Students Left Behind: Measuring 10^{th} to 12^{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 U.S. 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 a cohort of students at 82 Texas public high schools to assess the accuracy and precision of three widely-used high school graduation rate measures: Texas's official graduation rates, and two competing estimates based on publicly available enrollment data from the Common Core of Data. Our analyses show that these widely-used approaches yield inaccurate and 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 essential to reconcile conflicting estimates.

I. Introduction:

Triggered by press reports of falsified dropout records at Sharpstown High School, in summer 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 of the 5,500 students who left these schools during the 2000-2001 academic year, 3,000 were dropouts misclassified as transfers in order to boost the district's graduation rate (Archer, 2003; Schemo, 2003). The Houston dropout reporting scandal underscores widespread problems associated with students' grade progression through American public high schools.

Even before the *No Child Left Behind Act* (*NCLB*) 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 intensified recently because the U.S. Department of Education will soon require states to adopt a uniform graduation rate reporting method (Dillon, 2008) and the U.S. Senate has advanced a proposal monitor graduation rates of 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. Four years later Texas high schools began collecting individual-level student dropout records and reporting school-specific dropout counts to the TEA. Despite the state's extensive experience collecting dropout data, the Houston audit calls into question the validity of Texas's high school graduation rates. The state currently requires public high schools not only to file annual reports on the number of students who leave a campus, but also to distinguish between dropouts and transfers. Following Texas's lead, several states have implemented similar dropout data collection systems (Winglee, Marker, Henderson, Young, & Hoffman, 2000), and the Government Accountability Office (GAO) has endorsed the Texas method for measuring high school graduation (Government Accountability Office, 2005). Still, concerns about data quality remain. Following the 2003 Houston audit, the state implemented oversight procedures to improve the quality of data used to calculate graduation rates, but the published dropout rates suggest that many schools continue to designate dropouts as transfers. Texas is not unique, however; most states are susceptible to dropout/transfer misclassification bias (Swanson, 2003a; Swanson, 2003b; National Center for Education Statistics, 2005).

Official rates based on school-reported dropout data are but one measure 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 methods for calculating graduation rates for individual high schools and districts to minimize misclassification bias inherent in school-reported dropout data. Estimates of the nationwide high school graduation rate vary widely, however, ranging from less than 70 percent (Swanson, 2004; Greene & Forster, 2003; Greene & Winters, 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.

This paper assesses the validity of widely used school-level graduation rates, identifying the strengths and limitations of each. The analyses distinguish between two attributes of a valid measure: *accuracy* and *precision*. Across multiple measurements, an *accurate* measure of high school graduation conforms closely on average to the actual rate. A *precise* measure of high school graduation has low variance, which is essential to discriminate reliably between low and high performing schools as well as annual fluctuations (Crocker & 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. We argue that the neglected issue of measurement precision is crucial for education analysis and policy, because precision is necessary to compare graduation rates between schools and to detect changes in school performance over time.

Accordingly, our analyses evaluate both the *accuracy* and the *precision* of available graduation rate measures. Specifically, we measure 10^{th}-to-12^{th} grade persistence rates for students at 82 Texas public high schools using longitudinal data collected by the Texas Higher Education Opportunity Project (THEOP, 2005), corrected 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. Our analyses are designed to address two specific questions:

1. How accurate and precise are the school-level measures of high school graduation that are currently available for U.S. public high schools? Which of these measures are most accurate and precise?
2. In what ways are currently available measures of graduation rate biased, and how can researchers and policy-makers address these biases?

II. Measurement of High School Graduation

Defining a valid measure

A valid measure of high school graduation rates is both accurate and precise, two features that are best established in the context of repeated measurement. Measurement techniques that produce unbiased estimates of graduation rates are deemed accurate; techniques that generate consistent estimates i.e., that do not vary widely across measurement attempts are considered precise. These two dimensions of validity can vary independently; hence it is possible for a measurement technique to be accurate but imprecise, or alternatively, precise but inaccurate. (For example, a bathroom scale that is improperly balanced is precise if it returns the same weight measurement repeatedly, even though that measurement may be substantially biased, and thus inaccurate.)

Accuracy is necessary to assess the magnitude of the high school dropout problem. Educators, policy-makers, researchers, and the general public want an accurate estimate of the proportion of students who graduate from U.S. high schools. 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 also a pressing concern. A graduation rate measure that, on average, corresponds with the true rate does not suffice for these purposes. Rather, a measure that is reliably sensitive to differences in graduation rates between schools and over time is required. *NCLB*'s use of high school graduation measures illustrates why this is so.

In response to NCLB reporting mandates, school accountability systems have focused almost entirely on measuring annual improvements in standardized test scores. The 2002 law also requires states to measure graduation rates at public high schools and to incorporate these rates in calculations of annual yearly progress (AYP) for schools and districts (Losen, 2005). Several stake-holders have advocated strengthening the law's accountability requirements around high school graduation rates (*c.f.* Kennedy and Spellings, 2007; Commission on No Child Left Behind, 2007) since the law's implementation, but measurement issues have complicated this goal. If states incorporate an accurate but imprecise high school graduation measure into their AYP calculations, they can not distinguish between high schools where graduation rates are improving and those making less satisfactory progress. In this instance, schools that are improving their graduation rates may be mistakenly designated as needing improvement and schools that do not improve can escape detection. Alternatively, if states adopt a precise but inaccurate measure of graduation rates, schools with relatively low and declining rates can be correctly identified for sanction under NCLB. A precise but inaccurate graduation rate measure is adequate for purposes of school accountability even though it would mislead observers about the magnitude of the state's dropout problem.

Measurement precision is also essential for obtaining valid results in multivariate or panel data analyses that seek to isolate the influences of school characteristics, educational policies, or school-based interventions on graduation rates. Because such studies typically 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, they require low levels of measurement variance in order to distinguish reliably between high-performers and low-performers.

Standard Measures of High School Graduation

Despite the policy relevance of measurement precision, especially for longitudinal assessments of annual progress, recent debates about the measurement of high school graduation rates largely revolve around issues of accuracy. 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 has risen over time (U.S. Department of Education, 2006, Table 26-1). As discussed below, several recent studies have called into question estimates of graduation rates based on household surveys. Graduation rates calculated from school-specific enrollment reports show that less than three-fourths of U.S. public high school students earn diplomas. Moreover, several authors argue that this share is declining (Heckman & LaFontaine, 2007; Miao & Haney, 2004; Warren & Halpern-Manners, 2007).

Table 1 summarizes four different measures of the national graduation rate for recent U.S. high school cohorts. The first panel reports high school graduation data for 25-29 year olds calculated from the 5 percent sample of the 2000 U.S. Census. This sample includes both institutionalized and non-institutionalized populations.[1] Foreign born persons with less than 15 years of U.S. residence are excluded from the calculations reported in Table 1 to reduce biases from non-enrollment in U.S. high schools (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.

Table 1 About Here

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 & 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, & Taylor, 2003; Warren & Halpern-Manners, 2007). Therefore, several researchers assert that population-based estimates yield upwardly biased estimates of U.S. graduation rates.

The second panel of Table 1 presents two estimates of graduation rates based on public high school enrollment and graduation data available from the National Center for Education Statistics (NCES) Common Core Data (CCD). The Basic Graduation Rate (BGR) is calculated by dividing the number of students who graduate from a given high school each year with a diploma by the number of 9th graders enrolled in that high school 3 years earlier. The BGR indicates that 69 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 tests. Consequently, 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 & Roy, 2006; Roy & Mishel, 2008). (Appendix A provides detail about the calculation of rates based on school administrative data.)

Two related formulae that attempt to correct for the 9th grade retention bias are the Average Freshman Graduation Rate (AFGR) and the Cumulative Promotion Index (CPI). AFGR is derived by dividing the number of graduates from U.S. public high schools in a given year by the average of the number of 8th graders four years earlier, 9th graders three years earlier, and 10th graders two years earlier (Seastrom, Hoffman, Chapman, and Stillwell 2005; Laird et al. 2007). This estimate yields a higher national graduation rate compared with the BGR, indicating that 75 percent of US public high school students graduate. It suffers from other limitations, however. Warren (2005) demonstrated that the AFGR does not fully address 9th grade retention bias and proposes an improvement that combines data from the CCD and the Current Population Survey. Neither of these rates can be calculated at the high school level, and thus do not impact NCLB accountability requirements, therefore we do not consider them further.

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 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 national 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 agree on the most accurate measure based on cross-sectional data series. Mishel and Roy (2006) argue longitudinal studies that follow a nationally representative cohort of students through high school are the most direct, and therefore most accurate, way to estimate U.S. graduation rates. Table 1 reports Mishel and Roy's estimates of U.S. high school graduation rates, based on two panel surveys; the National Educational Longitudinal Survey (NELS:88) and the National Longitudinal Survey of Youth's 1997 cohort (NLSY97) data. These cohort measures yield considerably higher estimates of the U.S. high school graduation rate than measures based on cross-section high school enrollment and graduation data. Over four-fifths of NELS and NLSY respondents earned a diploma by their early to mid-twenties. Approximately three-quarters of black and Hispanic students earned diplomas by these ages, compared with 85 percent of whites. Moreover, when NELS and NLSY respondents who earned GEDs are included among high school completers, estimated graduation rates are comparable to population estimates based on census data (Mishel & Roy, 2006).

Critics have noted that sample attrition (or loss to follow-up) 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. These estimates, therefore, are likely to be accurate. Nevertheless, national longitudinal surveys can not be used to derive valid school-specific graduation rates.

III. Estimating high school-specific graduation rates

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 rates in two ways: (a) by redirecting focus from *national* to *school-level* graduation estimates and (b) by addressing the second component of measurement validity, precision. 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 three widely used measures –Texas's official graduation rate and two rates calculated from CCD school 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 probability sampling design, drawing a random sample of public high schools and attempting to survey every 10th grader enrolled in these schools. The study then re-interviewed a random sample of these students two years later, when most were about to graduate from high school, to determine their school enrollment status. The THEOP study provides many of the advantages associated with longitudinal, cohort-based graduation rates like those based on NELS and NLSY. Because the study followed students as they progressed through high school, it is not susceptible to the biases related to student migration and grade-retention that plague graduation rates based on school-level CCD enrollment data. Furthermore, because the study collected school status data directly from the students in question, it is not susceptible to the misreporting biases detected in the TEA and other official graduation rates that rely on dropout reports from high school administrators. Importantly, the THEOP study's large sample sizes for each school makes it possible to longitudinally estimate school-level persistence rates, which is impossible in national cohort-based longitudinal studies. Although the missing data problems that we detail below challenge the validity of the THEOP school-level persistence rates, after thoroughly accounting for non-response, we maintain that the THEOP data produces an accurate and precise measure of school persistence for the sampled Texas high schools. In the analyses that follow, we benchmark Texas's official TEA graduation rates and CCD-derived rates against the THEOP persistence rate.

The THEOP study was based on a sample of 108 high schools, drawn from the sampling frame of 1,258 regular Texas public high schools. Charter schools, schools with fewer than 10 seniors, and schools devoted to special education were excluded from the sampling frame. Three of the 108 sampled 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). In this paper, we restrict our sample to the 82

Texas high schools where the baseline paper-and-pencil surveys were administered in school to all attending sophomores. (For a more detailed discussion of the THEOP sophomore cohort longitudinal study design, see THEOP 2005.)

Table 2 About Here

Table 2 summarizes descriptive statistics for students who participated in the THEOP study. The first column reports data gathered from the CCD summarizing the gender and racial composition of the 2001-2002 Texas public high school sophomore class. Column two summarizes data for all respondents who participated in spring 2002 baseline survey. A comparison of these columns shows that the THEOP baseline is representative of the state's public high school sophomores. Although male students are somewhat under-represented in the THEOP sample, the discrepancy is not large, especially if the bulk of the students who did not respond to the gender item on the THEOP questionnaire, and are therefore missing data on gender, were men. Nearly 10 percent of THEOP respondents failed to provide racial data, but the racial composition of the THEOP cohort roughly corresponds to that of Texas public school sophomores as of 2001-02, especially if white students were highly prone to nonresponse for this item.

Two years later, in the spring of 2004, a random subsample of the baseline sophomore respondents was drawn. Of the 19,696 sophomores who participated in the baseline survey, 17,071 provided requisite tracking information to participate in the follow-up survey. A comparison of the second and third columns of Table 2 indicates that the students who provided tracking information closely match the universe of sophomores who participated in the baseline survey on gender, race/ethnicity, parental education, and class rank. Of these a random sample of 8,146 respondents was screened to obtain information about their school enrollment status. For these students, we have a direct measure of high school enrollment as of spring of 2004, when nearly all still-enrolled students were on the verge of high school graduation. Based on responses to the Wave 2 screener, 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 remained enrolled at another school as “movers.” For the remaining 2,879 students not reached by phone, senior year enrollment status is missing.

Sample attrition and potential predictors

Despite the THEOP study’s many strengths, these data have the same major drawback as other longitudinal studies in the form of sample attrition at the two-year follow up. Approximately 25 percent of baseline survey respondents who were sampled to participate in the Wave 2 screener lack data about the 2004 school status. Fewer than 5 percent of these wave 2 non-respondents were contacted and refused to participate in the study. [2] Thus, we do not know whether or not these students persisted in high school to their senior year. If wave 2 school status data were missing completely at random and the students who could not be located were a random sub-sample of all students, sample attrition would not bias the high school persistence rates based on the THEOP survey. According to baseline characteristics, however, the students who did not participate in the Wave 2 screener differ in systematic ways from the students who did participate in the Wave 2 screener. As the fourth and fifth columns of Table 2 indicate, males, African-Americans, students with relatively low levels of parental education and students with low class rank are particularly over-represented among Wave 2 non-responders.

The vast research literature on the predictors of high school dropout, much of which is based on national longitudinal studies, clearly indicates that these characteristics place these students at high risk of noncompletion (*c.f.* Rumberger, 2004). If, as seems likely, Wave 2 non-responders are more likely to be high school dropouts compared with Wave 2 responders, attrition will undermine the accuracy of the THEOP persistence rates. This would overstate school-specific persistence rates. Although sample attrition rates do not vary substantially from school to school, survey non-response could also undermine the precision of our estimates of high school persistence, particularly if rates of non-response were elevated in schools with low persistence rates.

In order to calculate valid school persistence rates based on the THEOP data, we must effectively account for sample attrition. We do so by taking advantage of the rich baseline data available for all THEOP respondents and implementing a multiple imputation strategy to address missing data. The baseline THEOP survey data provides a rich battery of early predictors of high school dropout for all study participants, including: students' gender, race/ethnicity, family educational background, residential mobility, language spoken at home, early high school class rank, student educational aspirations, college plans, and episodes of school retention. In addition, we have information about students' understanding of the college admissions process, the academic engagement of their peers, the extent to which their parents were involved in their schooling at the 10^{th} grade, and whether students were encouraged to attend college by parents, teachers, and counselors. Finally, we are also able to capture the school-level factors that are related to students' high school completion (Lee & Burkham, 2003), including school size, poverty concentration, racial composition, and the extent which school cultures are oriented toward academics and higher education.

Table 3 About Here

The THEOP data indicate that students who refused to provide racial and gender data were at high risk of dropping out of high school between 10th and 12th grades; so too were Hispanics. Also over-represented among high school dropouts are students from single parent families, whose parents completed relatively low levels of education, who lived in families that spoke a language other than English in the home, and whose families moved frequently. Not surprisingly, students who dropped out of high school between 10th and 12th grade had weaker academic records in high school, were less likely to either aspire to a BA or to expect to attain this degree, and were older, on average, compared with their classmates who persisted in high school. Dropouts also reported lower levels of parental involvement, as well as lower own and peer school engagement compared with students who remained in school, and they received less encouragement to pursue higher education from counselors and teachers. Finally, the THEOP respondents who dropped out high school disproportionately hailed from schools with high levels of poverty, where relatively few students took and passed algebra, and with relatively large Hispanic enrollments. Wave 2 non-respondents are also over-represented relative to high school stayers in each of these categories, lending further credence to the idea that dropouts were less likely to participate in the THEOP follow-up.

Multiple Imputation for W2 non-response

Multiple imputation uses student and school data on the rich set of observed background characteristics to predict 2004 high school enrollment status for students who did not participate in the Wave 2 screener. In contrast to an expectation maximization type algorithm for missing data, the multiple imputation algorithm generates plausible values for the missing enrollment status values so that we can incorporate these when computing our school-specific persistence rates. The confidence bands are appropriately widened to reflect the fact that some values were imputed rather than observed.

Using students' baseline characteristics, we define an imputation model to generate multiple predictions of missing Wave 2 high school status values (Collins, Schafer, & Kam, 2001). We conduct the imputation using the software package IVEW are, which implements a sequential regression imputation approach (Raghunathan et al., 2001; Raghunathan, Solenberger & Van Hoewyk, 2002). 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 estimate ten parallel independent chains with different starting values and take a draw of imputed values when the chain converges to a posterior. We produce 10 imputed values for each missing case to reflect the uncertainty in these values (Schafer, 1997), thus explicitly accounting for the uncertainty that stems from non-response.

To generate a school-level 10^{th}-to-12^{th} grade dropout count for each of the 82 participating high schools, we combine students who reported that they dropped out of high school between 10^{th} and 12 grade from each of the 82 sampled high schools with respondents whose imputed status is dropout. Subsequently, we average the estimates across the ten imputations, computing within-imputation variance by averaging across the ten standard errors, and computing between-imputation variance across the ten imputed datasets.[3]

It is difficult to empirically assess the validity of the multiple imputation. However, re-estimating the imputation model on the 8,431 cases with reported Wave 2 school status data, confirms that the model is correctly assigning school status values to missing cases. After randomly selecting 1,000 respondents with non missing school status in Wave 2 and setting their values on the high school status variable to missing, we impute high school status using the same multinomial/polytomous logit regression model employed in our overall data. Imputation results closely match 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 is nearly identical at 3.63 percent. This high correspondence indicates that the multiple imputation model is effective.

Calculating 10^{th}-to-12^{th} grade persistence rates

For each of the 82 schools in our analysis sample, we use senior-year academic status data to calculate 10th-to-12^{th} grade persistence rates, which measure the proportion of 10^{th} graders who are enrolled in high school two years later. Persistence rates are an imperfect proxy for high school graduation rates because they do not account for students who drop out of high school before the 10^{th} grade or after the spring of the 12^{th} grade. The exclusion of these early dropouts 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 8^{th} 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). For reasons specified above and demonstrated next, we believe that the THEOP 10th-to-12th grade persistence rates provide a valid proxy for high school graduation rates.

We define the school-specific persistence rate as:

P/(D+P)

where P is the number of sampled sophomores classified as persisters, and D is the number of sampled sophomores classified as dropouts based on their wave 2 response.[4]

Weighting THEOP persistence rates for W1 non-response

Finally, we correct the THEOP persistence rates for student absenteeism in the 10th grade, when the baseline data was collected. Although the baseline study attempted to survey all sophomores enrolled in sampled high schools, we have data from 17 percent fewer spring 2002 sophomores than the 82 participating schools reported in their fall 2002 CCD enrollments. Absenteeism is the most likely explanation for this discrepancy, because the THEOP study was unable to collect data from students who were not at school on the day of data collection. Absenteeism is closely related to dropping out of high school (Finn, 1989; Rumberger, 2004), therefore the exclusion of these students may positively bias the THEOP persistence rate, particularly in schools that have high levels of absenteeism.

We use data from the Education Longitudinal Survey (ELS) to provide a rough correction for Wave 1 non-response due to absenteeism. This contemporaneous longitudinal study provides two valuable pieces of information for this purpose: (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 drop-out 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.[5] 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.

TEA and CCD graduation and persistence rates

In the analyses that follow, we use THEOP longitudinal persistence rates as benchmarks to assess the validity of the official TEA graduation rate. Official TEA graduation rates are based on the "leaver records" that Texas public high schools report annually to the TEA, which classify each student no longer enrolled in the high school as a diploma recipient, GED recipient, dropout, or 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 graduation rate, but students who transfer out of Texas public high schools are excluded from the rate (TEA, 2007). As the Houston Independent School

District audit revealed, the validity of the TEA graduation rate hinges on the quality of school leaver reports. If dropouts are misclassified as transfers, graduation 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 12^{th} graders enrolled in each school in 2004 by the number of 10^{th} graders enrolled in 2002 (refer to Appendix A for detailed formulas). Second, we adopt the Cumulative Promotion Index formula to calculate a 10^{th}-to-12^{th} 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. Of the 82 schools that participated in the THEOP study, 72 have valid Basic Persistence Rate values; 69 have valid 10^{th}-to-12^{th} grade Cumulative Promotion Index (CPI) values. Missing basic persistence rates or cumulative promotion indices result for schools that witnessed rapid growth over the study period. Therefore, enrollment-based persistence rate estimation techniques indicate that more than 100 percent of students persisted between 10^{th} and 12^{th} grade.

IV. Findings

Table 4 reports multiple persistence and graduation rate estimates for the class of 2004 attending in public high schools in the U.S. South (N=228), the 8 Texas public high schools in the THEOP study (N=82) and all Texas public high schools (N=1250). The top panel reports the 10^{th}-to-12^{th} grade cohort persistence rate for southern public schools based on the Educational Longitudinal Survey (ELS). Although the ELS national sampling scheme precludes calculation of school-level or even state-level persistence rates, regional estimates indicate that 91 percent of southern public school 10^{th} graders persisted to the 12^{th} grade. At 93 percent, the THEOP persistence rate reported in the second panel is only slightly higher than the average for all southern public schools. The high correspondence between the ELS (which has relatively low levels of sample attrition) and the corrected THEOP rates provides some external validation for the latter. The small difference likely reflects differences in mandatory enrollment laws between Texas and other southern states: Texas's compulsory schooling law makes school withdrawal prior to age 17 difficult, but most other southern states permit students to withdraw at age 16.

Table 4 About Here

The THEOP persistence rate is likely higher than the official TEA graduation rate because many students withdraw before 10^{th} grade and during their senior year. The THEOP study does not provide data for students who left high school before 10^{th} grade or after the spring of 12^{th} 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 CCD 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 10^{th} and 12^{th} 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.

Finally, the bottom panel in Table 4 reports the TEA, BPR, and CPI for all Texas public high schools. That these state-wide rates correspond closely with the TEA, BRP, and CPI for the 82 THEOP schools bolsters confidence in the representativeness of the THEOP sample.

Comparisons of school-specific rates

In the remainder of the paper, we use the THEOP persistence rate as a benchmark to assess the precision of TEA and CCD estimates. As argued at the outset, the issue of precision has been neglected in the literature surrounding high school graduation rate measurement, even though precision is a central 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.

Table 5 presents several analyses that regress the TEA graduation rate, the BPR, and the 10^{th}-to-12^{th} grade CPI on the THEOP persistence rate for the 82 Texas public high schools for which we have data. Each of these models takes the following functional form:

$$\mathbf{Y=a+bX+u}$$

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

In interpreting these analyses, we assume that the THEOP persistent rate is a valid benchmark. By comparing the TEA rate, the BPR, and CPI against the THEOP rate, we assess the accuracy and precision of these widely-available school-level indicators. The intercept in each of these models reflects 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 unit standard deviation difference in the THEOP rate is associated with a standard deviation difference in the estimated persistence rate. Because these models are estimated on data for a relatively small number of schools, we emphasize the magnitude of the constants and coefficients in the models, rather than their statistical significance. Finally, the R-square statistic indicates the degree of agreement between the THEOP rate and the estimated rate across schools.

Table 5 About Here

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 a somewhat inaccurate and strikingly imprecise measure of high school persistence. The small but negative intercept (a= -.138), indicates that for schools near the sample mean, the TEA rate is slightly negatively biased relative to the THEOP persistence rate. The positive coefficient for the THEOP rate, (b=.493) indicates that a unit standard deviation increase in THEOP persistence is associated with half a standard rise in the official TEA graduation rate. These results suggest that the TEA rate is less variable than the THEOP longitudinal persistence rate; thus, the TEA graduation rate understates the difference between schools with high and low levels of 10^{th}-to-12^{th} grade 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 very small intercept (a=.024) reveals 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 10^{th}-to-12^{th} cumulative promotion index. The small positive intercept (a=.087) indicates a small positive CPI bias 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 understates 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 5 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 an acceptably precise measure and an unacceptably imprecise measure; however, these results indicate that the three most commonly used measures for high school level data are disturbingly imprecise. The most precise of the measures examined in Table 5, the BPR, captures less than two-fifths of the between-school variance in persistence rates; other widely used persistence and graduation measures are even less precise.

To contextual these results, we constructed OLS regression models predicting 2004 TEA, BPR, and CPI persistence rates for all Texas high schools, based on observable school characteristics from Texas's Academic Excellence Indicator System such as ethnic composition, teacher qualification, school size, test score performance, and attendance rates. The adjusted R-square values in these models are approximately the same magnitude as the R-square values reported in Panel A of Table 5, suggesting that these observable school characteristics that are conceptually unrelated to graduation might work as effectively as proxies for graduation than the widely-used measures.[6] We conclude, therefore, given the available data, 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. Nonetheless, Table 5 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 5 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' 10^{th} grade classes in 2002 to the bivariate models summarized in Panel A. This covariate returns a fairly large, negative coefficient in the BPR model (c= -.187) and in the CPI model (c= -.130), indicating that both of these measures substantially underestimate persistence rates in schools with large concentrations of black and Hispanic students. The official TEA graduation rate fairs better in this regard, but its relatively small positive coefficient (c=.057) indicates that the TEA somewhat exaggerates retention rates in racially segregated high schools.[7]

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

In Panels C and D of Table 5 we use polynomial terms to determine whether the fit between THEOP persistence rates and estimated rates is nonlinear. These models indicate that the TEA rate, the BPR, and the CPI all correspond most closely with the THEOP rate for schools that are near the mean, but that this correspondence does not hold in schools where persistence rates are relatively high or relatively low. The cubic terms introduced in Panel D are particularly informative: The THEOP-cubed term reported in Panel D is large and negative for the TEA estimate (c= -.144) as well as 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. For example, adding the cubic term to the BPR model increases the THEOP persistence rate score from a=.784 in Panel A to a=.981 in Panel D. The point of inflection in the Panel D BPR model is at approximately 1.5 standard deviations above and below the mean. In other words, the Panel D BPR model indicates that for the nearly 90 percent of schools whose persistence rate is within 3 standard deviations of the mean, the BPR matches the THEOP persistence rate very closely. But the BPR is positively biased for schools with very low persistence rates and negatively biased for schools with very high persistence rates.

Figure 1 illustrates the results of these regression analyses by graphing the level of agreement between the school-specific THEOP persistence rate and each of three commonly used measures: the official TEA graduation rate, the BPR and the CPI. To improve the clarity and readability of these graphs, we only report data for the 20 largest high schools in the THEOP study. These large high schools provide sufficient cases to predict graduation rates with high levels of confidence. In each of these images, the graphed high schools are sorted by their THEOP persistence rate, with highest persistence rates on the left and lowest rates on the right. Table 6 reports the same 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.

Figure 1 About Here

Table 6 About Here

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, but the rates based on the CCD are generally considerably lower. The official TEA graduation rate falls within the confidence interval for 13 of the 20 school profiled in Table 6. In three of the cases where the TEA rate falls outside of the THEOP confidence interval, it 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. Finally, the CPI estimate is higher than the THEOP rate only in one instance;, for the remaining 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 1a show that the TEA aligns imperfectly with the THEOP persistence rate across the 20 schools. Rather than tracking to the decline in the THEOP rate that occurs from the left of Figure 1a to the right, the TEA rates fluctuate around a relatively flat trend line. Consistent with the TEA regression results reported in Table 5, Figure 1a suggests that TEA graduation statistics tend to understate 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 (Figure 1b) seems 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 and those with relatively low persistence rates. Figure 1b is particularly useful for making sense of the THEOP-cubed term in Panel D of Table 5. This graph indicates that the BPR is particularly biased for the high-persistence schools at the far left of Figure 1b (where it over-states persistence) and the low-persistence schools at the far right of Figure 1b (where it under-states persistence). In the middle of the graph, however, the BPR does not seem to be systematically biased.

Finally, Figure 1c illustrates the relationship between the CPI and the THEOP persistence rate. The results for the CPI regressions in Table 5 indicate that this measure is not systematically biased relative to the THEOP persistence rate, but the low R-square values in these models suggest that the CPI is a highly unreliable indicator of the persistence rate in any given school. The graph in Figure 1c is consistent with this interpretation. The CPI trend line in Figure 1c is nearly parallel to the THEOP trend line, suggesting a close correspondence between these two rates; however, school CPI measures fluctuate widely around the CPI trend line.

In addition to providing a tabular representation of the data represented in Figure 1, Table 6 presents basic demographic data for each of the 20 largest THEOP high schools. There are a few notable exceptions, but as a general rule schools with relatively high persistence rates tend to have relatively high concentrations of black, Hispanic and economically disadvantaged students. In a few highly segregated schools, however, the TEA rate seems to dramatically exaggerate student graduation rate. School #20 is the clearest example of this phenomenon. According to the THEOP data, just 89 percent of the 2002 10th graders in this almost exclusively Black and Hispanic high school remained enrolled in the spring of 2004. Yet, this school reported a 97 percent graduation rate to the TEA. By contrast, the BPR seems to understate persistence in some high-minority schools.

V. Conclusion

To enforce school accountability policies fairly 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 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. Furthermore, the official TEA graduation rate is a highly imprecise measure of high school persistence, capturing just 23 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. However, neither of the alternatives rates that we consider in our analyses yields accurate or reliable estimates of school level persistence rates.

Based on these analyses, 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 understates 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 .78 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, the 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 9^{th} graders. Such a count would allow researchers to calculate a version of the BPR that includes 9^{th} graders, while avoiding the biases caused by high rates of retention in the 9^{th} 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. In addition a growing number of states are creating data systems that allow them to track students as they move between in-state public schools. But in order to accurately and precisely measure the proportion of students in all U.S. public high schools that earn high school diplomas, we must build longitudinal student tracking systems that cover all students or at least a sizeable random sample of students at all schools nationwide.

References:

Adelman, C. (2006). *The Toolbox Revisited: Paths to Degree Completion from High School Through College.* Washington, DC: U.S. Department of Education. Retrieved April 29, 2008 from http://www.ed.gov/rschstat/pubs/toolbocrevisit/index.html

Archer, J. (2003, September). "Houston Case Offers Lesson on Dropouts." *Education Week* September 24, 2003. Retrieved April 29, 2008 from http://www.teachermag.net/ew/ew_printstory.cfm?slug=04Houston.h23

Black, D., S. Sanders, & L. Taylor. (2003). Measurement of Higher Education in the Census and Current Population Survey. *Journal of the American Statistical Association*, 98(463): 545-554.

Cameron, S. V. & J. J. Heckman. (1993). The Non-equivalence of High School Equivalents. *Journal of Labor Economics*, 11(1): 1-47.

Collins, L.M., J.L. Schafer, & C.M. Kam. (2001). A comparison of inclusive and restrictive strategies in modern missing data procedures. *Psychological Methods* 6(4): 330-51.

Commission on No Child Left Behind. (2007). *Beyond NCLB: Fulfilling the promise to our nation's children*. Washington, DC: The Aspen Institute.

Crocker, L. & J. Algina. (1986). *Introduction to Classical and Modern Test Theory*. Orlando, FL: Holt, Rinehart, and Winston.

Dillon, S. (2008, April). U.S. to Require States to Use a Single School Dropout Formula. *New York Times*, April 1, 2008. Retrieved April 29, 2008 from http://www.nytimes.com/2008/04/01/education/01child.html

Engberg, J. & B. Gill. (2006). Estimating Graduation and Dropout Rates with Longitudinal Data: A Case Study in the Pittsburgh Public Schools. RAND Working Paper.

Finn, J.D. (1989). Withdrawing from school. *Review of Educational Research* 59(2): 117-142.

Fry, R. (2005). *The Higher Dropout Rate of Foreign-born Teens: The Role of Schooling Abroad*. Washington, DC: Pew Hispanic Center. Retrieved April 29, 2008 from http://pewhispanic.org/files/reports/55.pdf

Government Accountability Office. (2005). *No Child Left Behind Act: Education Could Do More to Help State Better Define Graduation Rates and Improve Knowledge About Intervention Strategies*. GAO-05-879. Retrieved April 29, 2008 from http://www.gao.gov/cgi-bin/getrpt?GAO-05-879.

Greene, J. P. & G. Forster. (2003). *Public High School Graduation and College-Readiness Rates in the United States*. Manhattan Institute: Education Working Paper 3. Retrieved April 29, 2008 from http://www.manhattan-institute.org/pdf/ewp_03.pdf

Greene, J. P. & M. Winters (2005). *Public High School Graduation and College-Readiness Rates: 1991-2002*. New York, NY: Manhattan Institute for Policy Research. Retrieved April 29, 2008 from http://www.manhattan-institute.org/html/ewp_08.htm

Haney, W. (2000). The Myth of the Texas Miracle in Education. *Education Policy Analysis Archives*, 8(41). Retrieved April 29, 2008 from http://epaa.asu.edu/epaa/v8n41.

Heckman, J. J. & P. A. LaFontaine. (2007). The American High School Graduation Rate: Trends and Levels. IZA Discussion paper #3216. Retrieved April 29, 2008 from ftp://repec.iza.org/RePEc/Discussionpaper/dp3216.pdf

Kaufman, P. (2001). The National Dropout Collection System: Assessing Consistency. Paper prepared for Dropout Research: Accurate Counts and Positive Interventions, Achieve and the Civil Rights Project, January 13, 2001.

Kennedy, E. & and M. Spellings. (2007). National epidemic, economic necessity. *Politico.com*. Retrieved June 30, 2008 from http://www.politico.com/news/stories/0507/3951.html

Laird, J., G. Kienzl, M. DeBell, & C. Chapman. (2007). *Dropout Rates in the United States: 2005 Compendium Report*. Washington, DC: Institute of Education Statistics, U.S. Department of Education. Retrieved April 29, 2008 from http://nces.ed.gov/pubs2007/2007059.pdf

Lee, V.E. & D.T. Burkham. (2003). Dropping out of high school: The role of school organization. *American Education Research Journal* 40(2): 353-393.

Library of Congress. 2007. S. 1185 Graduation Promise Act of 2007.

Lord, F. and M.R. Novick. (1968). *Statistical Theories of Mental Test Scores*. Reading, MA: Addison-Wesley.

Losen, D. (2005). Graduation Rate Accountability Under the No Child Left Behind Act. In G. L. Sunderman, J. S. Kim, and G. Orfield (Ed.) *NCLB Meets School Realities: Lessons From the Field* (pp. 105-120). Thousand Oaks, CA: Corwin Press.

Miao, J. & W. Haney. (2004). High School Graduation Rates: Alternative Methods and Implications. *Education Policy Analysis Archives,* 12(55). Retrieved April 29, 2008 from http://epaa.asu.edu/v12n55/.

Mishel, L. & J. Roy. (2006). *Rethinking High School Graduation Rates and Trends*. Washington, DC: Economic Policy Institute. Retrieved April 29, 2008 from http://www.epi.org/books/rethinking_hs_grad_rates/rethinking_hs_grad_rates-FULL_TEXT.pdf

National Center for Education Statistics. (2005). *National Institute of Statistics Sciences/ Education Statistics Services Institute Task Force on Graduation, Completion, and Dropout Indicators: Final Report*. NCES 2005—105.

Raghunathan, T.E., P.W. Solenberger, & J Van Hoewyk. (2002). *IVEware: Imputation and Variance Estimation Software*. Ann Arbor, MI: Institute for Social Research.

Raghunathan, T.E., J.M. Lepkowski, J. Van Hoewyk, & P. Solenberger. (2001). A multivariate technique for multiply imputing missing values using a sequence of regression models. *Survey Methodology* 27(1): 85-95.

Roy, J. and L. Mishel. 2008. Using administrative data to estimate graduation rates: Challenges, proposed solutions and their pitfalls. *Education Policy Analysis Archives* 16(11). Retrieved July 1, 2008 from http://epaa.asu.edu/epaa/v16n11/.

Rubin, D.B. (1987). *Multiple Imputation for Nonresponse in Surveys.* New York: J. Wiley & Sons.

Rumberger, R.W. (2004). "Why students drop out of school." In G. Orfield (Ed.), *Dropouts in America: Confronting the graduation rate crisis* (pp. 131-156). Cambridge, MA: Harvard Education Publishing Group.

Schafer, J. L. (1997). *Analysis of Incomplete Multivariate Data*. London: Chapman and Hall.

Schemo, D. J. (2003 July). Questions on Data Cloud Luster of Houston Schools. *New York Times,* p. A1

Seastrom, M., L. Hoffman., C. Chapman, & R. Stillwell. (2007). *The Averaged Freshman Graduation Rate for Public High Schools From the Common Core of Data: School Years 2002–03 and 2003–04*. U.S. Department of Education. Washington, DC: National Center for Education Statistics. Retrieved April 29, 2008 from http://nces.ed.gov/pubs2006/2006606rev.pdf

Swanson, C. (2003a). *NCLB Implementation Report: State Approaches for Calculating High School Graduation Rates*. Washington, DC: Urban Institute Education Policy Center.

Swanson, C. (2003b). *Keeping Count and Losing Count: Calculating Graduation Rates for All Students Under NCLB Accountability*. Washington, DC: Education Policy Center, The Urban Institute. Retrieved April 29, 2008 from http://www.urban.org/UploadedPDF/410843_keeping_count.pdf

Swanson, C. (2004). *Who Graduates? Who Doesn't? A Statistical Portrait of Public High School Graduation, Class of 2001.* Washington, DC: The Urban Institute. Retrieved April 29, 2008 from http://www.urban.org/UploadedPDF/410934_WhoGraduates.pdf

Texas Education Agency. (2007). *Secondary School Completion and Dropouts in Texas Public Schools 2005-06*. Austin, TX: Texas Education Agency. Retrieved June 26, 2008 from http://www.tea.state.tx.us/research/pdfs/dropcomp_2005-06.pdf#xml=http://www.tea.state.tx.us/cgi/texis/webinator/search/xml.txt?query=secondary+school+completion+and+dropout&db=db&id=38396a4338a03a2a.

Texas Higher Education Opportunity Project. (2005). *Texas Higher Education Opportunity Project (THEOP) Wave 2 "Stayer/Leaver" Survey Methodology Report*. Retrieved July 31, 2008 from http://www.texastop10.princeton.edu/surveys/soph_w2/soph_w2_methods_pu.pdf

Tyler, J. H. (2003). Economic Benefits of the GED: Lessons From Recent Research. *Review of Educational Research*, *73*(3): 369–403.

U.S. Department of Education, National Center for Education Statistics. 2006. *The Condition of Education 2006* (NCES 2006-071). Washington, DC: U.S. Government Printing Office. Retrieved April 29, 2008 from http://nces.ed.gov/pubs2006/2006071.pdf

Warren, J. R. (2005). "State-Level High School Completion Rates: Concepts, Measures, and Trends." *Education Policy Analysis Archives,* 13(51). Retrieved April 29, 2008 from http://epaa.asu.edu/epaa/v13n51.

Warren, J. R. & A. Halpern-Manners. (2007). "Is the Glass Emptying of Filling Up: Reconciling Divergent Trends in High School Completion and Dropout." *Educational Researcher*, 36(6): 335-343.

Winglee, M., D. Marker, A. Henderson, B. Aronstamm Young, & L. Hoffman. (2000). *A Recommended Approach to Providing High School Dropout and Completion Rates at the State Level.* Washington, DC: U.S Department of Education, National Center for Education Statistics.

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

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

[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] % of NELS respondents who held a high school diploma (transcript-verified, excluding GED) in 2000 (Mishel and Roy 2006, p. 17).

[c] % 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)

	2002 Sophomores (CCD) (1)	Baseline Sample (2)	W2 screen Sample (3)	W2 screened (4)	W2 not screened (5)
Gender					
Male	51.34	43.71	43.70	42.87	46.13
Female	48.66	47.19	49.81	51.30	45.47
Missing	--	9.09	6.49	5.83	8.41
Race/Ethnicity					
White	45.79	36.82	36.76	38.52	31.61
Afro-American/Black	14.07	11.66	12.82	11.52	16.43
Hispanic	36.93	34.45	34.24	34.62	33.10
Asian/Pacific Islander	2.94	3.53	5.18	5.23	5.04
Native American/Other	.27	4.10	4.06	3.77	4.93
Missing	--	9.93	6.94	6.27	8.89
Parents' highest degree					
Less than High School	--	12.25	12.41	12.25	12.89
High School	--	16.04	17.47	16.36	20.7
Some College	--	18.52	19.61	19.81	19.03
Four-year college+	--	30.25	30.63	32.96	23.83
Missing	--	22.94	19.88	18.62	23.55
Class rank (self-report)					
Top 10%	--	11.91	12.83	14.77	7.16
10-50%	--	48.39	49.19	50.34	45.81
50-90%	--	28.25	28.31	26.35	34.00
Bottom 10%	--	2.35	1.92	1.50	3.16
Missing	--	9.1	7.76	7.03	9.86
Number of cases		**19,969**	**11,295**	**8,416**	**2,879**

Source: THEOP Sophomore Surveys

Table 3: Comparison of W2 stayers, movers, dropouts, and non-responders on baseline variables employed in imputation model

	Stayer (1)	Mover (2)	Dropout (3)	W2 Non-responder (4)
Demographic/ Background				
Gender				
Male	43.38	38.08	41.89	46.13
Female	50.88	56.78	47.55	45.47
Missing	5.73	5.15	10.57	8.41
Race/Ethnicity				
White	39.43	35.23	22.26	31.61
Afro-American/Black	11.49	13.82	7.92	16.43
Hispanic	33.77	36.72	52.83	33.10
Asian/Pacific Islander	5.58	2.71	2.20	5.04
Native American/Other	3.59	5.42	4.15	4.93
Missing	6.14	6.10	10.57	8.89
Single parent family	18.99	26.27	34.98	31.35
Parents' highest degree				
Less than High School	11.57	14.50	24.91	12.89
High School	15.94	18.70	21.51	20.7
Some College	19.99	19.51	15.47	19.03
Four-year college+	34.25	27.51	12.08	23.83
Missing	18.24	19.78	26.04	23.55
Home language not English	44.06	47.57	61.07	44.29
Number of moves while in school	1.42	2.31	2.63	2.48

…..Continues

Table 3 (cont'd): Variables employed in imputation model

	Stayer (1)	Mover (2)	Dropout (3)	W2 Non-responder (4)
Student academic engagement				
Class rank (self-report)				
Top 10%	15.92	7.32	3.46	7.16
10-50%	51.49	46.88	27.92	45.81
50-90%	24.63	35.23	49.81	34.00
Bottom 10%	1.50	2.30	7.17	3.16
Missing	7.03	8.27	11.70	9.86
BA aspirations	77.16	67.38	42.75	64.44
BA expectation	73.26	60.00	36.02	60.44
Age/grade delay				
At grade level	79.20	75.51	46.31	70.04
-1 year	19.10	22.73	36.89	26.10
-2 years	1.47	1.61	15.16	3.51
-3 or more years	0.23	0.15	1.64	0.36
Parental involvement scale (z-score)	.054	-.050	-.223	-.023
School engagement scale (z-score)	.164	-.283	-.427	-.136
Peer encouragement scale (z-score)	.143	-.093	-.546	-.161
Counselor encouraged college plans	56.38	51.41	45.90	51.47
Teacher encouraged college plans	80.03	76.52	65.92	73.44
School characteristics				
% students economically disadvantaged	45.72	49.16	58.33	47.50
% students passed algebra	32.46	32.23	26.67	32.72
% students African American	12.53	13.97	11.78	14.63
% students Hispanic	37.47	39.35	52.05	37.43
Total school enrollment	515.68	494.02	510.94	524.02
Number of cases	**7,413**	**738**	**265**	**2,879**

Table 4: 10th-12th grade persistence rates (Confidence interval in parentheses, where applicable)

	Persistence rate estimate	Standard deviation	N schools
Southern High Schools			
ELS, public schools in US south (N students= 4,297)[a]	90.6 (89.7-91.5)	228	
THEOP Schools			
Persistence rate	92.6 (92.1-93.1)[b]	2.8	82
Official graduation rate (TEA, Class of 2004)	92.6	4.0	82
Basic persistence rate 10-12 (CCD, Class of 2004)	81.5	9.9	72
Cumulative promotion index 10-12 (CCD, Class of 2004)	81.4	9.1	69
Texas Public High Schools			
Official graduation rate (TEA, Class of 2004)	92.7	4.91	1250
Basic persistence rate 10-12 (CCD, Class of 2004)	82.3	8.9	1098
Cumulative promotion index 10-12 (CCD, Class of 2004)	81.4	8.8	1072

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.

[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 f1pnlwt and Taylor series adjustments.

[b] MI confidence interval accounts for sampling error and non-response uncertainty

Table 5: Standardized regression coefficients comparing three persistence rate estimates with longitudinally observed persistence rates in Texas public schools (weighted by 10th grade enrollment, 2002)

Measure (Source)	Official graduation (TEA)	Basic persistence (CCD)	Cumulative Promotion 10-12th grade (CCD)
A. THEOP persistence rate (z-score)	.493*	.784*	.407*
Constant	-.138	.024	.087
R-square	.2280	.3555	.1436
B. THEOP persistence rate (z-score)	.530*	.658*	.318*
% black or Hispanic (z-score)	.057	-.187	-.130
Constant	-.153	.068	-.122
R-square	.2305	.3758	.1549
C. THEOP persistence rate (z-score)	.498*	.857*	.408*
(THEOP persistence rate ((z-score))^2	.027	.117	.006
Constant	-.158	-.038	.082
R-square	.2290	.3652	.1436
D. THEOP persistence rate (z-score)	.802*	.981*	.631*
(THEOP persistence rate ((z-score))^2	-.037	-.012	-.050
(THEOP persistence rate ((z-score))^3	-.144*	-.102	-.107
Constant	-.094	.020	.132
R-square	.2792	.3755	.1685
N=	82	72	69

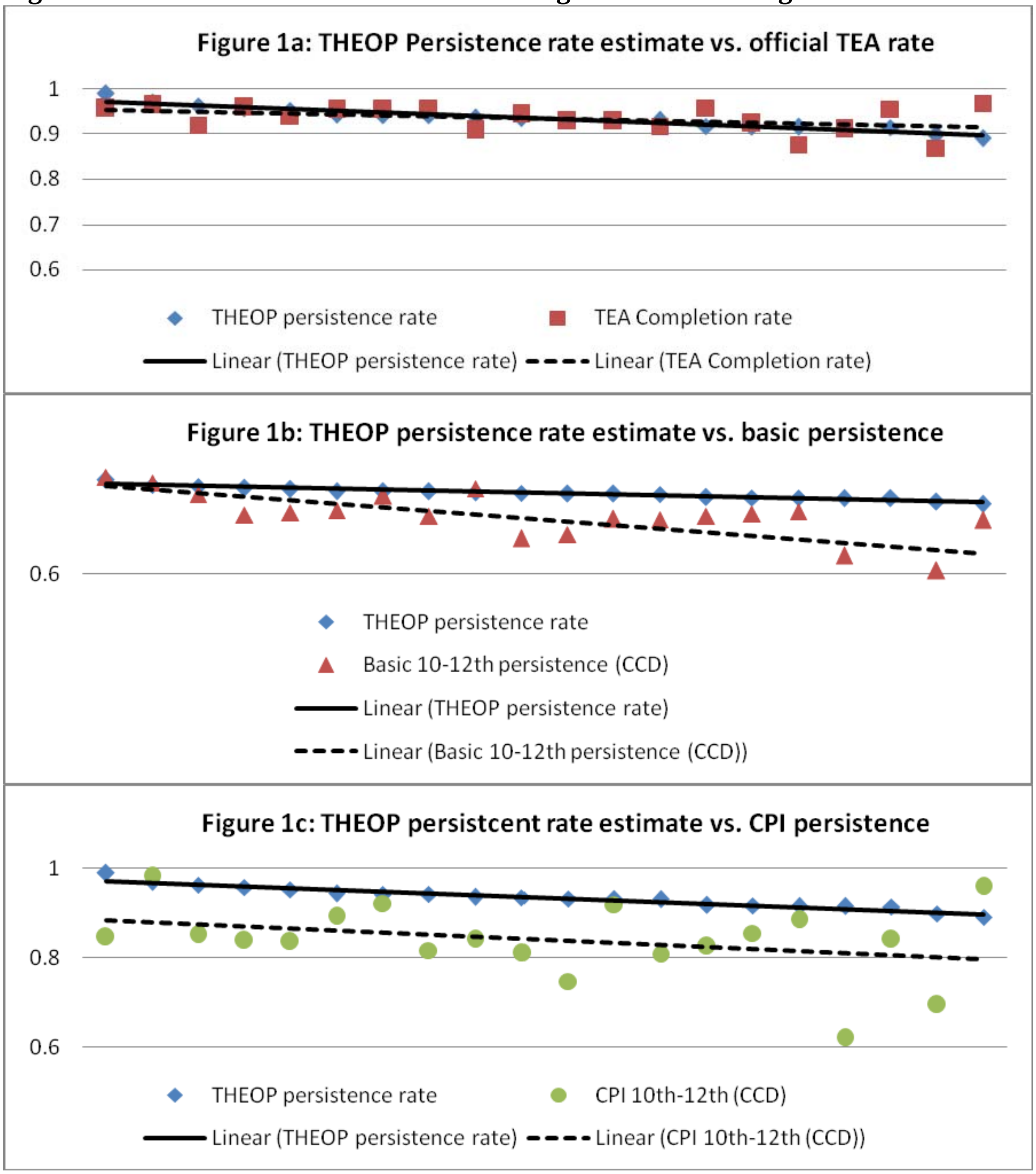
Note: * $p < .05$

Table 6: 10th to 12th Grade persistence rates and school characteristics for 20 large Texas public high schools

	THEOP persistence rate	THEOP persistence confidence interval	Official TEA completion rate	Basic persistence rate	Cumulative promotion index (10-12)	% black or Hispanic	% Economically disadvantaged
1	98.9	96.1-100.0	95.6	--	84.6	15.8	9.0
2	96.8	94.5-99.2	96.4	97.7	98.2	28.4	18.9
3	96.2	93.2-99.2	91.9	92.9	85.1	23.4	10.2
4	95.7	94.2-97.1	95.8	84.4	83.8	45.5	32.3
5	95.2	90.7-99.8	94.0	85.3	83.6	33.3	29.1
6	94.2	91.0-97.4	95.4	86.3	89.2	41.8	23.8
7	94.2	92.3-96.0	95.4	92.2	92.1	16.6	9.1
8	94.2	92.0-96.2	95.7	84.0	81.6	95.6	74.2
9	93.6	90.8-96.4	90.8	95.3	84.1	37.4	27.6
10	93.4	92.6-94.3	94.3	74.7	80.9	77.3	58.6
11	93.1	90.3-96.0	92.9	76.3	74.7	33.4	29.9
12	93.1	90.3-95.8	92.8	82.6	91.8	45.7	45.9
13	93.0	91.6-94.4	91.7	82.6	80.9	93.1	71.6
14	91.7	90.6-92.7	95.7	83.9	82.5	94.7	63.9
15	91.6	89.8-93.4	92.3	--	--	27.0	31.3
16	91.5	89.8-93.3	87.6	85.8	88.4	45.8	37.8
17	91.4	90.6-92.2	91.1	67.5	62.1	43.2	47.3
18	91.4	89.8-93.0	95.5	--	84.1	95.9	80.7
19	89.8	88.2-91.4	86.9	61.4	69.5	69.7	46.6
20	89.0	88.0-90.0	96.8	82.2	95.8	97.5	92.1

Sources: Texas Higher Education Opportunity Project baseline and follow-up surveys; Texas Education Agency school reports (2004); NCES Common Core of Data 2002-2004.

Figure 1: Persistence rate estimates for 20 large Texas Public high schools



Appendix A: Measures of high school graduation using high school administrative data

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	$(\frac{\text{\# graduates } Y_x}{\text{\#12th graders } Y_{x2}}) * (\frac{\text{\#12th graders } Y_{x+1}}{\text{\#11th graders } Y_{x2}}) * (\frac{\text{\#11th graders } Y_{x+1}}{\text{\#10th graders } Y_{x2}}) * (\frac{\text{\#10th graders } Y_{x+1}}{\text{\# 9th graders } Y_{x2}})$
Texas graduation rate	$\frac{\text{\# graduates } Y_x + \text{\# students still enrolled } Y_x}{\text{\# 9th graders } Y_{x-3} - \text{transfers out} + \text{transfers in}}$
Basic persistence rate (10-12)	$\frac{\text{\#12th graders } Y_x}{\text{\#10th graders } Y_{x-2}}$
Cumulative promotion index (10-12)	$(\frac{\text{\#12th graders } Y_{x+1}}{\text{\#11th graders } Y_{x2}}) * (\frac{\text{\#11th graders } Y_{x+1}}{\text{\#10th graders } Y_{x2}})$
THEOP persistence rate (10-12)	$1 - \frac{(\text{\# observed dropouts}) + (\text{\# imputed dropouts})_x}{\text{\#10th graders in W2 sample}}$ - W1 non-response adjustment (W1 non-response adjustment= $\frac{\text{\# W1 non-responders} * 0.135}{\text{Total \#10th graders}_{2002}}$)

Appendix B: Estimating 10th-to-12th grade persistence for Wave 1 non-responders based on ELS respondents from Southern public high schools

	% of all students (1)	% absent on given day (2)	% dropped out between 10th and 12th grade (3)	N
Never absent	14.01	0	3.89	548
1-2 absences	35.8	13.8	5.02	1398
3-6 absences	34.4	39.7	8.26	1344
7-9 absences	9.4	21.7	16.62	367
10+ absences	6.5	24.9	29.02	252
Total	100	100	8.61	3908

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.

[1] Because the Census IPUMS 5 percent sample includes prisoners, the hospitalized, military enlistees and other institutionalized persons, these data are considerably more useful than widely-cited Current Population Survey (CPS) data, which exclude institutional units. (See Greene and Winters 2003 and Fry 2005 on CPS data limitations.)

[2] For the remainder THEOP researchers attempted to locate sampled respondent using contact information collected in the wave 1 survey and then searched school directories, and free web-based and subscription-based person finders on the web but failed to reach these students.

[3] If $\bar{U}$ is the within-imputation variance, and B is the between-imputation variance, and *m* is the number of imputations, then the total variance T and the degrees of freedom for the MI confidence intervals are

$$T = \bar{U} + (1 + m^{-1})B \text{, and}$$

$$df = (m-1)\left(1 + \frac{m\bar{U}}{(m+1)B}\right)^2 .$$

We then apply a finite population correction factor (*f*) to the total variance term to slightly reduce the wide MI confidence intervals, as we have a very high sampling rate in the sophomore survey because we followed up with a large fraction of the sophomores in each school. Finally, the square root of this adjusted MI variance is the standard error used to compute confidence intervals for the school-level persistence rate. Thus, if *P* is a school-level persistence rate, then the MI confidence interval is

$$P \pm t_{df,.025}\sqrt{Txf} .$$

[4] This formula neither penalizes high schools for students who moved between schools between 2002 and 2004 nor does it give high schools credit for their persistence. An ideal high school graduation rate might arguably include a mechanism to account for students who transfer into and out of high schools. However, for the purposes of this study, excluding movers from the graduation rate calculation is important to maintain the conceptual match between the THEOP rate, the official TEA rate, and the rates derived from CCD data.

[5] This assumption is buttressed by the fact that Texas has a larger public school enrollment than any other state in the U.S. South .

[6] These models, which are available upon request, regress 2004 school graduation rate estimates on the following school-level independent variables: High school pass rates on Texas's 11th-grade math, English language arts, science, and social studies standardized tests; the proportion of students enrolled in AP courses; the proportion of graduates who complete the states' recommended college prep curriculum; attendance rates; average teacher base salary; the proportion of teachers who are tenured; the proportion of teachers who are in their first year; the number of students in the average English and math class; the proportion of students who have limited English proficiency; the proportion of students who are economically disadvantaged; the proportion of students who are black, Hispanic, and Native American. These school characteristics account for 34 percent of between-school variation in TEA graduation rates, 27 percent of between-school variation in the BPR, and 18 percent of between-school variation in the CPI.

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