: Math (Z)	1.57***	1.12***	2.07***	0.86***	0.87***
	(11.61)	(7.55)	(13.67)	(5.58)	(7.96)
Tenth grade test score: Reading (Z)	1.01***	0.78***	0.38***	1.44***	0.92***
	(10.99)	(7.38)	(3.69)	(8.17)	(8.70)
Math in grade 10: Geometry		1.38*		0.78	0.53
		(1.71)		(1.33)	(1.56)
Math in grade 10: Algebra 2 or higher		2.33***		1.79***	1.49***
		(2.91)		(3.06)	(4.71)
N students	6362	5786	6326	4857	5763
(schools)	(115)	(106)	(113)	(103)	(97)

Absolute *t* statistics in parentheses
Source: UT Dallas Education Research Center data, 2002-2004
* p<0.10, ** p<0.05, *** p<0.01