Strengthening College Preparation and Access Through Concurrent Enrollment in High School and Community College

Daniel M. O'Brien
Teresa D. Nelson
The University of Texas at Dallas

Abstract

During the past decade community colleges have again focused on one of their original missions, preparing students to enter a four-year college in pursuit of a bachelors degree. Cooperation between community colleges and high schools has increased the number of students simultaneously attending high school and community college. In Texas, the number of Dual Enrollees has more than quadrupled during the past 12 years. One of every six Texas public high school seniors in 2002 took at least one college course during their junior or senior year in high school. Using Texas as an example, this paper examines participation in dual enrollment programs and whether these programs increase access to and success in four-year public colleges and universities.

We find that enabling legislation in 1995 led to increased participation in concurrent enrollment. Despite attending high schools with proximity to community colleges, however, minority and economically disadvantaged students are less likely to use the program. Because they have similar characteristics to Dual Enrollees, we use students who take advanced placement courses (AP) in high school as a comparison group. We find that Dual Enrollees are less likely to earn an advanced high school diploma, but are at least as likely as AP Takers, and much more likely than students who do not participate in college credit programs, to transfer from community college to four-year college, keep on grade level in four-year college, and earn a bachelor's degree more quickly. Based on these findings, and particularly in light of increasing tuition in Texas public universities, we believe that education agencies could improve access, equity and success in college by encouraging school districts and colleges to offer dual enrollment, especially in those high schools with high proportions of minority and economically disadvantaged students.

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Introduction

Community colleges originated in the United States in response to the imperative of an increasing demand for more education, to provide young adults with an environment for maturational transition prior to taking on senior college demands and to provide the academic preparation necessary for college success (Kane and Rouse 1999; Cohen 1990; Tuttle 2002). The use of local taxes, then direct state aid, for fulfilling this mission combined with open-admissions policies enabled the community college system to improve access to higher education to a larger part of the population. In recent decades, community colleges have greatly increased their scope of services to include technical and vocational training, remedial coursework, professional training, non-academic continuing education and career counseling. These diverse offerings, combined with lower tuition than senior colleges, and, in some cases, overcrowding at senior colleges have contributed to community college growth rates that have outpaced the growth rates of senior colleges (Kane and Rouse 1999; Evelyn 2001). Enrollment data over the last three decades reveal that two-year institutions experienced 95 percent growth in enrollment in the 1970s, 16 percent growth in the 1980s, and 9 percent growth in the 1990s, compared to 18 percent, 13 percent and 7 percent for 4-year institutions (U.S Dept. of Education 2002). Most high school graduates will take at least one course from a community college and many are earning their terminal degree from a community college (Kane and Rouse 1999).

As early as the 1980s, many community colleges and high schools began cooperating more formally to bridge the high school-college transition by providing students with earlier access to the higher education (Greenberg 1991; TCPA 1994). Concurrent enrollment and dual enrollment programs, whereby high school students simultaneously attend high school and college prior to earning a high school diploma, have grown dramatically in size and range. This is particularly true in Texas where concurrent enrollment increased fourfold during the 1990s. More than 15 percent of

Texas public high school seniors now take college courses during their junior or senior year in high school compared to just 4.8 percent in 1991.

In this paper we examine dual enrollment participation in Texas and whether access to these programs has been effective at improving academic outcomes of students from Texas public high schools. Using individual panel data for all Texas public high school and college students from 1991 through 2002, we describe enrollment trends by student characteristics such as race/ethnicity and economic disadvantage. We examine student progress through college and college graduation using advanced placement (AP) course takers as a control group and further control for differences in observable characteristics such as race/ethnicity, eligibility for the Federal lunch program and gender using a binary choice (probit) model. Our final models include controls for student characteristics that are correlated in central cities/suburbs, the state's geographic regions, school districts and campuses and separate estimates by race/ethnicity. We find consistent evidence that dual credit students share many of the academic advantages of students who take AP courses. Dual Enrollees are nearly as likely as AP Takers to earn an advanced high school diploma, are *more* likely to enroll in and then transfer from community college to a four-year college, and once student skills and other characteristics are controlled for, to stay on a timely college grade level trajectory and to earn a bachelors degree in four through six years. For each of these measures, both Dual Enrollees and AP Takers have large advantages over students enrolled in no program. Reaching degree completion faster reduces time spent out of the labor market and the cost of earning a bachelor's degree. Participation in dual enrollment programs can have important implications for raising the socioeconomic status of disadvantaged groups in Texas.

We conclude with a policy recommendation: If concurrent enrollment promotes successful transition to and graduation from college, as our results indicate, state education leaders should support policies that encourage colleges and high schools to collaborate in order to offer dual enrollment to more high school students.

Description of College Credit Programs

Several avenues allow Texas public school students to pursue college credit while still in high school. These include Advanced Placement and dual enrollment programs. We use concurrent enrollment or dual enrollment to refer to high school students enrolled in at least one public community or four-year college course during their junior or senior year of high school. Advanced Placement (AP) courses, developed by the College Board, are taught in the high school setting by high school teachers. They cover a variety of subjects using standardized curricula equivalent to college material. These courses alone generally do not earn the students college credit; they must take the nationally standardized AP exam. Students can utilize the courses to prepare for the AP examination or simply to introduce themselves to the rigor of college coursework. Taking the course, however, is not a prerequisite for taking the examination (The College Board 2001; Klopfenstein 2002). Universities and colleges to which students send their AP exam scores determine which AP scores will earn college credit. Award of credit is then contingent upon the student's enrollment in that award-granting institution. Even if the student does not take the AP exam (or does not score high enough to earn college credit), the student may still benefit from having taken what is effectively considered to be college-level course work (The College Board 2001; Greenberg 1991). The College Board's Advanced Placement Program has been highly successful, greatly expanding nationally the option to pursue college credit while still in high school to students of a wide range of ability levels. Participation in the AP program has grown dramatically in Texas, particularly since 1994 (Klopfenstein 2002).

In Texas, concurrent enrollment programs have formal status due to the 1995 passage of a state law allowing community colleges to enter into agreements with school districts that enable community colleges to reduce or waive tuition to dual enrolled students in the community college service area. Through dual enrollment, high school students receive an introduction to college-level

work and can earn credit toward an associate degree or toward professional certificates (THECB 1998). These credits also count toward high school graduation requirements. Dual credit entails a more certain award of college credit than taking an AP course or AP exam, requiring only that the student earn a passing grade in the dual credit course. As more colleges adopt a statewide common course numbering system for core courses, dual credit students will have greater assurance that college credits earned in this manner will be accepted by another Texas college or university.

Dual credit courses, however, are not always available on the high school campus. While availability is growing, many dual credit students must attend both high school and the community college. We cannot identify which students took their courses in a classroom solely consisting of high school students or in a mixed classroom of high school and "regular" college students, nor can we determine whether this was at the high school or at the community college. One constant factor, however, is instructor's minimum level of instructor accreditation. Each community college has the responsibility for selection and/or supervision of any instructor who teaches a dual credit course, including high school teachers. These teachers must meet the same requirements as other faculty teaching the same courses at the community college, no matter where the course is taught (THECB 1998). Typically, high schools have allowed both juniors and seniors to concurrently enroll, contingent on meeting some specified grade point or grade average criteria, or on the recommendation of school counselors, but a small percentage of freshmen and sophomores have also participated in dual or concurrent enrollment.

The Legal Foundation for Dual Enrollment

Until May 1995, high school students in Texas pursued dual credit enrollment on a student-by-student and high school-by-high school basis (TCPA 1994a; Mathieu 2001). Noting the benefits reported by other states, including Oklahoma, Minnesota and Washington, the Texas Comptroller of

Public Accounts recommended in 1994 that the Texas State Legislature develop a program for high school students to pursue concurrent enrollment (TCPA 1994a). In May 1995, the Texas House of Representatives passed House Bill 1336, giving community colleges the option to reduce or waive tuition to students living within the community college's taxing district or service area (Texas Legislature 1995). The bill took effect immediately, enabling community colleges to waive tuition and instructing the commissioners of the Texas Education Agency and the Texas Higher Education Coordinating Board to develop funding formulae and administrative rules for providing dual enrollment courses to high school students.

Dual Enrollment Patterns

We use data for the 1990-91 through 2001-02 school years from the Texas Schools Microdata Panel (TSMP). This database, developed by John Kain at the University of Texas at Dallas, contains individual student data collected by the Texas Education Agency (TEA) and the Texas Higher Education Coordinating Board (THECB). There are extensive administrative data for each student including campus, grade, and the student's demographic characteristics. Course information for high school students has identifiers for each AP course taken and whether the student passed or failed the course. TEA data also include individual student results on the Texas Assessment of Academic Skills (TAAS), a criterion-referenced test administered annually to students in grades 3 through 8, as well as for the exit-level TAAS, first taken in grade 10, that students must pass to graduate from high school. TSMP also includes SAT and ACT test scores for students taking these college entrance exams.

By matching high school data with enrollment and graduation data from the THECB, we are able to identify students who are simultaneously enrolled in high school and a Texas public college, community college or university. We can then compare these students to those who took AP courses. We first look at the entire population of high school seniors. Any high school senior taking

at least one credit hour at a Texas public college during the fall or spring term during her senior year, during the fall or spring of her junior year or during the summer after her junior year is flagged as a dual credit enrollee. We exclude the many high school students who take college courses during the summer after graduation. By our definition, these students are not dual enrolled.

Table 1 shows the number and percent of Texas public high school seniors who were concurrent enrollees. We use the calendar year of the spring semester to identify each school year (e.g. the academic year 1990-1991 is denoted "1991"). The first panel, for all students, gives the number of students as well as the number and percent dual enrolled from 1991 through 2002. The number of public high school seniors increased by almost 27 percent, from 164,539 to 208,781[1]. During this same period, concurrent and dual enrollment more than quadrupled, from 7,897 students in 1991 to 32,629 in 2002. The proportion of students dual or concurrently enrolled more than tripled, from 4.8 percent to 15.6 percent.

The next five panels of Table 1 show the number of students and percents by race/ethnicity. The number and rate of participation for each group increased between 1991 and 2002, however, concurrent enrollment continues to be dominated by Anglo students who accounted for 76.5 percent of concurrent enrollees in 1991 and 68.4 percent in 2002, approximately twenty percent higher than their proportion of seniors in each year. African American students were underrepresented in each year accounting for 13 percent of high school seniors, but only seven percent of concurrent enrollees in 1991, falling to less than six percent in 2002. Asian students represented a higher proportion of concurrent enrollees than of seniors in both 1991 and 2002. Hispanic students made progress, particularly in the last two years but remain underrepresented.

Figure 1 summarizes the proportion of students concurrently enrolled by race/ethnicity. The flatter trajectory for African American students exacerbates the gap in take up rates. Asian and

[1] This count includes only seniors with numeric encrypted student identifiers used for linking to SAT/ACT and college records. Approximately nine percent of the enrollment records have missing or alphabetic (temporary) ID's. In cases where a student has multiple enrollment records, we keep only the first senior year record for each student.

Anglo students are clearly recognizing the advantages of dual enrollment. Their participation rates are larger and accelerating. Figure 1 clearly shows that most of the growth in dual and concurrent enrollment occurred followed the passage of enabling legislation in 1995. Though limited in its extent, increased publicity following passage of the law, increased availability and greater familiarity, are likely contributors to this growth (Chastain 2002).

The bottom panel of Table 1 shows the count and percentage of economically disadvantaged students. Almost 30 percent of recent public high school seniors are eligible for the Federal lunch program. From 1990 to 2002 the number and proportion of these students increased from 31,293 (19 percent) to 59,508 (28 percent). Economically disadvantaged students participated in dual or concurrent enrollment at less than 1/3 the rate for other students in 1991, but by 2002 increased their participation to 8.7 percent, almost half the 18.7 percent rate for students not participating in the Federal lunch program.

Spatial Patterns of Dual enrollment

Texas is an excellent laboratory for studying educational issues due to the state's demographic diversity, as well as the size and heterogeneity of its regions and major cities. Economic and race/ethnic differences in high school participation are partly explained by the geographic pattern of students and schools involved in dual enrollment. To examine the spatial context of dual enrollment programs, we divide the state's school districts into census categories, rural, non-metropolitan, small central cities, and the suburbs of small central cities. For each of seven major metropolitan areas, we identify the district that is most like the central city, and assign the label "suburb" to each of the other districts in the same county or counties adjacent to the central city. For Houston, we add one additional category, Houston ex-urban, encompassing counties that are close to the central-city district but are not contiguous. This is an imperfect division due to the diversity within central-city districts and their suburbs. For example, several districts classified as

suburban (such as Wilmer-Hutchins ISD in the Dallas area and Edgewood ISD near San Antonio) have higher proportions of minority and economically disadvantaged students than the nearby central city. Even given this heterogeneity, clear patterns of dual enrollment participation emerge.

Table 2 provides dual enrollment statistics for Texas geographic areas for the 1991 and 2002 school years as well as averages for 1991 through 2002. The top panel illustrates the diversity of Texas cities and suburbs. The proportion of dual enrolled students actually declined in one of the central city districts, El Paso ISD. Only two of the central city districts, Austin ISD and San Antonio ISD had participation growth (2.1 to 10.5 percent and 1.4 to 10.1 percent) that was nearly comparable to large suburban districts. All of the large central-city suburbs had increasing rates of dual enrollment, with most experiencing a three-fold increase. Only the Dallas suburbs had less than twice the rate in 2002 as 1991. Overall, suburban district rates increased from 4.3 to 14.6 percent.

All of the more rural areas increased dual enrollment participation more than three-fold. This is surprising, since the average distance from a high school to the nearest community college is much greater for rural areas than central cities and their suburbs. Each of the major metropolitan areas has at least one extensive community college system. Despite their geographic proximity to local high schools, dual enrollment has not become a common practice in most of the central cities of the state. This geographic anomaly helps to explain disparities in dual enrollment rates for minority students, and especially among African American students who disproportionately attend central-city district schools. (Kain and O'Brien 2002) Participation by community colleges mirrors the geographic distribution of participating high schools. Suburban and rural community colleges had the fastest growth. Among the large metropolitan areas, growth was greatest in the San Antonio area, where school districts have aggressively pursued dual enrollment. The high proportion of Hispanic students in and around San Antonio accounts for much of the increase in statewide participation rates for Hispanic students.

The Impact of Dual Enrollment on Student Progress

As we have already seen, participation in dual enrollment programs is far from a random assignment process. We are therefore placed in the unenviable position of trying to parse the effect of dual enrollment on student success from the effect of the student's own abilities, motivation, family background and other factors. Fortunately we have a convenient group of students who may be quite similar to dual enrollment students but either do not have access to dual enrollment, or choose another route toward expediting their educational goals.[2] Students taking Advanced Placement courses during high school, we will call them "AP Takers", may be quite similar to dual enrollment students. As explained above, by scoring high enough on an AP exam, AP Takers can earn college credits and forego basic college courses. In many high schools they receive honors credits, enhancing their grade point averages, and the quality of their college applications.[3]

In the following sections we compare Dual Enrollees, AP Takers, students who are both ("Both"), and students who are neither AP Takers nor Dual Enrollees ("Neither"). We examine their academic progress using four achievement measures: 1) type of high school diploma earned, 2) propensity to transition from community college to four-year college, 3) rapidity of progress through four-year college, and 4) earning a bachelor's degree. Our sample consists of all Texas public high school seniors in 1994 through 2002. In each analysis we include each school year for which sufficient data are currently available.

Type of High School Diploma

Recent research ties the difficulty of high school curriculum to students' outcomes, including success in the labor market (Rose and Betts 1999). The Texas Education Agency recognizes the

[2] We also account for student academic skills which are often missing from studies of college credit program studies. {Bailey, 2003 #12}

[3] School districts have the latitude to weight AP and honors courses when calculating the student's grade point average and class rank.

importance of advanced high school course participation, and awards several types of high school diplomas. These reflect completion of required courses, or of honors or advanced placement courses in addition to basic requirements. There is also a type of diploma designated for students with special educational needs who are following an individual education plan (IEP). The requirements and number of degree types has grown between 1994 to 2002 period; we classify high school diplomas by "Regular," "Advanced," or "IEP" in order to compare diplomas earned by Dual Enrollees, AP Takers, Both and Neither.

Table 3 shows the percent of Texas public high school seniors earning an advanced diploma by program participation and year. The number of Texas public high school graduates has grown steadily during the period from 162,564 in 1994 to more 208,781 in 2002. This is due to overall population growth in the state and fewer students leaving school early. Growth in graduation rates has been especially high for African American and Hispanic students. The number and proportion of high school graduates earning advanced diplomas has also grown steadily. In 1994, fewer than 57,000 advanced diplomas were awarded, compared with more than 115,000 in 2002, increasing from 30 to 40 percent of high school graduates.

The highest rate in 1991, 74.1 percent, is for AP Takers. From 1991 to 2002, Dual Enrollees have made steady gains, increasing more than 13 percent, to 70 percent. By 2002, more than 90 percent of students who took AP courses and concurrently enrolled earned advanced diplomas. Dual Enrollees, AP Takers and "Both" students all earn advanced high school diplomas at more than twice the rate of those students who did not seek college credit in high school. We expect these high achieving Dual Enrollees and AP Takers to also have higher rates of college attendance at community colleges and four-year colleges.

College Attendance

Annually more than half of the graduates of Texas public high schools attend a Texas public community college or four-year college in the fall following graduation. The high proportion of students staying in the state and attending public colleges is not surprising, given the relatively low tuition, geographic convenience, generally open admissions policies, and efforts by the colleges and universities to recruit students. In Table 4 we show the number and proportion of Texas public high school seniors attending these institutions in the fall after their senior high school year in 1994 and 2001. Community college enrollment increased 15.8 percent from 39,178 in 1994, to 45,383 in 2001. Four-year college attendance increased 10.7 percent during the same period, from 34,573 to 38,276.

In 1994 students who were Dual Enrollees, AP Takers or Both comprised only 10.2 percent of community college and 25.3 percent of four-year college attendees. By 2001, credit-seeking students were one fourth of community college and more than half (53 percent) of four-year college attendees in the fall after their senior years. Approximately 45 percent of Dual Enrollees attended community college in the fall following graduation in 1994, with 55 percent attending four-year colleges. These proportions are reversed by 2001 with 52.1 percent of Dual Enrollees attending community college. In both years a higher proportion of AP Takers attend a four-year college. Twenty four percent of AP Takers start at community college in 1994, growing to 32.6 percent in 2001. Only a slightly higher proportion of students who are both Dual Enrollees and AP Takers attend community college in 2001, 26.7 percent, compared with 21.5 percent in 1991.

Dual Enrollees continue to be much more likely than AP Takers to enroll in community college following high school graduation. Perhaps this is due to recruitment efforts by the community colleges while the student is dual enrolled, and familiarity with the community college and its offerings.

The last two rows for each year show the percent of students attending community college in the fall after graduation who transfer to a four-year college after attending community college for one

or two years. In both 1994 and 2001, 15.2 percent of the high school seniors starting higher education at a community college transferred to a four-year college by their third year out of high school. The proportions for Dual Enrollees and AP Takers and "Both" are much higher, ranging from 23.0 percent of AP Takers in 2001 to 32.3 percent for students who were both Dual Enrollees and AP Takers in 2001. In each year, the proportion of Dual Enrollees, AP Takers and "Both" that start their college experience in community colleges then transfer to four-year colleges is approximately twice that for students who were not AP Takers or Dual Enrollees.

Progress Through College

We have explicit information about individual college attendance only for public colleges and universities in Texas. Students who attend Texas private colleges or a college or university out of state are part of the non-attendee group in the descriptive and statistical analyses below.[4] We use high school seniors in 1994 to illustrate the college progress of dual enrolling students.[5] Starting with 1994 gives us more than six years of college attendance and graduation data. Most full time students will either graduate or discontinue college during that period.

Table 5 displays college progress for students who were Dual Enrollees, AP Takers, Both or Neither and attended a four-year college in the fall of the 1995 college year. Grade progress is measured during the spring semester of each year and is indicative of the number of credit hours taken and passed as well as the amount of credit earned through AP exams and dual enrollment. Several patterns emerge. While most students are classified as freshmen in the first college year, approximately 15 percent of Dual Enrollees and 20 percent of students who took advantage of Both are classified as sophomores in the spring term. This compares with eight percent for AP Takers and

[4] The Texas Schools Project is currently working with THECB and TEA to identify private and out of state college attendees from data maintained by the National Student Clearinghouse. Once this data and several more years of THECB and TEA data are added to the TSMP, the analyses presented here can be extended and enhanced.
[5] Due to the six-year graduation timeframe in subsequent estimates, we limit the discussion here to the 1994 cohort. Estimates for the senior class of 1995 reveal similar patterns and are available upon request.

less than two percent for the Neither students. The pattern of grade progress continues through the remaining years except that AP Takers catch up with Dual Enrollees during their junior and senior years. Each of the groups of students who sought college credit in high school had a substantial advantage over other students who made slower progress and were more likely to leave Texas public higher education. Dual Enrollees and AP Takers are twice as likely as Neither students to graduate by the end of their fourth year out of high school.

Graduation from College

Our final benchmark of the effectiveness of dual enrollment is graduation from a four-year public college or university.[6] We have considered examining additional outcomes such as the type of bachelor's degree earned and effects on future earnings, but concluded that these issues are beyond the scope of a single paper. We treat receiving any bachelor's degree as being an equally weighted accomplishment, although we recognize that there are differences in degree type, major and institutional selectivity.

In the following analyses we estimate three probit models for college graduation in four, five or six years. As we have seen in examining grade progression through college, taking AP courses and dual enrollment give students a head start in college. We expect to find that dual enrollment and AP taking have a positive impact on graduation, and a more powerful impact in the shorter term than over a longer period.

As mentioned above, a primary concern is selection of our sample. Even though we compare two groups, AP Takers and concurrent enrollees whose unmeasured motivation and endowments may be similar, we have already seen several differences between them. To identify other measured

[6] Note again that we only have college attendance and graduation data for Texas public institutions. Our graduation probabilities are lower bounds because graduates of private and out-of-state schools are counted among the non-graduates.

differences, Table 6 gives means and standard deviations for a number of student characteristics for each group.

African American students comprise a higher proportion of AP Takers than of Concurrent Enrollees. AP Takers have higher average SAT/ACT and TAAS scores. AP Takers graduate in four years at similar rates to Dual Enrollees, and have higher graduation rates in five or six years.[7] Students who Both dual enroll and take AP courses have the highest graduation rates. Dual credit students are starkly different from students who Neither take AP nor dual enroll. To compare program participation for students with similar characteristics, we employ a binary choice model to estimate the differential program impacts on whether high school seniors will graduate from a Texas public four year institution within four, five or six years. The basic strategy is to control for measured student attributes and skills by including these variables in the model, then use several fixed-effects specifications to examine whether the estimated effects hold within geographic areas, school districts and campuses. Our final estimates are by race/ethnicity to examine whether program impacts differ for each race/ethnic group.

Tables 7 and 8 show estimated marginal effects for each variable in the basic model. We estimate models using two different measures of student skills. The estimates in Table 7 include the composite math and English SAT score as a control for student ability while the estimates in Table 8 use the student's TAAS z-Score.[8] Students taking the SAT or ACT intend to seek college admission. In addition, the SAT/ACT score is a proxy for two important student characteristics, directly representing the student's academic skill, and indirectly the student's motivation. Highly motivated students, such as those taking AP courses or dual enrollment, may also seek to enhance their

[7] Note that we are most interested in program effects. The question is whether students with similar skills and other characteristics benefit more from dual enrollment than taking AP courses.

[8] The composite SAT score is taken from SAT results for students taking the test. We convert ACT taker scores to SAT equivalent scores and adjust for the rescaling of SAT scores based on information provided by the College Board. TAAS scores are from the most recent TAAS results available. For most students this is the tenth grade test, but some ninth grade scores (in 1991 and 1992) and eighth grade scores are used for students who did not take the exam in tenth grade. All TAAS scores are z-Scores based on all students taking the exam in a given year and grade.

SAT/ACT scores using tutors or tutorial products, so the SAT/ACT score has both academic and motivational components. This will help limit to some degree the effect of unmeasured individual differences on estimated program effects. We use TAAS scores for two reasons: each student is required to take the test, so the sample includes more students than college applicants. Highly skilled students may be less motivated to perform well on the TAAS test. Passing TAAS, the benchmark by which schools and school districts is judged, is easily accomplished by the best prepared students. As noted above, we also control for student individual characteristics, race/ethnicity, eligibility for the Federal lunch program and gender. In lieu of coefficients we show the estimated marginal changes in probability at the means labeled dF/dX in the tables.

In Tables 7 and 8, all of the marginal changes have a z statistic greater than two, indicating statistical significance at the five percent level or greater with one exception, Native American, due to the small number of students. Signs are those we might expect, based on prior findings. Asian students are more likely to graduate sooner than the omitted category, Anglo students. African American and Hispanic students are less likely to graduate than Anglo students. Students who are economically disadvantaged and male students are also less likely to earn a Bachelor's degree in four, five or six years. Student academic ability is positive and highly significant with z-scores ranging from 26.0 to 51.0. A one standard deviation (162 point) increase in SAT/ACT composite score is associated with a 3.1 percent, 7.0 percent or 7.6 percent increase in the likelihood of graduating in four, five and six years. A one standard deviation increase in TAAS z-Score is predictive of a 3.2 percent, 10.0 percent or 13.4 percent advantage. The larger relative impact on the TAAS sample may be due to the association between higher scores and college success and, as mentioned above, the intent of SAT and ACT takers to attend college.

The last row of each table gives the number of students and the observed probability of graduation in four, five or six years. We are able to match nearly one third more students to TAAS scores than those for whom we have SAT or ACT scores. The increased number of students

included in Table 8 results in lower observed probability of graduation in each timeframe. More than 7 percent of SAT or ACT takers graduate from a Texas public four year college by the end of their fourth year, increasing to 19.9 percent within five years and 26.5 percent within six years. This compares with 4.4, 11.7 percent and 15.7 percent for the larger TAAS taking sample.

Our estimate of primary interest is the marginal effect of concurrent enrollment, AP taking or Both shown in the first three rows of each table. Each of the college credit options has a positive estimated impact on the likelihood of graduation in comparison to the omitted Neither program category, controlling for the other explanatory variables. The estimates indicate that Dual Enrollees and those in the Both category are even more likely than AP Takers to graduate in four, five or six years. Furthermore, Dual Enrollees and students who participated in Both programs have an advantage over AP Takers[9]. They are more likely to graduate sooner.

While the estimates shown in Tables 7 and 8 control for several important measured differences in student characteristics, we recognize that there are many additional systematic differences between Dual Enrollees, AP Takers and other students. One method used to control for unmeasured program participant differences is to group students with their peers and assume that many unmeasured characteristics are correlated within each group. Consider family income. It is likely that most families in very high priced neighborhoods, whose children attend local schools, would themselves have high incomes. In Table 9 we show estimates for each credit seeking program based on the same equations shown in Tables 7 and 8, but including identifiers (dummy variables) for four student groupings. Central City/Suburb and Region are identical to the definitions described in the discussion of Table 3. We also group students within the same school district, which may have the same policies and funding levels, and within the same campus, a further refinement that will often group students within the collection of neighborhoods in the campus attendance zone.

[9] We tested the difference between Dual Enrollees and AP Takers by estimating the models while omitting the AP Taker category. The Dual Enrollee advantage is statistically significant for each of the models shown in Tables 7 and 8.

Table 9 shows the fixed effect estimates for each of the credit seeking programs. These can be interpreted as the estimated marginal probability of graduation from a Texas four year institution compared with other students in the same geographic or school grouping. The results are very encouraging. The signs in each estimate are positive and exhibit the same relative magnitudes as those without fixed effects. Holding the other control variables constant, we estimate that participation in dual enrollment has a positive impact on a student's probability of graduation in four, five or six years compared with AP Takers and students without credit seeking program participation. Dual Enrollees have an advantage over AP Takers whether we compare them with all students, within major central cities or suburbs, in the same school district or attending the same high school campus as seniors.

Estimated Effects by Race/Ethnicity

We are also interested in whether these credit seeking programs are effective for groups of students, and especially African American and Hispanic students whose graduation rates from college are historically lower than other students. Marginal effects for separate estimates by race/ethnicity are shown in Table 10. The estimates control for eligibility for the Federal lunch program, gender and SAT composite score. Estimates using TAAS z Scores, which are not shown, are qualitatively similar.

Note the last line of each panel. Approximately three percent of African American and Hispanic students graduate in four years compared to nine percent of Anglo and 12 percent of Asian students. Part of the difference may be due to a combination of much higher participation rates in dual enrollment for Anglo students, more than twice the rate for African American or Hispanic students.

For each student group, participation in dual enrollment, AP courses or both has a positive estimated marginal effect compared with non-participants. When considering the first two rows, the

estimated effect on graduation in four years, the pattern is the same as our prior estimates. Participation in dual enrollment has a larger estimated marginal impact on graduation rates than AP taking. However, for African American students, AP taking appears to have a larger estimated impact on graduation in five years and for Hispanic students' graduation in six years[10]. This may be due to higher AP taking rates relative to concurrent enrollment rates for African American and Hispanic students who were seniors in 1994.

Conclusions and Policy Recommendations

Dual enrollment in Texas high schools and community colleges has grown rapidly during the five years following enabling legislation in 1995. Less than five percent of the state's public high school seniors were Dual Enrollees in courses at a public community college or university in 1991, but this rate more than tripled by 2002. This growth is not evenly distributed geographically or demographically. Dual enrollment rates are dependent on cooperative agreements between community colleges and high schools. Dual enrollment in non-metropolitan areas, central city suburbs and the Austin and San Antonio area have all increased rapidly, while central city enrollment has stagnated, despite the large numbers of community colleges available to central city high school students. As a result, minority student dual enrollment rates, especially for African American students, trail those for Anglo students, who account for almost three quarters of Dual Enrollees.

While we cannot separate the effects of dual enrollment from the motivation and academic skills of the students involved in the program, we compare academic outcomes between Dual Enrollees, students taking at least one AP course, and other students and employ fixed effects models to identify the effects of unmeasured systematic similarities between students. Based on our descriptive statistics and estimates, dual enrolled students and AP Takers, earn advanced high school diplomas, progress through four-year colleges and graduate from four-year college with a bachelors

[10] None of the differences between Dual Enrollees and AP Takers for African American or Hispanic students is statistically significant (see footnote 6).

degree at similar rates. Dual Enrollees are more likely to earn the degree sooner, and if they enroll in community college in the fall following high school graduation, are more likely than AP Takers to transfer to a four-year college after one or two years in the community college.

Given the greater assurance of receiving college credit for the investment of time and energy and other benefits that dual credit offers, we recommend that policy makers in Texas, including educational leaders in the state legislature, Texas Education Agency and Texas Higher Education Coordinating Board, devise and implement legislation and administrative rules to encourage the expansion of dual enrollment. Because the schools least involved in dual enrollment have the highest concentrations of minority and low income students and are located in urban areas with access to community college systems, these policies should focus on the state's central cities in order to improve minority, and especially African American, access to dual enrollment.

Expansion of dual enrollment could help high schools provide more meaningful course work to juniors and seniors, reduce the shortage of qualified teachers, and offer broader career opportunities for experienced teachers. Students would be more likely attend college, move from a community college to a four-year college, earn a degree, and begin to work sooner than other students. Broadening access to dual enrollment has the potential to provide a head start in college for many more of the state's students, thus helping to equalize educational opportunities across Texas.

We expect that our continuing investigation of the effects of dual enrollment will address at least three additional topics. First, one of the benefits of dual enrollment could be the gradual nature of the transition from high school to college level work that may especially help middle achievers. This would be an important contribution in part because Advanced Placement is available to, and effective primarily for high achievers. We can identify these students from their TAAS results and assess their likelihood of college success compared with comparably achieving students who do not dual enroll or take AP courses. Second, as we mentioned above, there is variation in the quality of four year colleges in Texas, measured by such characteristics as mean SAT scores of entering

students, and in the types of bachelors degrees awarded. Dual enrollment may impact the decision to send scores to or to attend high quality institutions, as well as the selection of majors and types of degrees earned. Finally, we have earnings data for most Texas workers for the past twelve years. Using these data, we could study the differential earnings of Dual Enrollees, as compared with those of AP Takers and other students who complete similar levels of education.

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Table 1. Concurrent Enrollment by Texas Public High School Seniors

School Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
All Students												
High School Seniors	164,539	164,288	168,097	163,727	172,425	170,646	180,602	192,595	198,550	202,897	204,572	208,781
Dual Enrolled	7,897	7,380	7,881	7,965	9,475	11,558	14,989	18,866	20,753	23,239	27,945	32,629
Percent Dual Enrolled	4.8	4.5	4.7	4.9	5.5	6.8	8.3	9.8	10.5	11.5	13.7	15.6
Race/Ethnicity												
Native American												
High School Seniors	305	301	374	365	395	413	400	464	841	510	555	542
Dual Enrolled	19	15	18	22	41	21	32	48	108	49	71	90
Percent Dual Enrolled	6.2	5.0	4.8	6.0	10.4	5.1	8.0	10.3	12.8	9.6	12.8	16.6
Asian/Pacific Islander												
High School Seniors	4,071	4,288	4,727	5,021	5,230	5,073	5,301	5,646	6,322	6,299	6,441	6,740
Dual Enrolled	283	286	351	345	454	538	577	727	937	896	1147	1389
Percent Dual Enrolled	7.0	6.7	7.4	6.9	8.7	10.6	10.9	12.9	14.8	14.2	17.8	20.6
African American												
High School Seniors	21,492	20,764	20,762	19,840	20,838	21,584	23,439	25,425	25,941	26,129	27,099	27,644
Dual Enrolled	559	474	531	465	516	647	781	964	1051	1034	1394	1918
Percent Dual Enrolled	2.6	2.3	2.6	2.3	2.5	3.0	3.3	3.8	4.1	4.0	5.1	6.9
Hispanic												
High School Seniors	44,912	46,181	48,181	47,812	50,419	49,578	53,268	57,542	59,859	62,900	63,593	65,906
Dual Enrolled	992	1,006	1,017	1,086	1,285	1,694	2,580	3,329	3,577	4,554	5,849	6,892
Percent Dual Enrolled	2.2	2.2	2.1	2.3	2.5	3.4	4.8	5.8	6.0	7.2	9.2	10.5
Anglo												
High School Seniors	93,759	92,754	94,053	90,689	95,543	93,998	98,194	103,518	105,587	107,059	106,884	107,949
Dual Enrolled	6,044	5,599	5,964	6,047	7,179	8,658	11,019	13,798	15,080	16,706	19,484	22,340
Percent Dual Enrolled	6.4	6.0	6.3	6.7	7.5	9.2	11.2	13.3	14.3	15.6	18.2	20.7
Federal Lunch Program												
Ineligible												
High School Seniors	133,246	130,001	130,878	125,331	131,561	129,934	135,594	143,152	147,005	148,946	149,035	149,283
Dual Enrolled	7,341	6,701	7,124	7,159	8,575	10,460	13,184	16,539	18,131	20,088	23,836	27,455
Percent Dual Enrolled	5.5	5.2	5.4	5.7	6.5	8.1	9.7	11.6	12.3	13.5	16.0	18.4
Eligible												
High School Seniors	31,293	34,287	37,219	38,396	40,864	40,712	45,008	49,443	51,545	53,951	55,537	59,508
Dual Enrolled	556	679	757	806	900	1098	1805	2327	2622	3151	4109	5184
Percent Dual Enrolled	1.8	2.0	2.0	2.1	2.2	2.7	4.0	4.7	5.1	5.8	7.4	8.7

Note: Dual/Concurrent enrollees are high school seniors with valid ID's attending two- or four-year Texas public college during their junior or senior years. We do not include high school graduates attending public college during the summer after their senior year.

Table 2. Percent of Texas Public High School Juniors and Seniors Dual Enrolled by Year and Metropolitan Area

	1991	2002	All Years	Average Enrollment
Large Metropolitan Areas				
Houston Suburbs	3.5	15.1	8.1	25,733
Houston ISD	3.6	4.0	2.7	6,674
Houston Ex Urban	7.2	21.1	12.2	5,358
Dallas Suburbs	7.0	13.0	9.0	20,307
Dallas ISD	7.5	9.8	6.9	4,889
Fort Worth Suburbs	4.6	12.8	8.3	10,534
Fort Worth ISD	1.6	3.2	2.7	3,085
San Antonio Suburbs	1.8	19.1	10.6	11,911
San Antonio ISD	1.4	10.1	6.3	2,409
Austin Suburbs	2.3	15.5	6.7	5,449
Austin ISD	2.1	10.5	4.6	2,799
El Paso Suburbs	1.5	4.6	1.9	4,533
El Paso ISD	1.7	1.2	1.6	2,829
Corpus Christi Suburbs	3.3	10.2	6.1	2,043
Corpus Christi ISD	6.5	9.3	7.0	1,911
Large Central Cities	3.7	6.7	4.3	24,596
Large Suburbs	4.3	14.6	8.5	85,868
Other Geographic Areas				
Small Metro Suburb	3.6	19.5	7.8	11,658
Small Metro Cent. City	3.9	15.4	8.2	14,822
Rural	7.4	23.5	12.5	9,110
NonMetro	6.7	22.0	11.9	35,381
All Districts	4.8	15.7	8.7	181,435

Note: School districts are included in the major metopolitan suburbs if they are in the county of the central city district or one of the counties bordering the central city district.

Table 3. Percent of Texas Public High School Seniors Earning an Advanced High School Diploma

School Year	Dual Enrollees	AP Takers	Both	Neither	Number of Students
1994	56.5	74.1	73.2	29.9	162,564
1995	57.3	73.1	75.3	30.0	171,179
1996	53.5	76.3	77.4	28.7	169,671
1997	55.8	73.1	72.9	28.1	179,921
1998	55.1	69.3	68.4	25.7	192,005
1999	43.7	66.4	76.7	23.8	198,156
2000	45.6	62.7	74.3	23.5	202,875
2001	60.3	77.7	85.2	32.2	204,572
2002	70.8	83.4	90.1	40.0	208,781

Table 4. Number and Percent of High School Seniors Attending Public College or University in the Fall Following Their Senior Year and Transferring from Two-Year to Four-Year Institutions

Year and Type of College Attended	Dual Enrollees	AP Takers	Both	Neither	Total
1994					
Community College Students	2,014	1,768	202	35,194	39,178
Four-year College Students	2,457	5,538	739	25,839	34,573
Community College	45.0	24.2	21.5	57.7	53.1
Four Year College	55.0	75.8	78.5	42.3	46.9
Total	100.0	100.0	100.0	100.0	100.0
CC to 4 Yr in Year 2	13.0	10.9	15.8	4.9	5.6
CC to 4 Yr in Year 3	28.4	25.9	26.7	13.8	15.2
2001					
Community College Students	3,641	6,270	1,445	34,027	45,383
Four-year College Students	3,352	12,973	3,961	17,990	38,276
Community College	52.1	32.6	26.7	65.4	54.2
Four Year College	47.9	67.4	73.3	34.6	45.8
Total	100.0	100.0	100.0	100.0	100.0
CC to 4 Yr in Year 2	10.1	8.2	13.4	4.1	5.5
CC to 4 Yr in Year 3	25.1	23.0	32.3	11.9	15.2

Table 5. 1994 Public High School Senior Progression Through College: Proportion of Students by College Grade Level

Years Out of H.S.	College Grade	Dual Enrollee	AP Takers	Both	Neither
First Year	Frosh	75.7	86.4	72.5	85.7
	Soph	15.3	8.0	20.8	1.6
	Out of Sample	9.0	5.7	6.7	12.7
	Total	100.0	100.0	100.0	100.0
Second Year	Frosh	4.3	5.3	2.2	10.5
	Soph	52.4	62.6	50.2	52.3
	Junior	18.0	12.2	27.9	3.2
	Out of Sample	25.4	19.9	19.7	33.9
	Total	100.0	100.0	100.0	100.0
Third Year	Frosh	1.1	1.0	0.4	2.3
	Soph	8.2	9.4	6.1	15.1
	Junior	42.8	51.5	45.6	38.8
	Senior	18.1	13.3	24.8	4.6
	Out of Sample	29.8	24.8	23.0	39.2
	Total	100.0	100.0	100.0	100.0
Fourth Year	Frosh	0.4	0.3	0.1	1.0
	Soph	2.4	2.6	1.8	4.3
	Junior	11.1	12.7	9.2	16.2
	Senior	28.4	34.8	32.1	24.1
	Graduates	23.6	22.9	28.6	12.9
	Out of Sample	34.0	26.7	28.2	41.5
	Total	100.0	100.0	100.0	100.0

Table 6. Sample Means and Standard Deviations by Program Participation

	Concurrent Enrollee		AP Taker		AP and Concurrent Enrollee		Neither	
	Mean	**sd**	**Mean**	**sd**	**Mean**	**sd**	**Mean**	**sd**
Fall College Attendance								
Two Year College	30.7	46.1	14.7	35.5	14.0	34.8	24.3	42.9
Four Year College	37.3	48.4	45.6	49.8	51.9	50.0	17.9	38.3
Two and Four Year	0.6	7.6	0.2	4.6	0.7	8.0	0.2	3.9
Student Characteristics								
Native American	0.3	5.4	0.2	4.9	0.2	4.7	0.2	4.7
Asian	3.0	17.0	9.4	29.2	10.4	30.6	2.5	15.5
African American	5.5	22.9	8.5	27.9	7.4	26.2	12.8	33.4
Hispanic	14.6	35.3	12.2	32.7	9.5	29.3	31.5	46.5
Anglo	76.6	42.3	69.6	46.0	72.5	44.7	53.0	49.9
Federal Lunch Pgm.	10.7	30.9	9.0	28.6	7.7	26.6	25.5	43.6
Male	42.4	49.4	44.1	49.7	40.6	49.1	50.7	50.0
Number of Students	6,477		11,828		1,381		142,878	
Test Scores								
SAT/ACT Composite	1,034	162	1,119	176	1,136	163	931	177
Percent with Score	76.2		87.8		92.9		46.9	
TAAS z-Score	0.78	0.63	1.01	0.47	1.07	0.41	0.21	0.80
Percent with Score	79.5		79.5		83.3		74.6	
College Graduation								
Four Years	11.6	32.1	11.8	32.3	16.9	37.5	2.8	16.6
Five Years	24.9	43.2	28.4	45.1	32.1	46.7	8.4	27.8
Six Years	31.1	46.3	34.9	47.7	38.6	48.7	11.9	32.4

Table 7. Estimated Marginal Probability of Earning a Bachelors Degree Controlling for SAT/ACT Composite Score

Degree in	Four Years		Five Years		Six Years	
	dF/dX	z	dF/dX	z	dF/dX	z
Dual enrollee	4.3	13.0	7.1	12.4	7.9	12.1
AP Taker	1.2	5.4	3.6	8.8	3.8	8.0
Dual enrollee and AP Taker	3.8	6.5	4.4	4.3	4.5	3.7
Native American	1.2	0.7	-5.9	-2.1	-8.6	-2.7
Asian	1.4	3.9	1.7	2.7	3.9	5.3
African American	-1.3	-4.3	-3.2	-6.3	-4.7	-8.3
Hispanic	-2.1	-9.4	-5.1	-13.2	-4.6	-10.6
Federal Lunch Program	-2.5	-9.4	-7.3	-16.5	-8.5	-17.4
Male	-4.4	-27.8	-7.1	-26.4	-6.4	-21.0
SAT Composite Score	1.9	40.7	4.3	51.0	4.7	48.8
N, P(observed)	83,650	7.4	83,650	19.9	83,650	26.5

Table 8. Estimated Marginal Probability of Earning a Bachelors Degree Controlling for TAAS Score

Degree in	Four Years		Five Years		Six Years	
	dF/dX	z	dF/dX	z	dF/dX	z
Dual enrollee	2.2	14.7	5.4	16.1	7.0	16.3
AP Taker	1.3	12.6	4.4	17.9	5.6	17.8
Dual enrollee and AP Taker	2.9	9.7	5.7	8.7	7.3	8.6
Native American	0.3	0.4	-1.7	-1.2	-3.9	-2.2
Asian	1.2	7.1	2.8	7.2	5.1	9.8
African American	-0.4	-3.6	-1.1	-4.1	-1.5	-4.7
Hispanic	-0.9	-11.0	-2.9	-15.6	-3.2	-13.4
Federal Lunch Program	-1.2	-11.7	-4.1	-19.9	-5.7	-22.0
Male	-1.6	-26.0	-3.7	-26.6	-4.1	-23.2
TAAS z-Score	3.2	48.7	10.0	74.6	13.4	82.1
N, P(observed)	122,313	4.4	122,313	11.7	122,313	15.7

Table 9. Fixed Effect Estimates of Marginal Graduation Probability

Type of Fixed Effect:	Cent. City/Suburb		Region		School District		Campus	
Student Ability Score	**SAT**	**TAAS**	**SAT**	**TAAS**	**SAT**	**TAAS**	**SAT**	**TAAS**
Graduate within 4 Years								
Concurrent Only	3.4	2.1	4.3	2.4	5.5	3.2	5.7	3.6
AP Only	1.1	1.3	1.1	1.3	1.8	1.8	1.9	1.9
Concurrent and AP	3.6	2.9	4.0	3.1	6.7	5.3	7.0	5.7
Actual Probability	7.8	4.8	7.4	4.4	7.8	4.7	7.9	4.9
Graduate within 5 Years								
Concurrent Only	6.0	4.6	7.1	5.7	9.0	7.4	9.3	7.8
AP Only	3.8	4.6	3.5	4.5	4.7	5.3	5.0	5.5
Concurrent and AP	3.2	4.7	4.7	6.3	8.6	9.4	9.2	9.7
Actual Probability	20.7	12.7	19.9	11.8	20.1	11.9	20.1	12.2
Graduate within 6 Years								
Concurrent Only	7.0	6.2	8.1	7.5	10.0	9.7	10.4	10.1
AP Only	3.9	5.8	3.6	5.7	4.6	6.6	5.0	6.7
Concurrent and AP	3.2	6.2	4.9	8.1	8.0	11.2	8.4	11.4
Actual Probability	27.4	16.9	26.5	15.7	26.6	15.9	26.6	16.1

Note: Additional control variables are race/ethnicity, Federal lunch program and gender

Table 10. Estimated Marginal Probability of Graduation by Race/Ethnicity

Degree in	Four Years		Five Years		Six Years	
	dF/dX	z	dF/dX	z	dF/dX	z
Asian						
Dual enrollee	7.6	2.8	14.5	3.7	11.5	2.8
AP Taker	0.7	0.6	2.8	1.6	3.6	1.9
Dual enrollee and AP Taker	4.2	1.6	1.0	0.3	2.2	0.5
N, P(observed)	3,583	12.2	3,583	26.9	3,583	35.6
African American						
Dual enrollee	2.9	2.9	3.2	1.6	7.9	3.2
AP Taker	1.5	3.1	4.4	4.1	6.7	5.1
Dual enrollee and AP Taker	2.0	1.6	3.2	1.2	4.8	1.4
N, P(observed)	8,348	3.7	8,348	12.1	8,348	16.7
Hispanic						
Dual enrollee	2.5	4.4	4.3	3.8	4.4	3.0
AP Taker	0.7	2.0	3.7	4.4	5.4	4.9
Dual enrollee and AP Taker	4.2	3.1	4.0	1.5	3.8	1.1
N, P(observed)	18,369	3.2	18,369	10.7	18,369	16.9
Anglo						
Dual enrollee	5.1	11.3	7.8	11.0	8.3	10.7
AP Taker	1.4	4.3	3.6	6.6	3.1	5.1
Dual enrollee and AP Taker	4.8	5.6	5.8	4.2	5.6	3.7
N, P(observed)	53,180	9.2	53,180	23.8	53,180	30.7

Figure 1. Concurrent Enrollment by Race/Ethnicity