The Process of High School Attrition: An Analysis of Linked Student Records

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State of Washington

April 15, 2008

This research has been supported by grants from the Andrew W. Mellon Foundation and the Bill and Melinda Gates Foundation. We are grateful to Jerald Herting and Lowell Hargens for their statistical advice and we also thank Gunnar Almgren, Kurt J. Bauman, Sonalde Desai, Jerald Herting, Robert A. Kominski, Robin Munson, Stewart Tolnay, and John Robert Warren for their comments on earlier versions of this paper and Patty Glynn for programming support. Please direct all correspondence to: Charles Hirschman, Department of Sociology, Box 353340, University of Washington, Seattle, WA 98195; Phone: (206) 616-9353; email: charles@u.washington.edu

The Process of High School Attrition

High school attrition is a process in which failure and retention often precede dropping out. Some students are able to recover from failure, but relatively few do. This study applies life table models to estimate the risks of retention, dropout, and graduation using school administrative records from a West Coast metropolitan school district. For many students, poor academic performance in the first semester of the 9th grade is the critical experience that leads to subsequent failure and attrition.

Introduction

The near universality of high school graduation is considered one of the major achievements of the American education system. National survey and census data show that the rate of high school graduation has risen from about 50% of young adults in mid 20th century America to almost 90% of recent cohorts (Ingels, Curtin, Owings, Kaufman, Alt & Chen, 2002: 14, Mare, 1995: 162; Stoops 2004: 2). There appears, however, to be systematic upward biases in survey-based reports of high school graduation. Studies based on administrative records of enrolled students report that the "on-time high school graduation rate" in the United States is about 15 to 20 percentage points lower than survey-based estimates of 85 to 90% of American youth graduating from high school (Greene & Winters, 2002; Laird, DeBell, & Chapman 2006: 32; Seastrom, Hoffman, Chapman, & Stillwell, 2005: 5; Swanson, 2004; Warren, 2005).

The first objective of this article is to address the debate over the measurement of high school graduation rates and to illustrate the potential of a life table analysis of attrition and retention of high school students based on matched records of individual students in a large West Coast metropolitan school district. Tracing the enrollment status of cohorts of students through high school provides new insights into the temporal dynamics of retention, exit, catching up, and reentry.

The second objective is to provide an integrated model of social background risk factors and school experiences on the probability of high school graduation. In particular, we focus on the transition to high school as a critical step in high school progression. Many students stumble early in the 9th grade, and very few of them ever recover in time to graduate from high school. While 9th grade failure is linked to earlier academic performance, low grades in the first year of high school are far more pervasive and consequential than what would be predicted from background variables alone. It seems that many students are just not ready for the expectations and demands of large high schools.

Measuring High School Dropouts and Completion

Although there are a few small differences resulting from changes in questions on educational attainment (Hauser, 1997: 162-167; Mare, 1995), every national study based on survey and census data

shows an upward trend in high school completion over the course of the 20th century (Duncan 1968: 655; Fox, Connolly & Snyder, 2005: 48; Hauser, 1997: 161; Mare, 1995: 162; Mare & Winship 1988: 182). For example, the top line in Figure 1 (from a recent Census Bureau report) shows that the proportion of successive cohorts (measured at age 25 to 29) graduating from high school rose steadily from around 50% to about 85 or 90% before leveling off. It seems that high school graduation is approaching a "ceiling" with only a small number of dropouts remaining.

[Figure 1 About Here]

This portrait of near universality of high school graduation stands in stark contrast with enrollment patterns by grade in the West Coast metropolitan school district that is the focus of this study. Figure 2, based on enrollment data, shows that there are typically 3,000 students in the 9th grade freshman class, but only half of that number—less than 1,500 students—are enrolled as seniors. These data are cross-sectional, but are averaged over 7 years (1996 to 2002) to adjust for annual fluctuations in enrollment. Although there is a 9th grade "bulge," relative to 8th grade enrollment, because of in-transfers and retentions, the picture of a high level of school dropout would not be radically different if 8th grade enrollments were used as the base.

[Figure 2 About Here]

Although Figure 2 is based on only one school district, which admittedly has an above average high school dropout rate (Bylsma &Ireland, 2005), these figures are only slightly lower than national estimates of on-time graduation rates based on administrative records of enrolled students (Greene & Winters, 2002; Swanson, 2004; Seastrom, Hoffman, Chapman, & Stillwell, 2005: 5; Laird, DeBell & Chapman, 2006: 32; Warren, 2005). According to the National Center for Educational Statistics, there were over 4.1 million high school freshmen enrolled in public schools, but less than 3 million high school seniors (Hoffman, Sable, Nam, &Grady, 2005: 41). Since not all high school seniors graduate, the implied high school graduation rate is probably well below 75%.

Perhaps, the most likely reason for lower estimates of dropouts from survey data (relative to administrative data) is the conflation of high school graduation and high school equivalency certification.

The standard retrospective question of educational attainment does not differentiate between the types and timing of high school completion. When directly asked about GED (or other certification of high school completion), about 9 percent of NELS (National Educational Longitudianl Survey) respondents (at age 22) reported they had completed high school, but did not receive a standard high school diploma (Ingels, Curtin, Owings, Kaufman, Alt & Chen, 2002: 14).[1] This is likely to be an underestimate since some persons may "upgrade" their high school equivalency completion as constituting a high school diploma. Hauser (1997: 165) shows a consistent increase of about 4 to 5 percentage points in the proportion of a cohort who reported that they completed high school by their mid twenties relative to when the cohort was age 19 to 20.

The conflation of high school graduates with GED holders is significant because the degrees are not equivalent in the labor market. The employment patterns and earnings of GED recipients are more similar to high school dropouts than those of high school graduates, and GED recipients are less likely than high school graduates to finish a post-secondary education or training program (Cameron & Heckman, 1993; Tyler, 2003).

The other possible reason for lower estimates of dropouts in survey data is selective under-enumeration in censuses and household surveys. Estimates of the under-coverage (not interviewed) of 16 to 19 year old males in the Current Population Survey were 10% of whites, 16% of blacks, and 13% of Hispanics (U.S Census Bureau, 2002: 16-2). Rates were even higher for men in their twenties. Although CPS data are weighted to adjust for undercoverage by age, sex and race/ethnicity, the adjusted data rely on the assumption that the characteristics of those not interviewed in each population segment are the same as persons who are interviewed in the same group (Kaufman, 2004: 116). Our expectation is that persons with lower educational attainment are more likely to be missed in censuses and surveys than those with more education.

Although in-school surveys should be less affected by selective under coverage than household surveys, there is a possibility of selective omission of less successful students (in terms of educational

attainment) if school absenteeism is selective. Most in-school surveys are limited to students who are present on survey day.

Models of High School Attrition and Completion

There is an extensive research literature on the correlates and causes of high school dropouts. Most studies report "risk factors" or student characteristics that are associated with above average rates of academic failure and dropout. For example, African American, Native American, and Hispanic, as well as students born outside of the United States, and male students have above average dropout rates (Freeman & Fox, 2005; Kaufman, Alt, & Chapman, 2004; Wojtkiewicz & Donato, 1995). Socioeconomic status (SES), typically measured by parental education, occupational status, or income is one of the strongest and most consistent correlates of dropping out (Alexander, Entwisle & Kabbani, 2001; Lareau, 2003; Rumberger, 1983, 1987). Moreover, adolescents from single parent families, those with high rates of residential mobility, and many other factors are at a higher risk of educational failure (Astone & McLanahan, 1991; McLanahan & Sandefur, 1994; Rumberger & Larson, 1998).

Sorting out the inter-relationships among these potential causes, correlates, and mechanisms that affect student educational progression has been a major challenge. One of the important conceptual leaps in the field has been the formulation of the life course perspective that attempts to measure the events and influences over the span of years from childhood to adolescence (Alexander, Entwisle & Kabbani, 2001). The life course perspective posits that dropping out of school is not an isolated event; rather, it is the culmination of a process of academic failure and disengagement that begins early in the student's academic career. Thus, to fully understand a student's decision to drop out, it is important to examine the temporally proximate and distal forces that influence this outcome.

Over the span of an educational career, the socioeconomic status of the family of origin works through a myriad of mechanisms, such as the availability of additional educational resources (Ainsworth, 2002), educational expectations (Entwistle, Alexander, & Olson, 2004), and parenting style and parental attitudes (Rumberger, Ghatak, Poulus, Ritter, & Dornbusch, 1990; Alexander, Entwisle, & Dorsey, 1997). Changes in family structure can interact with residential mobility and vary by student's age in its effect on

the probability of educational failure (Astone & McLanahan 1991, 1994; Alexander, Entwisle, & Dorsey, 1997; Haveman, Wolfe, & Spaulding, 1991; Sandefur, McLanahan, & Wojtkiewicz, 1992).

The life course perspective suggests the impact of social and economic disadvantage on high school dropout will be mediated by early educational performance. In addition to mediating the effects of family origins, school performance (measured by grades) in primary and middle school strongly predicts of dropping out of high school, net of many other risk factors (Alexander, Entwisle, & Dorsey, 1997; Ekstrom, Goertz, Pollack, & Rock,1986). One of the most important findings in the literature is the negative effect of grade retention in primary or middle school on high school dropout rates (Alexander, Entwisle & Dauber, 2003: Chapter 11). Although school retention is sometimes recommended as a means of allowing students to succeed by moving through school at a slower pace, the problem may simply be postponing failure. Retained students, who are "over age" relative to their peers may face problems in social adjustment during later adolescence when they move from middle to high school.

Another important thread of the research literature on high school dropout rates emphasizes the structure of schools and school effectiveness. Inner city public high schools, especially with concentrations of minority and low income students, have much higher dropout rates than private and suburban schools (Bryk & Thum 1989; Hauser, Simmons & Pager, 2004; Rumberger, 1995; Rumberger & Thomas, 2000). Although a significant share of between school differences may be due to student composition, the structure of schools and educational practices may also be important. Lee and colleagues have emphasized the potential impact of the size and structure of secondary schools on educational outcomes (Lee & Smith, 1995; Lee & Burkham, 2003). Larger schools are associated with less contact and rapport between students and teachers.

Many students, especially those from disadvantaged families or who have attended poorer elementary and middle schools, may not be ready for the transition from middle school to large and impersonal high school institutions (Roderick & Camburn, 1999). Typically, high schools present challenging environments where students must adapt to a larger and more heterogeneous school composition as well as to more teachers with diverse teaching styles. In contrast to middle school, high

schools expect more from students – to meet higher academic demands, to be self motivated and organized, and to be able to avoid the risks and temptations from older students. Many young students may not have the skills and maturity to handle the complexity of demands of high school life. The dearth of high quality teacher-student relationships in larger schools is particularly harmful to at-risk students, as they appear to be more dependent on encouragement and informal guidance from teachers (Cronninger & Lee, 2001). A study of 9th graders in Chicago noted that at least 40% failed a course during their first semester of high school (Roderick & Camburn, 1999). Academic failure may be the first step leading to disengagement and dropping out of school.

Data and Methods

This study is based on unit-record school enrollment data from 1994 to 2004 for a large metropolitan school district on the West coast. Linked administrative records provide a novel analytical approach to the study of the process of high school attrition. School records are maintained primarily for administrative needs, including the counts of students that are required to allocate budgets, teachers, and other resources within districts as well as to apply for financial support from state and federal governments. One of the primary sources of student records is the academic report of courses taken, grades received, and credits accumulated. These records are supplemented with demographic characteristics supplied by students and their families as well as additional information from teachers, counselors, and administrators[2]. These materials provide both a rich array of background characteristics that are typically considered risk factors, as well as detailed data on academic performance.

With unique identifiers, individual student records were matched from semester to semester and from year to year. The underlying logic is that students follow the standard path of progression up the academic ladder from year to year. For example, the entering 9th grade students are expected to be 10th graders the following year and to graduate from high school at the end of their senior (12th grade) year. Students who are retained because they have insufficient credits to be promoted are classified in a grade below their expected level.

The student database represents the complete universe of students from all five comprehensive high schools in the district as well as students in a broad variety of alternative programs. With enrollment data from all institutions within the district, local transfers (within the school district) do not pose a problem for tracking students from year to year. However, the measured "exit rate" (the proportion of students who can not be matched in files across semesters) includes dropouts and students who transferred out of the school district.

Short of searching administrative records of other school districts, there is no way to identify transfers from dropouts at the individual level. We can, however, provide a reasonable estimate of the aggregate level of out-transfers from the school district. As detailed in an appendix, we can directly measure that 47% of first-time 9th graders entering high school in the school district graduate 4 years later. Six years from the time of entering high school, the cohort graduate rate rises to about 50%. In this study, we label the 47% as the "non-transfer on-time cohort graduation rate." In the appendix, we offer two indirect methods of estimating a total cohort dropout rate.

The first method is an indirect estimate of the out-transfer graduation rate based on a comparison of annual inflows (in-transfers) and outflows (out-transfers and dropouts) for each academic year from 1998-99 to 2002-03. Outflows exceed inflows because dropouts are included in the former, but not the latter. Temporal stability in the inflow and outflow rates and only modest changes in total school enrollment (in grades 9-12) are consistent with (but do not prove) the assumption that the inflow rate is a crude proxy for the out-transfer rate (see appendix Table A2). The difference between the inflow rate of about 15% and an outflow rate of 25% per annum yields an estimate of a net dropout rate of about 10% per year of high school. If we apply this dropout rate over four years of high school, the implied graduation rate is about 70% of non-transfer students. The figure is probably an upper bound on the total cohort graduation rate since transfer students have higher dropout rates than non-transfer students (Lee & Burkam, 1992; Rumberger & Larson, 1998).

The second method relies on the assumption that exit rates are equal to the transfer rate for students who are at minimal risk of dropping out, such as high school students with a GPA above 3.0.

The measured exit rate for high achieving students is a plausible proxy for their transfer rates. We cannot apply this rate to all students, however, because of the strong relationship between GPA (and all other background characteristics) and student mobility (Rumberger & Larson, 1998). Assuming that patterns of student mobility by GPA are proportionally comparable between middle school (where exit rates are assumed to equal out-transfer rates) and high school, we have estimated expected transfer rates for high school students by GPA (see appendix for details).

Summing over all years of high school, we estimate that about 37% of students who enter 9th grade will transfer during the next 4 years. Subtracting the sum of the transfer rate (37%) and the non transfer graduation rate (47%) from 100 yields an estimated 16% non transfer dropout rate. If transfer students dropout at the equivalent GPA-specific rates as non-transfer students (this is a very conservative assumption), we estimate a transfer graduation rate of 22% and a transfer dropout rate of 15% (see appendix for details).

Adding the estimated non-transfer dropout rate of 16% and the transfer dropout rate of 15%, the estimated total cohort dropout rate is approximately 31% for method 2. Similar to method 1, the result from method 2 is very likely to be an underestimate of the total cohort dropout rate.

These total cohort graduation rates (approximately 70%) and dropout rates (approximately 30) provide a reasonable estimate of the aggregate situation (see appendix for more details), but our subsequent analysis of school attrition is based on exit rates assembled from individual student records. In other words, we measure the non-transfer cohort graduation rate, not the total cohort graduation dropout rate. Although the absolute measures of high school completion reported here are too low (since some exiting students will graduate elsewhere), we posit that the relative differentials and the underlying causal processes are probably correct. The determinants of student out-transfers and dropping out are very similar (Rumberger & Larson, 1998).

With the exception of not being able to identify out transfers (from the school district) at the individual level, matched administrative records provide a unique data source to estimate an individual-level longitudinal model of the process of high school completion. We have tracked students for six years

after entry into 9th grade and can estimate on time and delayed high school graduation rates. Moreover, with annual data, we can estimate life table probabilities of staying "on-track," being retained, or exiting schooling—"the life history" of high school careers.

Since there are only slight differences across cohorts, we have created a merged data file of four cohorts of students that entered the 9th grade from 1996 to 1999. Each cohort only includes first-time 9th graders—that is, we have excluded retained 9th graders (who were in the 9th grade the year before). The sample includes students who transferred into the school district at the beginning of the 9th grade. Since we do not have prior school records for these in-transfer students, some may have been repeating the 9th grade for the second time. Students who transfer into the school district after the beginning of the 9th grade (or later) are excluded from the sample.

At the micro-level, we are able to measure year to year survival (still enrolled or retained) as well as on-time and delayed high school graduation. Given the binary nature of these outcome variables we employ binary logistic regression to examine the effects of the independent variables on the log-likelihood of school progression and high school graduation. Drawing upon the life course perspective as well as prior studies that have stressed the significance of early academic success on school attrition, we construct a series of sequential regression models that add mediating and explanatory variables to a baseline model of ascriptive characteristics.

Although missing data are very modest (no more than 4% of any independent variable is missing), we have used stochastic regression methods to impute missing values for the explanatory variables. This method samples from the error distributions in order to maintain the natural variance of each variable and provides a predicted value for the missing data point (Allison, 2002). Results were compared to analyses in which listwise deletion was employed and there were no significant differences in the magnitude or statistical significance of the coefficients. To account for any possible heteroskedastic disturbances amongst the independent variables we estimate robust standard errors, which provide a more conservative estimate of standard errors.

A Life Table Model of High School Progression and Attrition

Figure 3 presents a graphic representation of the educational pathways through high school of students in our West Coast metropolitan school district. Specifically, Figure 3 presents "life table" estimates of year-to-year progression, retention, and exit for the population of four cohorts of first time 9th graders[4] that entered high school from 1996 to 1999 to their eventual graduation outcome status. With life-table logic, this model traces the "survival" (remaining enrolled, either on-track or retained) of 1000 entering 9th graders through four years of high school (measured as of the spring semester of each academic year). The numbers within each box show the numbers in that status (can be read as percentages of the original population or L(x) values). The values beside each arrow are the proportion of students in the origin category (conditional probability) who follow a particular trajectory—akin to p(x) and q(x) values in a life table.

[Figure 3 About Here]

We trace the initial cohort of 9th graders (actually four cohorts standardized on a base of 1000) for four years (spring of the 9th, 10th, 11th, and 12th grades), and then conduct a summary measure of final status, which is measured 6 years after entry into the 9th grade. In each year, students may be in three possible states: on-track (on time grade progression), retained (enrolled behind expected grade level), and not enrolled (exited the school data base). As noted earlier, perhaps about half of those exiting the school system transferred and graduated from another school district (within district transfers are matched). Since we cannot identify transfer students at the individual level, the non-enrolled students are labeled as "exits," not dropouts. Some students who have exited (either as dropouts or transfers) do return as students to the school system, the figures in the top row are "net exits" or former students who are currently not enrolled (and not all those who ever-exited).

Less than half (46%) of the students who begin 9th grade graduate "on time" four years later. We are able to identify another 11% of the students who graduated late (5 or 6 years after entering 9th grade) or "probably graduated"—students who are still enrolled after 6 years or had sufficient credits to graduate, but for whom there was no record of graduation.

Student retention and student exits are evident at every stage of the schooling process. Looking at the bottom panel of "on-track" progression, there is a loss of 28% from the spring of freshman year to the spring of the sophomore year and another 23% to the junior year and 14% to the senior year. Failure is ubiquitous. One might think of grade retention (non promotion) as the first step to school failure, which is eventually followed by exiting from school. However, many students just leave without first being held back: 7% in the freshman year, 14% between the sophomore and junior years, 12% between the sophomore and junior years, and another 9% before the senior year. Retention is also common: 14% of freshmen are retained as are 11% of sophomores.

Retained students are very likely to leave school—about one-third or more of retained students are not enrolled the following year (35% of expected 10^{th} graders, 41% of expected 11^{th} graders, and 34% of expected 12^{th} graders). The most common path of retained students is to remain behind their peers. It is also possible, but fairly rare, for retained students to catch up and resume on-track status. Similarly, students who have exited can re-enter the schools, though they are most likely behind their expected grade level. A few rare students leave the school system and return to on-time status (about 1%).

If students remain on-track for four years, then the odds are more than 90% that they will graduate in four years. About 51% of the cohort reaches their senior year on time, and 92% of on-time seniors are on-time graduates. About one-quarter of students in each cohort will experience grade retention sometime during their high school career, and less than half of these students make it to their senior year. About two-thirds of the ever-retained students who make it to their senior year eventually graduate from high school. Of the 40 plus percent of students who exit the school system, only a small fraction returns to graduate from a local school.

The myriad of educational pathways presented in Figure 3 is exceedingly complex and represents many possibilities for causal analysis. In Table 1, we summarize the basic patterns of enrollment and graduation (akin to life table measures of survival or l_0) for the 6 years after entering 9^{th} grade.

[Table 1 about Here]

The first row identifies enrollment status in the spring of the first year (of their freshman year). At this point, 93% of the entering cohort of 9th graders is still enrolled, and by definition, all enrolled students are on-track. By the spring of the second year, only 81% of the original cohort was still in school, and only 67% were classified as 10th graders—the balance of 14% had been retained in the 9th grade. In the spring of the 3rd year, only 70% of the cohort remained in school, which include 16% who were classified below their expected grade level. Only a little over half of the cohort was on-track as high school juniors.

By the spring of what should have been the senior year (the 4th year after entering 9th grade), another 10% of the cohort had exited school. Of the remaining 60%, 1 percent had graduated, 49% were on-track as seniors, and 10% were classified as juniors or lower. Five years after entering 9th grade, half of the students had graduated and 4 percent were still enrolled. After six years, the graduate number increased by one percent, and 2 percent were still enrolled.

The life table approach also allows for estimation of annual exit rates (akin to probabilities of mortality or q_x values). These rates are shown in the first column of Table 2, which contains the probabilities of exiting from school (non-enrollment) for each year, conditional on survival (still enrolled) to the prior year.

[Table 2 about Here]

During the first year of high school, about 7% of the enrolled students exit—have disappeared from school database. During each of the next three years, about 14-16% of still enrolled students will leave school annually. The risk of "mortality" varies by the enrollment status of student. The third column shows the exit probabilities for "never retained students", those who are promoted to the next highest grade each year and who entered 9th grade before their 15th birthday. We assume that students who entered 9th grade after their 15th birthday had been retained in primary or middle school. These previously retained students have higher exit rates—generally double those of never retained students.

The balance of Table 2 shows the conditional exit rates for each year (after entering 9th grade) for students retained during high school by the year of their first retention (excluding those retained prior to

high school). Since a student is only retained at the end of the year (even if the signs of failure were evident during the year), we can only estimate the impact of retention on the year following retention. Thus, non promotion to 10th grade (retention in the 9th grade) can only be measured for students in year 2 after entering 9th grade and the impact on exit can only be measured for the following period—from the 2nd to the 3rd year after entering 9th grade. This lag in measurement leads to an underestimate of effect of retention on exit. For example, the risk of exiting among students who drop out in the same year as they were retained is attributed to the column of "never retained" students. This bias narrows the gap between the reported exit rates of never-retained and retained students. Even with this bias, the exit rates of those who are first retained in high school are three or four times those of never retained students. Annual exit rates of 30 percent or more for students who fail 9th or 10th grade mean it is very unlikely that such students will ever graduate. The probability of exiting among students still enrolled 5 or 6 years after entering 9th grade (the probability of delayed graduation) for those who fail their junior or senior years is even bleaker.

A Multivariate Model of On-Time High School Graduation

In the balance of the paper, we formulate and estimate a model of "on-time graduation," which represents the probability that a student entering 9th grade will graduate four years later from the same school district.[5] To estimate the effects of prior academic record as well as the transition to 9th grade, the universe of students is limited to 7, 441 students enrolled in the school district as 8th graders and who were first-time 9th graders in four cohorts from 1996 to 1999. The results are relatively unaffected by the definition of the universe of students and the exact specification of the dependent variable. Alternative dependent variables, including "continuously on-track on-time graduates" (students who are enrolled in the appropriate grade level every year and graduate on time) and delayed high school graduation (5 and 6 years after entering 9th grade) yield very similar results to those presented here.

The definition and measurement of the independent variables are presented in Table 3. There are two measures of social ascription, gender and race/ethnicity. A little more than half of the sample was

male. Almost 58% of the students were white, 20% were African American, 15% were Asian, and the balance was of Hispanic, American

[Table 3 about Here]

Indian, and Pacific Islander origins. There are two measures that tap the socioeconomic status of the student's family. The first measure is an index of family income. A little more than 40% percent of the students were from homes with family incomes of less than 185% of the federal poverty level (making them eligible for subsidized lunch programs). The other measure of socioeconomic status is based on a classification of "neighborhoods," which differ in average socioeconomic status, ethnic composition, and other characteristics that may influence educational outcomes. Neighborhoods are indexed by a classification of 38 elementary school catchment areas (attendance zones) in the school district. In the subsequent analysis, these neighborhoods are measured by 38 dummy variables, but the results are only presented in the tables for selected neighborhoods that correspond to values of the 90th, the 75th, the 50th (median), the 25th, and the 10th percentiles of neighborhoods ranked in order of the proportion of students graduating from high school in four years.

The next set of variables measure academic progress prior to entering high school. The first measure is a proxy for school retention (indexed by being more than one year above the modal age for 9th grade). Alexander et. al. (2003: Ch. 9) find that prior school retention is the major predictor of high school attrition. Almost one-quarter of first time 9th graders in our sample appear to have been retained at least once in primary or middle school The second measure is 8th grade GPA, which is considered to be a measure of academic ability and/or performance prior to entering high school.

Tracking status and 9th grade GPA are the two measures that represent the transition to high school. Students are assigned to certain levels of 9th grade classes based on teacher recommendations and academic performance in middle school. If students were assigned to an honors or advanced 9th grade English class, we classified them as in a college bound track. About 16% of 9th graders were assigned to honors or advanced English classes. English class assignment also allows for the identification of special education and ESL students. About 10% of students were taking special education classes, but only one-

third of these students were in all (or mostly) special education classes. These figures on special education students correspond very closely to national data, which show that about 12% of public school students have an individualized educational plan (IEP) that makes them eligible for special education services (Ingles & Quinn, 1996: 2). About 2 to 3% of students are enrolled in ESL (English as second language) classes, but most will eventually transition to one of the other streams.[7] The balance of the students—about 70%— is in a traditional curriculum as evidenced by their enrollment in a regular 9th grade English class.

The second measure of the transition to high school is first semester 9th grade GPA. In this school district, as in many others, expectations of performance in high school are much higher than those in middle school. Ninth graders must adjust to a more "bureaucratic" high school culture, which means being in classes with older students and teachers who are less likely to coddle students who fall behind. This adjustment is reflected in the poor grades received by many first semester 9th graders, which we label as the "9th grade shock." About 1 in 6 students (15-16%) have a GPA of less than 1.0 and another 20% have a GPA between 1.0 and 2.0. Altogether, more than one-third of 9th graders begin their second semester of high school with a GPA below 2.0, which indicates failing (or almost failing) one or more classes.

Table 4 presents the results from a series of logistic regressions of on time graduation in four years. Models were also run for delayed high school graduation, and the results are broadly similar to those presented here. The multivariate analyses presented in Table 4 assume that high school

[Table 4 about Here]

graduation is a product of exogenous "risk factors" and intervening school experiences. Four models or equations are estimated for each educational outcome. The baseline (Model 1) includes gender and race/ethnicity—two fundamental ascriptive variables. These exogenous risk factors may be explained or mediated through a variety of intermediate variables. In Model 2, we add two measures of socioeconomic status, including family income and the neighborhood, to test the hypotheses that race and ethnic

differentials in high school graduation are primarily explained by socioeconomic status and neighborhood location.

In the third model, two early schooling variables are added as covariates in order to measure how much inequality in high school graduation is mediated and/or "created" by educational experiences prior to high school. These covariates include a prior school retention (indexed by whether a student is more than one year older than the modal age for 9th grade) and 8th grade GPA. To the extent that these variables affect (directly or indirectly) the likelihood and timing of high school graduation, the script was written before entry into high school.

In Model 4, 9th grade educational placement by type of English class (honors, special education, ESL or regular) and GPA from the first semester of the 9th grade are added as covariates. The first measure is an indicator of tracking and the second is an indicator of the 9th grade "shock"—the high degree of failure of many 9th graders that was not predicted by 8th grade GPA. The increment to the (pseudo) R-squared of each model (equation) shows how much additional explanatory power (above and beyond that of all prior variables) of high school graduation is explained with the inclusion of each block of variables.

Results

Gender has a strong and significant effect that is entirely mediated by early schooling experiences, as indexed by 8th grade GPA. Girls do better than boys academically, but boys with the same grades as girls are just as likely to complete high school. Gender differences in socialization or maturation mean that girls are probably more likely to pay attention in class, complete assignments, and maintain other behaviors that lead to greater academic success than are boys.

Race and ethnicity are strongly associated with high school graduation. The baseline model in Table 4 shows that Hispanic and American Indian/Pacific Islander students are less than half as likely as white students to graduate from high school, while African American students are about 25% less likely than white students to achieve on-time graduation. Asian Americans are about 20% more likely than whites to graduate from high school.

The addition of the family background variables (income, neighborhood in which student lives) in Model 2 explains most of the observed black-white disparity in on-time graduation rates and about one third of the gap faced by Hispanic and American Indian/Pacific Islander students. Socioeconomic inequality, which is only partially measured by these variables, is an important reason for race/ethnic differentials in high school completion (Hauser, Simmons & Pager, 2004). The observed advantage of Asian American students (relative to whites), however, is increased in Model 2, when socioeconomic and neighborhood characteristics are held controlled. This finding indicates that other resources associated with ethnicity (not measured here) can compensate for disadvantaged origins.

The inclusion of early educational experiences in Models 3 and 4 reveals interesting insights into the mechanisms of race/ethnic differentials in high school graduation rates. The higher graduation rates of Asian Americans and lower graduation rates of American Indian/Pacific Islander students are completely mediated by early schooling experiences, especially 8th grade GPA. These patterns do not explain the ultimate reasons for success in schooling, but they do tell us that the reasons for differential high school completion are the same as those that would explain differences in school grades.

An important component of lower graduation rates of Hispanic students is shown in Model 4 which adds tracking and 9th grade GPA. This suggests that the transition to high school—"the 9th grade shock" is particularly acute for Hispanic students. The most complex finding is that African American students would be more likely to graduate from high school if they had grades comparable to white students. In addition to poorer socioeconomic resources, African American students are disadvantaged with lower grades. However, many African American students appear to be able to bounce back from these low grades and make it through high school. This finding is consistent with earlier research on the resilience and high educational aspirations of African American adolescents (Bauman, 1998).

Measures of family resources, including income and neighborhood, have significant net effects on high school graduation. Net of every measured variable (in Model 4), children from poor families are still 25 percent less likely to graduate from high school than children from non poor families. The pattern of neighborhood effects is consistent with the expected hypothesis, but is not statistically significant in

Model 2. However, net of 8th grade GPA (and 9th grade placement), in Model 3 (and 4), very "poor" neighborhoods have a net adverse effect on high school graduation. This impact is "masked" in Model 2 because some students from disadvantaged areas manage to get above average grades in middle school. The risk from poor neighborhoods is largely mediated by the 9th grade shock—a very low GPA in the first semester. Students who were retained in middle or primary school are about 20 percent less likely to graduate from high school in four years than students who were not retained. Similar to the disadvantage of poor neighborhoods, the negative impact of a prior retention is mediated by the early 9th grade experiences.

The addition of 8th grade GPA in model 3 increases the pseudo R-square by 15 percentage points relative to model 2. Academic ability as well as many other traits that led to academic success are indexed by 8th grade GPA. The huge effect here is to be expected. Poor (or high) grades at any prior stage of schooling might show the same phenomenon—low (high) performing students are less (more) likely to make it through high school.

Students who were placed in honors classes in 9th grade are much more likely to graduate than students in regular classes; while students who take special education classes are much less likely to make it through high school in 4 years. Net of background variables and GPA, ESL students are not any more or less likely to graduate from high school than regular students. The extremely positive effect of being tracked into an honors class in Model 4 is net of 8th grade GPA. To some extent, tracking may reflect student ability and potential that is reflected in teacher recommendations, but not evident in grades. There is little evidence that tracking is used to advantage students from favored economic and racial backgrounds—there is little change in the effects of background variables when tracking is entered as a covariate. However, there is an impact associated with placement in an honors class on high school graduation, which is independent of all other measured variables.

The inclusion of first semester 9th grade GPA in model 4 is the primary reason for the increase of 8 percentage points in the pseudo R-square. Initial grades in high school not only mediate much of the

handicaps of the social background and prior school experience, but also add considerable explanatory power that is independent of all other measured predictors in this model, including 8th grade GPA.

This finding suggests that the transition to high school (entering 9th grade) is a shock for many students who are not ready for the independence and maturity expected in high schools, relative to middle schools. Many of the students who are doing relatively well in 8th grade become 9th grade failures. Among the many background variables that are mediated, in whole or in part, by the 9th grade shock, are minority students (black and Hispanic students), students from poor neighborhoods, and students who were retained.

Additional Multivariate Models of High School Progression

Four year high school graduation is the culmination of continued progress from grade 9 to grade 12. There may be differential risks over the high school career. Some students may encounter major problems in the transition to high school in grades 9 and 10, while other students may encounter greater risks and potential diversions from their continued schooling at grades 11 and 12. To evaluate whether the results of the multivariate model hold for progression through high school, we replicated the multivariate models in table 4 for five educational transitions: (1) Still enrolled in the spring of year 1 of students who entered 9th grade, (2) Still enrolled in the spring of year 2 of students who were enrolled in the spring of year 1, (3) Still enrolled in the spring of year 3 of students who were enrolled in the spring of year 2, (4) Still enrolled in the spring of year 4 of students who were enrolled in the spring of year 3, and (5) Graduation of students who were enrolled in the spring of year 4. These results, presented in appendix table A1, largely confirm the patterns identified in the models of on time high school graduation.

There are some variations, however. Females are less likely to continue enrollment in 9th and 10th grades than boys, but the reverse is true at higher grades. Hispanic students who are enrolled for four years are much less likely to graduate from high school than other groups. Special education students continue to progress through high school each year until it comes to graduation. They are 75% less likely to graduate after 4 years of high school than students in regular 9th grade English classes. Their likelihood of graduation improves after 6 years of high school (results not show here), but there is still a substantial

gap. It is interesting and important to note that ESL status is not associated with a higher risk of dropping out at any stage of high school. We also conducted additional analyses to see if current GPA (or academic failure) might be a better predictor of dropping out the following year than 9th grade GPA. We found that the impact of 9th grade first semester GPA on continuation through each year of high school and to high school graduation is comparable to the GPA measured during the immediate prior year (analyses not shown here).

Conclusions

The gap between the high rates of high school completion and the much lower rates of on-time graduation is largely explicable by the variety of ways that a high school degree can be patched together without marching steadily through four years of high school. A surprisingly high fraction of students drop out of high school sometime before graduation. Many of these students find their way back to the educational system, including re-enrollment in regular high schools, alternative programs operated by the school district, or in high school equivalency programs operated by community colleges. Given a second chance, many high school dropouts find a way to complete a high school degree.

One of the crucial points in students' high school career is the transition from middle school to high school. While all grade transitions are difficult, the transition to high school is particularly challenging as students must adapt to increased academic demands and they must learn to navigate a more complex educational and social environment (Barber & Olson, 2004). Upon entering high school, freshmen are placed in larger classes and assigned more coursework, while simultaneously being granted increased responsibility for their academic careers (Schiller, 1999). Also, freshman must forge new relationships with their teachers and new classmates.

The transition from middle to high school is further complicated by the fact that at this point in the life course many students must also confront the physical and developmental changes associated with pubertal development—increased risky behavior, depression, anxiety, and eating disorders (Patton & Viner, 2007). Pubertal development has a particularly adverse effect on female students' academic achievement (Cavanagh, Riegle-Crumb & Crosnoe, 2007). Given the confluence of personal, social, and

academic changes that students experience it is of no surprise that performance declines upon entering the 9th grade (Alspaugh, 1998; Roderick & Camburn, 1999; Heck & Mahoe, 2006). However, it is striking that students' initial ability to transition to high school, as measured by 9th grade GPA or number of failed classes in 9th grade, is so highly predictive of eventual high school completion.

Many of the risk factors associated with students' ability to successfully transition into high school and eventually graduate are well documented. Every study of high school attrition reports a familiar litany of risk factors associated with minority status, economic marginality, families in distress, student disengagement, and human and social capital deficits (e.g Alexander, Entwisle & Kabbani, 2001; Rumberger, 1987; Perriera, Harris & Lee, 2005). Dropout rates are higher in inner-city schools and in high poverty areas (Ainsworth, 2002; Rumberger & Thomas, 2000). Although some adolescents have the resilience to survive and achieve in harsh environments and deprived circumstances, many, perhaps most, youth need help to make it from childhood to adolescence (Catterall, 1998). Students need economic, social, and emotional support from their families, communities, and schools to keep them out of trouble as well as the positive direction and encouragement to attend and actively participate in their schooling. Even children with all the advantages of middle class families still need considerable encouragement and monitoring to get through high school. Students with fewer resources to fall back on are simply less likely to make it. The analysis reported here reinforces these findings, including the disadvantages of race/ethnicity, family resources, gender, and neighborhood.

One possible reason for the high failure rate in high school is that many entering 9th graders are simply not ready for the rigors and independence of high school. Not all children and adolescents develop and mature at the same pace. Some children are independent learners and self-motivated at a very early age, while others are easily distracted and require more external supervision and monitoring to complete homework and pay attention in a classroom. For example, research has shown that the frontal lobe, the portion of the brain involved in planning, organizing and executive functions, reaches a peak thickness more than a year earlier in females than it does in males (Patton & Viner, 2007). It is possible that there is a wide range of individual predispositions in development over which are layered the impacts of families,

peers, and teachers, and the structure of schools. Many students, at the age of 15, may not be ready for the abrupt change in the educational and social expectations involved in moving from middle to high school.

In an analysis of the transition to ninth grade, Weiss and Bearman (2007) find that all students that move from 8th to 9th grade experience a similar sized decrease in GPA regardless of whether they change schools (moving to a high school for 9th grade versus staying at a junior high school for 9th grade). Interestingly, they find a small positive effect of changing schools on social integration in high schools and college aspirations for students that were previously retained. Also, they note that students that were socially isolated and transferred schools displayed higher levels of social integration in ninth grade than the isolated students that did not transfer schools. They conclude that the ability to transfer schools may in fact serve as a positive experience for some students, as it provides them with a fresh start in a new school environment. Schiller also found that poor performing students benefited from a 'fresh start' in a high school which few of their middle school class mates attended (1999).

Weiss and Bearman's findings are somewhat contrary to the findings noted in this analysis and that of Roderick and Camburn (1999). The decrease in academic performance between 8th and 9th grade was less steep in the Weiss and Bearman analysis. A potential explanation for this could be that this analysis and that of Roderick and Camburn relied upon administrative school records from large urban school districts, while Add Health data is based upon a nationally representative survey. Perhaps, the transition to high school has a more severe impact on students in urban schools. Also, in the multivariate analyses they included a measure of integration into a peer group as a covariate. It is possible that students that are socially engaged in school are also academically engaged in school, so the negative effect of changing schools (as well as grades) may be mediated by this covariate. As all of the students in this analysis changed schools between 8th and 9th grade, we are unable to asses whether changing schools provided certain groups of students with a fresh start.

Many students simply may not be ready for the abrupt change in the educational and social expectations involved in moving from middle to high school. High school teachers have different, and greater, expectations for students than middle school teachers, while displaying less perceived interest in

the students (Barber & Olson, 2004). Furthermore, many 9th graders find the school environment to be impersonal, bureaucratic, and challenging. Students often have a hard time socially integrating into a peer group and forging new relationships with teachers and school administrators, the lack of a social and academic niche can quickly lead to student disengagement. As with any school change, it is not surprising that students experience an initial academic 'hiccup' and that they find it difficult to forge relationships with peers and teachers, however, these small missteps combined with inattention and school absences quickly turn into failed tests, and then a failed course.

Given the levels of high school completion there is room for improvement in the current structure of American high schools. As the transition to high school is difficult for many students, school districts need to focus more attention and resources on helping students make this transition. School districts need to implement comprehensive transition programs, which target the students, their parents, and the school staff, as they have been shown to deter students from dropping out (Smith, 1997). Also, schools need to provide a non-stigmatizing and engaging avenue through which students that have fallen behind can complete additional course work to catch up to their cohort. Often these students are placed in alternative schools or in classes with younger students, both of which can be off putting environments for students that have had academic problems and are, most likely, not fully engaged in the academic process.

Appendix: Estimates of Dropout Rates From School Enrollment Records

The student database includes the complete universe of students from all five comprehensive high schools in the district as well as students enrolled in a broad variety of alternative educational programs. There is "open enrollment" across high schools in the district, which means that students are free to transfer from one school to another in the district. Over 90 percent of enrolled students attend the comprehensive high schools in the district, and the remainder are enrolled in a variety of alternative programs for students with academic problems, special interests, handicaps, or who require some accommodation. Since there is considerable mobility of students between the comprehensive high schools and the alternative programs, the enrollment figures presented here are inclusive of all students in the district.

Students can be matched from year to year by unique identifiers across years and tracked as they progress from 9th grade until high school graduation. Students who are retained at a grade level, and even those who exit and return, can also be identified and tracked. The major analytical problem is that "exits" from the database include both dropouts and students who transfer out of the school district. With enrollment data from all institutions within the district, local transfers (within the school district) do not pose a problem for tracking students from year to year. In theory, the best method to estimate dropouts would be to directly measure transfer students who are enrolled in other school districts, then to subtract transfers from exits. The residual would be dropouts, and the appropriate dropout rates could be estimated for each grade level for each cohort. Without data to directly measure transfers, we designed alternative methods for indirect estimation.

The first method simply compares the aggregate measures of inflows and outflows for each year—both the absolute levels and as percentages of the total enrolled students in each year. The actual numbers of inflow and outflow students are computed by tracing individual students who enter or leave the enrollment database from the first semester of the 9th grade to the 2nd semester of the 12th grade of each academic year. Inflows are students who are first enrolled from second semester 9th graders up to

and including second semester 12th graders, but were not enrolled the prior term. In a parallel fashion, outflows are computed as students who would have been expected to be enrolled, based on enrollment in the prior semester, but are missing from the database from the second semester of 9th grade to the second semester of 12th grade. The denominator for inflow and outflow rates is the total academic year enrollment, which is the simple average of enrollment in the fall and spring semesters

The assumption of this method is that the in-transfer rate of students is a proxy for the out transfer rate (i.e. if the rate of in-transfers is equal to the rate of out-transfers). In Appendix table A.2, we compare the numbers and percentages of inflows and outflows of enrolled high school students for each academic year from 1998/99 to 2002/03. The number of enrolled students has crept upward from about 8,500 to 9,300 students from 1998-99 to 2002-03—an increase of about 9 percent over 4 years. There have also been small increases in the absolute numbers of annual entries and exits from the district every year. What is most remarkable is the stability of the inflow and outflow rates—computed as a percentage of the enrolled students. About 14-15% of enrolled students in the school district are new entrants every year and about 24-25% of enrolled students exit the school system each year (the exit rate was marginally higher at 27% in 1999-00). If we can assume that in-transfer rate and out-transfer rate are approximately equal, then the dropout rate is the difference between the outflow rate (which includes both dropouts and transfers) and the inflow rate—or about 10% per year. The equivalence of in-transfers and out-transfers is true if the process of in- and out-transferring occurring in this school district is also occurring in all other school districts at equal rates. Although we do not have evidence that the transfer rates at this school district are equivalent to other school districts, temporal stability of in- and out-transfer rates is suggestive of a structural regularity.

Appendix Table A.2 Here

The second method estimates the dropout rate by first calculating an "expected transfer rate" for high school students and then computing the dropouts as the residual between exits and transfers. The logic is that some groups of students are unlikely to dropout, and therefore their exit rate is a good proxy for their transfer rate. This approach is illustrated with Appendix table A.3, which shows the observed

(one year) exit rates from 2003 to 2004 for each grade transition from 6th to 12th grade by GPA in 2003. There are clear direct effects of grade and GPA, as shown in the marginal, as well as an interaction effect in the interior of the table.

Appendix Table A.3 Here

There are probably few, if any dropouts in middle school—represented by the transitions from 6th to 7th grade and from 7th to 8th grade (the few students who are retained in middle school are considered "non exits"). Most middle school students are below the minimum age (16) when students are allowed to quit school. Therefore, we assume that the observed exit rates from 6th to 7th grade and from 7th to 8th grade approximate a normal transfer rate. Note that the average exit rates for these students in middle school (14.5%) is approximately equal to the inflow rate of 14.6% (for 9th to 12th grade), which was the estimated transfer rate for the first method.

There is also a very strong relationship between GPA and the observed exit rates in Appendix Table A.3. In the high school years (9-12) the exit rate includes both transfers and dropouts, but for middle school students the exit rates presumably reflect only transfer rates. There is, however, a much higher level of transfers among students with lower GPAs. Among middle school students, the transfer (exit) rates are 25% higher among students with a GPA from 2.0 to 3.0 relative to students with a GPA above 3.0. For students with a GPA below 2.0, transfer rates are double those of high scoring students (GPA above 3.0). We suspect that some of this mobility may be a result of low GPAs as families decide to transfer their poor achieving students to other schools (private or a neighboring school district) in the hope of getting their children back on-track. There may also be other factors that influence both GPA and the likelihood of transferring. Loss of a parental job, family dissolution, and other background factors may adversely affect academic outcomes and also geographic mobility.

Among high school students (in grades 9 to 12) for whom dropping out is possible, there is a much stronger relationship between GPA and exit rates. The exit rates from low achieving students (GPA less than 2.0) range from 34% (9th to 10th grade) to 46% (11th to 12th grade). Exit rates for average performing high school students (GPA from 2.0 to 3.0) remain at about the same level as for middle

school students—in the mid teens, while exit rates for high performing students (GPA above 3.0) decline to below 10%. We suspect that very few students with a GPA above 3.0 drop out and that their observed exit rate is a very good proxy for their transfer rate. The lower transfer (exit) rate for high school students relative to middle school students (among those with high GPAs) probably reflects an increase in parental reluctance to move once their children enter high school.

Assuming that there are few dropouts among middle school students and among high school students with a GPA above 3.0, Method 2 uses their exit rates as estimates of the normal transfer rates for all high school students. The middle school rates offer the advantage of specifying GPA-specific transfer rates that are not conflated with dropouts. However, transfer rates might be lower in high school than during middle school, as observed above, because families worry less about the impact of geographic mobility on younger children than for high school age children.

To incorporate both these elements in our estimation of transfer rates, we first specify the observed grade-specific exit rates for high school students with a GPA above 3.0 as their transfer rates. We next take the ratio of low to high GPA exit rates from the middle school data as an ingredient in the estimation of the transfer rates for high school students with a GPA below 3.0. Specifically, we estimate the ratio of exit rates of middle school students with lower GPAs to middle school students with higher GPAs (greater than 3.0).

The results are shown in Appendix table A.4, which shows the estimated transfer rates by grade (9^{th} to 10^{th}, 10^{th} to 11^{th}, etc.) and GPA. The estimated transfer rates for students with a GPA over 3.0 are the observed exit rates by grade, and the transfer rate for students with lower GPAs is estimated to be 25% (for those with GPAs from 2.0 and 3.0) and 200% higher for those with GPAs below 2.0 (in comparison to those with GPAs over 3.0). The exit rates are computed from the fall of year 1 to the fall of year 2. The only missing element is the transfer rate for students from the beginning of 12^{th} grade to graduation. Since there is only one point to exit (between semesters during the academic year), we take ½ of the nearest neighbor (the estimated transfer from 11^{th} to 12^{th} grade) as the estimated transfer rate from the beginning of the 12^{th} grade to graduation. [11]

Appendix Table A.4 Here

The information contained in the matrix of exit rates (Table A3), the matrix of estimated transfer rates (Table A4), and the matrix of the distribution of students by grade and GPA in fall of 2003 (Table A3) allows us to estimate the graduation and dropout rate for non-transfer students. The non-transfer graduation rate, as illustrated in equation 1.1 (below), is estimated by first multiplying the matrix of exit rates (matrix E) by the matrix of the distribution of students by grade and GPA in fall of 2003 (matrix D). The product of these two matrices is subtracted from a matrix of ones (matrix S), so that the diagonal elements are the probability of non-transfer students graduating for each grade level. Thus, the overall non-transfer graduation rate is the product of the diagonal elements, which is .47 (the joint probability of an entering 9th grader not transferring and graduating in 4 years). If 47% of entering freshman graduate on time four years later, then the balance of 53% of the students "exit" the district without graduating. They either: dropout, transfer to another district and graduate, or transfer to another district and dropout.

Matrices:

$$E = \begin{bmatrix} .34 & .15 & .09 \\ .35 & .16 & .07 \\ .47 & .13 & .11 \\ .23 & .07 & .05 \end{bmatrix} \quad T = \begin{bmatrix} .17 & .11 & .09 \\ .14 & .09 & .07 \\ .22 & .14 & .11 \\ .11 & .07 & .05 \end{bmatrix} \quad D = \begin{bmatrix} .47 & .32 & .20 & .14 \\ .27 & .32 & .36 & .31 \\ .26 & .36 & .44 & .55 \end{bmatrix}$$

$$S = \begin{bmatrix} 1.0 & 1.0 & 1.0 & 1.0 \\ 1.0 & 1.0 & 1.0 & 1.0 \\ 1.0 & 1.0 & 1.0 & 1.0 \\ 1.0 & 1.0 & 1.0 & 1.0 \end{bmatrix} \quad G = \begin{bmatrix} .24 & .30 & .37 & .45 \\ .61 & .70 & .79 & .89 \\ .82 & .88 & .92 & .97 \end{bmatrix} \quad P = \begin{bmatrix} .08 & .03 & .02 \\ .04 & .02 & .02 \\ .03 & .04 & .04 \\ .01 & .01 & .02 \end{bmatrix}$$

(1.1) Non-Transfer Graduation Rate = $pr\left[S - \left[\mathrm{ED}\right]\right]$

Notation: pr() denotes the product of the diagonal elements of the matrix.

The next step is to estimate each of these components. The non transfer dropout rate is estimated by equation 1.2.

(1.2) Non-Transfer Dropout Rate = $\left[pr\left[\text{S-[TD]}\right] - pr\left[\text{S-[ED]}\right]\right]$

Using a logic similar to that in equation 1.1, we first take the product of the matrix of estimated transfer rates (matrix T) and the matrix of the distribution of students by grade and GPA in fall of 2003 (matrix D). Second, we subtract the values in the matrix DT from a matrix of ones (matrix S) and take the product of the diagonals, which provides us with the proportion of students that have not-transferred. This includes both graduates and dropouts (.63). The proportion of non-transfer dropouts is the difference between the proportion of students that have not transferred (.63) and the proportion of students that did not transfer and graduated (.47 from equation 1.1). Thus, the non-transfer dropout rate is .16 (.63-.47). In other words, ~16% of entering freshman dropout without transferring to another school district.

Of the 37% who transfer to another school district, some will graduate from their new school, and others will drop out before graduating. These components are estimated with equations 1.3 and 1.4.

(1.3) Transfer Graduation Rate = tr[PG]

(1.4) Transfer Dropout Rate = $\left[1\text{-}[pr(\text{S-(TD)})] - tr(PG)\right]$

The logic behind these estimations is to assume that transfer students graduate at the same rate as non transfer students with a similar GPA the semester prior to exiting the district.[12] The elements of the estimation are matrix G: -- the observed graduation rates by grade level and GPA for cohorts of students who started 9th grade from 1996 to 1999 (rows = level of GPA, <2, 2 to 3, and > 3 and columns = grade level in school, 9th, 10th, 11th, 12th) and matrix P: -- the proportion of entering 9th graders that transferred, by grade level at which they transferred, and their GPA from the semester prior to transferring (rows = grade level at which student transferred, columns = level of GPA semester prior to transferring, <2, 2 to 3, and >3).

To estimate the transfer graduation rate we first take the product of the matrices G and P (equation 1.3). Second, we sum the diagonal elements which yields the estimated transfer graduation rate (.22). Of all students we estimate that 22% transfer to another district and eventually graduate. Equation 1.4 estimates the transfer dropout rate. The estimated transfer dropout rate is .15, which is obtained by

subtracting the proportion of non-transfer students (.63) and the proportion of transfer students that graduated (.22) from 1. Thus, among the 37% of students who transfer, we estimate that 22% graduate and 15% drop out. The dropout rate is higher among transfers than non-transfers because transfers have lower GPA's.

In sum, we estimate that 69% of all students of entering 9th graders will graduate from high school (47% are non-transfer graduates and 22% are transfer-graduates). Conversely, 31% of all students drop out of high school (16% are non-transfer dropouts and 15% are transfer dropouts).

NOTES

[1]GED certificates are underestimates of the numbers of students who complete high school equivalency programs. In our "West Coast metropolitan school district" some students who are counted as enrolled in high school administrative records are former dropouts who are enrolled in high school equivalency programs in local community colleges.

[2]Only limited aspects of student records were made available to the researchers under terms that prevent the identification of individual students.

[3]This is a net figure because it measures only in-transfers who have not dropped out before graduation.

[4]First time 9th graders are students that are in 9th grade for the first time. This population excludes students who were enrolled in 9th grade the previous year. For students that transferred into the school district for 9th grade, we were unable to verify that they were first time 9th graders.

[5]In this measure, "out transfers" are confounded with dropouts.

[6]In trying to reconcile some of these inconsistencies, school staff explained that high school graduation is often "negotiated" for students who have sufficient or nearly sufficient credits but who may not have met every requirement. A school counselor or the school principal may certify a student for graduation, if the student is short a credit or has not taken a specific requirement.

[7]About 3 to 6% of students nationally are classified as limited English proficient (LEP), see Ingles and Quinn 1996: (2).

[8]Although not included, we estimated the bivariate relationship between the social and economic characteristics in table 4 and two additional educational outcomes: on-track on-time graduation and graduating in 5 years. The relationship between these additional educational outcomes and the social and economic characteristics are similar to those presented in table 4.

[9]The lower likelihood of American Indian students graduating from high school in 6 rather than in 4 years is a product of different samples for these two outcomes (only 3 of the 4 cohorts were observed for 6 years).

[10]This analysis could only be estimated for the subset of the sample that were enrolled in the school district in 8th grade (excluding in-transfers). The full results are not presented here, but available on request from the authors.

[11]Among students from grades 9 to 12, there are two points of potential transfer: the fall to spring semester and the summer between academic years.

[12]For example, if 24% of all non-transfer students with GPA of less than 2.0 in their first semester of 9th grade graduate from high school (in 4 years), we assume that that the same graduation rate holds for students with a similar GPA (in their 1st semester of 9th grade) who transferred between grade 9 and grade 10.

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Table 1. Proportions by Enrollment Status of All First Time 9th Graders by Years Since Entering 9th Grade for 4 Cohorts of 9th Graders (1996 to 1999)

		Enrollment Status		
Spring of:	All Enrolled/Graduated	Graduated	On-track	Retained
Year 1	.93	.00	.93	na
Year 2	.81	.00	.67	.14
Year 3	.70	.00	.54	.16
Year 4	.60	.01	.49	.10
Year 5	.54	.50	.00	.04
Year 6	.52	.51	.00	.01

Table 2. Conditional Probability of "Exit" of Enrolled Students by Years Since 9th Grade, 9th Grade Given Survival to that Year for 4 Cohorts of First Time 9th Graders (1996 to 1999)

			Year of First Retention				
Spring of:	**All Enrolled Students**	**Never Retained**	**Prior/MS**	**Year 1**	**Year 2**	**Year 3**	**Year 4**
Year 1	.07	.06	.13	X	X	X	X
Year 2	.14	.13	.19	X	X	X	X
Year 3	.16	.10	.23	.29	X	X	X
Year 4	.16	.08	.21	.37	.35	X	X
Year 5	.11	.03	.11	.29	.35	.54	X
Year 6	.04	.00	.04	.17	.18	.31	.60

Note: Students that exited and later returned to school were not included in the estimation of conditional probabilities for the first year that they re-enrolled. Most of these students returned to school at a lower grade level. For this reason, the probabilities in this table vary slightly from those in figure 3.

Table 3. Distribution of Social and Economic Characteristics and Educational Outcomes for 4 Cohorts of First Time 9th Graders.

Variables	All 9th graders	9th graders in district for 8th grade	Variable Description
Educational Outcomes:	**Percent**	**Percent**	
ON-TRACK ON-TIME FOUR YEAR GRADUATES			Student was continuously enrolled, made normal grade progression for all four years, and graduated from high school in four years.
Graduated	40.1%	43.8%	
Did not Graduate	59.9%	56.2%	
GRADUATED IN 4 YEARS			Student graduated from high school 4 academic years after beginning high school in this school district.
Graduated	45.7%	49.8%	
Did not graduate	54.3%	50.2%	
GRADUATED IN 5 YEARS			Student graduated from high school five academic years after beginning high school in this school district.
Graduated	49.2%	52.3%	
Did not graduate	50.8%	47.8%	
GRADUATED IN 6 YEARS			Student graduated from high school six academic years after beginning high school in this school district.
Graduated	50.6%	53.0%	
Did not graduate	49.4%	47.0%	
Risk Factors:			
GENDER			Student's Gender. Females are coded '1' and males '0'.
Male	51.5%	51.6%	
Female	48.5%	48.4%	
RACE/ETHNICITY			Race/Ethnicity of the student. Coded as a series of binary variables for the following racial/ethnic groups: white, African American, Asian, Hispanic, and Native American/ Pacific Islander.
Hispanic	5.3%	4.8%	
African American	19.5%	20.0%	
Asian	15.2%	16.1%	
American Indian/ Pac. Islander	2.1%	1.9%	
White	57.9%	57.2%	
FAMILY INCOME			Family income of the student during the year in which the student began 9th grade for the 1st time. If the income of a student's family was less than or equal to 185% of the federal poverty level the student is coded '1'.
Above 185% of the federal poverty level	58.3%	57.6%	
Less than or 185% of the federal poverty level	41.7%	42.4%	
NEIGHBORHOOD[B]			Neighborhood is a set of 38 geographic areas in the school district which correspond to elementary school catchment areas. Students with missing address data (~5%) are classified in an additional dummy variable. Neighborhoods are measured by 38 dummy variables, but the results from only five categories are presented in the multivariate results: the neighborhoods that are closest to values of the 90th, the 75th, the 50th (median), the 25th, and the 10 percentiles of students graduating from high school in four years.
90th to 100th Percentile	14.7%	9.5%	
75th to 90th Percentile	12.5%	14.2%	
50th to 75th Percentile	24.9%	29.0%	
25th to 50th Percentile	20.6%	20.1%	
10th to 25th Percentile	15.3%	15.6%	
0 to 10th Percentile	12.0%	11.6%	

Table 3 (cont). Distribution of Social and Economic Characteristics and Educational Outcomes for 4 Cohorts of First Time 9th Graders.

Variables	All 9th graders	9th graders in district for 8th grade	Variable Description
TRANSFERRED INTO DISTRICT FOR 9TH GRADE			Students that transferred into the district for 9th grade are coded '1'. To determine whether a student had transferred into the district, administrative files from prior years were examined to see if the student was previously enrolled in the district.
Transferred	15.5%	NA	
Did not transfer	84.5%	NA	
Educational Experiences:			
EVER RETAINED IN GRADES K TO 8TH GRADE			Students that are overage for 9th grade are coded as 1. Students are over age if they are older than 15 years old on September 1st of the year in which they start 9th grade for the first time.
Never Retained	75.6%	76.8%	
Retained	24.4%	23.2%	
9TH GRADE CLASSES			The type of classes the student took their first semester of high school. Coded as a series of dummies: Advanced/college bound indicates enrollment in an honors /advanced English class, Full-time special education indicates more than 2/3rds of their classes are special education, Part-time special education indicates less than 2/3rds of their classes are special education, and English as a second language indicates they enrolled in a English as a second language class.
Traditional Curriculum	69.1%	68.5%	
Advanced/College bound classes	17.5%	18.5%	
Special education: full time	3.0%	3.0%	
Special education: part time	7.7%	8.0%	
English as a second language	2.7%	2.1%	
GPA 1ST SEM OF 9TH GRADE			Students' GPA from their 1st semester of high school on a 0 to 4 scale. Coded as a series of dummy variables: GPA is less than 1.0, GPA is greater than or equal to 1 and less than 2, GPA is greater than or equal to 2 and less than 3, GPA is greater than or equal to 3 and less than or equal to 4, or student took only pass/fail classes.
GPA less than 1.0	15.5%	15.2%	
GPA 1.0 to 1.99	20.7%	21.6%	
GPA 2.0 to 2.99	29.6%	30.7%	
GPA 3.0 to 4.0	31.8%	30.8%	
Took only Pass/Fail classes	2.4%	1.7%	
GPA 2nd SEM OF 8TH GRADE[C]			Students' grade point average (GPA) from 8th grade 2nd semester on a 0 to 4 scale. Coded as a series of dummy variables (see 9th grade for specific coding of dummy variables).
GPA less than 1.0	5.6%	5.6%	
GPA 1.0 to 1.99	16.6%	16.6%	
GPA 2.0 to 2.99	34.7%	34.7%	
GPA 3.0 to 4.0	42.5%	42.5%	
Took only Pass/Fail classes	.6%	.6%	
N of 9th graders	8,948	7,441	

Notes:

[B] Although neighborhoods are measured by 38 dummy variables, the percentage composition is only shown for those between the maximum, minimum and 5 intervening categories: the neighborhoods that are closest to values of the 90th, 75th, 50th, 25th and 10th percentiles of students graduating in 4 years.

[C] 8th grade 2nd semester GPA is only reported students enrolled in the district for 8th grade (exclude in-transfers for 9th grade).

Table 4. Odds-Ratios from Logistic Regressions of Social and Economic Characteristics on Graduating from High School in Four Years with Robust Standard Errors (N=7,441).								
	Model 1		**Model 2**		**Model 3**		**Model 4**	
Risk Factors:	e^B	**P>|z|**	e^B	**P>|z|**	e^B	**P>|z|**	e^B	**P>|z|**
GENDER								
Female	1.40	.00	1.42	.00	1.01	.90	.97	.66
Male	--	--	--	--	--	--	--	--
RACE/ETHNICITY								
Hispanic	.51	.00	.66	.00	.73	.02	.82	.17
African American	.73	.00	.99	.84	1.31	.00	1.56	.00
Asian	1.18	.01	1.56	.00	1.12	.19	1.02	.87
American Indian/ Pac Isl.	.48	.00	.67	.03	.82	.37	.92	.73
White	--	--	--	--	--	--	--	--
FAMILY INCOME								
Less than or 185% of the federal poverty level			.63	.00	.69	.00	.74	.00
Greater than 185% of the federal poverty level			--	--	--	--	--	--
NEIGHBORHOOD [B]								
90th Percentile			1.33	.17	1.92	.01	1.40	.21
75th Percentile			1.22	.31	1.78	.01	1.20	.47
50th Percentile (Median)			--	--	--	--	--	--
25th Percentile			.75	.09	.79	.23	1.03	.87
10th Percentile			.77	.26	.68	.10	.71	.22
Educational Experiences: PRIOR GRADE RETENTION								
Retained: 1st to 8th grade					.79	.00	.91	.19
Never Retained					--	--	--	--
8th GRADE GPA								
GPA less than 1.0					.02	.00	.10	.00
GPA 1.0 to 1.99					.08	.00	.31	.00
GPA 2.0 to 2.99					.28	.00	.62	.00
GPA 3.0 to 4.0					--	--	--	--
Took only Pass/Fail classes					.09	.00	.27	.02

Table 4 (cont). Odds-Ratios from Logistic Regressions of Social and Economic Characteristics on Graduating from High School in Four Years with Robust Standard Errors (N=7,441).

	Model 1		Model 2		Model 3		Model 4	
9th GRADE CLASS TYPE	e^B	P>|z|	e^B	P>|z|	e^B	P>|z|	e^B	P>|z|
College bound classes							1.55	.00
Special education: full time							.46	.00
Special education: part time							.92	.47
ESL Student							.75	.12
Traditional Curriculum							--	--
9th GRADE GPA								
GPA less than 1.0							.04	.00
GPA 1.0 to 1.99							.17	.00
GPA 2.0 to 2.99							.47	.00
GPA 3.0 to 4.0							--	--
Took only Pass/Fail classes							.13	.00
McFaddens Pseudo R^2	.01		.07		.22		.30	
BIC	10,229		9,979		8,538		7,713	

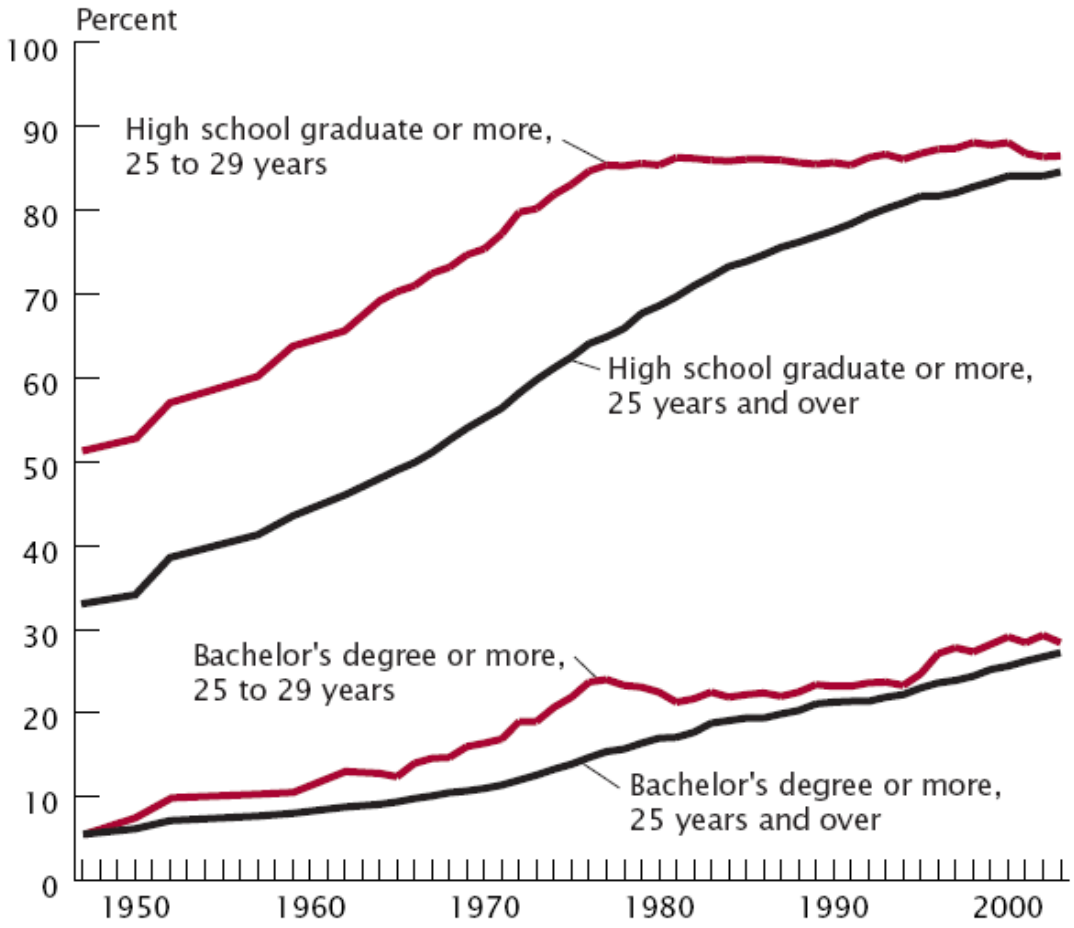
Notes:

[A] Specific variables definitions are included in table 3.

[B] Neighborhood is a set of 38 geographic areas in the school district which correspond to elementary school catchment areas. Neighborhoods are measured by 38 dummy variables, but only 5 categories are presented here: the neighborhoods that are closest to values of the 90th, 75th, 50th (referent category), 25th and 10th percentiles of students graduating in 4 years.

Figure 1.

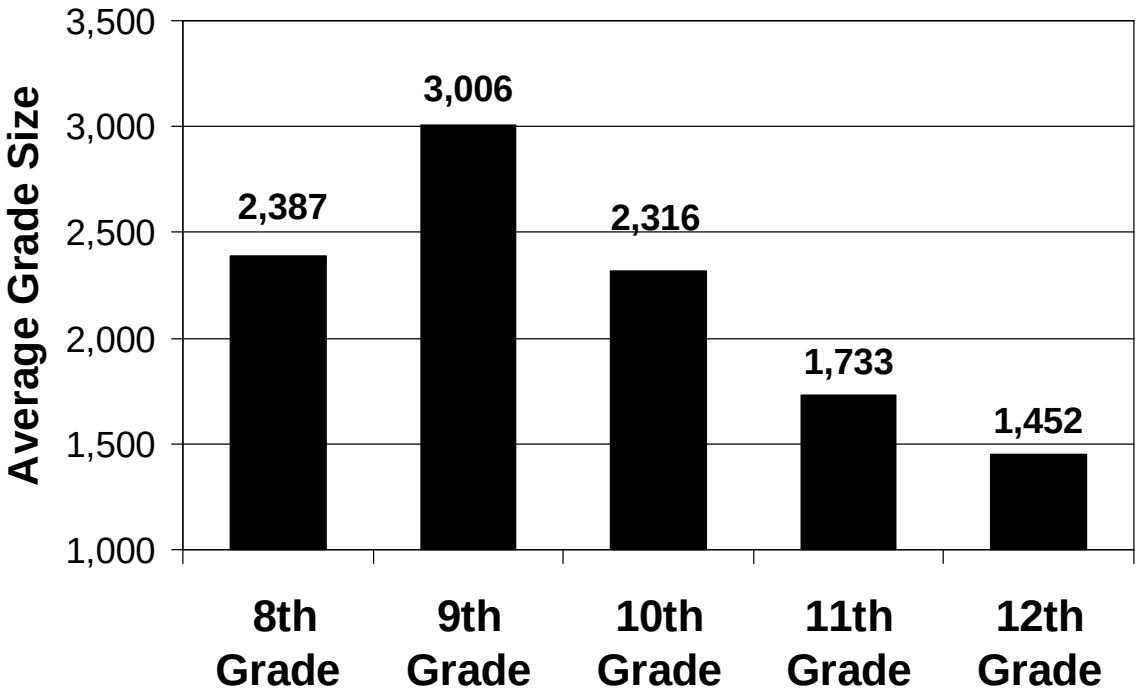
Educational Attainment of the Population 25 Years and Over by Age: 1947 to 2003



Note: Prior to 1964, data are shown for 1947, 1950, 1952, 1957, 1959, and 1962.
Source: U.S. Census Bureau, Current Population Survey and the 1950 Census of of Population.

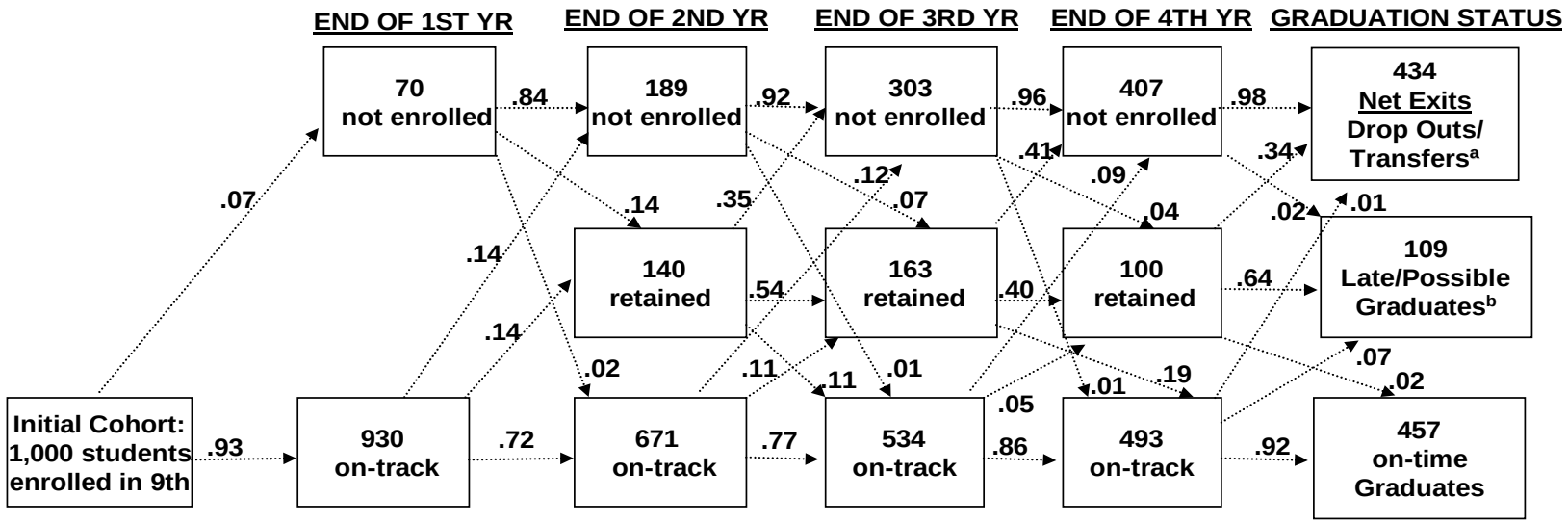
Source: Stoops, Nicole. 2004. "Educational Attainment in the United States: 2003" *Current Population Reports* P20-550. Washington, DC: U.S. Bureau of the Census.

Figure 2. Students enrolled, by Grade Level: Averages for Academic Years from 1997-98 to 2004-05.



Source: Merged grade history files (MRDF) of enrolled students from 1997-98 to 2004-05 in a West Coast metropolitan school district.
Notes: These figures are the numbers of enrolled students in the fall semester of each academic year, averaged across 8 academic years.

Figure 3. The Process of School Progression and Attrition For an Entering Cohort of 1,000 Ninth Graders: Averages from Cohorts of 1995-96 to 1998-99.



a) Net Exits include students that left high school with too few credits (does include some transfers).

b) Students who graduate late, are still enrolled after 6 years, or exited with sufficient credits to graduate.

Appendix

Table A1. Odds-Ratios from Logistic Regressions of Social and Economic Characteristics and Educational Experiences on School Enrollment (1 is enrolled) with Robust Standard Errors.

	Enrolled Year 1		Enrolled Year 2		Enrolled Year 3		Enrolled Year 4		Graduated Year 4	
Risk Factors:	e^B	P>|z|	e^B	P>|z|	e^B	P>|z|	e^B	P>|z|	e^B	P>|z|
GENDER										
Female	.82	.10	.72	.00	.87	.09	1.03	.72	1.22	.02
Male	--	--	--	--	--	--	--	--	--	--
RACE/ETHNICITY										
Hispanic	.78	.32	.91	.63	.97	.86	1.80	.01	.62	.02
African American	1.26	.14	1.36	.01	1.16	.15	1.43	.00	1.46	.00
Asian	1.13	.54	1.22	.14	1.22	.14	.87	.28	.86	.26
American Indian/ Pac Isl.	.58	.06	.63	.07	.81	.44	.87	.61	1.11	.76
White	--	--	--	--	--	--	--	--	--	--
FAMILY INCOME										
Less than or 185% of the federal poverty level	.85	.20	.83	.03	.87	.12	.87	.14	.84	.07
Greater than 185% of the federal poverty level	--	--	--	--	--	--	--	--	--	--
NEIGHBORHOOD										
90th Percentile	4.30	.18	1.02	.95	1.45	.38	1.16	.67	1.61	.25
75th Percentile	.83	.72	1.32	.44	.73	.31	1.81	.13	1.14	.72
50th Percentile (Median)	--	--	--	--	--	--	--	--	--	--
25th Percentile	.61	.24	.94	.83	.78	.38	1.12	.68	.99	.98
10th Percentile	.62	.37	.70	.30	.82	.61	1.12	.79	.51	.08

Educational Experiences										
PRIOR GRADE RETENTION										
Retained: 1st to 8th grade	.78	.05	.85	.08	.67	.00	.77	.01	1.12	.28
Never Retained	--	--	--	--	--	--	--	--	--	--
8th GRADE GPA										
GPA less than 1.0	.40	.00	.29	.00	.47	.00	.43	.00	.15	.00
GPA 1.0 to 1.99	.75	.18	.70	.02	.61	.00	.67	.01	.23	.00
GPA 2.0 to 2.99	1.03	.86	.77	.03	.83	.10	.68	.00	.53	.00
GPA 3.0 to 4.0	--	--	--	--	--	--	--	--	--	--
Took only Pass/Fail classes	1.19	.72	.80	.64	.33	.01	.66	.42	.42	.21
9th GRADE CLASS TYPE										
College bound classes	.98	.95	1.43	.02	1.40	.02	1.66	.00	1.70	.00
Special education: full time	1.02	.95	.92	.73	1.81	.04	.94	.80	.28	.00
Special education: part time	1.33	.17	.99	.93	1.14	.33	.81	.13	.96	.80
ESL Student	.51	.08	.99	.99	.90	.72	.80	.46	.70	.22
Traditional Curriculum	--	--	--	--	--	--	--	--	--	--
9th GRADE GPA										
GPA less than 1.0	.12	.00	.22	.00	.13	.00	.08	.00	.06	.00
GPA 1.0 to 1.99	.47	.01	.44	.00	.27	.00	.19	.00	.17	.00
GPA 2.0 to 2.99	.75	.26	.80	.11	.58	.00	.38	.00	.42	.00
GPA 3.0 to 4.0	--	--	--	--	--	--	--	--	--	--
Took only Pass/Fail classes	.06	.00	.51	.07	.20	.00	.20	.00	.17	.00
McFaddens Pseudo R^2	.23		.19		.13		.17		.26	
Sample Size	7,441		7,059		6,252		5,491		4,473	

Note: 8th grade 2nd semester GPA is only reported students enrolled in the district for 8th grade (exclude in-transfers for 9th grade)

Appendix Table A2. Inflow and Outflow Rates Among all High School Students (Grades 9 to 12) in a West Coast Metropolitan School District by Academic Year

Academic year	Total Enrollment	Inflows	Percent Inflow	Outflows	Percent Outflow
1998-1999	8,522	1,265	.148	2,150	.252
1999-2000	8,656	1,237	.143	2,380	.275
2000-2001	8,814	1,282	.145	2,184	.248
2001-2002	9,069	1,279	.141	2,120	.234
2002-2003	9,337	1,440	.154	2,272	.243
Average	**8,880**	**1,301**	**.146**	**2,221**	**.250**

Source: Grade history files from 1998-99 to 2002-03

Notes:

1. Total enrollment is the number of students enrolled (average of the Fall and Spring semesters) in the entire school district, including 5 comprehensive high schools and all alternative programs

2. Inflows include all in-transfers (students not enrolled in school district in prior semester) from first-semester freshmen (9th grade) to second semester seniors (12th grade).

3. Outflows include all students who were enrolled one semester, but were not enrolled in the following semester from first-semester freshmen to second semester seniors.

4. Percent inflows and outflows are the numbers of inflows and outflows divided by total enrollment.

Appendix Table A3. Percentage of Students who Exited the School District from Fall of 2003 to Fall of 2004 by 2003 GPA.

Grade Transition from 2003 to 2004	Percent Exited by GPA in 2003			Percentage of all Students that Exited
	< 2.0	2.0 to 3.0	> 3.0	
6th to 7th	23.3%	14.4%	11.9%	**14.5%**
7th to 8th	22.6%	14.0%	11.1%	**14.5%**
8th to 9th	30.0%	20.5%	17.2%	**21.6%**
9th to 10th	33.7%	15.1%	8.5%	**22.2%**
10th to 11th	35.1%	15.7%	7.1%	**18.9%**
11th to 12th	46.5%	26.0%	10.8%	**23.4%**
Weighted Mean	**32.0%**	**16.7%**	**11.5%**	**19.0%**

2003 Student Enrollment at each grade level by 2003 GPA

	GPA in 2003				Enrolled Students
2003 Grade Level	< 2.0	2.0 to 3.0	> 3.0	Total	
6th grade	14.9%	34.4%	50.7%	100.0%	2,312
7th grade	21.2%	33.0%	45.7%	100.0%	2,274
8th grade	25.7%	33.6%	40.7%	100.0%	2,360
9th grade	47.0%	27.3%	25.7%	100.0%	2,573
10th grade	32.3%	32.2%	35.5%	100.0%	2,019
11th grade	19.9%	36.2%	43.9%	100.0%	1,597
12th grade	13.7%	31.3%	55.0%	100.0%	1,336

Source: Grade history files from 1st semester of the 2003-04 and 2004-05 academic years.

Notes: This table excludes the small number of students with a missing grade level and students that did not take graded classes.

Appendix Table A4. Estimated Percentage of Students that Transferred from Fall of 2003 to Fall of 2004, by Grade and 2003 GPA

	GPA in 2003		
Grade Level	**< 2.0**	**2.0 to 3.0**	**> 3.0**
9th	17.0%	10.6%	8.5%
10th	14.2%	8.9%	7.1%
11th	21.6%	13.5%	10.8%
12th	10.8%	6.8%	5.4%

Note:

1. The out transfer rate is for 9th, 10, 11th, and 12th graders is assumed to be:

   -for students with GPA of 3.0 or higher: based on observed exit rates

   -for students with GPA of 2.0 -3.0: assumed to 25% higher students with GPA of 3.0; proportional to ratio of middle school students.

   -for students with GPA below: assumed to twice that of students with GPA of 3.0; proportional to ratio of middle school students.