DROPOUTS FROM DURHAM PUBLIC SCHOOLS

MASTER'S PROJECT
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Executive Summary

Low high school graduation rates prove a major challenge for policymakers throughout the United States. Durham, North Carolina is no exception. Durham's graduation rate is currently 77%, compared to the North Carolina average of 80%.[1] This project seeks to answer the following policy questions: who is dropping out from Durham public high schools and what characteristics in ninth grade or before can predict dropout from Durham public high schools? The project is being completed for the Durham chapter of Communities In Schools, a nationwide network of affiliated non-profit organizations focused on "empowering students to stay in school and achieve in life" through integrated school-based services.

This project has four main components, which are based on administrative data from the North Carolina Education Research Data Center, and interviews with several staff members of Durham Public Schools. The first two components explore who dropouts are, by examining dropout definitions, and how dropout and graduation rates are measured using event and cohort dropout rates for Durham's first-time ninth graders of 2006-2007. The second component describes where dropouts are in Durham through a series of maps showing student and dropouts' home census block groups. The final component estimates a model for predicting graduation for this cohort.

Defining, counting and mapping dropouts

High school dropout is a key construct that needs a precise definition, uniformly applied, in order for one to fully understand the dropout problem in Durham and the nation as a whole. Though No Child Left Behind increased the collection of data on student performance, it did not enforce a uniform dropout or graduation measure until 2011. Dropout is defined as a student who leaves school before graduation without transferring to another school or verified homeschool. Students in community college or GED programs are counted as dropouts, whereas students in youth correction centers are not. Students who re-enroll within the same month, according to the state manual, or the following year, according to Durham high school social workers, are not counted as dropouts. I calculate Durham's dropout count for 2011 at 379, whereas the state

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[1] Public Schools of North Carolina (2012)

reports 371. Though the discrepancy is small, the difference suggests that defining or counting dropouts is not fully transparent or replicable.

Two measures are used to capture dropout and graduation: the dropout event rate and the cohort graduation rate. The event rate is the number of dropouts in a given year divided by the enrollment of the school. I calculate the event rate for ninth through 12th grade in Durham in 2010, which is the expected graduation year for the cohort of this study. At 4.2%, the dropout event rate I calculate is slightly higher than the 3.8% rate the state reports for Durham. The cohort graduation rate is the preferred measure to understand dropout, as it captures the number of graduates for a single cohort as a percent of the number of students, factoring in expansion and contraction of the cohort over time. The cohort graduation rate measures the cohort's full experience in high school. I calculate the four-year graduation rate for Durham's first-time ninth graders from 2006-2007, at 56.9%, and the five-year rate at 61%. The state reports much higher rates, at 69.8% for the four-year rate and 76.4% for the five-year rate. The discrepancy is difficult to explain. I theorize that the difference lies in the way a student who originally dropped out but re-enrolls is counted, depending on when that student returns to school.

Mapping where Durham dropouts live, compared to the student population at large, shows that the dropout population is concentrated in areas of higher poverty. Using ArcGIS, I produced several maps of the 2009 high school student population (the most recent address information was available). Visuals of where dropouts are concentrated in Durham may help direct neighborhood-based resources.

Predicting graduation

Using an ordinary least squares regression, I estimate a model that predicts the five-year graduation of the students in the cohort as a function of three main explanatory variables: failing one or more courses in ninth grade, absences in ninth grade, and number of reported offenses in ninth grade. The model also includes background characteristics (race, parent education, being overage for ninth grade, qualification for free or reduced-price lunch, gender) and a measure of previous achievement (third and sixth grade math and reading end-of-grade test results).

Summary statistics are provided for the full cohort, as well as graduate and dropout subgroups. The cohort is 52% male, 59% black, 5% overage, 20% with parents with a high school education or less and 66% who have qualified for free or reduced-price lunch. Prior

academic achievement, captured by reading and math end-of-grade test scores in third and sixth grade, is significantly higher for graduates than dropouts. The separation between graduates and dropouts widens between third grade scores and sixth grade scores. Students who graduate differ from the full cohort in many expected ways: 71% of graduates never failed a class in ninth grade compared to 49% of the full cohort; 89% of graduates have no reportable offenses in ninth grade compared to 80% of the full cohort; and 58% of graduates have under eight absences in ninth grade compared to 45% of the full cohort.

With or without controlling for other characteristics, the results show that course failure, absences and reportable offenses are all significant predictors of graduation. The effect of the predictors does not sharply decrease when background characteristics such as race, which is generally thought to be strongly correlated with high school graduation, are included in the model. Course failure and over 36 absences in ninth grade have the largest effect size as predictors of not graduating from high school. Having failed a course in ninth grade decreases the probability of graduation by 24 percentage points, and being absent 36 days or more in ninth grade decreases the probability of graduation by 25 percentage points, when controlling for background characteristics and previous achievement.

Discussion and conclusion

The results have multiple implications. First, the results demonstrate that the predicative factors generally used for dropout and early warning system indicators—course failure, absences and behavior—hold as significant predictive factors for this Durham cohort. Second, while much attention is paid to race as an important correlate with high school dropout, this study shows that the indicators with the biggest effect sizes are course failure and absences. Third, the discrepancies between the counts and rates that I produce and those published are cause for concern over transparency on dropout counts.

For Communities In Schools, I make the following three recommendations:

1) Focus prevention efforts on students who have failed one or more classes in ninth grade, are absent more than 19 times and especially more than 36 times in ninth grade, or have reportable offenses on their record.

2) Position efforts based on ninth grade characteristics, rather than other background characteristics.

3) Consider the discretionary nature of counting dropouts when targeting students for interventions.

I. Introduction and Background

A. Policy problem

The dropout issue has long been a major challenge in the United States' education system. The impacts of dropping out of high school are well understood from many angles. The lifetime loss in earnings for those who do not have a high school diploma compared to those who have at least a high school diploma is estimated to be approximately $630,000.[2] High school graduation is strongly predictive of employment: only 52% of 25-64 year olds without a high school diploma are employed, compared to 68% with a high school diploma as their highest educational attainment, in 2010.[3] Regardless of income, those without a high school diploma have more health problems than those who have a high school diploma.[4] High school graduation is also associated with increased civic participation and increased life expectancy.[5] The benefits of high school graduation are significant both to the individual and to society as a whole.

While attention has recently shifted from high school to college completion rates in the United States, high school completion is still a serious issue.[6] The Obama administration has framed its focus on college completion as an issue of national competitiveness. This frame may be missing a bigger problem with high school graduation. High school completion is the U.S. lags behind other OECD countries. In 2010, the U.S. ranked 22nd among OECD nations for upper secondary graduation rates, at 77%, compared to the OECD average of 84%. The

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[2] Chapman et al (2011), 1. The value is originally in Rouse (2007) using 2004 CPS data but updated to 2008 dollars.
[3] OECD (2012), 133
[4] quoted in Chapman et al (2011), 1
[5] OECD (2012), 202
[6] U.S. Department of Education (2011)

comparable graduation rates for tertiary education (university) place the United States 14th, at 38% compared to the OECD average of 39%.[7] These international comparisons imply that in the U.S., the graduation crisis is more urgent at the high school level than the college level.

Despite the importance of understanding the dropout problem and how it has changed over time, measurement of the dropout population has been rife with problems. Though data on high school graduation are part of one of the oldest series of data collected at the national level, no clear picture emerges about the dropout population. Data sources (the Current Population Survey, the Common Core of Data, and the National Center for Education Statistics Longitudinal Studies Program) differ based on population, methodology and often have large sampling errors.[8] Furthermore, data are often not comparable over time as metrics have changed.

Education data have become increasingly available due to major education policy changes, mainly No Child Left Behind in 2002. However, the focus remains on measures of student achievement rather than on graduation data. Accountability rests almost exclusively on improvements in test scores. Ensuring that students students graduate is of secondary importance. However, for both the individual students and society as a whole, it is high school graduation that proves the most pivotal. Greater understanding of graduation rates and of the dropout population is essential to reducing the dropout rate. There is little incentive for school districts to focus data collection or analysis efforts on this task. It is also not a priority. Philip Kaufman, a national expert on dropout data, notes, "The federal government spends over $40 million on the National Assessment of Education Progress [testing a national sample of students]. It probably spends less than $1 million on dropout statistics."[9]

The following figure, based on data from North Carolina's Department of Public Instruction, shows the cohort graduation rates for the state as a whole as well as Durham Public Schools between 2006 and 2012.[10] The four-year cohort graduation rate captures the number of students who graduate divided by the number of students in that cohort in 9th grade adjusted for movement in and out of the school over the next four years. The rate for both the state as a whole and Durham Public Schools started at 68% in 2006. The state average has risen over the following six years. Durham's graduation rate experienced a significant dip to 63% in 2008 and

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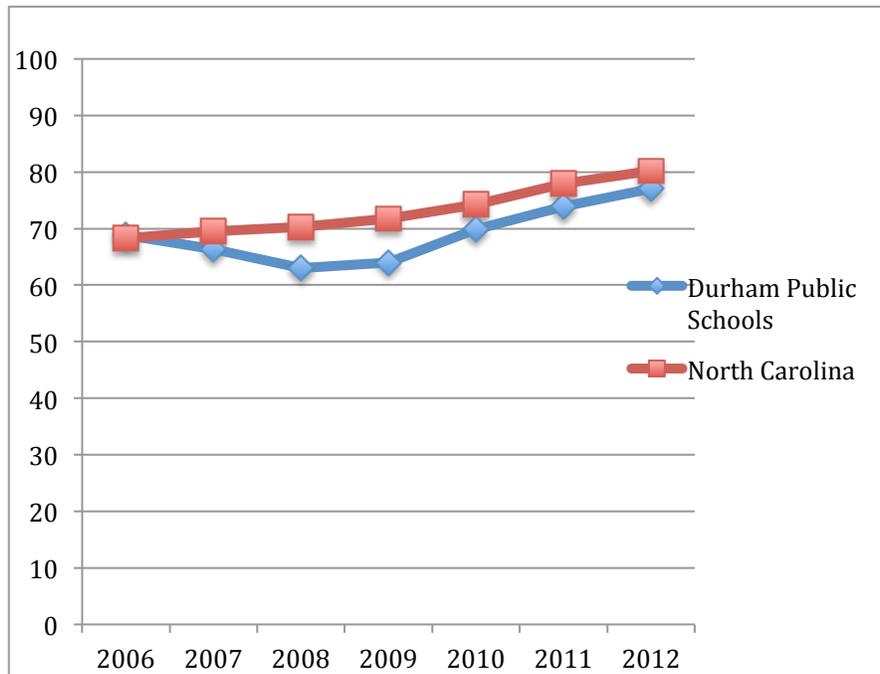[7] OECD (2012), 40 and 60.
[8] Kaufman (2004), 108
[9] quoted in Orfield (2004), 3
[10] Public Schools of North Carolina (2012)

has yet to re-converge with the state average. Durham's graduation rate is currently 77%, compared to the state average at 80%.

Figure 1. Four-year cohort graduation rates, 2006-2012

Source: http://www.ncpublicschools.org/accountability/reporting/cohortgradrate

Despite improvements, these rates still show a dire situation: one in five Durham high school students does not graduate within four years of entering ninth grade. The five-year graduation rate is only slightly higher, at 80% for 2012 compared to 77% for the four-year rate in the same year. Although this study will not examine graduation trends in Durham over time, it sheds light on the current dropout population and, using their characteristics, estimates a model to predict whether a student will graduate. This project is completed for a local client, Communities In Schools, which works with the dropout issue in Durham.

B. Research question

This project seeks to answer the following policy questions: who is dropping out of Durham public high schools and what characteristics in ninth grade or before can predict dropout in Durham public high schools?

C. Approach

This project has four main components that are based on administrative data provided by the North Carolina Education Research Data Center and interviews with several staff members of Durham Public Schools. First, I explore dropout definitions and the reporting repercussions of those definitions. Second, I calculate the event and cohort dropout rates for Durham's first-time ninth grade of 2006-2007. Third, I create maps of where in Durham the most recent Durham high school population and its dropouts live. Fourth, I estimate a model to predict graduation for this cohort. Using background characteristics and prior academic achievement as controls, the model uses the ninth grade characteristics of course failure, absences and behavior to predict graduation. These three explanatory variables were taken from the literature on dropouts.

D. About the client

Communities In Schools (CIS) is a nationwide network of affiliated non-profit organizations all focused on "empowering students to stay in school and achieve in life," through integrated services based in schools. CIS operates in 28 states with over 200 offices nationwide and is a leading national organization in dropout prevention. Focusing on integrating community resources and monitoring students at risk, a CIS site coordinator/graduation coach works within the high school.

Communities In Schools of Durham operates four main programs. These include programs focused on fourth grade summer reading and parenting programs for parents with kids in elementary and middle school. The Performance Learning Center, a small non-traditional high school within the Durham public school district, is another major program of CIS. Finally, CIS runs a graduation coach program in three Durham public high schools including its own Performance Learning Center and a single middle school. The graduation coach program helps students who are at high risk of dropping out as well as helping the school as a whole with a

comprehensive case management model that includes supportive services such as college tours and skill development.

All CIS programs are aimed at increasing the graduation rates in Durham. Understanding the dropout population and related risk factors in Durham is vital to effectively address the problem. I am undertaking this project for Communities In Schools to better inform current and future programming choices. While I will not be able to make explicit programming or policy recommendations, I present my data and findings for practical use by the client.

E. Literature review

The dropout issue has been studied for decades. The "Equality of Education Opportunity," (1966) better known as the Coleman Report, first brought the dropout issue to light. Though the report mainly focused on the question of educational equity across race and ethnicity, it was the first clear picture of what was happening across America's schools. It looked at high school enrollment of 16 and 17 year-olds who were not in college. By that definition the national dropout rate was 10%, based on the 1965 Current Population Survey. However, 17% of African-American 16 and 17 year olds were not in college, compared to 9% of whites. This early statistical portrait of the education system in the U.S., before the National Center for Education Statistics began measuring dropout rates in 1972, provided both policymakers and researchers with an understanding of the magnitude of the high school dropout problem.

The National Center for Education Statistics published a report that tracks dropout rates from 1972-2008 (2010), using data from the Current Population Survey and the Common Core of Data. The report uses the event dropout rate, which captures the percent of youth between 15 and 24 years of age who dropped out of grades 10, 11 or 12 between one October and the next. By this definition, leaving high school without a diploma or equivalent, such as a GED certificate, constitutes dropping out. Unlike the dropout definition currently used in North Carolina and under the Department of Education, students with a GED are counted as graduates. Under current definitions, students who leave high school and obtain a GED still count as dropouts. The dropout rate decreased significantly from 1972 to 2008, from 6.1% to 3.5%. The change has been irregular, with a high of 6.7% in the late 1970s falling to a low of 4.0 in the early 1990s, rising again through the end of the 1990s and then declining steadily from 2004 to

2008. These numbers, which capture the event rate of dropout, are somewhat lower than one might expect because GED-holders are counted as graduates.

In light of the education policy changes under the No Child Left Behind Act, more recent studies are much more relevant. In particular, I am interested in studies that look at a single urban school district. Two major studies, in Chicago and Philadelphia, provide important methodological guidance. A third study, based on a single third grade cohort across the state of North Carolina, is also significant and draws on the same data I will be using for this project.

The Consortium on Chicago School Research at the University of Chicago published "What Matters for Staying On-Track and Graduating in Chicago Public High Schools: A Close Look at Course Grades, Failures and Attendance in the Freshman Year" (2007). This longitudinal single cohort study looks at the ninth grade year in detail for first-year ninth graders in the academic year 2004-2005. The study seeks to determine which observable characteristics can predict high school graduation. The study focuses on ninth grade course grades as an important indicator and confirms that course grades are a better predictor than standardized test scores. Allensworth et al (2007) produce an on-track estimator to calculate whether a student is on-track at the end of ninth grade to graduate. This estimator is based on credits earned in ninth grade and course failures. With 80% accuracy, it predicts high school graduation and dropout. Closely connected to course grades, attendance is also a key indicator for graduation. The study also shows that high school behaviors, such as attendance, are more important for course grades than background characteristics. Seven percent of course failure is explained by background characteristics; sixty-one percent of course failure is explained by student behavior when controlling for background characteristics.

Following this study, I have chosen to focus on the ninth grade year as the primary period of interest. The cohort of this study is defined as those students who were first-time ninth graders in the academic year 2006-2007. I also consider the same predictors of dropout: course grades, attendance and student behavior. Though Chicago is a distinctly different district from Durham, I expect the approach of Chicago study to be generalizable and will apply similar methodology.

Richard Balfanz of Johns Hopkins University is one of the leading academics on the topic of high school dropout. His study of sixth graders in Philadelphia's public schools provides important findings on the role of middle school as a pivotal period in a student's academic and social life (2007). By looking at the 1996-97 sixth grade test scores, behavior, and attendance

data for students in Philadelphia' public schools, Balfanz is able to see which of these variables predict whether a student will drop out of school.

Using a logit regression model, Balfanz then applied a two-step test to determine the usefulness of each characteristic as a flag for risk of dropout. In the first step, Balfanz identifies the predictive power of the characteristic, examining whether 75% or more of the students with this characteristic go on to drop out. The second step identifies the yield of the characteristic, examining whether the characteristic identifies 10% or more of the dropouts. Balfanz finds that sixth grade is the most important time to begin looking for early indicators and that indicators that show up in later grades are usually first identifiable in sixth grade. He identifies poor attendance, poor behavior marks, failing math or failing English as the characteristics with the highest predictive power and yield. The interplay of each of these characteristics suggests that whole school reform models designed to approach multiple aspects of student engagement with school can result in the highest reductions in the dropout rate. There are many similarities between this Philadelphia study and the earlier Chicago study. Again, the same three predictor variables are identified: course performance (this time more specifically failure of math or English), attendance and behavior. This Durham cohort study will use the same predictor variables.

Cratty (2012) provides a recent longitudinal statistical analysis of the dropout population for the state of North Carolina. She examines the 1997-98 third grade cohort, which had an expected high school graduation in 2006. By looking across the state of North Carolina, Cratty is able to explore dropout predictors and their interrelatedness across many kinds of school districts and student backgrounds. This diverse sample and large sample size increases the external validity of her study. Using a logit model, she examines the risk factors of various characteristics as students move from third grade through high school. Cratty finds that though the predictors of dropout (low grades, absenteeism and behavior problems) are indeed at work, the vicious cycle that often develops can be turned into a virtuous cycle with only small marginal improvements. The study also estimates the impact of adopting the academically or intellectually gifted model for students at risk of dropping out by simulating the impact of the program based on characteristics of the cohort. She claims adopting gifted programs for high-risk students would result in a 25% reduction in the dropout rate.

Though Cratty's study uses a logit model, I primarily rely on an ordinary least squares (OLS) function. OLS outputs are immediately interpretable and results should be very similar to a logit model. Logit model results are located in the appendix. Based on this study's exploration of early academic achievement, I also include third and sixth grade end of grade test scores in my model. Given that Cratty uses the same dataset for her study, I also rely on her methodology for normalizing test scores and constructing socio-economic background as a combination of free/reduced lunch eligibility and parents' education.

II. Defining, Counting and Mapping Dropouts

One reason that the high school dropout crisis is known as the "silent epidemic" is that the problem is frequently masked or minimized by inconsistent and opaque data reporting systems. For example, in some districts, a student who leaves school is counted as a dropout only if he or she registers as one. In others, a dropout's promise to get a GED at an unspecified future date is good enough to merit "graduate" status. With such loose definitions of what it means to graduate, it's no wonder this epidemic has been so silent!
—Margaret Spellings, U.S. Secretary of Education, April 1, 2008[11]

A. Dropout definitions

The common understanding of high school dropout is clear: one who leaves school without graduating. However, a more technical definition is more difficult to pin down. Without precise and uniform definitions of how to identify dropouts in school administrative data, it becomes hard to gain an understanding of the issue and how it is changing over time. Another challenge is that this definition changes over time, making it hard to meaningfully compare rates across time. This section will review state and national definitions of dropout, and will show various administrative and reported data for each definition.

The state of North Carolina defines a dropout according to State Board Policy GCS-Q-001: "any student who leaves school for any reason before graduation or completion of a program of studies without transferring to another elementary or secondary school."[12] This broadly inclusive definition, originally named State Board Policy HSP-Q-001, was adopted by

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[11] Quoted in Owen et al (2008).
[12] http://sbepolicy.dpi.state.nc.us/

the state in 2004. A related policy, GCS-Q-000, which specifies procedures for the referral of dropouts, mentions the administrative code associated with dropout, W2. It goes on the clarify that if a student, initially coded as W2, enrolls in an alternative program within the same school month, the code is changed to W1. However, students who enroll in community college programs including GED programs are kept as W2s. North Carolina State Board Policy defines a dropout as someone who leaves school and doesn't re-enroll in another secondary or alternative school within a month. These dropouts show up in administrative data with the label W2.

The "Dropout Data Collecting and Reporting Procedures Manual July 2012"[13] clarifies that dropouts in youth correction centers are not dropouts, whereas minors sentenced to adult correction centers are counted as dropouts. It also clarifies that students who were permanently expelled will be counted as dropouts for federal counting purposes, but counted in a separate category for state purposes. Students who leave the United States are also not counted as dropouts, if a "responsible adult" verifies the move. Students who drop out multiple times are counted only once a year, but may be counted multiple times over their experience in the school system. This distinction is important for the event rate, which captures the event of dropping out rather than the count of individuals who drop out. It differs from the cohort graduation rate in this regard.

At the federal level, the dropout definition appears to be the same. National Center for Education Statistics provides a definition of dropout along with the Common Core of Data's (CCD) event dropout count. The U.S. Department of Education's non-regulatory guidance manual on cohort graduate rates does not explicitly define a dropout.[14] The CCD definition matches the state's definition.

Using the above definitions and the administrative data, I count dropouts by gender and race. The tables below compare the most recent CCD data reported in "Public School Graduates and Dropouts From the Common Core of Data: School Year 2008-09" with the Annual Dropout Report from North Carolina's Department of Public Instruction (DPI) and administrative data for students with a W2 withdrawal code. Data sources are for the academic year 2008-2009 and report the dropout count for students in grades 9-12. All data is for North Carolina as a whole.

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[13] DPI

[14] http://www2.ed.gov/policy/elsec/guid/hsgrguidance.pdf

Table 1 Reported NC Dropouts, Grades 9-12, 2008-09 by Gender

North Carolina	Male	Female	Reported Total
CCD	13,387	8,990	22,966
DPI	11,309	7,875	19,184
W2	12,901	8,693	21,594

Sources: NCES, 2011; DPI, 2008; NCERDC, 2008

Table 2 Reported NC Dropouts, Grades 9-12, 2008-09 by Race/ethnicity

North Carolina	American Indian	Asian	Hispanic	Black	White	Multi-racial	Reported Total
CCD	450	213	2,365	8,264	11,135		22,966
DPI	339	194	2,030	7,019	9,070	532	19,184
W2	407	204	2,226	7,766	10,480	511	21,594

Sources: NCES, 2011; DPI, 2008; NCERDC, 2008

It is clear that despite working with the same definition, the CCD federal data for North Carolina and the North Carolina DPI reported data largely differ for this year. They also both diverge from the administrative data implied in the definitions. It is difficult to explain what could be driving these differences. Explanations could range from simple human error in reporting to varying *de facto* definitions used in the construction of these counts.

Even looking only within the administrative data also presents a conflicting picture of the dropout numbers. The only administrative code mentioned in the state definition is the school withdrawal code W2. W2 appears in the dropout dataset. The school exit dataset contains three different indicators of dropouts: the LEA reported exit code, the effective exit code and a separate dropout variable. The local education agency works as the school district, and in this case is LEA 320, or Durham Public Schools. The following tables break down these various administrative datasets for Durham schools, and compare them to numbers published by DPI for Durham schools. Note that these data are for the most recent administrative data available, which is the academic year of 2010-2011 (unlike the state-wide reported data above, which is 2008-2009). There is only a slight difference between the dropout count reported in the school exit dropout variable, 375, and the number reported by DPI, 371. When the data records the student as a dropout in the exit code variable, the count is much higher, at 575.

Table 3 Administrative and reported Durham dropouts, Grades 9-12, 2010-11 by gender

Durham LEA	Male	Female	Reported Total
Effective Exit Code- 4	235	340	575
LEA reported Exit Code- 4	335	231	566
School Exit Dropout	221	154	375
W2	212	149	379
DPI	218	153	371

Table 4 Administrative and reported Durham dropouts, Grades 9-12, 2008-09 by Race/ethnicity

Durham LEA	Black	Hispanic	White	Multiethnic	American Indian	Asian	Reported Total
Effective Exit Code-4	403	92	60	16	2	2	575
LEA reported Exit Code-4	397	93	56	16	2	2	566
School Exit Dropout	274	50	35	12	3	1	375
W2	252	66	35	5		3	379
DPI	258	68	37	5	less than 5	less than 5	371

Sources: DPI, 2011; NCERDC, 2011

The differences among the various dropout counts reflect the ways in which dropouts are counted at different points in time. The bottom row totals in both of the above tables are the lowest counts, and they are the numbers published by the state. This reflects the fact that though a student may be reported at one point as a dropout, that student does not get counted as a dropout unless s/he fails to re-enroll in school within the first 20 days of the following school year.

Practically, this makes sense, as a student who drops out but returns to school should not be counted in the same way as a student who drops out permanently. However, it does allow the school system to manipulate the numbers without meaningfully returning dropouts to school. The beginning of the school year is a time of chasing down those students coded as W2s, in an effort to get them back in school. Once enrolled through day 20, many of these students drop out

again, according to Durham school social workers interviewed for this study. As a result, dropout counts are not the most accurate measure of school dropout. Instead, the cohort graduation rate captures this movement in and out of school in proportion to the number of students who eventually graduate.

B. Dropout and graduation rates in Durham

Definitions of high school dropout and calculations of graduation rates vary. The four-year cohort graduation rate measures the percent of the first-time ninth grade class that graduates within four years (or within five years, in the case of the five-year rate) while factoring in movement in and out of the school. In 2008 the U.S. Department of Education released a non-regulatory guidance manual that defined the four- and five-year cohort graduation rate. The federal government requires use of this calculation. Another commonly used measure is the event rate, which captures the number of dropouts from the school in a single year as a percent of total school enrollment. Though the cohort graduation rate is more in line with national reporting guidelines, I will calculate the event rate as it is commonly used in North Carolina. Comparing the two rates may also shed light on Durham's dropout problem in different ways.

Event rate

The event rate captures the number of dropouts as a percent of the total number of students enrolled. In the rate defined below, the event dropout rate is for the 2009-2010 academic year, which is the expected graduation year for the cohort. The event rate includes any ninth through twelfth grade student in 2009-2010 year who dropped out of Durham public schools. The event rate measures instances of dropout as an occurrence, rather than a count of individuals who dropout. A student who drops out of a school, re-enrolls in another school and then drops out again would be counted as a dropout twice.

The numerator of the event rate is the number of dropouts reported in Durham, grades nine and above as captured by the students flagged as W2, which is the dropout indicator. Students who drop out but re-enroll before the twentieth day of the school year are not be counted as dropouts. Students who initially enroll in an LEA for the first time and dropout within the first 20 days are also excluded. Though initially counted as dropouts, this population then must be subtracted from the numerator, per the dropout manual from the North Carolina

Department of Public Instruction. The denominator of the event rate is the twentieth day membership plus the total number of dropouts. Twentieth day membership is a standard measure of enrollment used, as enrollment actually fluctuates throughout the year.

Table 5. 2009-2010 Event Rate, Grades 9-12, Durham Public Schools

Numerator:						
Initial numerator	451	number of W2s, not incuding the 20 who are missing an ID number				
Subtract	21	W2s who enrolled elsewhere by 20th day				
Final numerator	430					
Denominator: Enrollment		20th day enrollment of grades 9 and up, by school				
school	9th	10th	11th	12th		TOTAL
Early College High	90	86	94	74		344
Jordan	517	470	418	434		1,839
CMA	65	56	62	36		219
PLC	48	31	51	29		159
DSA	241	215	184	144		784
Hillside	422	286	299	246		1,253
Hospital School	2	4	3	1		10
Lakeview	65	35	14	12		126
Middle College High			39	57		96
Northern	386	347	404	351		1,488
Riverside	563	479	458	387		1,887
Southern	326	255	283	190		1,054
Southern School of Engineering	54	47	53	46		200
Hillside New Tech	92	79	83	85		339
TOTAL						9,798
Final denominator	430+9798	10,228				
Event rate	430/10,228	4.2%				

Source: NCERDC, 2010

Per the administrative data, Durham's event rate for high school is 4.2%, which is slightly higher than the reported 3.8%. This discrepancy may be explained by the earlier differences found between the dropout counts, even when accounting for re-enrollment of W2 students. The event rate is meant to put the dropout count in the context of school enrollment.

While the event rate is commonly used, it is not the most meaningful measure of dropout as it is static, capturing only the dropouts in a single year. Furthermore, it generally is a low number, which at a quick glance, makes the dropout problem appear not very dire.

Cohort rate

Using data from the North Carolina Education Research Data Center, I construct four and five-year cohort graduation rates for students who entered ninth grade in the fall of 2006 for the first time. These students would graduate in four years as the class of 2010. The five-year graduation rate relies on the most recent data from the academic year 2010-11. Allensworth and Easton (2001) recommend basing the cohort on student age rather than grade, as dropout is more closely related to age rather than grade. However, because the cohort graduation rate was defined by national standards after Allensworth and Easton published their technical manual, I use grade rather than age so that my research can be more practically utilized and aligned with standard reporting procedures.

The cohort graduation rate looks at the number of graduates for a single cohort of students as a percent of that total. By examining a cohort defined by ninth grade over four and five years, the cohort rate sheds light on their experience throughout high school. The denominator of the equation is the number of first-time ninth grade students in 2006-07, plus students who transferred into the school in later years to join this cohort (i.e. in 10th grade in 2007-08, 11th grade in 2008-09, or 12th grade in 2009-10), minus students who transferred out of the district with verification that they enrolled in another district, are being homeschooled or who are deceased. Students who drop from the cohort but do not show up as enrolled into another system are not subtracted from the sample. I use the masterbuild variable as well as the school exit variable to construct this number.

The numerator of the equation is the number of graduates in the cohort. These students graduated in 2009-10 for the four-year rate, or as late as 2010-11 for the five-year rate. Only students who have a recorded school exit code as a graduate are counted as graduates. Students who complete a GED are considered dropouts by federal definition and are therefore not counted as graduates. The graduate code includes students who have graduated from schools in North Carolina through the Graduate Verification System. The count is subject to a downward bias, as neither students who have graduated from schools outside of North Carolina, nor students who

have completed homeschooling are counted as graduates. As a result, the cohort graduation rate will be underestimated. Moreover, the cohort graduation rate is also highly sensitive to movement in and out of the school that is captured in the denominator. Despite these issues, the cohort graduation rate is currently the best possible measure of graduation.

Table 6. Four and five-year cohort graduation rates, 2006-2007 first-time 9th grade, Durham Public Schools

Four year	First time 9th in 06-07	10th transfer in 07-08	11th transfer in 08-09	12th transfer in 09-10	Numerator	Calculation	Rate
	plus 2883	plus 528	plus 358	plus 278			
denominator	2883	3411	3769	4047			
	9th leave in 06-07	10th leave in 07-08	11th leave in 08-09	12th leave in 09-10	Grads in 10		
	minus 7	minus 26	minus 93	minus 369	numerator 2022		
denominator	4040	4014	3921	3552		=2022/3552	56.9%
Five year	First time 9th in 06-07		13th transfer in 10-11	13th leave 10-11	Grads in 11		
	2883		plus 271	minus 249	numerator 2180		
denominator		3552	3823	3574		=2180/3574	61.0%

Source: NCERDC, 2007-2011

I subtracted students from the denominator if they left the school by transferring to another verified school or homeschool, or are deceased. Each of these categories shows up in the exit code variable in the school exit file. However, some students show up multiple times in a given year. If the student shows up multiple times in any of the above categories, the student is subtracted from the denominator only once.

The resulting rates, 56.9% for the four-year rate for the first-time ninth grade class of 2007, and 61.0% for the five-year rate, are significantly lower than those reported by the state. For the same cohort, Durham's four-year rate is 69.8% and five-year rate is 76.4% according to DPI's Accountability Services Division. This difference is hard to account for, as one would expect the administrative data should remain consistent in my re-creation of the rates and the rates that have been published. Standardization and scrutiny have improved how dropout and

graduation rates are measured, but clearly there is still room for improvement. The graduation rate should be replicable from the same data source, but is clearly not.

C. Mapping the dropout population in Durham

In an effort to understand the neighborhood-based aspect of dropout from Durham Public Schools, I have created a series of maps to visualize where in Durham the student and dropout populations live. These maps were compiled using the most recent address data for students, which is for 2009. As a result, block groups are based on the 2000 census. By home address at the census block group ID level, the following three maps show the count of high school students, the count of high school dropouts, and the dropout density, defined as the number of dropouts as a percent of students. The darker the color, the higher the number of students, dropouts or percent of dropouts out of students, depending on the map. White areas on the map indicate places without any students (or dropouts, depending on the map) in Durham high schools. While most of these areas are outside the boundary of Durham, one exception is the Duke University campus, which appears in the center left.

Figure 2. 2009 Students in Durham High Schools

Source: NCERDC, 2009 Student Addresses by Block Group

This map needs to be interpreted with caution, as several stages of matching administrative data has meant that it does not represent the full student and dropout population. This map represents 23,510 students enrolled in Durham schools during the 2008-2009 school year. These 23,510 students are 94% of all students, which excludes 2,109 students. The missing addresses are not randomly distributed across subgroups of students. The population missing from the map is statistically different from the represented population for both gender and ethnicity. The missing population has a higher percentage of male students than the student population as a whole, at 57% males for those not on the map compared to 50% for the map. There is also a statistically significant difference among the ethnic groups of those on the map compared to those who are not, meaning that minority populations are less represented.

Figure 3. 2009 Dropouts from Durham High Schools

Source: NCERDC, 2009 Student Addresses by Block Group

The matching of dropouts to address data had a much lower match rate than the student population as a whole, where 75% of the students in the dropout file match to students with address data. This map represents 329 dropouts from Durham High Schools in 2008-2009. Of the 118 missing files, 25 are because of no identification number, and 93 of them do not appear in the address file. Therefore, the map also underrepresents the dropout count.

Comparing these two maps reveals that for the most part, areas with higher numbers of dropouts are also areas with higher numbers of students. Exceptions include areas of higher income in the south of Durham, where the student population is higher but the dropout population is lower. The block group to the south of Southern High School is interesting to note, as it has a high population of students but zero dropouts.

The final map shows the dropout population as a percentage of the student population by block group. Though the dropout count of students may be of primary interest in understanding where the dropout population in Durham lives, this density is also important. For example, even if the numbers of students in a block group are low (such as just to the west of the Durham boundary), if a high percentage of students are dropping out, it may suggest neighborhood impacts on student success.

Figure 4. 2009 Dropouts as a Percent of Students in Durham High Schools

Source: NCERDC, 2009 Student Addresses by Block Group

Comparing these three maps, areas to note are those that appear to have a high dropout count and low student count. These areas appear in dark colors in the dropout count and density maps but light colors in the student count map. Several neighborhoods in southeast Durham, between Southern and Hillside, fit this description. Though more rigorous analysis of the neighborhood impacts on dropouts is beyond the scope of this project, it is worth noting that some trends do appear for certain areas of Durham.

III. Predicting Graduation

A. Analytical model and data

In order to gain an understanding of the factors that affect dropout, I estimate a model that seeks to predict the probability that a student will graduate. Data are administrative records at the student-level, from the North Carolina Education Research Data Center. All data has been de-identified; a unique student identification number can be used to merge datasets. Supplementary to the quantitative analysis are interviews with several members of Durham Public Schools staff, including the Prevention Services Coordinator and two high school social workers. The implications section will incorporate results from the model and the interviews.

The analytical model is not estimating a causal relationship between student characteristics and graduation, but predicting graduation. Using an ordinary least squares (OLS) regression, I look at the relationship between several of factors that previous research has flagged. Though a logit model may be more appropriate for predicting a dichotomous outcome variable, I use an OLS for ease in interpreting the results. I run the same model as a logit to see if the results are significantly different. I also control for background characteristics. The function is explained below:

Probability of graduation = $f(X_1, X_2, X_3, Z_1)$

Where the variables are defined as follows:

The probability of graduation takes on the value 1 if the student does graduate in five years or less from the beginning of ninth grade and 0 if the student does not graduate from high school in five years.

X_1 is course failure, captured by student course grades at the end of ninth grade. Course grades are a better measure of student academic achievement than end of course (EOC) scores as they offer a cumulative look at student performance throughout the year rather than performance on a single test. EOC scores are only available for some courses, so some students would be excluded by this measure and my sample would be biased towards those who elect EOC courses. This variable specifies student achievement as a dichotomous variable where 1 indicates one or more course failures in ninth grade and 0 indicates no course failures in ninth grade.

Course grade information was available for only 81% of the cohort, which means 548 students have missing data. For those students with missing data, I include the median value (0.3974) of the dichotomous variable for those students with grade information, and an indicator variable for this imputed value. Because the imputed value is the median, it does not impact the results under any assumption other than that all students without grade information are treated the same in the model.

The variable X_2 is student behavior, captured by the number of reported offenses for each student. This data comes from the superintendent's office, and records legally reportable offenses. These are offenses that result in out-of-school suspension, expulsion, or referrals to alternative schools. Assault, bringing a weapon to school, possession of alcohol or other illegal substances, and rape are all examples of such offenses. Though the original dataset is structured around specific offenses involving one or more students, I aggregate offense counts by student. Offense data is collected only when a reportable offense occurs, so there are no observations with missing data. The data is included as categorical, rather than continuous, thus allowing for a non-linear relationship between behavior and graduation. The appendix includes results of a model with offense count as a continuous variable. I choose the categories based on meaningful breaking points of looking at the distribution of values for each variable as a histogram. As with all categorical variables in the model, indicator variables are used and one group is excluded as the base, against which all other groups are compared.

The variable X_3 is student absences in ninth grade. Absences record full days of student absence, not partial days such as tardiness or period skips. Student absences are also converted to

a categorical variable, with indicator variables. The appendix includes results of a model with the absence count as a continuous variable. For students without absence data, I create a separate category for the missing values and exclude it from the results. Rather than imputing values (such as including these students into the modal category), I chose this strategy to keep observations from leaving the sample non-randomly without building in assumptions inherent in imputation.

The variable Z_1 is a vector for other student background characteristics, which include gender, race, if the student is overage for grade in ninth grade, parent education, and if the student has ever qualified for free or reduced-price lunch. Where these values change over time in the data (race and parent education), modal values were chosen.[15] Students are considered overage if they are 16 years old or older at the beginning of ninth grade. While students are traditionally 14 years old and turning 15 during their ninth grade year, including students who are 15 captures many students who began kindergarten just over the age cut-off and have not repeated grades. Using the 16 year-old cut-off better captures students who have repeated previous grades. For those students without birthdates available, I include the median value of the dichotomous variable for those with data (0.0576) and a flag for the imputation. As with course failure, because the imputed value is the median, it does not impact the results under any assumption other than that all students without birthdate information are treated the same in the model.

Parent education is reported by the students on end of grade testing previous to 2006, and has been aggregated to report the highest level of parent education ever reported. These levels of reported parent education seem suspiciously high. Because the reported parent education level is the maximum ever reported, rather than the modal value, category for lowest level of education may be underreported in the final aggregated data. Free or reduced-price lunch represents if the students were ever eligible between third and ninth grade. For students without parent education data, I create a separate category for the missing values and exclude it from the results. Rather than imputing values (such as including these students into the modal category), I choose this strategy to keep observations from leaving the sample non-randomly without building in assumptions inherent in imputation.

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[15] This aggregated modal-based data was taken from the Beyond Test Scores project at Duke University, courtesy of Professor Helen Ladd.

Z_1 also includes a control for previous achievement, captured by end-of-grade (EOG) reading and math scores for third and sixth grade. Mean values are reported in the summary statistics. Third grade scores are the earliest available. Sixth grade scores are also used to capture the transition from elementary to middle school, as most middle schools start in sixth grade. If on track, this cohort would have been in third grade in 2000-2001 and sixth grade in 2003-2004. Using only these years' scores, there is a match rate of 60% for third grade math and reading and 71% for sixth grade math and reading scores. By expanding to include EOG scores from surrounding years to account for grade retention between third and ninth grade, these match rates improve to 66% for third grade and 75% for sixth grade. To account for grade retention, I am also controlling for whether students are overage for grade by ninth grade. EOG scores have been normalized according to statewide scores from the year the test was taken.

I also run the model with and without school-level fixed effects for each school to correct for any school-level unobserved effects that might have an influence on the dropout patterns and characteristics for each individual student. Cratty's recent longitudinal cohort study of third grade students in North Carolina (2012) includes district level fixed-effects rather than school-level fixed effects, and notes that school-level fixed effects did not have an impact on the results. For the purposes of this project, the effect of unobserved school-level effects may be significant. However, using fixed effects then limits the comparison to within schools and not across schools. Comparing the model results with and without this fixed effect is therefore of interest. The fixed effects model, included in the appendix, uses the ninth grade school for each student, and may not reflect the school from which the student graduated.

The incidence of missing data in this dataset is high, as illustrated in the following summary statistics section. I make an effort to keep students with missing data, who more commonly do not graduate and often drop out, in the sample using the aforementioned strategies. The appendix also includes results from the model described above but with only those observations for which the data for all variables are available.

B. Summary statistics of cohort

The following table describes the cohort of this study, 2006-2007 first-time ninth graders in Durham public schools. The cohort consists of 2,883 students. The statistics count the students as graduates if they graduate within either four (spring of 2010) or five years (spring of 2011).

Graduation is limited to graduation verified by the Graduate Verification System within the state of North Carolina. It is possible that students who are counted as non-graduates have in fact graduated from high school outside of the state. Graduation is the dependent variable of interest, though the tables also report official dropout. The dropout count is all students who have been recorded as dropping out of school at any time between and including the academic years of 2006-2007 and 2010-2011. Eight of the students recorded as dropouts did graduate, and thus have been re-coded as non-dropouts. It is possible that other dropouts re-enrolled and graduated from high school outside of North Carolina. These students would appear as dropouts and non-graduates. The dropout and graduate counts don't always total the total number of students in the cohort, as students may still be in school, have died or have left the state.

Predictors of graduation

The three explanatory variables of interest, course failure, reportable offenses, and absences in ninth grade, are summarized above as categorical variables. To read Table 7, compare the percentages in parentheses while moving across the rows. If the graduate and dropout populations mirror the full cohort, thus suggesting no correlation between the variable and either graduation or dropout, the percents will be the same. When the full cohort percent differs from the graduate percent, the data suggests that the factor may be an important factor in predicting graduation. The results of the analytical model allow a complete look at the interactions between multiple of the factors.

The plurality of students (49%) did not fail any classes in ninth grade, though 19% are missing class grade data. Course failure breaks down in predictable ways for the graduation and dropout populations. Although 49% of all students never failed in ninth grade, 70% of graduates never failed, whereas only 7% of dropouts never failed. Even considering the missing data of course grades, this low number of students who never failed a course in the cohort is concerning. There are as few as 32% and as many as 51% of students in the cohort who failed one or more classes in ninth grade. Given the suggestions in the literature that course failure is predictive of graduation, and this study's test of these factors for the Durham cohort, this is worrisome for Durham graduation rates.

Reported offenses are skewed, with 80% of the cohort not having any reported offenses in ninth grade. As expected, a higher percentage of graduates (89%) have no offenses, while only

52% of dropouts have no reported offenses. With increased reported offenses, the association flips, as expected. While 17% of the cohort had between one and three offenses, 10% of graduates and 37% of dropouts have offenses. More dropouts and fewer graduates have this number of offenses than do the original cohort. Reported offenses appear correlated with student outcome.

Student absences are spread over a wide range, from zero to 174 absences. Just under half, at 45%, of the cohort had between zero and seven absences. A higher percentage of the graduates have this low number of absences, at 58%, while only 16% of the dropouts have fewer than seven absences. The highest absence bracket, 36 to 174 absences, shows an expected reversal of this trend. While six percent of the cohort has this high rate of absence, fewer than one percent of the graduates have such a high absence count. Thirty-two percent of the dropouts are within this high range of absences.

Table 7. Summary statistics of first-time 9th grade class of 2006-07

Key explanatory variables	Full cohort count	(%)	Graduates count	(%)	Dropouts count	(%)
Never failed	1,407	(48.8)	1283	(70.5)	25	(7.0)
1 or more course failures in 9th grade	928	(32.2)	492	(27.0)	230	(64.8)
No grade information	548	(19.0)	37	(2.0)	100	(28.2)
TOTAL	2,883	(100)	1821	(100)	355	(100)
No reported offenses in 9th grade	2,304	(79.9)	1617	(89.2)	184	(51.8)
1-3 reported offenses	496	(17.2)	186	(10.3)	131	(36.9)
4-7 reported offenses	71	(2.5)	8	(0.4)	34	(9.6)
8-13 reported offenses	12	(0.4)	1	(0.1)	6	(1.7)
TOTAL	2,883	(100)	1812	(100)	355	(100)
0-7 reported absences in 9th grade	1,303	(45.2)	1055	(58.2)	57	(16.1)
8-18 reported absences	777	(27.0)	533	(29.4)	82	(23.1)
19-35 reported absences	370	(12.8)	173	(9.5)	78	(22.0)
36-174 reported absences	272	(9.4)	39	(2.2)	112	(31.5)
No data on absences in 9th grade	161	(5.6)	12	(0.7)	26	(7.3)
TOTAL	2,883	(100)	1812	(100)	355	(100)
Background characteristics						
Male	1,506	(52.2)	849	(46.9)	209	(58.9)
Female	1,377	(47.8)	963	(53.1)	146	(41.1)
TOTAL	2,883	(100)	1,812	(100)	355	(100)
White	710	(24.6)	557	(30.7)	39	(11.0)
Other	135	(4.7)	94	(5.2)	10	(2.8)
Black	1,705	(59.1)	1,024	(56.5)	262	(73.8)
Hispanic	333	(11.6)	137	(7.6)	44	(12.4)
TOTAL	2,883	(100)	1,812	(100)	355	(100)
Overage	157	(5.4)	32	(1.8)	44	(12.4)
Not overage	2,571	(89.2)	1,776	(98.0)	288	(81.1)
Missing birthdate	155	(5.4)	4	(0.2)	23	(6.5)
TOTAL	2,883	(100)	1,812	(100)	355	(100)
Parent education: High school or less	587	(20.4)	231	(12.7)	145	(40.8)
Trade and community college	453	(15.7)	261	(14.4)	84	(23.7)
Four-year college	1,014	(35.2)	786	(43.4)	77	(21.7)
Graduate degree	558	(19.4)	485	(26.8)	16	(4.5)
Missing data	271	(9.4)	49	(2.7)	33	(9.3)
TOTAL	2,883	(100)	1,812	(100)	355	(100)
Ever on free/reduced lunch	1,906	(66.1)	1,087	(60.0)	321	(90.4)
Never on free/reduced lunch	977	(33.9)	725	(40.0)	34	(9.6)
TOTAL	2,883	(100)	1,812	(100)	355	(100)

Note that the graduate and dropout count does not add up to the full cohort. Students who did not graduate but also did not dropout may still be in high school for a sixth year, or may have died or otherwise dropped from the administrative data without being counted as a dropout.
Source: NCERDC, 1997-2011

Background characteristics

The background characteristics of the cohort include gender, race, if the student is overage for grade, highest level of parent education and if the student has ever qualified for free or reduced-price lunch. Similarly to the three predictors of graduation, these background characteristics are also disproportionately distributed in the graduate and dropout subgroups. This means that when comparing distributions, as seen in the percent columns, the distributions for the graduates and dropouts do not match the full cohort, i.e. the rows moving across show different percentage values

The cohort has slightly more male than female students, at 52% to 48%. Though the cohort is majority male (at 48% to 52% female), the graduates are majority female, at 53%. The dropout population has a higher percent of males than the cohort in general, where 59% of dropouts are male compared to 52% male in the full cohort.

The cohort is majority black, at 59%, and is 25% white and 12% Hispanic. The graduates are slightly more white and other race, and less black and Hispanic, than the cohort. The proportions of graduates, rather than dropouts, by race more closely match the proportions of the full cohort. However, the race of dropouts is highly disproportionate. Where 59% of the cohort is black, 74% of the dropouts are black. White students are more likely to graduate: they make up 25% of the cohort, but 31% of the graduates and only 11% of the dropouts. Hispanic students are proportionally represented in the cohort and dropout subpopulation at 2% but slightly underrepresented in the graduate subpopulation, at eight percent.

Of the cohort, 89% are not overage for ninth grade. This is not surprising, given that the cohort is defined by being first-time ninth graders. The measure of being overage would only capture students who were not already young for their grade who repeated grades before ninth grade. Students who are overage disproportionately drop out, whereas students who are not overage disproportionately graduate.

The plurality of the cohort, at 35%, report having a parent with a four-year college degree. Parent education of the cohort is also disproportionate to the dropout and graduate subpopulations. However, the plurality for dropouts is those with parents who graduated from high school or less (at 40%). Unsurprisingly, students with parents who have a graduate degree are more likely to graduate, making up 19% of the cohort and 27% of the graduates.

Most students in the cohort, 66%, have been eligible for free/reduced lunch at some point 1997 and 2007. As a result, most of the high school graduates also have qualified; however, this percent is slightly lower than the total cohort. The proportion of dropouts who have qualified, 90%, is much higher than the proportion of the full cohort which indicates a correlation between poverty status and dropout.

Previous achievement

Students' third and sixth grade EOG scores for math and reading are presented in the next table. The table includes mean scores, standard deviations, the difference between the means for graduates and dropouts, and the statistical significance of those differences are presented.

Table 8. Third and sixth grade EOG scores, first-time 9th grade class of 2006-07

	Full cohort		Graduates		Dropouts		Difference	
	mean	(standard deviation)	mean	(standard deviation)	mean	(standard deviation)	mean	(standard error)
Third grade reading EOG	-0.119	(0.815)	0.027	(0.819)	-0.516	(0.808)	0.543	(0.047)***
Third grade math EOG	-0.101	(0.804)	0.035	(0.832)	-0.516	(0.735)	0.551	(0.047)***
Sixth grade reading EOG	-0.218	(0.895)	-0.026	(0.879)	-0.702	(0.850)	0.676	(0.051)***
Sixth grade math EOG	-0.287	(0.865)	-0.097	(0.875)	-0.819	(0.741)	0.722	(0.050)***

***The standard errors from unpaired t-tests of the difference of means show values for dropouts are statistically significant from values for graduates at the 0.05% level.
Source: NCERDC, 1998-2005

The mean scores for the full cohort are all below the state average of zero in third and sixth grade. The difference becomes even larger in sixth grade compared to third grade. For all scores except sixth grade math, the graduates have mean values above the state average. The dropouts, conversely, have mean values well below the average. It is also interesting to note that while the graduates have above the state average scores in third grade (positive means), they dip below the average by sixth grade. The difference in test scores between the graduate and dropout subpopulations is statistically significant for all four EOG tests, with the gap widening in sixth grade compared to third grade. The gap is also wider for math than reading.

High schools

Although not included in the model to predict dropout beyond a test of fixed effects, I also include the schools attended by the cohort in the table below. Note that the table reports students' school by ninth grade year, and does not reflect from which school the student graduated or dropped out. The percentage of graduates and dropouts in the cohort is not proportionally distributed across each school. While the plurality of the cohort and of the graduates are from CE Jordan High School, the plurality of dropouts are from Hillside High School. While Hillside has 14% of the cohort initially, 22% of the dropouts attended Hillside in ninth grade.

Table 9. High School of first-time 9th grade class of 2006-07

	Full cohort		Graduates		Dropouts	
	count	(%)	count	(%)	count	(%)
JD Clement Early College	97	(3.4)	85	(4.7)	4	(1.1)
CE Jordan	591	(20.5)	379	(20.9)	56	(15.8)
Durham School of the Arts	204	(7.1)	169	(9.3)	11	(3.1)
Hillside	416	(14.4)	242	(13.4)	79	(22.3)
DPS Hospital School	6	(0.2)	1	(0.1)	1	(0.3)
Lakeview	91	(3.2)	10	(0.6)	32	(9.0)
Northern	476	(16.5)	302	(16.7)	63	(17.7)
Riverside	570	(19.8)	362	(20.0)	59	(16.6)
Southern	432	(15.0)	262	(14.5)	50	(14.1)
TOTAL	2,883	(100)	1,812	(100)	355	(100)

Source: NCERDC, 2007

C. Results

Column one shows the three main explanatory variables of interest without controls, shown in the table below. All of the three variables show significant values associated with graduation. Having ever failed a class, compared to never having failed a class, is associated with a 29 percentage point decrease in probability of graduation. Having between 36 and 174 absences in ninth grade has a comparable effect on probability of graduation, with a 28 percentage point decrease in probability of graduation.

As one might expect, the effect size of absences and offenses generally increases with each category: having more absences and more offenses decreases ones probability of graduating. The highest category of offenses, between eight and 13 offenses, does not have a

statistically significant value. Because only 12 students in the cohort are in this group, is it hard to pick up statistical significance. Of these students, half dropped out and one graduated. Though having between eight and 13 offenses does not have a statistically significant value, the coefficient is negative and the practical significance is consistent with the negative impact of the other categories on graduation.

The model in column two includes the same three explanatory variables, but with the added controls of race/ethnicity, parent education, if the student is overage for grade, if the student was ever on free/reduced-price lunch and gender. With these control variables there are slight declines in the coefficients of the three explanatory variables, suggesting that the associations between graduation outcomes of those three factors are affected by background characteristics of the students. By adding these controls, the goodness-of-fit (R-squared at the bottom of the table) increases from 48% to 51%. Slightly more of the variability in graduation outcomes is explained with these background characteristics than without them.

Because graduation is disproportionate by race, it is interesting to see that the race variables are not statistically significant. Particularly for black students, for whom the summary statistics show a dire picture of disproportionate dropout (74% of dropouts compared to 59% of the full cohort), it is interesting that the percentage point change in probability of graduation compared to white students is positive though not significant. Black students' parental education is much lower than the cohort in total, and more of them frequently have failed at least one course, and have a higher rate of offenses, all of which are significant predictors of graduation.

The variables with biggest effects size (here, the coefficient with the highest absolute value that is also statistically significant) in the second model are having ever failed a class (which decreases a student's probability of graduating by 29 percentage points) and having 36 or more absences in ninth grade (which decreases a student's probability of graduation by 28 percentage points). This is not surprising, as having the proper number of course credits and showing up to school are the requirements most directly related to graduation from a practical standpoint.

The model presented in column three introduces controls of previous academic achievement, in the form of normalized reading and math EOG scores from third and sixth grade. The first interesting result is the lack of significance of the previous test scores, suggesting that graduation is greatly impacted by factors in high school and is not predetermined. Previous

achievement is also meant to control for student ability, and the lack of significance of these variables shows that graduation is not determined by ability alone.

With controls for previous academic achievement, the race variable becomes statistically significant. Interestingly, black students, who disproportionately do not graduate, have a six percentage point increase in the probability of graduation. Hispanic students also show a nine percentage point increase in probability of graduation compared to their white counterparts. Students who are non-black, non-Hispanic and also non-white have a decreased probability of graduation when controlling for previous achievement: they have a nine percentage point decrease in probability of graduation compared to their white counterparts. However, it is also worth noting that these percentage point values are very low.

Comparing the three models to each other, the coefficients on the three predictor variables do not change very significantly. The coefficients decrease slightly as more controls are added, which implies that the impact of background characteristics only slightly mitigate the relationship between the predictors and graduation. While background characteristics do play a role in a student's graduation outcome, it is clear that even a single course failure and absences over 36 in ninth grade, have the biggest effect size on graduation.

When including school-level effects, which account for unobserved differences among the schools that the cohort attends in ninth grade, the results for each of the three models are almost identical. Schools are the school the student was enrolled in during ninth grade, which differ from the school of graduation. See Appendix A for results. Using fixed effects also limits the interpretation of the results to exploring the variability within each school rather than across students in all schools. Understanding student outcomes for the cohort as a whole is of much more interest than understanding the differences in outcomes for students only compared to their classmates at the same school in ninth grade.

Table 10. Probability of graduating (linear probability model)

	(1)	(2) With backgound controls	(3) With backgound and previous achievement controls
	No controls		
Predictor variables			
Course failure in 9th grade	**-0.29***	**-0.25***	**-0.24***
	(0.00)	(0.00)	(0.00)
Absences in 9th grade:			
0-7 absences	(base)	(base)	(base)
8-18 absences	**-0.03**	**-0.03**	**-0.03**
	(0.03)	(0.04)	(0.04)
19-35 absences	**-0.15***	**-0.13***	**-0.13***
	(0.00)	(0.00)	(0.00)
36-174 absences	**-0.28***	**-0.24***	**-0.25***
	(0.00)	(0.00)	(0.00)
Reportable offenses in 9th grade:			
0 reported offenses	(base)	(base)	(base)
1-3 reported offenses	**-0.08***	**-0.08***	**-0.08***
	(0.00)	(0.00)	(0.00)
4-7 reported offenses	**-0.15***	**-0.14***	**-0.14***
	(0.00)	(0.00)	(0.00)
8-13 reported offenses	-0.07	-0.11	-0.11
	(0.50)	(0.30)	(0.30)
Background variables			
Race:			
White		(base)	(base)
Other		-0.02	-0.01
		(0.55)	(0.74)
Black		0.03	**0.04***
		(0.12)	(0.07)
Hispanic		0.04	**0.05***
		(0.14)	(0.06)
Parent education:			
Four-year college		(base)	(base)
High school or less		**-0.15***	**-0.13***
		(0.00)	(0.00)
Trade/community college		**-0.07***	**-0.06***
		(0.00)	(0.00)
Graduate degree		0.01	-0.00
		(0.75)	(0.95)
Overage for grade		**-0.13***	**-0.12***
		(0.00)	(0.00)
Ever on free/reduced lunch		-0.01	-0.01
		(0.74)	(0.66)
Female		**0.05***	**0.05***
		(0.00)	(0.00)
Reading Grade 3 EOG			-0.01
			(0.72)
Math Grade 3 EOG			-0.00
			(0.75)
Reading Grade 6 EOG			0.02
			(0.19)
Math Grade 6 EOG			0.02
			(0.27)
Constant	**0.94***	**0.93***	**0.93***
	(0.00)	(0.00)	(0.00)
Observations	2,883	2,883	2,883
R-squared	0.48	0.51	0.51

pval in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: NCERDC, 1997-2011

IV. Discussion and Conclusion

This study seeks to understand Durham's dropout population and what impacts probability of graduation. It would be a stretch to generalize those results to draw conclusions about the value of particular interventions. Also, we cannot make causal inference from these results, drawing conclusion about what *causes* some students to graduate and other not to, as a function of the variables in this study. At the same time, it is important to translate these results into meaningful information for stakeholders.

The first important result is that the predictors of graduation that emerge from the literature (course failure, absences, and behavior) also apply to this Durham cohort. Of those three predictors, having failed one or more courses in ninth grade and having more than 36 absences have the largest negative effective on the probability of graduation. Both have a clear relationship with graduation, and conversely, dropout. Students who struggle in school academically or do not attend school are likely on the path to dropping out. While course failure may be impacted by a number of factors, only one of which is innate ability, it may also be affected by student absences. Students who do not often show up for class may struggle to pass.

Theorizing about student absences is more difficult than theorizing about course failure. Students may miss many days of school for many reasons, ranging from illness to complex personal circumstances. Understanding what drives student absences may go a long way in improving the graduation rate in Durham. In-depth interviews with two social workers in two Durham public high schools also reveal that mitigating student absences is a major focus. In-house truancy courts within each high school are the biggest intervention focused on student absences, though they specifically only address absence after it crosses the 10-day threshold. The truancy system also does not address partial-day skipping, which is a serious issue according to school social workers.

One social worker recommended having a truancy court in every elementary and middle school. She stated that issues with student absences are deep-seeded, and that having courts only at the high school level is too late. Elementary and middle school truancy courts are used, though rarely. In elementary and middle schools, truancy courts can charge parents as responsible parties. At the high school level, it is generally the student who is charged with the offense of

truancy. The increased parent involvement with the elementary and middle school system courts is also essential.

The second important result is the lack of or low significance of race and previous achievement for students. Though black students disproportionally drop out, no race variable emerges as a significant predictor of graduation until third and sixth grade test scores are included. With these scores in the model, black and Hispanic students show a significant (at the 10% level only) *increased* probability of graduating. The disadvantage of black students, demonstrated by the disproportionately high incidence of dropout, can be better explained by achievement gaps tracing back to third and sixth grade. Though dropout is often considered to be a significant issue for black males, it is important to note that the empirical evidence for this cohort does not support any focus on race. The true predictive factors for graduation are course failure and absences, and to a lesser extent behavior.

The third important result comes from the section on defining and counting dropouts as well as measuring dropouts and graduation rates. The discrepancy between the counts and rates that I produce and those published is cause for concern regarding transparency. Measuring and counting dropouts has come a long way towards standardization, but there is clearly still need for improvement. There is a discretionary element to *when* a student is counted as a dropout. Practically it is hard to change this process, as communication with often hard-to-find students who are not attending school is intermittent or non-existent. For those within and outside of the school system, it would be beneficial to use more standard time horizons for when a student is counted as a dropout and when students can return to school and not count as dropouts.

What is the significance of these results for Communities In Schools? Understanding who dropouts are, where they live and what are the main predictive factors for graduation are all pieces of information that could drive programming. Following the three results listed above, I recommend the following three actions. First, focus prevention efforts on students who have failed one or more classes in ninth grade, are absent more than 19 times and especially more than 36 times in ninth grade, and have reportable offenses on their record. These are the students with the most significant decreased probability of graduating. Second, position efforts based on ninth grade characteristics, rather than other background characteristics. The evidence in this study shows that though race is correlated with graduation outcomes, it is not predictive when considering other factors. Third, consider the discretionary nature of counting dropouts when

targeting students for interventions. Because the dropout counts and rates reflect badly on the school and district, schools have an incentive to play a numbers game rather than focus on addressing the issues that have an impact on student outcomes. Thought these three strategies may not directly keep students in school, they can help better inform the efforts of CIS, as they are based in empirical evidence from Durham's high schools.

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Appendix A: Probability of graduating (linear probability), school-level fixed effects

	(1)	(2) With backgound controls	(3) With backgound and previous achievement controls
	No controls		
Predictor variables			
Course failure in 9th grade	**-0.29*****	**-0.25*****	**-0.24*****
	(0.00)	(0.00)	(0.00)
Absences in 9th grade:			
0-7 absences	(base)	(base)	(base)
8-18 absences	**-0.03***	**-0.03***	**-0.03***
	(0.05)	(0.06)	(0.06)
19-35 absences	**-0.13*****	**-0.12*****	**-0.12*****
	(0.00)	(0.00)	(0.00)
36-174 absences	**-0.25*****	**-0.23*****	**-0.23*****
	(0.00)	(0.00)	(0.00)
Reportable offenses in 9th grade:			
0 reported offenses	(base)	(base)	(base)
1-3 reported offenses	**-0.09*****	**-0.09*****	**-0.09*****
	(0.00)	(0.00)	(0.00)
4-7 reported offenses	**-0.17*****	**-0.16*****	**-0.16*****
	(0.00)	(0.00)	(0.00)
8-13 reported offenses	-0.10	-0.13	-0.13
	(0.33)	(0.19)	(0.18)
Background variables			
Race:			
White		(base)	(base)
Other		-0.02	-0.01
		(0.59)	(0.75)
Black		0.03	**0.03***
		(0.15)	(0.08)
Hispanic		0.03	0.04
		(0.27)	(0.14)
Parent education:			
Four-year college		(base)	(base)
High school or less		**-0.14*****	**-0.12*****
		(0.00)	(0.00)
Trade/community college		**-0.06*****	**-0.06*****
		(0.00)	(0.00)
Graduate degree		0.01	0.00
		(0.70)	(0.98)
Overage for grade		**-0.12*****	**-0.11*****
		(0.00)	(0.00)
Ever on free/reduced lunch		-0.01	-0.01
		(0.51)	(0.49)
Female		**0.04*****	**0.04*****
		(0.00)	(0.00)
Reading Grade 3 EOG			-0.01
			(0.66)
Math Grade 3 EOG			-0.00
			(0.89)
Reading Grade 6 EOG			0.02
			(0.20)
Math Grade 6 EOG			0.01
			(0.36)
Constant	**0.99*****	**0.96*****	**0.96*****
	(0.00)	(0.00)	(0.00)
Observations	2,883	2,883	2,883
R-squared	0.49	0.51	0.52

pval in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: NCERDC, 1997-2011

Appendix B: Probability of graduating (linear probability) without missing values

	(1)	(2) With backgound controls	(3) With backgound and previous achievement controls
	No controls		
Predictor variables			
Course failure in 9th grade	**-0.25***	**-0.21***	**-0.19***
	(0.00)	(0.00)	(0.00)
Absences in 9th grade:			
0-7 absences	(base)	(base)	(base)
8-18 absences	-0.03	-0.03	-0.03
	(0.10)	(0.16)	(0.20)
19-35 absences	**-0.14***	**-0.13***	**-0.12***
	(0.00)	(0.00)	(0.00)
36-174 absences	**-0.38***	**-0.34***	**-0.34***
	(0.00)	(0.00)	(0.00)
Reportable offenses in 9th grade:			
0 reported offenses	(base)	(base)	(base)
1-3 reported offenses	**-0.12***	**-0.11***	**-0.10***
	(0.00)	(0.00)	(0.00)
4-7 reported offenses	**-0.17**	**-0.17**	**-0.17**
	(0.02)	(0.02)	(0.02)
8-13 reported offenses	-0.09	-0.09	-0.06
	(0.62)	(0.59)	(0.71)
Background variables			
Race:			
White		(base)	(base)
Other		**-0.09***	**-0.08***
		(0.06)	(0.08)
Black		0.03	**0.06**
		(0.17)	(0.03)
Hispanic		**0.10**	**0.10**
		(0.04)	(0.04)
Parent education:			
Four-year college		(base)	(base)
High school or less		**-0.15***	**-0.13***
		(0.00)	(0.00)
Trade/community college		**-0.09***	**-0.08***
		(0.00)	(0.00)
Graduate degree		0.02	0.00
		(0.52)	(0.89)
Overage for grade		**-0.22***	**-0.20***
		(0.00)	(0.00)
Ever on free/reduced lunch		0.00	0.01
		(0.91)	(0.56)
Female		**0.06***	**0.06***
		(0.00)	(0.00)
Reading Grade 3 EOG			0.00
			(0.93)
Math Grade 3 EOG			-0.00
			(0.83)
Reading Grade 6 EOG			0.02
			(0.15)
Math Grade 6 EOG			0.02
			(0.20)
Constant	**0.97***	**0.93***	**0.90***
	(0.00)	(0.00)	(0.00)
Observations	1,626	1,626	1,626
R-squared	0.27	0.30	0.31

pval in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: NCERDC, 1997-2011

Appendix C: Probability of graduating (linear probability), continuous predictors

	(1)	(2) With backgound controls	(3) With background and previous achievement controls
	No controls		
Predictor variables			
Course failure in 9th grade	**-0.31***	**-0.27***	**-0.25***
	(0.00)	(0.00)	(0.00)
Absences in 9th grade	**-0.00***	**-0.00***	**-0.00***
	(0.00)	(0.00)	(0.00)
Reportable offenses in 9th grade	**-0.03***	**-0.03***	**-0.03***
	(0.00)	(0.00)	(0.00)
Background variables			
Race:			
White		(base)	(base)
Other		-0.02	-0.01
		(0.61)	(0.81)
Black		0.03	**0.04***
		(0.11)	(0.05)
Hispanic		0.04	**0.05****
		(0.13)	(0.05)
Parent education:			
Four-year college		(base)	(base)
High school or less		**-0.15***	**-0.13***
		(0.00)	(0.00)
Trade/community college		**-0.07***	**-0.06***
		(0.00)	(0.00)
Graduate degree		0.01	0.00
		(0.57)	(0.87)
Overage for grade		**-0.14***	**-0.13***
		(0.00)	(0.00)
Ever on free/reduced lunch		-0.01	-0.01
		(0.50)	(0.47)
Female		**0.05***	**0.05***
		(0.00)	(0.00)
Reading Grade 3 EOG			-0.01
			(0.66)
Math Grade 3 EOG			-0.01
			(0.73)
Reading Grade 6 EOG			0.02
			(0.19)
Math Grade 6 EOG			0.02
			(0.19)
Constant	**0.94***	**0.93***	**0.93***
	(0.00)	(0.00)	(0.00)
Observations	2,883	2,883	2,883
R-squared	0.47	0.50	0.50

pval in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: NCERDC, 1997-2011

Appendix D: Probability of graduating (logit model)

	(1)	(2)	(3)
		With background controls	With backgound and previous achievement controls
	No controls		
Predictor variables			
Course failure in 9th grade	-1.73***	-1.48***	-1.39***
	(0.00)	(0.00)	(0.00)
Absences in 9th grade:			
0-7 absences			
8-18 absences	-0.30**	-0.32**	-0.32**
	(0.02)	(0.02)	(0.02)
19-35 absences	-0.89***	-0.82***	-0.83***
	(0.00)	(0.00)	(0.00)
36-174 absences	-1.89***	-1.75***	-1.78***
	(0.00)	(0.00)	(0.00)
Reportable offenses in 9th grade:			
0 reported offenses	(base)	(base)	(base)
1-3 reported offenses	-0.49***	-0.50***	-0.49***
	(0.00)	(0.00)	(0.00)
4-7 reported offenses	-1.13***	-1.07**	-1.05**
	(0.01)	(0.02)	(0.02)
8-13 reported offenses	-0.67	-0.98	-0.84
	(0.54)	(0.39)	(0.46)
Background variables			
Race:			
White		(base)	(base)
Other		-0.18	-0.07
		(0.53)	(0.82)
Black		0.18	0.28
		(0.30)	(0.12)
Hispanic		0.23	0.39
		(0.33)	(0.11)
Parent education:			
Four-year college		(base)	(base)
High school or less		-0.95***	-0.78***
		(0.00)	(0.00)
Trade/community college		-0.50***	-0.43***
		(0.00)	(0.01)
Graduate degree		0.15	0.07
		(0.43)	(0.74)
Overage for grade		-1.07***	-0.95***
		(0.00)	(0.00)
Ever on free/reduced lunch		-0.06	-0.08
		(0.71)	(0.64)
Female		0.48***	0.48***
		(0.00)	(0.00)
Reading Grade 3 EOG			-0.02
			(0.87)
Math Grade 3 EOG			0.00
			(0.98)
Reading Grade 6 EOG			0.10
			(0.35)
Math Grade 6 EOG			0.21*
			(0.08)
Constant	2.60***	2.59***	2.65***
	(0.00)	(0.00)	(0.00)
Observations	2,883	2,883	2,883

pval in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: NCERDC, 1997-2011