Students Left Behind:  
Measuring 10\textsuperscript{th} to 12\textsuperscript{th} Grade Student Persistence Rates in Texas High Schools 

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Abstract:

The No Child Left Behind Act requires states to publish high school graduation rates for public schools and the Department of Education is currently considering a mandate to standardize high school graduation rate reporting. However, no consensus exists among researchers or policy-makers about how to measure high school graduation rates. In this paper, we use longitudinal data tracking students at 82 Texas public high schools to assess the validity of the graduation rates that Texas calculates annually for all public high schools, as well as two competing estimates based on publicly available enrollment data from the Common Core of Data. Our analyses indicate these widely-used approaches yield highly imprecise estimates of high school graduation and persistence rates. We propose several guidelines for using existing graduation and persistence rate data and argue that a national effort to track students as they progress through high school is needed.
I. Introduction:

Triggered by press reports of falsified dropout records at Sharpstown High School, in the summer of 2003 the Texas Education Agency audited school graduation rates reported by 16 middle and high schools in the Houston Independent School District. The audit found that over half of the 5,500 students who left these schools during the 2000-2001 academic year were dropouts who were misclassified as transfers to help boost the school district’s graduation rate (Archer 2003; Schemo 2003). The Houston dropout reporting scandal underscores widespread problems associated with measuring the rates at which students advance through American high schools.

Since 2002, when the No Child Left Behind Act required states to publish annual graduation rates for all public high schools, researchers and policy-makers have debated how best to define and measure high school graduation. This debate has become particularly heated recently, as the U.S. Department of Education states to adopt a uniform graduation rate reporting technique (Dillon 2008) and the U.S. Senate debates a proposal monitor graduate rates from all U.S. high schools (Library of Congress 2007). As one of the first states to collect and report detailed graduation rates, Texas is at the center of these debates. In 1984, the Texas state legislature mandated the Texas Education Agency (TEA) to collect data on dropouts from the state’s public high schools. In 1988 Texas high schools began collecting individual-level student dropout records and, reporting school-specific dropout counts to the TEA. The state began reporting longitudinal dropout rates by school district. Despite the state’s extensive experience with collecting dropout data, the Houston audit calls into question the validity of Texas’s high school graduation rates. Texas high schools are required to report which students leave
high school, distinguishing between dropouts and transfers. After the 2003 audit, Texas implemented oversight procedures to improve the quality of data used to calculated graduation rates, but it is likely that many schools will continue to misclassify dropouts as transfers. Nevertheless, Texas’s graduation data collection is among the most sophisticated in the nation (GAO 2005; Winglee, Marker, Henderson, Young, and Hoffman 2000). Although the calculation of high school graduation varies across states, the official graduation rate in nearly every state is susceptible to dropout/transfer misclassification bias (Swanson 2003a, NCES 2005).

Official rates based on school-reported dropout data are not the only available measures of high school completion. At the national level, population surveys as well as cohort-based longitudinal studies provide estimates of the proportion of young adults who complete U.S. high schools. Researchers have proposed several methodologies for calculating graduation rates for individual high schools and districts to minimize misclassification bias inherent in school-reported dropout data. But estimates of the nationwide high school graduation rate also vary widely, ranging from 70 percent or lower (Swanson 2004; Greene and Forster 2003; Greene and Forster 2005; Warren 2005) to nearly 90 percent (U.S. Department of Education 2006, Table 26-1; Adelman 2006). This state of affairs undermines efforts to track and improve high school graduation rates, just when the NCLB Act raised the stakes for doing so.

Accordingly, this paper assesses the validity of several widely-used graduation rates, identifying the strengths and limitations of each. Our empirical analyses distinguish between two important attributes of a valid measure: accuracy and precision. An accurate measure of high school graduation conforms closely to the actual rate; a precise measure
of high school graduation is one that has low variance, and can discriminate between low and high performing schools as well as annual fluctuations (Crocker and Algina 1986). After elaborating the distinction between accuracy and precision, we summarize the recent debate around the measurement of U.S. high school graduation rates, which largely has focused on the question of accuracy. Because a *precise* measure is necessary to compare graduation rates between schools and to detect changes in school performance over time, the issue of precision is of equal or greater importance from the perspective of analysts or policy makers.

Therefore, we move beyond discussions about the accurate measurement of high school graduation rates, focusing instead on the accurate and reliable measurement of graduation rates at the school level. Specifically, we measure 10th-to-12th grade persistence rates for students at 82 Texas public high schools using longitudinal data collected by the Texas Higher Education Opportunity Project, which we correct for sample attrition using multiple imputation. These rates provide empirical referents to assess the accuracy and precision of school-level persistence rates derived from CCD enrollment data, as well as official school-specific graduation rates reported by the TEA. We anchor these analyses in the current debate about the temporal measurement of educational progress, which we elaborate in the concluding section.

**II. Measurement of High School Graduation**

*Defining a valid measure*

Valid measures of high school graduation rates are both accurate and precise. *Accuracy* is necessary to judge the magnitude of the high school dropout problem, but for
analysts interested in understanding the causes of high school dropout and policy-makers seeking to design interventions to improve student graduation rates, *precision* is arguably the more pressing concern. The *No Child Left Behind Act*’s use of high school graduation measures illustrates why this is so.

Although in implementation NCLB school accountability systems have focused almost entirely on annual improvements in standardized test scores, the 2002 law requires states to measure graduation rates at public high schools and to incorporate rates in calculations of annual yearly progress (AYP) for schools and districts (Losen 2005). States that adopt an *accurate* but imprecise measure of high school graduation, cannot distinguish between schools that are improving high school graduation rates and those making less satisfactory progress. Alternatively, if states adopt a *precise* measure of high school graduation, schools with relatively low and declining graduation rates will be subject to sanction under NCLB, regardless of the accuracy of their reported graduation rates. Precision in the measurement of high school graduation is crucial under this requirement, while measurement accuracy is of secondary import.

Measurement precision also is essential for obtaining valid results in multivariate or panel data analyses that attempt to isolate the influences of school characteristics, educational policies, or school-based interventions on graduation rates. These types of studies focus attention on between-school differences in graduation rates or the changes in school graduation rates over time, rather than the absolute level of high school graduation.

*Standard Measures of High School Graduation*
Media reports about the proportion of U.S. high school students who earn a diploma largely revolve around issues of accuracy, yet estimates vary widely. Educational status reports from household surveys indicate that nearly 90 percent of American young adults hold high school diplomas or their equivalent, and that this percentage is rising over time (U.S. Department of Education 2006, Table 26-1). However, several recent studies have called into question estimates of graduation rates based on household surveys. Graduation rates calculated from school-reported enrollment and graduation rates indicate that less than three-fourths of U.S. public high school students earn diplomas. Moreover, several authors argue that this share is declining (Heckman and LaFontaine 2007; Miao and Haney 2004; Warren and Halpern-Manners 2007).

Table 1 summarizes five competing estimates of the graduation rate for recent U.S. high school cohorts. The first column in Table 1 reports high school graduation data for 25-29 year olds calculated from the 2000 U.S. Census’s IPUMS 5 percent sample. This Census survey which is administered to 5 percent of all U.S households, includes institutionalized and non-institutionalized populations. To reduce bias due to individuals who did not attend U.S. high schools, immigrants who came to the U.S. in the past 15 years are excluded from the calculations reported in Table 1 (see Fry, 2005). According to Census 2000, nearly 88 percent of 25-29 year olds who resided in the United States long enough to have attended U.S. high schools earned high school diplomas or their equivalent. This rate varies substantially by ethnicity, with 91 percent of whites reporting high school diplomas or their equivalent, compared to 81 percent of blacks and 73 percent of Hispanics.
These population based estimates of graduation rates are limited in two ways. First, the census status reports do not distinguish between young adults who graduated with a high school diploma and those who dropped out of high school and earned a GED or equivalent degree. Alternative degrees are important second-chance opportunities for high school dropouts, but do not yield the same labor market advantages as conventional high school diplomas (Cameron and Heckman 1993; Tyler 2003.). Second, census status reports are based on unverified data provided by heads of household, making them susceptible to social desirability response bias. Dropping out of high school carries social stigma, hence respondents may exaggerate their educational attainment and that of their household members (Black, Sanders, and Taylor 2003; Warren and Halpern-Manners 2005). Therefore, several researchers assert that educational status report data yield overly optimistic conclusions about U.S. graduation rates.

The second panel of Table 1 presents three estimates of graduation rates based on public high school enrollment and graduation data published in the Common Core Data (CCD) available through the National Center for Education Statistics. (Appendix A provides more detail regarding the calculation of these rates.) The Basic Graduation Rate (BGR) is calculated by dividing the number of students who graduate from a given high school with a diploma by the number of 9th graders enrolled in that high school 3 years earlier. The BGR indicates that fewer than 70 percent of U.S. public high school students – and fewer than half of all African-American students – receive a diploma in four years. This rate may be biased downward, however. Ninth grade marks an important transition in American education because students must prepare for high-stakes skills tests. As a
result, 9th grade retention rates are higher than those of subsequent years, and there were 14 percent more 9th graders in U.S. public schools in the 2002-2003 school year than there were 8th graders the year before. These 9th grade repeaters artificially deflate estimates of the BGR (Mishel and Roy 2006).³

Because the BGR is based on school data collected over four years, it is missing data for new schools and yields misleading estimates for schools that expanded or contracted over time due to student migration. The Cumulative Promotion Index (CPI) attempts to correct for population growth and student migration by using data from two contiguous years to portray annual transitions between grades. CPI essentially estimates the likelihood that a 9th grader from a particular school system will complete high school with a regular diploma in four years, given the conditions prevailing in their third year of high school (Swanson 2004). This measure does not address 9th grade retention, however, and it yields graduation rates that closely parallel the BGR.

Given the large disparities among estimates of the U.S. high school graduation rate depending on data sources and formulae, it is unlikely that researchers will soon agree on the most accurate measure based on cross-sectional data series. Mishel and Roy (2006) point to possible path for adjudicating between competing approaches for estimating high school graduation rates nationwide. They claim that longitudinal studies that follow a nationally representative cohort of students through high school are the most direct, and therefore most accurate, way to estimate US graduation rates.

Table 1 reports Mishel and Roy’s estimates of the U.S. high school graduation rate, based on National Educational Longitudinal Survey (NELS) and the National Longitudinal Survey of Youth’s 1997 cohort (NLSY97) data. These longitudinal studies
yield considerably higher estimates of the U.S. high school graduation rate than any of
the measures based on high school enrollment and graduation data. Over four-in-five
NELS respondents earned a diploma by their mid-twenties, and 82 percent of NLSY
respondents earned a diploma by age 20-22. In both studies, the high school graduation
rate for black and Hispanic students was approximately 75 percent. Moreover, when
NELS and NLSY respondents who earned GEDs are included among the high school
graduates, estimated graduation rates are comparable to population estimates based on
census data (Mishel and Roy 2006).

Critics note that sample attrition threatens the accuracy of graduation rates based
on longitudinal data. If high school dropouts are more difficult to track over time than
their peers who finish high school, these longitudinal estimates may overstate the national
high school graduation rate. The magnitude of this potential bias is difficult to assess;
however, fewer than 10 percent of respondents leave the NELS and NLSY sample
between waves and both studies use population weights to correct for attrition.

At present, the debate over the accurate measurement of the U.S. graduation rate
has reached an impasse. In light of the stringent reporting requirements of NCLB, we
advance the debate about valid measurement of graduation persistence rates by
redirecting focus from national to school-level graduation estimates and by addressing
the second component of measurement validity, namely precision.

III. Estimating high school-specific graduation rates

In what follows we empirically validate school-level graduation rate estimates
using longitudinal data collected by the Texas Higher Education Project (THEOP). We
calculate 10th-to-12th grade persistence rates for 82 Texas public high schools, using multiple imputation to correct for sample attrition. We then compare school-specific longitudinal persistence rates with two widely used measures - TEA graduation rates and several rates based on CCD enrollment data – in order to assess their validity.

Data

In the spring of 2002, THEOP conducted a statewide survey of two cohorts of Texas public high school students—nearly 20,000 sophomores and 14,000 seniors. The study implemented a unique design, drawing a random sample of public high schools, and then attempting to survey every student enrolled in these schools. From a sampling frame of 1,258 high schools, 108 schools were sampled. Three schools were ineligible to participate based on pre-established exclusion criteria. Of the 105 eligible high schools, seven refused the request to survey students, and 16 permitted surveys only with a subset of enrolled sophomores (either in classes or by mail). We restrict our sample to the 82 Texas high schools where the baseline paper and pencil surveys were administered to all sophomores. In these high schools, more than 80 percent of enrolled sophomores completed the spring 2002 baseline survey. Diagnostic analyses confirm that this subset of high schools is representative of the state’s public high schools in 2002.

Two years later, in the spring of 2004, a random subsample of the baseline sophomore respondents was re-interviewed when the majority was in their senior year of school. From a random sample of over 11,000 baseline respondents, 8,416 were screened for their high school status during the spring of their senior year, while 2,879 were unavailable for screening. Fewer than 5 percent of the screener respondents refused to participate. Figure 1 summarizes the design of the sophomore cohort samples.
For the 8,416 students screened for a wave 2 interview, we have a direct measure of senior-year academic status. We classify students who left high school between their sophomore and senior years as “dropouts,” students who remained enrolled at their sophomore-year school as “persisters,” and students who left their sophomore school but remain enrolled at another school as “movers.”

For each of the 82 schools in our analysis sample, we use these senior-year academic status data to calculate 10th-to-12th grade persistence rates, which measure the proportion of 10th graders who are enrolled in high school two years later. These longitudinal persistence rates provide a unique opportunity to examine both the accuracy and precision of Texas high school-level graduation rates. Persistence rates do not account for students who drop out of high school before the 10th grade or after the spring of the 12th grade, but they provide a reliable proxy for high school graduation rates. We define the school-specific persistence rate as:

$$1 - \frac{D}{D + P}$$

where D equals the number of sampled sophomores classified as dropouts based on their wave 2 response, and P equals the number of sampled sophomores classified as persisters.

If the THEOP data included every sophomore enrolled at these 82 high schools at both points in time, the persistence measure for each school would be both accurate and precise. As occurs in all cohort-based longitudinal studies, however, sample attrition may undermine the validity of persistence rates based on such data. If students who did not participate in either of the two waves are less likely to persist in high school compared
with students who did participate, our calculations may overstate persistence in the THEOP high schools. Although sample attrition rates do not vary substantially from school to school, survey non-response could potentially undermine the precision of our estimates of high school persistence, particularly if rates of non-response were elevated in schools with low persistence rates. Therefore, correct for school-specific non-response bias our calculated persistence rates using the procedures detailed below.

**Weighting THEOP school graduation rates for W1 non-response**

Table 2 provides a descriptive summary of the students who participated in the baseline sample. The gender, race/ethnicity, and parental education distribution of the baseline sample matches closely with the distribution of Texas public high school students, although there is some item non-response in each of these attributes. The class-rank distribution of Wave 1 responders indicates that nearly 12 percent of the responders were in the top decile of their high school class, while just 2 percent were in the bottom decile. In large part, this data discrepancy is likely due to the tendency of students to exaggerate their high school class rank. It is also conceivable that low-performing students may be under-represented in the baseline sample, raising concerns about nonrandom survey non-response.

Table 2 About Here

Although the baseline survey attempted to survey all sophomores enrolled in sampled high schools, we lack data for approximately 20 percent of the sophomores enrolled in the sample of 82 public high schools. Some of these students were absent from school on the day the survey was administered. Because absenteeism is closely
related to dropping out of high school (Finn 1989, Rumberger 2001), these missing students likely have a higher dropout rate than students who participated in the survey.

Therefore, we correct the THEOP school-level persistence rates for survey non-participation using data from the Education Longitudinal Survey (ELS). This contemporaneous longitudinal study provides two valuable pieces of information for these purposes: (a) the marginal distribution of the number of days missed in a year by 10th graders in Southern public high schools and (b) the conditional distribution of dropout rates by number of days missed. We used the marginal distribution of days missed to estimate the relative likelihood that students who did not participate in the baseline survey were absent 1-2 days, 3-6 days, 7-9 days or 10 or more days, assuming that the absentee rate at the 82 Texas high schools in our analysis sample mirrors that of the Southern public high schools in the ELS sample. Subsequently we used ELS data on student persistence to weight the estimated distribution of absent THEOP students by their odds of dropping out of school.

The ELS data for 10th graders in Southern public schools suggest that approximately 13.5 percent of Wave 1 non-respondents dropped out of high school between 10th and 12th grade. Therefore, we correct 10th-to-12th grade persistence rates for the 82 THEOP high schools for Wave 1 non-response, assuming that 13.5 percent of non-responders were dropouts and that the remaining 86.5 percent persisted through 12th Grade. Appendix B summarizes the ELS data and our calculations based on these data.

**Multiple imputation for W2 non-response**

A comparison of the first two columns of Table 2 indicates that the students randomly sampled to participate in Wave 2 closely match the students who participated
in the baseline on gender, race/ethnicity, parental education, and class rank. Of the 11,295 students sampled to participate in Wave 2, we were unable to screen 2,879. If these students are a random sample of all sophomores, missing data would not bias our estimates of 10th-to-12th grade persistence rates. This condition is not satisfied, as the third and fourth columns of Table 2 demonstrate. Students with relatively low levels of parental education and students with low class rank are particularly over-represented among Wave 2 non-responders. National longitudinal studies indicate that students with these characteristics have relatively high rates of high school non-completion (Rumberger 2001). A comparison of the descriptive statistics for THEOP Wave 2 responders confirms that this pattern holds in Texas high schools as well. Therefore, failing to account for Wave 2 non-response would overstate 10th-to-12th grade student persistence rates in the sampled high schools.

We use a multiple imputation (MI) strategy to predict the high school status value for the 2,879 students who participated in the baseline study but not the Wave 2 follow-up. To generate valid standard error estimates when the percent of missing data are large, we produce 10 imputed values for each missing case and compute confidence intervals that are wider than those derived from sampling error. In so doing, we explicitly account for the uncertainty that stems from non-response (Rubin 1987; Schafer 1997; Collins, Kam, and Schafer 2001).

The first step entails defining an imputation model using students’ baseline characteristics to generate multiple predictions of their missing Wave 2 high school status values. Based on the extensive literature documenting the predictors of high school dropout (Lee and Burkham 2000, Rumberger 2001), our imputation model includes
student background characteristics, baseline measures of students’ academic success and school engagement, and various school-level measures. Table 3 summarizes the covariates used in the multiple imputation strategy.

Table 3 About Here

The imputation was conducted using the software package IVEWare (Raghunathan, Solenberger and Van Hoewyk 2002), which implements a sequential regression imputation approach (Raghunathan et al. 2001). The imputation model treats students’ high school enrollment status as a polytomous dependent variable, using the baseline data to classify students who are missing Wave 2 data as dropouts, persisters, or movers. We ran ten parallel independent chains with different starting values and took a draw of imputed values when the chain had converged to a posterior.

In the ten resulting datasets, we aggregated data to generate a school-level 10th-to-12th grade dropout count for each of the 82 participating high schools. To do so, we combined students who reported that they dropped out of high school between 10th and 12th grade from each of the 82 sampled high schools with respondents assigned the dropout value in the multiple imputation process. We averaged these ten dropout estimates across the ten imputations, computing within-imputation variance by averaging across the ten standard errors, and also computed the between-imputation variance across the ten imputed datasets. The MI variance is a weighted sum of the within-imputation and between-imputation variance. We apply a finite population correction factor to the total variance term, because the sophomore survey follows up with a large fraction of the
school students. The square root of the adjusted MI variance is the standard error used to compute confidence intervals for the school-level persistence rate.

For each of the 82 Texas public high schools in our analysis sample, therefore, we have a 10th-to-12th grade persistence rate that is based on longitudinal data from a sample sophomores as of spring, 2002. By comparing THEOP longitudinal persistence rates with official TEA graduation rates for these schools as well as persistence rates derived from CCD data, we assess the validity of these more widely-available rates.

**TEA and CCD graduation and persistence rates**

Official TEA completion rates are based on the “leaver records” that Texas public high schools report annually to the TEA, classifying each student who is no longer enrolled in the high school as a diploma recipient, GED recipient, dropout, or high school transfer. For each of the schools analyzed, the rates represent the proportion of 9th graders enrolled in 1999-2000 who had either graduated, earned a GED, or remained enrolled as of spring, 2004. Students who transfer into Texas public high schools during this time period are included in their destination-school’s completion rate, but students who transfer out of Texas public high schools are excluded from the rate (TEA 2006). As the Houston Independent School District audit revealed, the validity of the TEA completion rate hinges on the quality of school leaver reports. If dropouts are misclassified as transfers, completion rates will be artificially high.

In addition, we compare the THEOP longitudinal persistence rates against two persistence rates derived from the CCD. First, we adopt the Basic Graduation Rate formula to calculate Basic Persistence Rates for each of the 82 high schools. This rate is defined as the ratio of 12th graders enrolled in each school in 2004 by the number of 10th
graders enrolled in 2002 (refer to Appendix A for detailed formulas). Second, we adopt the Cumulative Promotion Index formula to calculate a 10th-to-12th Grade CPI. In rare occasions, these formulae return out-of-range values. We set school BPR or CPI values to missing if a school has a value of greater than 100 percent or less than 60 percent in the analyses that follow.\textsuperscript{10} Of the 82 schools that participated in the THEOP study, 72 have valid Basic Persistence Rate values; 69 have valid 10th-to-12th grade Cumulative Promotion Index (CPI) values.

IV. Findings

Table 4 compares the longitudinal 10th-to-12th grade persistence rate for students attending the 82 Texas public high schools in the THEOP study with official TEA graduation rates and both the basic persistence rate and the cumulative promotion index. These measures are also reported for all Texas public high schools as of 2004. We also estimate the 10th to 12th grade persistence rate for a sample of public high schools in the U.S. South.

Adjusted for W1 and W2 non-response, the longitudinal THEOP data indicate that 93 percent of the 10th graders attending these 82 schools remained enrolled in high school 2 years later. This estimated rate closely matches the 91 percent persistence rate for ELS respondents from public high schools in the U.S. South, which provides external validity for the THEOP estimate. The small difference likely reflect differences in mandatory enrollment laws: specifically Texas’s mandatory laws make withdrawal prior to age 17 difficult, but most other southern states permit students to withdraw at age 16.
We would expect the THEOP persistence rate to be higher than the official TEA graduation rate because many students withdraw before 10th grade and during their senior year. The THEOP study does not provide data for students who left high school before 10th grade or after the spring of 12th grade, but these dropouts should be counted in the TEA rate. As Table 4 indicates, however, the average THEOP persistence rate for the 82 sampled schools is nearly identical to the average TEA graduation rate for these schools. By contrast, although they were calculated to match the THEOP rate, the persistence rates based on school enrollment data are substantially lower. Assuming no net migration at participating high schools, the BPR suggests that 81.5 percent of the students in these high schools remained enrolled between 10th and 12th grades; the CPI yields a retention rate of 81.4 percent. Thus, rates for the sampled high schools presented in Table 4 indicate that neither the official TEA graduation rates nor enrollment-based estimates of high school persistence are accurate.

Comparisons of school-specific rates

As argued above, measurement reliability should be the paramount concern for researchers and policy-makers interested in designing and assessing interventions to reduce the incidence of high school dropout, especially in light of NCLB accountability requirements. Therefore, we turn to this issue in the remainder of the paper.

Figure 2 graphs the level of agreement between the school-specific THEOP persistence rate and each of three commonly used measures: the official TEA graduation rate, the Basic Persistence Rate and the Cumulative Promotion Index based on the Common Core Data for the 20 largest high schools in the THEOP study. These large high
schools provide sufficient cases to predict graduation rates with relatively high levels of confidence. Schools are sorted by their THEOP persistence rate, with highest persistence rates on the left and lowest rates on the right. Table 5 reports the same plotted estimates for each of the 20 largest THEOP high schools in tabular form, along with confidence intervals for the THEOP persistence measures and the minority composition and economic status of the campuses.

Consistent with the summary statistics presented in Table 4, these school-specific comparisons show that the official TEA graduation rates are comparable in magnitude to the THEOP persistence rates, while the rates based on the CCD generally are considerably lower. The official TEA graduation rate falls within the confidence interval for 12 of the 20 school profiled in Table 5. There is no consistent pattern of bias for the schools in which the TEA estimate is outside of the THEOP estimate; in four of these cases the TEA rate is higher than the THEOP rate, in four cases it is lower. By contrast, the persistence rates estimated from school enrollment data are consistently lower than the longitudinal persistence rate. Only two of the largest 20 high schools report BPR values within the THEOP rate’s confidence interval. Likewise, only the only two schools report CPI values within the THEOP rate’s confidence intervals. In one instance the CPI estimate is higher than the THEOP rate, but in all other cases both rates estimated from the Common Core Data are well below the longitudinal THEOP rate.

Despite the apparent similarly between the official TEA graduation rate and the THEOP persistence rate, the trend lines represented in Figure 2a show that the TEA does
not align perfectly with the THEOP persistence rate across the 20 schools. The THEOP rate falls across schools positioned from left to right in Figure 2, while the TEA rates fluctuate around a relatively flat trend line. Figure 2a suggests that TEA graduation statistics tend to under-state the degree of between-school variation in persistence rates, perhaps because schools with relatively low persistence and graduation rates are more likely to report flawed dropout data to the TEA.

By comparison, the BPR and the CPI measures (Figures 2b and 2c, respectively) seem to more reliably capture the between-school differences in measured persistence rates. The BPR trend line falls sharply from left to right, indicating that this enrollment-based persistence measure exaggerates the degree of variation between schools with relatively high persistence rates and schools with relatively low persistence rates. By contrast, the CPI trend line is nearly parallel to the THEOP trend line, suggesting a close correspondence between these two rates. A closer inspection of the school-specific rates reveals that the CPI values for individual schools fluctuate widely around the CPI trend line.

In addition to providing a tabular representation of the data represented in Figure 2, Table 5 presents basic demographic data for each of the 20 largest THEOP high schools. The results reported here indicate a clear negative relationship between measured persistence rates and both the concentration of black and Hispanic students and the concentration of students who were ever economically disadvantaged. Overall, schools where the longitudinal THEOP persistence rates are high tend to enroll relatively few black, Hispanic, or economically disadvantaged students, while the minority and poor student enrollment rates are relatively high in schools with low persistence rates.
**Regression validation**

A regression analysis allows a more rigorous assessment of how well these three estimates correlate with the longitudinal THEOP persistence rate. Table 6 presents several OLS regression analyses that regress the TEA graduation rate, the BPR, and the 10th-to-12th grade CPI on the THEOP persistence rate for all 82 Texas public high schools. Each of these models takes the following functional form:

\[ Y = a + bX + u \]

where \( Y \) is the longitudinally observed THEOP persistence rate; \( a \) is the intercept, \( b \) is the slope, and \( X \) is the estimated graduation or persistence rate under consideration. In each of these models, all variables are standardized as z-scores, with a mean of zero and unit standard deviation.

Combined, the intercept and the slope in the regression models capture the bias and variance in the three cross-sectional rates with respect to the longitudinal THEOP persistence rate. Our interpretations assume that the longitudinal THEOP persistence rate is unbiased and its distribution approximately captures between-school variance. Therefore, the intercept reflects both the magnitude and direction of the bias in the estimated measure for schools at the middle of the THEOP persistence rate distribution. An intercept of zero indicates that the estimated rate is an unbiased reflection of the THEOP rate for the average high school. The slope represents the variance in the estimated rate relative to the variance in the THEOP rates for the sample of 82 schools. A slope of one indicates that a standard deviation difference in the estimated persistence rate is associated with a one standard deviation difference in the THEOP rate. The R-square statistic indicates the degree of agreement between the THEOP rate and the
estimated rate across schools. Specifically, an R-squared value of 1.0 indicates that the estimated rate does just as well as the THEOP persistence rates.

Panel A summarizes the bivariate association between the THEOP persistence rate and the three persistence measures based on school enrollment data. The first column of panel A, which reports estimates from regressing the TEA graduation rate on the THEOP persistence rate, reveals that the TEA rate is fairly accurate, but not particularly precise. The intercept is not statistically significant, indicating that for schools with THEOP persistence rates near the sample mean, the TEA rate is unbiased. The coefficient for the THEOP rate, which is positive and statistically significant (b=.49), indicates that a unit standard deviation increase in THEOP persistence is associated with half a standard rise in the official TEA graduation rate. Consistent with Figure 2, the slope suggests that the TEA rate is less variable than the THEOP longitudinal persistence rate; thus, the TEA graduation rate under-states between-school differences in persistence. Finally, the R-squared statistic shows that the TEA rate captures just one-fifth of the school-level variation in the THEOP persistence rate.

The second column in Panel A summarizes the fit between the BPR and the THEOP persistence rate. The small and statistically insignificant intercept (a=.02), indicates that the BPR is unbiased for schools whose THEOP persistence rate is near the mean. Furthermore, a unit standard deviation difference is a school’s THEOP persistence rate is associated with a .78 standard deviation difference in the school’s BPR values. The R-squared value .36 reveals a stronger association between the BPR and the THEOP rate
compared with the association between the TEA graduation rate and the THEOP persistence rate.

Finally, the third column of Table 5 summarizes the fit between the THEOP persistence rate and the 10th-to-12th cumulative promotion index. That the intercept is not significantly different from zero (a=.087), indicates that CPI is not substantially biased for schools near the mean of the THEOP persistence rate. However, the relatively flat slope in this model (b=.407) suggests that the CPI substantially underestimates the differences between schools with high and low persistence rates. Furthermore, the school-level agreement between the CPI persistence measure and the longitudinal THEOP persistence rate is noisy, as revealed by the low R-squared value of .14.

Overall, the results presented in Panel A of Table 6 should give pause to researchers and policy-makers who utilize these or similar enrollment-based measures of high school graduation and persistence. No empirical threshold exists to distinguish between a precise and an imprecise measure, but the three most commonly used measures for high school level data are disturbingly imprecise. The most precise of the measures examined in Table 6, the BPR, captures less than two-fifths of the between-school variance in persistence rates, and other widely used persistence and graduation measures are even less precise. This finding suggests that school accountability programs or research designs that require distinctions between schools with relatively high and low persistence or graduation rates will be fraught with error, regardless of the measure utilized. Nonetheless, Table 6 suggests that the BPR is the most useful of the currently-available rates for tracking improvements in student persistence through high school.
Furthermore, as the results reported in Panel B of Table 6 show, each of these three widely-used high school persistence measures render especially biased estimates for schools with high concentrations of black and Hispanic students. These models add a standardized measure of the minority composition of high schools’ 10th grade classes in 2002, to the bivariate models summarized in Panel A. This covariate does not attain statistical significance in any of the three models, its value in the BPR model \(c=-0.187\) and in the CPI model \(c=-0.130\) suggests that both measure substantially underestimate persistence rates in schools with large concentrations of black and Hispanic students.\(^{11}\)

The negative coefficients for minority enrollment and student poverty in the BPR models are worrisome because they suggest that this measure attributes lower persistence rates to high-minority schools than they actually warrant. Several explanations for these negative biases are plausible. If high minority and high poverty schools have higher rates of grade retention between the 10th and 12th grade, then the BPR would underestimate persistence rates in these schools. Likewise, if students are more likely to move out of schools with high minority and poor-student enrollment, the BPR would underestimate persistence rates in these schools. Regardless of the explanation, unless researchers and policy-makers acknowledge and develop strategies to control for these biases, they fundamentally undermine the validity of the widely used BPR metric.

In panels C and D of Table 6 we use polynomial terms to determine whether the fit between THEOP persistence rates and the estimated rates is nonlinear. Although the quadratic term does not reach statistical significance in any of these models, there is some evidence that the relationship between the BPR and the THEOP persistence rate is
nonlinear. The THEOP squared term in this model is relatively large and positive (c=.117); including the quadratic raises the model R-square from .356 to .365.

The addition of a cubic term to these models further clarifies the nature of the association between the THEOP persistence rate and the three estimated rates. The THEOP-cubed term reported in Panel D is large, negative and statistically significant for the TEA estimate (c=-.144), but fails to reach statistical significance in both the BPR model (c=-.102) and the CPI model (-.107). Inclusion of the cubic term also improves the R-squared value for each of these models and boosts the slope of the THEOP persistence rate. The cubic term is particularly informative in the BPR model, where the THEOP persistence rate slope rises from .784 to .981. This change suggests that the BPR matches the THEOP persistence rate relatively closely at schools where the persistence rate is near the mean, but that it is positively biased for schools with low persistence rates and negatively biased for schools with high persistence rates.

V. Conclusion

In order to fairly enforce school accountability policies and to assess the effects that school organization and policy interventions have on students’ odds of graduation, it is necessary to measure graduation and persistence rates accurately and precisely. Our findings suggest the data that states and the federal government currently collect to measure high school persistence and graduation rates are not up to the task. The persistence and graduation rates currently reported by most public high schools are neither accurate nor precise.
The mean official graduation rate across the 82 Texas public high schools participating in the THEOP study was nearly identical to the mean longitudinally observed 10th-to-12th grade persistence rate across these schools. Nonetheless, these official rates should be used with caution. We expected our longitudinal 10th-to-12th grade persistence rate to be somewhat higher than the official TEA graduation rate, because the latter includes withdrawals before the spring of 10th grade or after the spring of 12th grade. Because often this is not the case, we suspect that the official graduation rates are artificially high for many high schools. Furthermore, the official TEA graduation rate is a highly imprecise measure of high school persistence, capturing just 21 percent of the between-school variation in longitudinally-observed persistence. School-by-school analyses reveal that the official Texas graduation rate is biased upward in high schools that have relatively low longitudinal persistence rates. This finding is consistent with allegations that Texas high schools systematically misreport high school dropouts to avoid sanction under the state’s school accountability policies.

We are, of course, not the first to notice the shortcomings associated with school-reported graduation rates. In recent years researchers have proposed several techniques for estimating high school graduation and persistence rates based on publically available school enrollment data. Our analyses of accuracy and precision reveal that none of the measures we evaluate yields accurate or reliable estimates of school level persistence rates.

We conclude that the CPI technique yields particularly biased estimates. School persistence rates as estimated by the CPI are consistently lower than the longitudinal THEOP persistence rate. The CPI underestimates the variation between schools on the
longitudinal THEOP persistence rate, and the CPI is extremely imprecise, capturing just 14 percent of the between-school variance in longitudinally observed 10th-to-12th grade persistence. By comparison, the BPR is considerably more precise as a measure of high school persistence. In the Texas high schools that we studied, the BPR captured 36 percent of the between-school variance in 10th-to-12th grade persistence. Across the 72 Texas high schools for which we have both longitudinally observed persistence rates and in-range BPR values, a unit standard deviation difference in THEOP persistence is associated with a .80 standard deviation difference in BPR. Furthermore, our polynomial models reveal that the BPR is a reliable measure of persistence rates for schools situated in the middle of the longitudinally-observed persistence rate distribution.

Therefore, although this measure remains highly imprecise, we believe that the Basic Persistence Rate is the best available option for measuring students’ progress through U.S. public high schools. Still, we caution that this measure must be used with a great deal of care, because the BPR exaggerates dropout rates in schools with high concentrations of minority students. Analysts and policy-makers should consider school racial composition when they utilize the Basic Persistence Rate. Furthermore, even though the BPR tracks relatively closely to the longitudinally observed persistence rate for modal high schools, it is an unreliable indicator in schools at the high and low ends of the persistence distribution.

As accountability measures take hold in American educational policy, development of accurate and precise measures of school-specific student graduation rates becomes imperative. In the short-term, school-level enrollment data collected in the CCD would be considerably more useful if schools were asked to provide a count of first-time
9th graders. Such a count would allow researchers to calculate a version of the BPR that includes 9th graders, while avoiding the biases caused by high rates of retention in the 9th grade. In the longer-term, however, there is no substitute for longitudinal data that tracks students over time and across schools and districts. Without such longitudinal data, high school graduation rate estimates will inevitably be biased by student retention, transfer, and school misreporting. Researchers currently have cohort-based longitudinal data for a small number of U.S. students through national studies such as the ELS and local studies such as THEOP. But in order to accurately and precisely measure the proportion of students in all U.S. public high schools that earn high school diplomas, expansion of longitudinal student tracking systems that cover all students (or at least a sizeable random sample of students at all schools) is a necessary adjunct for evaluating the success of NCLB.
References:


Table 1: Recent Estimates of US High School Graduation and Persistence Rates

<table>
<thead>
<tr>
<th>Source</th>
<th>All Students</th>
<th>White</th>
<th>Black</th>
<th>Hispanic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Census household survey, ages 25-29</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Census IPUMS 5% Sample, excluding recent immigrants (2000)a</td>
<td>87.8</td>
<td>91.2</td>
<td>81.4</td>
<td>72.9</td>
</tr>
<tr>
<td><strong>Public high school administrative data</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic Graduation Rate (CCD, Class of 2004)b</td>
<td>68.6</td>
<td>75.7</td>
<td>49.5</td>
<td>54.2</td>
</tr>
<tr>
<td>Average Freshman Graduation Rate (CCD, Class of 2004)c</td>
<td>74.3</td>
<td>80.1</td>
<td>57.6</td>
<td>62.1</td>
</tr>
<tr>
<td>Cumulative Promotion Index (CCD, Class of 2003)d</td>
<td>69.6</td>
<td>76.2</td>
<td>51.6</td>
<td>55.6</td>
</tr>
<tr>
<td><strong>Longitudinal survey data, diplomas only</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>National Education Longitudinal Survey (Class of 1992)c</td>
<td>83.0</td>
<td>85.5</td>
<td>74.4</td>
<td>73.7</td>
</tr>
<tr>
<td>National Longitudinal Survey of Youth 1997, ages 20-22f</td>
<td>82.2</td>
<td>85.1</td>
<td>74.5</td>
<td>76.4</td>
</tr>
</tbody>
</table>

a % of 25-29 year olds who report a high school degree (including a GED). Sample includes military and institutional population; sample excludes people who immigrated within 15 years (Mishel and Roy 2006, p. 40).
b BGR=# diplomas (2003-2004)/#9th (2000-01); derived from CCD.
e % of NELS respondents who held a high school diploma (transcript-verified, excluding GED) in 2000 (Mishel and Roy 2006, p. 17).
f % of NLSY respondents who held a high school diploma (excluding GED) at age 20-22 (Mishel and Roy 2006, p. 19).
Table 2: Comparison of 2002 Sophomores Baseline and W2 screener by enrollment status (in percent)

<table>
<thead>
<tr>
<th>Gender</th>
<th>Baseline Sample</th>
<th>W2 screen Sample</th>
<th>W2 screened</th>
<th>W2 not screened</th>
<th>W2 screened only</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>43.71</td>
<td>43.70</td>
<td>42.87</td>
<td>46.13</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>47.19</td>
<td>49.81</td>
<td>51.30</td>
<td>45.47</td>
</tr>
<tr>
<td></td>
<td>Missing</td>
<td>9.09</td>
<td>6.49</td>
<td>5.83</td>
<td>8.41</td>
</tr>
<tr>
<td>Race/Ethnicity</td>
<td>White</td>
<td>36.82</td>
<td>36.76</td>
<td>38.52</td>
<td>31.61</td>
</tr>
<tr>
<td></td>
<td>Afro-American/Black</td>
<td>11.66</td>
<td>12.82</td>
<td>11.52</td>
<td>16.43</td>
</tr>
<tr>
<td></td>
<td>Hispanic</td>
<td>34.45</td>
<td>34.24</td>
<td>34.62</td>
<td>33.10</td>
</tr>
<tr>
<td></td>
<td>Asian/Pacific Islander</td>
<td>3.53</td>
<td>5.18</td>
<td>5.23</td>
<td>5.04</td>
</tr>
<tr>
<td></td>
<td>Native American/Other</td>
<td>4.10</td>
<td>4.06</td>
<td>3.77</td>
<td>4.93</td>
</tr>
<tr>
<td></td>
<td>Missing</td>
<td>9.93</td>
<td>6.94</td>
<td>6.27</td>
<td>8.89</td>
</tr>
<tr>
<td>Parents' highest degree</td>
<td>Less than High School</td>
<td>12.25</td>
<td>12.41</td>
<td>12.25</td>
<td>12.89</td>
</tr>
<tr>
<td></td>
<td>High School</td>
<td>16.04</td>
<td>17.47</td>
<td>16.36</td>
<td>20.7</td>
</tr>
<tr>
<td></td>
<td>Some College</td>
<td>18.52</td>
<td>19.61</td>
<td>19.81</td>
<td>19.03</td>
</tr>
<tr>
<td></td>
<td>Four-year college+</td>
<td>30.25</td>
<td>30.63</td>
<td>32.96</td>
<td>23.83</td>
</tr>
<tr>
<td>Class rank (self-report)</td>
<td>Top 10%</td>
<td>11.91</td>
<td>12.83</td>
<td>14.77</td>
<td>7.16</td>
</tr>
<tr>
<td></td>
<td>10-50%</td>
<td>48.39</td>
<td>49.19</td>
<td>50.34</td>
<td>45.81</td>
</tr>
<tr>
<td></td>
<td>50-90%</td>
<td>28.25</td>
<td>28.31</td>
<td>26.35</td>
<td>34.00</td>
</tr>
<tr>
<td></td>
<td>Bottom 10%</td>
<td>2.35</td>
<td>1.92</td>
<td>1.50</td>
<td>3.16</td>
</tr>
<tr>
<td></td>
<td>Missing</td>
<td>9.1</td>
<td>7.76</td>
<td>7.03</td>
<td>9.86</td>
</tr>
</tbody>
</table>

| Number of cases | 19,969 | 11,295 | 8,416 | 2,879 | 7,413 | 738 | 265 |

Source: THEOP Sophomore Surveys
Table 3: Variables employed in imputation model

<table>
<thead>
<tr>
<th>Demographic/background</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
</tr>
<tr>
<td>Race/ethnicity</td>
</tr>
<tr>
<td>Family composition</td>
</tr>
<tr>
<td>Mother’s and father’s educational attainment</td>
</tr>
<tr>
<td># of residence changes since beginning of school</td>
</tr>
<tr>
<td>Language spoken at home</td>
</tr>
<tr>
<td>Student academic engagement</td>
</tr>
<tr>
<td>Class rank</td>
</tr>
<tr>
<td>Educational aspirations</td>
</tr>
<tr>
<td>Timing of first thoughts about enrolling college</td>
</tr>
<tr>
<td>Age/grade delay (proxy for grade retention history)</td>
</tr>
<tr>
<td>Parental academic involvement scale</td>
</tr>
<tr>
<td>Peer academic support and encouragement scale</td>
</tr>
<tr>
<td>Perceptions about factors in college admissions</td>
</tr>
<tr>
<td>How often encouraged by parents to attend college?</td>
</tr>
<tr>
<td>How often encouraged by teachers to attend college?</td>
</tr>
<tr>
<td>How often encouraged by counselors to attend college?</td>
</tr>
<tr>
<td>School characteristics</td>
</tr>
<tr>
<td>% students economically disadvantaged</td>
</tr>
<tr>
<td>% students encouraged by teacher or counselor to attend college</td>
</tr>
<tr>
<td>% of students who passed algebra</td>
</tr>
<tr>
<td>% of students who have college plans</td>
</tr>
<tr>
<td>% students African American</td>
</tr>
<tr>
<td>% students Hispanic</td>
</tr>
<tr>
<td>Total school enrollment</td>
</tr>
</tbody>
</table>

Source: THEOP Baseline and TEA school reports.
<table>
<thead>
<tr>
<th>THEOP Schools</th>
<th>Persistence rate estimate</th>
<th>Standard deviation</th>
<th>N schools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Persistence rate</td>
<td>92.6</td>
<td>2.8</td>
<td>82</td>
</tr>
<tr>
<td>(92.1-93.1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Official graduation rate (TEA, Class of 2004)</td>
<td>92.6</td>
<td>4.0</td>
<td>82</td>
</tr>
<tr>
<td>Basic persistence rate 10-12 (CCD, Class of 2004)</td>
<td>81.5</td>
<td>9.9</td>
<td>72</td>
</tr>
<tr>
<td>Cumulative promotion index 10-12 (CCD, Class of 2004)</td>
<td>81.4</td>
<td>9.1</td>
<td>69</td>
</tr>
<tr>
<td>Southern High Schools</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ELS, public schools in US south</td>
<td>90.6</td>
<td></td>
<td>228</td>
</tr>
<tr>
<td>(89.7-91.5)</td>
<td></td>
<td>(N students= 4,297)</td>
<td></td>
</tr>
<tr>
<td>Texas Public High Schools</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Official graduation rate (TEA, Class of 2004)</td>
<td>92.7</td>
<td>4.91</td>
<td>1250</td>
</tr>
<tr>
<td>Basic persistence rate 10-12 (CCD, Class of 2004)</td>
<td>82.3</td>
<td>8.9</td>
<td>1098</td>
</tr>
<tr>
<td>Cumulative promotion index 10-12 (CCD, Class of 2004)</td>
<td>81.4</td>
<td>8.8</td>
<td>1072</td>
</tr>
</tbody>
</table>

*MI confidence interval accounts for sampling error and non-response uncertainty

a ELS used a multi-stage sampling scheme, drawing a probability proportional to size sample of U.S. high schools, and then drawing a sample of approximately 26 students within these high schools. The ELS data reported here include public school students enrolled in public schools in Alabama, Arkansas, Delaware, the District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia. The ELS results are weighted for design effects and non-response using fiplnlwt and Taylor series adjustments.

Sources: Texas Higher Education Opportunity Project baseline and follow-up surveys; NCES Common Core of Data 2002-2004; NCES Education Longitudinal Study 2002, baseline and follow-up surveys; Texas Education Agency school reports 2004.
Table 5: 10th to 12th Grade persistence rates and school characteristics for 20 large Texas public high schools

<table>
<thead>
<tr>
<th></th>
<th>THEOP persistence rate</th>
<th>THEOP persistence confidence interval</th>
<th>Official TEA completion rate</th>
<th>Basic persistence rate</th>
<th>Cumulative promotion index (10-12)</th>
<th>% black or Hispanic</th>
<th>Economically disadvantaged</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>98.9</td>
<td>96.1-100.0</td>
<td>95.6</td>
<td>--</td>
<td>84.6</td>
<td>15.8</td>
<td>9.0</td>
</tr>
<tr>
<td>2</td>
<td>96.8</td>
<td>94.5-99.2</td>
<td>96.4</td>
<td>97.7</td>
<td>98.2</td>
<td>28.4</td>
<td>18.9</td>
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<tr>
<td>3</td>
<td>96.2</td>
<td>93.2-99.2</td>
<td>91.9</td>
<td>92.9</td>
<td>85.1</td>
<td>23.4</td>
<td>10.2</td>
</tr>
<tr>
<td>4</td>
<td>95.7</td>
<td>94.2-97.1</td>
<td>95.8</td>
<td>84.4</td>
<td>83.8</td>
<td>45.5</td>
<td>32.3</td>
</tr>
<tr>
<td>5</td>
<td>95.2</td>
<td>90.7-99.8</td>
<td>94.0</td>
<td>85.3</td>
<td>83.6</td>
<td>33.3</td>
<td>29.1</td>
</tr>
<tr>
<td>6</td>
<td>94.2</td>
<td>91.0-97.4</td>
<td>95.4</td>
<td>86.3</td>
<td>89.2</td>
<td>41.8</td>
<td>23.8</td>
</tr>
<tr>
<td>7</td>
<td>94.2</td>
<td>92.3-96.0</td>
<td>95.4</td>
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<td>92.1</td>
<td>16.6</td>
<td>9.1</td>
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<tr>
<td>8</td>
<td>94.2</td>
<td>92.0-96.2</td>
<td>95.7</td>
<td>84.0</td>
<td>81.6</td>
<td>95.6</td>
<td>74.2</td>
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<tr>
<td>9</td>
<td>93.6</td>
<td>90.8-96.4</td>
<td>90.8</td>
<td>95.3</td>
<td>84.1</td>
<td>37.4</td>
<td>27.6</td>
</tr>
<tr>
<td>10</td>
<td>93.4</td>
<td>92.6-94.3</td>
<td>94.3</td>
<td>74.7</td>
<td>80.9</td>
<td>77.3</td>
<td>58.6</td>
</tr>
<tr>
<td>11</td>
<td>93.1</td>
<td>90.3-96.0</td>
<td>92.9</td>
<td>76.3</td>
<td>74.7</td>
<td>33.4</td>
<td>29.9</td>
</tr>
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<td>12</td>
<td>93.1</td>
<td>90.3-95.8</td>
<td>92.8</td>
<td>82.6</td>
<td>91.8</td>
<td>45.7</td>
<td>45.9</td>
</tr>
<tr>
<td>13</td>
<td>93.0</td>
<td>91.6-94.4</td>
<td>91.7</td>
<td>82.6</td>
<td>80.9</td>
<td>93.1</td>
<td>71.6</td>
</tr>
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<td>91.7</td>
<td>90.6-92.7</td>
<td>95.7</td>
<td>83.9</td>
<td>82.5</td>
<td>94.7</td>
<td>63.9</td>
</tr>
<tr>
<td>15</td>
<td>91.6</td>
<td>89.8-93.4</td>
<td>92.3</td>
<td>--</td>
<td>--</td>
<td>27.0</td>
<td>31.3</td>
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<tr>
<td>16</td>
<td>91.5</td>
<td>89.8-93.3</td>
<td>87.6</td>
<td>85.8</td>
<td>88.4</td>
<td>45.8</td>
<td>37.8</td>
</tr>
<tr>
<td>17</td>
<td>91.4</td>
<td>90.6-92.2</td>
<td>91.1</td>
<td>67.5</td>
<td>62.1</td>
<td>43.2</td>
<td>47.3</td>
</tr>
<tr>
<td>18</td>
<td>91.4</td>
<td>89.8-93.0</td>
<td>95.5</td>
<td>--</td>
<td>84.1</td>
<td>95.9</td>
<td>80.7</td>
</tr>
<tr>
<td>19</td>
<td>89.8</td>
<td>88.2-91.4</td>
<td>86.9</td>
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<td>69.5</td>
<td>69.7</td>
<td>46.6</td>
</tr>
<tr>
<td>20</td>
<td>89.0</td>
<td>88.0-90.0</td>
<td>96.8</td>
<td>82.2</td>
<td>95.8</td>
<td>97.5</td>
<td>92.1</td>
</tr>
</tbody>
</table>

Sources: Texas Higher Education Opportunity Project baseline and follow-up surveys; Texas Education Agency school reports (2004); NCES Common Core of Data 2002-2004.
Table 6: Standardized regression coefficients comparing three persistence rate estimates with longitudinally observed persistence rates in Texas public schools (weighted by 10th grade enrollment, 2002)

<table>
<thead>
<tr>
<th>Measure (Source)</th>
<th>Official graduation (TEA)</th>
<th>Basic persistence (CCD)</th>
<th>Cumulative Promotion 10-12th grade (CCD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. THEOP persistence rate (z-score)</td>
<td>.493***</td>
<td>.784***</td>
<td>.407**</td>
</tr>
<tr>
<td>Constant</td>
<td>-.138</td>
<td>.024</td>
<td>.087</td>
</tr>
<tr>
<td>R-square</td>
<td>.2280</td>
<td>.3555</td>
<td>.1436</td>
</tr>
<tr>
<td>B. THEOP persistence rate (z-score)</td>
<td>.530***</td>
<td>.658***</td>
<td>.318*</td>
</tr>
<tr>
<td>% black or Hispanic (z-score)</td>
<td>.057</td>
<td>-.187</td>
<td>-.130</td>
</tr>
<tr>
<td>Constant</td>
<td>-.153</td>
<td>.068</td>
<td>-.122</td>
</tr>
<tr>
<td>R-square</td>
<td>.2305</td>
<td>.3758</td>
<td>.1549</td>
</tr>
<tr>
<td>C. THEOP persistence rate (z-score)</td>
<td>.498***</td>
<td>.857***</td>
<td>.408**</td>
</tr>
<tr>
<td>(THEOP persistence rate ((z-score))^2</td>
<td>.027</td>
<td>.117</td>
<td>.006</td>
</tr>
<tr>
<td>Constant</td>
<td>-.158</td>
<td>-.038</td>
<td>.082</td>
</tr>
<tr>
<td>R-square</td>
<td>.2290</td>
<td>.3652</td>
<td>.1436</td>
</tr>
<tr>
<td>D. THEOP persistence rate (z-score)</td>
<td>.802***</td>
<td>.981***</td>
<td>.631**</td>
</tr>
<tr>
<td>(THEOP persistence rate ((z-score))^2</td>
<td>-.037</td>
<td>-.012</td>
<td>-.050</td>
</tr>
<tr>
<td>(THEOP persistence rate ((z-score))^3</td>
<td>-.144*</td>
<td>-.102</td>
<td>-.107</td>
</tr>
<tr>
<td>Constant</td>
<td>-.094</td>
<td>.020</td>
<td>.132</td>
</tr>
<tr>
<td>R-square</td>
<td>.2792</td>
<td>.3755</td>
<td>.1685</td>
</tr>
</tbody>
</table>

N= 82  72  69

Note: * p < .05, ** p < .01 and *** p < .001
Sophomore Cohort Baseline
N=19,969

Sample for W2
N=11,295

Screened at W2
N=8,416

Unable to screen at W2
N=2,879

Stayers
N=7,413

Movers
N=738

Drop-outs
N=265

Figure 1: THEOP Sophomore cohort sample.
Figure 2: Persistence rate estimates for 20 large Texas Public high schools

Figure 2a: THEOP persistence rate estimate vs. official TEA graduation rate

Figure 2b: THEOP persistence rate estimate vs. basic persistence rate

Figure 2c: THEOP persistence rate estimate vs. CPI persistence rate
## Appendix A: Measures of high school graduation using high school administrative data

<table>
<thead>
<tr>
<th>Measure</th>
<th>Formula</th>
</tr>
</thead>
</table>
| Basic graduation rate                        | \[
\frac{\# \text{graduates } Y_x}{\# \text{9th graders } Y_{x-3}}
\] |
| Average freshman graduation Rate             | \[
\frac{\# \text{graduates } Y_x}{(\# \text{8th graders } Y_{x-4} + \# \text{9th graders } Y_{x-3} + \# \text{10th graders } Y_{x-2})/3}
\] |
| Cumulative promotion index                   | \[
\left(\frac{\# \text{graduates } Y_x}{\# \text{12th graders } Y_{x-2}}\right) \times \left(\frac{\# \text{12th graders } Y_{x+1}}{\# \text{11th graders } Y_{x-2}}\right) \times \left(\frac{\# \text{11th graders } Y_{x+1}}{\# \text{10th graders } Y_{x-2}}\right) \times \left(\frac{\# \text{10th graders } Y_{x+1}}{\# \text{9th graders } Y_{x-2}}\right)
\] |
| Texas graduation rate                        | \[
\frac{\# \text{graduates } Y_x + \# \text{students still enrolled } Y_x}{\# \text{9th graders } Y_{x-3} \text{ - transfers out + transfers in}}
\] |
| Basic persistence rate (10-12)               | \[
\frac{\# \text{12th graders } Y_x}{\# \text{10th graders } Y_{x-2}}
\] |
| Cumulative promotion index (10-12)           | \[
\left(\frac{\# \text{12th graders } Y_{x+1}}{\# \text{11th graders } Y_{x-2}}\right) \times \left(\frac{\# \text{11th graders } Y_{x+1}}{\# \text{10th graders } Y_{x-2}}\right)
\] |
| THEOP persistence rate (10-12)               | \[
1 - \frac{\left(\# \text{observed dropouts} + \left(\# \text{imputed dropouts}\right) \times \frac{\# \text{10th graders in W2 sample}}{\# \text{W1 non-responders}} \times 0.135}{\text{Total } \# \text{10th graders}^{2002}}\text{ - W1 non-response adjustment}
\] |
Appendix B: Estimating 10th-to-12th grade persistence for Wave 1 non-responders based on ELS respondents from Southern public high schools

<table>
<thead>
<tr>
<th>Column 1: % of all students</th>
<th>Column 2: % absent on given day</th>
<th>Column 3: % dropped out between 10th and 12th grade</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never absent</td>
<td>14.01</td>
<td>0</td>
<td>3.89</td>
</tr>
<tr>
<td>1-2 absences</td>
<td>35.8</td>
<td>13.8</td>
<td>5.02</td>
</tr>
<tr>
<td>3-6 absences</td>
<td>34.4</td>
<td>39.7</td>
<td>8.26</td>
</tr>
<tr>
<td>7-9 absences</td>
<td>9.4</td>
<td>21.7</td>
<td>16.62</td>
</tr>
<tr>
<td>10+ absences</td>
<td>6.5</td>
<td>24.9</td>
<td>29.02</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
<td><strong>100</strong></td>
<td><strong>8.61</strong></td>
</tr>
</tbody>
</table>

Source variables: bys24c (# absence), f1dostat (dropout status), f1pnlwt (weight)

We draw on the descriptive data summarized above from the 2004 senior-year follow-up of the ELS to correct THEOP persistence rates for Wave 1 nonresponse. We weight ELS data on the distribution school absences during student’s sophomore year (reported in Column 1) by students’ relative likelihood of absence on a given day, based on the assumption that students who miss more days in a year are more likely to be absent in a given day. We apply this weighted distribution (reported as the % absent in a given day in Column 2) to the dropout rate for students with different levels of absenteeism (reported in Column 3) to calculate an overall weighted average dropout rate for students absent on the day of Wave 1 survey administration.
The distinction between accuracy and precision can be illustrated with an analogy to an archery target: In this analogy, accuracy refers to how close the arrows are to the target’s bulls eye; precision refers to how closely the arrows cluster to one another. An archer is precise but not accurate if his arrows miss the bulls eye, but hit the target in the same place. Alternatively, an archer is accurate but not precise if his arrows are spread widely around the bulls eye. Of course, archers aim for both accuracy and precision, attempting to have all of their arrows hit the center of the target.

Because the Census IPUMS 5 percent sample includes prisoners, the hospitalized, military enlistees and other institutionalized people, these data are considerably more useful than widely-cited Current Population Survey (CPS) data, which are based on a sample of non-institutionalized households only. (See Greene and Winters 2003 and Fry 2005 on CPS data limitations.)

At least two related formulae exist that attempt to address 9th grade retention bias. The National Center for Education Statistics’ Average Freshman Graduation Rate (AFGR) is calculated by dividing the number of graduates from US public high schools in a given year by the average of the number of 8th graders 4 years earlier, 9th graders 3 years earlier, and 10th graders 2 years earlier (Seastrom, Hoffman, Chapman, and Stillwell 2005; Laird et al. 2007)). This formulation yields a higher national graduation rate compared with the BGR, indicating that 75 percent of US public high school students graduate. However, Warren (2005) demonstrates in a series of simulations that the AFGR fails to fully address the biases caused by 9th grade retention and proposes an approach the combines CCD data with population data from the Current Population Survey. Since neither of these rates can be calculated at the high school level, we do not focus on them here.

Charter schools, schools with fewer than 10 seniors, and schools devoted to special education were excluded from the sampling frame.

The state's high schools were allocated to eleven primary sampling strata and 651 primary sampling units (PSUs) for the sample selection process. The design for the baseline survey involved a two-stage probability sampling strategy. In the first stage, 62 PSUs were randomly selected with probability proportional to a measure of size equal to senior enrollment, which yielded a total of 108 high schools.

The exclusion of students who drop out of high school before the 10th grade undoubtedly leads us to understate the proportion of students who drop out of sampled high schools. Data from the NELS indicates that approximately 6.8 percent of students who were 8th graders in U.S. schools in 1988 dropped out before the spring of 1990, when they were scheduled to be high school sophomores (McMillen 1992). These early dropouts represent approximately 40 percent of all NELS respondents who do not eventually earn a high school diploma.

Note that students who changed high schools are excluded from this persistence rate formula.

Men and African-Americans are also overrepresented among THEOP Wave 2 non-responders.

We verified our imputation technique by re-estimating the imputation model on the 8,431 cases for which we had valid Wave 2 school status data. We randomly selected 1,000 of these respondents, set their values on the high school status variable to missing, and employed IVEWare to impute high school status for these 1,000 cases using the same multinomial/polytomous logit regression model employed in our overall data. The results of the imputation closely matched the observed results. In the observed data, 3.51 percent of students were not enrolled in high school at the time of the follow-up study; in the verification study, that proportion was nearly identical at 3.63 percent.

Most schools that are missing on the basic persistence rate or the 10th-to-12th grade cumulative promotion index are missing because their enrollments have grown over the study period, and therefore these enrollment-based persistence rate estimation techniques suggest that more than 100 percent of students persisted between 10th and 12th grade.

Our analyses suggest that the BPR and the CPI are similarly biased in measuring persistence at high-poverty high schools. However, since school racial composition and poverty are highly correlated (alpha=.914) we do not report these analyses here.