The Significance of High School Practices on Students' Four-Year College Enrollment

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CONTENTS

ABSTRACT

Like other major school districts throughout the country, the New York City Department of Education (NYC DOE) has shifted its focus over the last decade from holding high schools accountable for graduation rates to holding them accountable for rates of college and career readiness. There are two major challenges facing both research and policy related to accountability for postsecondary outcomes, however. First, we know relatively little about the conditions under which students are successful in getting college and career ready. Second, we do not yet know in the New York City context to what extent school-level differences in college-going rates are the function of compositional differences—that is, differences in the students' backgrounds and experiences prior to high school—or the function of real differences in school policy and practice.

Using an extensive longitudinal database from The New York City Partnership for College Readiness and Success, we employ a variance-partitioning approach to take up these questions. We find, similar to much of the previous literature on school effects, that the bulk of the variation in rates of four-year enrollment is within, rather than between schools, and that compositional effects account for much of the between-school variation. Yet we also find two markers of college-going academic culture that do significantly contribute to the remaining between-school variation: high teacher expectations and access to a college preparatory curriculum. This study also introduces two additional school-level control variables that have not been employed in the national literature on school effects—size and selectivity—and discusses their potential usefulness to the field.

INTRODUCTION & MOTIVATION

In the fall of 2015, New York City's Mayor, Bill de Blasio, announced a new effort to increase college access, as well as preparation for college-level work, to all New York City (NYC) public school students. As local K-12 and higher education policymakers develop plans in this direction, they will need more information about which practices and policies are best positioned to improve students' access to college. The goal of this study was to better understand the extent to which NYC high schools differ in the rates at which they send their students to four-year colleges, and to learn about the features of high schools associated with better rates of four-year college enrollment.

Using an extensive longitudinal database developed for The New York City Partnership for College Readiness and Success, we employed a value-added approach to investigating the role of high school practices on students' likelihood of attending a four-year college. Our exploration included the following components:

- Determining whether the variation in four-year college enrollment by high school is largely explained by differences in the incoming characteristics of students;
- Identifying features of high schools, focusing particularly on malleable institutional practices and policies, which explain differences in likelihood of four-year college enrollment across high schools.

This paper marks the first in a series of analyses investigating the role of NYC high schools in shaping students' postsecondary outcomes. This initial study followed the methodology of previous work on school effects and allowed us to compare our NYC-specific findings to those of prior national studies. It also sets the stage for a more complex set of analyses aimed at estimating *causal* effects of high schools, which we will explore in a forthcoming study.

BACKGROUND AND LITERATURE

Since 2011, the New York City Department of Education (NYC DOE) has held high schools accountable for their students' postsecondary outcomes. However, with the notable exception of recent work on the value of small high schools (Abdulkadiroğlu, Hu & Pathak, 2013; Unterman, 2014), we know very little about *why* some NYC high schools appear to send most of their students to college while others send relatively few.

The major challenge in answering this question is that schools differ not only in their policies and practices, but also in the population of students they serve. This is particularly the case in New York City, where high school choice policy allows students to select schools and programs that appeal to them, and many schools to select from among their pool of applicants. Rates of college-going may thus be as much a function of a school's composition—that is, everything the students bring with them when they enter the school, such as prior academic preparation and family expectations—as what the school does with them after they arrive.[1]

Addressing the complexity of school effects is a challenge not only for researchers but also for accountability policy, which assumes that schools have some degree of influence over their students' college-going. It would be both unfair and counter-productive to reward or punish schools for their students' postsecondary outcomes if, in fact, they have little real influence over and above their students' prior experiences. The work of disentangling compositional effects from school practice is thus all the more urgent in today's policy context of accountability.

Nationally, two bodies of literature have attempted to characterize the effects of schools on students' postsecondary outcomes. The first is large-scale research using a variety of variance-partitioning and value-added techniques, which attempt to control for the selection, or compositional effects, discussed above. The most current and sophisticated versions of this work suggest that schools account for a small but significant portion of the variance in student outcomes (Bryk & Raudenbush, 1988; Jennings, Deming, Jencks, Lopuch & Schuler, 2015), and that schools play a larger role in student outcomes beyond test scores, such as high school graduation, college enrollment, and labor market participation (Altonji & Mansfield, 2011; Hill, 2008; Jennings et al., 2015). The second body of work has used mixed methods within schools to identify the practices and policies that seem to improve their students' access to college: high-quality, intrusive college counseling (Hill, 2008; McDonough, 2005; Stephan & Rosenbaum, 2013), rigorous college-preparatory curricula (Allensworth et al., 2008; Atwell & Domina, 2008; Jeong, 2009) and college-going culture (Powell, 1996; Roderick, Coca & Nagaoka, 2011).

In this paper, we use a unique longitudinal dataset that allows us to adopt aspects of both of these approaches—large-scale, value-added techniques that also draw on more nuanced school practices data than are typically available in national datasets.

We focused our study on high school practices associated with rates of *four-year college enrollment,* as opposed to any postsecondary enrollment, for two substantive reasons.

First, recent national surveys find that most high school students expect to attain at least a Bachelor's degree, a preference echoed by their parents (Noel, Stark & Redford, 2016).[2] To the extent that students and families have high educational expectations, so too should high schools. Second, and perhaps more importantly, students with four-year degrees tend to see greater economic returns to their degrees than students with Associate's degrees (Carnevale, Rose & Cheah, 2011), and students who begin their postsecondary careers at four-year institutions are more likely to ultimately attain Bachelor's degrees than those who begin at two-year institutions (Alfonso, 2006; Long & Kurlaender, 2009; Reynolds, 2012; Reynolds & DesJardins, 2009; Rouse, 1995).

Drawing on the school practices literature, we explored three possible mechanisms that have some evidence of impact on students' four-year college enrollment:

- **Access to a college preparatory curriculum** – as measured by the percent of students who took advanced coursework (i.e., advanced mathematics or science or Advanced Placement courses)
- **High expectations for students' postsecondary achievement** – as measured by student perceptions of teacher expectations;
- **Professional capacity for college advisement** – as measured by the number of students per high school guidance counselor.

Although there are a number of other high school practices and conditions related to school improvement more broadly (see Bryk et al, 2010), we constrain our initial analyses to these three specific mechanisms, employing a value-added approach that separates out the effects of student composition.

RESEARCH QUESTIONS

For this paper, we examined the following research questions:

- **Research Question 1:** How much school-level variation in four-year college enrollment is there across NYC high schools?
- **Research Question 2:** How much of the between-school variation can be attributed to compositional effects, that is, to the incoming characteristics of students?
- **Research Question 3:** After accounting for compositional effects, which malleable institutional practices and policies explain any remaining between-school variation in the rates of in a four-year college enrollment?

DATA AND METHODS

Setting

New York City has the largest school district in the country, serving over 1 million students in 1,800 schools throughout New York City's five boroughs.[3] The NYC DOE serves a majority-minority population (14% White and 86% non-White in 2010-2011), and most of its students qualify for free or reduced price lunch (81% in 2010-2011). NYC DOE also serves a sizable immigrant population (14% English language learners in 2010-2011).[4]

The New York City public school system currently serves as the main feeder for the City University of New York (CUNY) system, with almost three-quarters of the university's first-time freshman coming from a New York City public high school (CUNY 2014b). In the fall of 2013, CUNY served almost a quarter of a million undergraduate students in its 7 community colleges and 11 senior colleges located throughout the 5 boroughs of New York City (CUNY 2014a). Access to such a large and diverse postsecondary education system distinguishes studies of patterns of college enrollment in NYC from national studies of college enrollment or those in other states and regions.

Data

The data used for this study came from an extensive longitudinal database with information about NYC public school students, compiled by the Research Alliance for New York City Schools using data from the NYC DOE. This database included key information about student demographic and high school transcript information.

This administrative database was linked to data from the National Student Clearinghouse (NSC) and administrative data from CUNY. Since 2006, the NYC DOE has tracked the postsecondary enrollment of its graduates through an agreement with the NSC, a nonprofit organization that collects information on postsecondary enrollment and degree attainment. The NSC is increasingly working with school districts around the country to track the postsecondary outcomes of students those districts serve.

To measure high school features associated with a school's learning climate we linked our longitudinal administrative database to student-level data from the College Board to calculate the rate of students in a high school who took an Advanced Placement (AP) exam. We also included responses to NYC DOE's New York City School

Surveys, which are administered annually to all of the district's students (in grades 6-12), teachers and parents. To measure professional capacity at high schools, we utilized human resources data from the NYC DOE, which contains information on guidance counselors at each high school for each year.

Sample

The population studied in this report included two incoming cohorts of first-time ninth-graders (2007-2008 & 2008-2009). A "first-time ninth grader" was a student who enrolled in a NYC public high school as a ninth grader in either the fall or spring semester of a given school year and was not enrolled in a NYC high school at any time during the previous two years. This means that we did not include students who enrolled in a NYC public high school *after* their ninth grade year. We also excluded students who transferred out of the NYC system after ninth grade, and students who attended special education high schools (District 75), alternative high schools (District 79), charter high schools (District 84), specialized high schools, or schools with fewer than 15 incoming ninth graders in a given year.

We also excluded students who were missing information on early high school academic performance, including 10th grade GPA, course-taking records, and Regents examination scores. All other missing data were imputed to the grand mean. Our base sample included 117,082 students in 377 high schools.

Measures

Student Characteristics

Our models included several student-level variables, which function as the variables of interest for Research Question One and the control variables for Research Question Two. These included: eighth-grade New York State English Language Arts (ELA) exam score, eighth-grade New York State mathematics exam score, and eighth-grade attendance rate (measured as percent of days absent from total days on roll). These academic student-level controls were all continuous variables and were standardized such that the mean of each variable was 0 and one standard deviation from that mean was 2. Missing values were replaced with mean values (0). Dummy variables indicating whether a student was missing values for each control variable were also included in each model.

Demographic student-level controls, represented as dummy variables, included race-ethnicity (White, Asian, Black, and Latino), gender (male and female), birthplace

(born in the U.S. and not born in the U.S.), home language (English and non-English), free or reduced-price lunch status (qualifies for free or reduced-priced lunch), borough in which student resides as of the ninth grade (Manhattan, Bronx, Brooklyn, Queens, Staten Island), and ELL status in eighth grade.

High School Control Variables

We also include two covariates at the school level: school size, as measured by total enrollment (all four grade levels), and selectivity as measured by the school's student acceptance rate (total number of available seats divided by the total number of applications to the school). Both of these variables are essentially malleable factors in the context of New York City's school choice and small school policies, but they may be less malleable in other contexts around the country. We also use these characteristics as controls rather than school practices because although adopting a more selective application process may allow a school to improve their college-going rates, it would do so largely through the change in school composition, rather than through improved school practices.

High school-level measures of school learning climate included the percentage of students taking any AP exam during high school, as well as school-level averages for a Likert-type scaled item from the NYC DOE's New York City School Survey. Students responded to the following survey item on a scale from one to four (1=Strongly Disagree, 4=Strongly Agree): ***My teachers expect me to continue my education after high school.*** Student scores were then aggregated at the high school level to produce an average school measure of student reports on postsecondary expectations. High school professional capacity was measured by the number of students per guidance counselor. All of these high school measures were then standardized at the grand mean, where the mean equals 0 and one unit is a half of a standard deviation.

Outcomes Measures

In this study, we focused on a student's immediate four-year college entry. "Immediate" entry was defined as entering a postsecondary institution (full- or part-time status) between August 1st and December 31st of a student's expected year of on-time high school graduation. The study focused on *immediate* fall enrollment, as opposed to including delayed enrollment, because the vast majority of NYC high school graduates who go to college enter in the subsequent fall. Also, research has shown that students who delay college enrollment are less likely to finish (Bozick &

DeLuca, 2005). Thus, immediate entry appears to be a better benchmark for a successful transition into college than enrollment over an extended time period. We focused on four-year enrollment, as opposed to two- and four-year enrollment, because most high school students expect to attain at least a Bachelor's degree (Fox, Connolly & Snyder, 2005).

Analytic Approach

To address our first question, we replicated an approach used in prior literature which estimates the effects of school context on student test scores by partitioning and comparing the within- and between-school variance (Altonji & Mansfield, 2011; Borman & Dowling, 2010; Bryk & Raudenbush, 1988; Raudenbush & Willms, 1995).[5]

To address our second research question, we first identified a set of school practices that were most clearly supported by previous research and theory to influence students' college-going behaviors. To explore the relationship between high schools and the likelihood of students enrolling in a four-year college, we used a series of two-level hierarchical logistic models—with students (level 1) nested in high schools (level 2; see Base Equations 1a and 1b).

Base Equation:

Level 1:

$$\text{Probability}(Y = 1 \mid \eta_{ij}) = \exp(\eta_{ij}) / \ 1 + \exp(\eta_{ij}) \qquad [1a]$$

$$\text{where } \eta_{ij} = \beta_{0j} + e_{ij}$$

Level 2:

$$\beta_{0j} = \gamma_{00} + u_{0j} \qquad [1b]$$

We then, incrementally included clusters of student-level or school-level covariates to examine changes in student- and school-level variance (see Equations 2a and 2b).

Equation 2:

Level 1:

$$\text{Probability}(Y = 1 \mid \eta_{ij}) = \exp(\eta_{ij}) / \ 1 + \exp(\eta_{ij}) \qquad [2a]$$

$$\text{where } \eta_{ij} = \beta_{0j} + \sum\beta_{ij}(\text{student demographic characteristics}) +$$

$$\sum\beta_{ij}(\text{student pre-high school academic characteristics}) + e_{ij}$$

Level 2:

$$\beta_{0j} = \gamma_{00} + [\gamma_{10} \text{ High school characteristic}] + u_{0j} \qquad [2b]$$

Fixed effects for the Level 1 equation (2a) included demographic characteristics (i.e., race/ethnicity, gender, home language, born in the U.S, and residential borough) and pre-high school academic characteristics (i.e., eighth-grade English Language Arts exam, score on eighth-grade mathematics exam, and eighth-grade attendance). At Level 2 (2b), fixed effects for high school characteristics included: percentage of ninth graders who took AP exam, average measure of teachers' postsecondary expectations of students, and number of students per guidance counselor, as well as, in the final model, our additional controls for school size and selectivity.

To measure the proportion of the variance in the log odds of enrolling in a four-year college that is between high schools, we used the linear threshold model method because our outcome was dichotomous (see Equation 3; Snijders & Bosker, 1999).

$$\text{Pseudo Intra-class correlation (ICC)} = \rho_s = (\sigma_s^2 / (\sigma_s^2 + (\Pi^2 / 3)). \qquad [3]$$

where σ_s^2 is the between-high school (level 2) variance and $(\Pi^2 / 3)$ is the variance of the standard logistic distribution (where $\Pi \sim 3.14159$).

To answer our research questions about the remaining between-school variance in our outcome after accounting for student-level factors like demographic characteristics and pre-high school academic characteristics, we estimated the proportion of variance explained across our various models in comparison to our Base Model (see Equation 4; Raudenbush & Bryk, 2002).

$$\text{Proportion variance explained} = \frac{(\sigma_s^2(\text{unconditional}) - \sigma_s^2(\text{fitted}))}{(\sigma_s^2(\text{unconditional}))} \qquad [4]$$

where σ_s^2(unconditional) is the between high school variance from unconditional means model, and σ_s^2(fitted) is the between high school variance from fitted model.

RESULTS

Few students who entered the ninth grade in the fall of 2007 or the fall of 2008 entered a four-year college after high school. Only 28 percent entered a four-year college[6] in the fall immediately after the spring of their expected graduation (see Table 1 on the next page). However, the observed rates of four-year college enrollment differed a great deal by high school (see Figure 1 on page 13).

The distribution of four-year college-going rates across high schools was highly skewed. Half of New York City high schools had rates below the system average of 28 percent and only 10 percent of high schools had half of their entering ninth graders enroll in a four-year college after their expected high school graduation. One-quarter of high schools had a third of their incoming ninth graders enter a four-year college. While these large differences might suggest that high schools had radically different practices and policies when it came to preparing students for college entry, these differences could be attributed to the fact that these high schools served fairly different populations. In the next step of our analysis, we used multi-level logistic models to examine the extent to which differences across high schools could be largely attributed to the incoming demographic and academic characteristics of students.

Research Question One: How much school-level variation in four-year college enrollment is there across high schools?

To begin, we ran an unconditional means model (Model 1 in Table 2 on page 14), which included none of the student-level or school-level covariates, but which allowed us to calculate the baseline level of variation in four-year enrollment between schools. Using the estimates from Model 1, our baseline pseudo-ICC indicated that 19 percent of the variability in four-year college enrollment was accounted for by differences across high schools. In other words, the overwhelming majority of variation in students' four-year college enrollment, was *within* rather than between schools.

Table 1: Descriptive Means

		N	Mean	SD
Student level 8th grade academic performance	8th grade ELA exam score	103,618	646.42	31.52
	8th grade mathematics exam score	106,100	655	34.11
	Attendance in 8th grade	107,434	91.64	8.47
	Missing 8th grade ELA exam score	117,082	0.11	0.32
	Missing 8th grade mathematics exam score	117,082	0.09	0.29
	Missing attendance in 8th grade	117,082	0.08	0.27
Student level demographics	Asian	117,082	0.13	0.34
	Latino	117,082	0.4	0.49
	Black	117,082	0.34	0.47
	White	117,082	0.12	0.33
	Other Race	117,082	0.01	0.07
	Female	117,082	0.51	0.5
	Male	117,082	0.49	0.5
	Born in the U.S.	117,082	0.78	0.41
	Home Language is English	117,082	0.57	0.5
	Eligible for FRPL in 8th grade	117,082	0.62	0.49
	ELL in 8th grade	117,082	0.1	0.29
	Lives in Bronx	117,082	0.22	0.41
	Lives in Brooklyn	117,082	0.33	0.47
	Lives in Manhattan	117,082	0.12	0.32
	Lives in Queens	117,082	0.28	0.45
	Lives in Staten Island	117,082	0.06	0.24
	Missing Borough Information	117,082	0	0.06
Student-level HS academic measures	Cumulative Academic GPA 10th grade	117,082	72.65	11.51
	Took Advanced Course in 11th grade	117,082	0.5	0.5
	Max Regents Mathematics Exam Score in 10th grade	117,082	62.26	25.45
	Missing Regents 10th grade mathematics exam score	117,082	0.11	0.32
School characteristics	Perceptions of Teacher Expectations	117,082	3.31	0.13
	Percent of Students who Took an AP Exam	117,082	0.18	0.15
	Number of Students per Counselor	105,294	82.1	42.62
	Missing Counselor Information	117,082	0.1	0.3
College outcomes	Enrolled in Four-Year College	117,082	27.63	44.72
	Number of Students	117,082		
	Number of Schools	377		

Figure 1: Distribution of 8th Grade ELA Scores

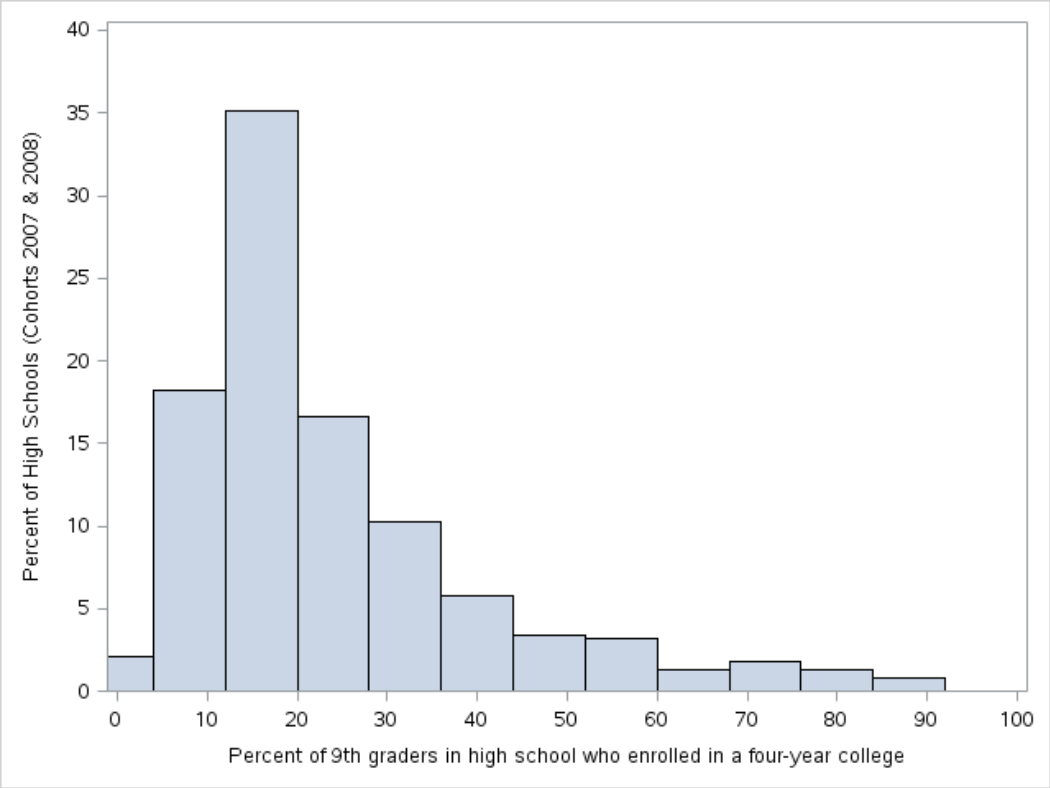

Table 2: Results from Logistic Regression Analysis

		Model 1			Model 2a			Model 2b			Model 3			Model 4			Model 5		
											B	SE		B	SE		B	SE	
	Intercept	-1.248	(0.05)	**	-1.272	(0.03)	**	-0.495	(0.06)	**	-0.739	(0.05)	**	-0.853	(0.06)	**	-0.855	(0.06)	**
Student level 8th grade academic performance	z8th grade ELA exam score				0.240	(0.01)	**				0.226	(0.01)	**	0.225	(0.01)	**	0.225	(0.01)	**
	z8th grade mathematics exam score				0.444	(0.01)	**				0.430	(0.01)	**	0.429	(0.01)	**	0.429	(0.01)	**
	zAttendance in 8th grade				0.327	(0.01)	**				0.316	(0.01)	**	0.314	(0.01)	**	0.314	(0.01)	**
Student level demographics	Asian							0.495	(0.03)	**	0.226	(0.03)	**	0.233	(0.03)	**	0.233	(0.03)	**
	Hispanic							-0.695	(0.03)	**	-0.545	(0.03)	**	-0.538	(0.03)	**	-0.539	(0.03)	**
	Black							-0.392	(0.03)	**	-0.206	(0.03)	**	-0.199	(0.03)	**	-0.200	(0.03)	**
	Other Race							-0.821	(0.11)	**	-0.715	(0.12)	**	-0.710	(0.12)	**	-0.706	(0.12)	**
	Male							-0.428	(0.02)	**	-0.378	(0.02)	**	-0.375	(0.02)	**	-0.375	(0.02)	**
	Born in the U.S.							-0.042	(0.02)	~	0.047	(0.02)	~	0.051	(0.02)	~	0.050	(0.02)	~
	Home Language is English							-0.314	(0.02)	**	-0.146	(0.02)	**	-0.145	(0.02)	**	-0.144	(0.02)	**
	Eligible for FRPL in 8th grade							-0.144	(0.02)	**	-0.052	(0.02)	*	-0.051	(0.02)	*	-0.052	(0.02)	*
	ELL in 8th grade							-0.763	(0.03)	**	-0.092	(0.04)	~	-0.094	(0.04)	~	-0.093	(0.04)	~
	Lives in Bronx							0.198	(0.04)	**	0.080	(0.04)	~	0.092	(0.04)	~	0.091	(0.04)	~
	Lives in Brooklyn							0.267	(0.04)	**	-0.038	(0.04)		-0.032	(0.04)		-0.030	(0.04)	
	Lives in Queens							0.379	(0.13)	*	0.051	(0.14)		0.039	(0.14)		0.038	(0.14)	
	Lives in Staten Island							0.432	(0.04)	**	0.092	(0.05)	~	0.089	(0.04)	~	0.084	(0.04)	
School characteristics	zPerceptions of Teacher Expectations													0.087	(0.01)	**	0.070	(0.01)	**
	zPercent of Students who Took an AP Exam													0.080	(0.01)	**	0.071	(0.01)	**
	zNumber of Students per Counselor													-0.036	(0.02)	~	0.014	(0.03)	
	zSchool Selectivity																-0.046	(0.01)	*
	zSchool Size																-0.064	(0.04)	
	-2 Res Log Pseudo-Likelihood	122,067			101,307			117,449			99,818			99,667			99,646		
	Variance between high schools	0.78	(0.06)	**	0.27	(0.02)	**	0.61	(0.05)	**	0.25	(0.02)	**	0.14	(0.01)	**	0.13	(0.01)	**
	Conditional Psuedo-ICC	19%			*8%*			*16%*			*7%*			4%			4%		.
	Proportion between school variance explained (from baseline)				65%			21%			68%			82%			83%		

Note: ~p<0.05, *p<0.01, **p<0.001; Estimation Method = Laplace; Cohort years=2007-2008, N students(first-time 9th graders) =117,082, N schools=377

This finding, which echoes much of the literature on school effects, indicates that although there may be differences in quality and practice between the various schools in New York City, we do not observe a clear division between "good" schools that send all of their students to college and "bad" schools that send none. Rather, most schools have student populations that display a wide range of college-going behaviors.

These initial findings also indicate that although we may find significant effects for malleable school practices on students' likelihood of enrolling in a four-year college, these effects will be relatively modest; they will only account for a percentage of the extant variation between schools, 19 percent in this case. We turn now to the question of how much of this between-school variation can be accounted for by the composition of the schools, that is, by the academic performance, personal history, and demographics of students even before they enter high school.

Research Question Two: How much of the between-school variation is associated with the incoming characteristics of students?

In order to answer our second research question, we built on the unconditional means model by first looking solely at students' incoming eighth-grade academic performance (Model 2a) and then solely demographic characteristics (Model 2b). We then included both sets of covariates in our model (Model 3). This approach allowed us to assess the extent to which students with stronger academic performance or more privileged backgrounds are entering different high schools and thereby driving any observed differences in college enrollment between schools.

Our results suggest that much of the variation in four-year college enrollment rates across high schools—65 percent of the 19 percent enrollment at baseline—was accounted for entirely by students' eighth-grade academic performance (Model 2a). In other words, a little more than 12 percent (.65 x 19% = 12.35%) of all the system-level variation in college enrollment can be explained by looking at students' 8th grade state test scores and 8th grade attendance.

By contrast, including only demographic and background characteristics, as we did in Model 2b, explained a more modest proportion of the between-school variance at baseline—only 21 percent of the 19 percent across schools, or just under 4 percent of all system-level variation (.21 x 19% = 3.99%). When we include both academic and demographic characteristics into the model, we explain a total of 68% of between-school variation, or almost 13 percent of all system-wide variation in college

enrollment (.68 x 19% = 12.92%). That is, demographic and background characteristics explain only an additional 3 percent of between-school variation, once we account for academic performance in eighth grade.

Although it is not the main focus of this analysis, it is worth emphasizing that the vast majority of the variation explained by demographic characteristics is also explained by eighth grade academic performance. That is, when we compare students with similar academics in eighth grade, adding information about their race/ethnicity or other aspects of their background only explains an additional 3 percent of the differences across schools in college enrollment. This is not to say that demographic differences do not matter for college enrollment. In fact, we would argue that the strong correlation between demographics and middle school academics suggests the contrary—that inequities in college preparation and access open up early in the school trajectory, prior to high school, and continue to drive student outcomes.

The low conditional, pseudo-ICC in Model 3 (7%) indicates that, after taking prior academics and demographics into account, the vast majority of the remaining variation in rates of four-year enrollment can be explained by differences within high schools rather than between high schools. In other words, the school's composition effects—the students and the prior experiences and characteristics they bring with them—are driving much of the between-school variance we observe in the system.

Research Question Three: After accounting for compositional effects, which malleable institutional practices and policies explain any remaining between-school variation in the rates of in a four-year college enrollment?

To address our third research question, we added three types of school-level covariates to the specification used in Model 3: teachers' postsecondary expectations for students, percentage of students who took an AP exam, and number of students per high school guidance counselor (Model 4).

These three school factors account for an additional 14 percentage points of the baseline between-schools variation in four-year enrollment, over and above that accounted for by the student-level characteristics—or an additional 2.7 percent of all variation system-wide (.14 x 19% = 2.7%). This is a relatively modest number in comparison with the amount of variation explained by student characteristics, but it is, nonetheless, significant. In combination with the other covariates, these school

factors explain a total of 82 percent of the baseline between-school variation, or close to 16% of all variation in four-year college enrollment rates.

As indicated in Model 4, two of these factors were highly statistically significant ($p<.001$). Students who attended high schools with higher teacher expectations and larger percentages of students taking an AP exam had significantly greater log odds of enrolling in a four-year college than students attending the typical high school. These findings are more interpretable as predicted probabilities, of course. Students attending high schools with high levels of postsecondary expectations had, on average, greater predicted probabilities of enrolling in a four-year college—approximately 27 percent—than their counterparts in high schools with lower levels of postsecondary expectations, where they had only an 18% chance of enrolling in a four-year college. Similarly, students in schools with high levels of AP-taking had a 26% chance of enrolling in a four-year college, on average, while students in schools with lower AP-taking had only a 21% chance.

As expected, our measure of the number of students per counselor was negatively, although weakly ($p<.05$), associated with the predicted log odds of four-year college enrollment. This finding suggests that although counseling does matter, it is perhaps less important than factors related to general academic or college-preparatory culture.

In the final phase of our analysis we added our two additional school-level controls—school size, as measured by enrollment in all four grades, and selectivity, as measured by the school's acceptance rate (Model 5). In part, we made these adjustments because we knew from prior literature that school size is a factor in student success in the New York City context. We were also concerned, however, that the high school factors we had identified might be correlated with school size—that it would be easier for a small school to have a large percentage of students taking AP exams, for example—and we wanted to be sure these findings held up regardless of how large or small the school was. We also suspected that we were not fully accounting for school selectivity with our measures of student-level characteristics.

With all five school features added in the model, postsecondary expectations and AP exam-taking remained highly statistically significant ($p<.001$). Selectivity was significantly, though less strongly ($p<.01$), associated with four-year college enrollment, probably because at least some of the student characteristics that drive school selection have already been accounted for in the model. Interestingly, school size was non-significant when controlling for selectivity and all the other factors in

the model, a finding that is somewhat at odds with other literature on the New York City schools landscape. Counseling capacity also became insignificant after these additional controls.

In terms of our account of variance in four-year enrollment, the additional two school-level predictors contributed only marginally to the overall between-school variation explained—only 83% of the baseline between-school variation in comparison to Model 4's 82%.

We consider two of these findings to be particularly noteworthy. First, that teacher expectations and AP exam-taking remained highly significant even after controlling for school size and selectivity was a noteworthy and promising discovery. Both of these are school features confirm the larger evidence base for high academic expectations and college-going culture. The fact that they are important regardless of how selective the school is, and regardless of whom the school serves, suggests that they may be a worthy focus for further study.

Second, the fact that school selectivity, as measured here by acceptance rate, is statistically significant, even given the wide range of other control variables in the model, is somewhat troubling from a research perspective. A large body of work using national datasets has attempted to control for selection issues at the school-level by including a wide range of student-level controls. At least in New York City, however, this approach appears insufficient to account for selection. Whether and how this concern may implicate research at the national level is less clear.

DISCUSSION AND CONCLUSION

The purpose of this study was to set the stage for forthcoming work that rigorously investigates the role of high schools in shaping students' college outcomes. Our initial results in this paper mirror much of the prior school effects literature, but we also found evidence of two promising school practices that contribute to rates of four-year college enrollment.

First, we found that variability in four-year college enrollment was largely within schools rather than between schools, and that much of the variation across the system was explained by students' previous academic performance and background characteristics. This result suggests that high schools are only modestly responsible for students' postsecondary outcomes; much of what prepares and motivates a

student to attend college has already begun to take shape even before students walk through the doors on the first day of high school.

And yet the large within-school variation also underscores the universal challenge schools face in preparing to send their students on to college. There were relatively few schools where the entire student body went on to college, or where almost none of the students enrolled in college. Rather, almost all schools we observed faced a diverse set of outcomes for their students and must therefore work to ensure more *equitable* access to postsecondary educational opportunities.

We also found evidence of promising school practices that significantly improved students' chances of immediate enrollment in a four-year college, over and above what their academic and demographic characteristics would predict. Establishing high expectations for students' postsecondary attainment seems to matter for four-year college enrollment. And this pattern of significance held even after controlling for student demographic and academic characteristics, as well as school selectivity. The finding on postsecondary expectations is particularly interesting given that the wording of the survey item did not specify the level of postsecondary institution (two-year versus four-year enrollment) that teachers expected students to enter after high school, yet it was significantly associated with four-year college enrollment. This could mean that the item conceals teachers' expectations for students to enter four-year colleges after high school, or it could simply mean that general expectations for postsecondary enrollment matters for all students. Nonetheless, this finding suggests that schools could improve the college outcomes by developing a climate of high educational expectations for students.

We also found that fostering a school-wide culture of AP test taking was significantly related to college enrollment. This finding is remarkable given that we measured AP exam taking not AP test *passing*. In addition, the broader research evidence on the effect of advanced course taking in high school on college outcomes at the student level is mixed (Ferenstein & Hershbein, 2013).

By contrast, our measure of the number of students per guidance counselor was not significantly associated with four-year college enrollment. This finding could suggest that the quality of college counseling, rather than the quantity of guidance counselors, was important for rates of four-year college enrollment (McDonough, 2005). This finding could also reflect the imprecise nature of this measure of professional capacity. For example, a growing number of community-based organizations in NYC work with high schools to serve as providers of college guidance and support to NYC DOE

students. However, these external providers would not be accounted for in the NYC DOE's human resource database.

Our findings also carry some interesting methodological implications, particularly for the decomposition of variance approach, which has most often been conducted at the student- and school-level. The NYC high school choice process, which requires that incoming ninth-graders apply directly to their preferred program, suggests that, at a minimum, high school program needs to be included as another level in our multi-level models. More broadly, it suggests that school selection and curricular tracking—which have typically been treated as separate matters in the literature—are part of the same phenomenon in the New York City context.

Another methodological concern is the fact that our initial models—which controlled for at least as many student factors as other studies in this line of work—identified a set of effective schools that are also turned out to be significantly more selective than average and below-average schools. Either the most effective schools were simply better at attracting the students most likely to be successful, or schools with the strongest practices were also the most coveted spots in the district. Current value-added approaches are not designed to differentiate between these two possibilities, and this is a challenge that other studies in this line of research will also need to face.

In terms of policy implications, findings from this study suggest the need for a certain degree of caution in the use of accountability measures for high schools, particularly when ranking high schools according to the college outcomes of their students. If much of both the within- and between-school variation in college enrollment is explained largely by students' experiences and backgrounds prior to high school, then it seems both unfair and unhelpful to punish or reward schools based on outcomes over which they have only a modest degree of influence. This is also an area of ongoing policy change. It is only recently that the NYC DOE has shifted their attention from decreasing high school dropout rates to improving college access and readiness for all students;[7] thus, we may continue to see changes in the patterns of college enrollment across the system as high schools begin to respond.

Taken as a whole, this study describes the vast and challenging task high schools face in preparing their most underserved students to enroll in college. They must complete in four years the preparatory work that many students have begun even before arriving in high school. And this problem is not one that is limited to a few struggling high schools or a few particularly ambitious ones; all administrations and

staff need resources and guidance on preparing their students to enter college after graduation.

Limitations

As a first look at the relationship between high school practices and patterns of four-year college enrollment, this study had a number of data and design limitations that have implications for the interpretation and generalizability of our findings.

First, this study did not test for heterogeneity of school effects by student subgroups, which recent work recommends (Jennings et al., 2015),[8] and future work will need to determine the extent to which these findings are sensitive to sample and imputation method.[9]

Our use of a dichotomous outcome within a multi-level regression framework also presented some analytic challenges as well as challenges for interpretation. In contrast with linear regression, where the outcome is continuous and the total variance can be clearly partitioned into level-1 (within) and level-2 (between) variance, the level 2 variance in logistic regression is fully determined by level 1 variance and is not estimated on a comparable scale (Larsen & Merlo, 2005; Larsen et al., 2000; Merlo et al., 2006). Although we chose to use a linear threshold correction (Snijders & Bosker, 1999), there are other strategies for generating more interpretable pseudo-ICCs, and we may need to consider these in future analyses.

Other potential design features that require further investigation and robustness tests included: a broad definition of advanced coursework, the exclusion of the smallest of high schools (fewer than 15 in a cohort), the use of fixed high school characteristics based on year of entry, the use of NYC DOE High School Directory information from a single year, the use of only two cohorts of students, and the use of fixed level-1 slopes.

Despite these limitations, however, this study was able to incorporate a wide range of student-level controls that are unavailable in the national datasets that form the basis for most of the school effects literature. We were also able to incorporate more direct evidence of selection in the form of high school acceptance rates—a feature that is unprecedented in previous work of this kind. These design features, in addition to the consistency of our findings with previous literature, suggest that although some aspects of this study may require additional fine-tuning, the overall pattern of results are likely to be stable and accurate.

Next Steps

There are several extensions of our present analysis that we intend to pursue, including, most immediately, adding a range of other school practices and interactions into the models. One of the great benefits of the Partnership dataset is its wide range of data sources, and there remains much to do even within the current research structure.

Given the extant evidence that school effects may differ by student subgroup, we also plan to examine potential heterogeneity in school-level effects by race-ethnicity, socio-economic status, and academic ability.

There are also alternative research designs that we think may be better able to address issues of self-selection. The most promising potential direction is to leverage the data from the NYC high school choice process to address issues of selection. Although this approach would require a narrower research design—examining only those students who applied to oversubscribed schools and were subject to a lottery, it has the value of estimating causal effects of attending high schools employing promising strategies to improve four-year college enrollment.

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APPENDIX 1: ADDITIONAL FIGURES

Figure A-1: Distribution of 8th Grade ELA Scores

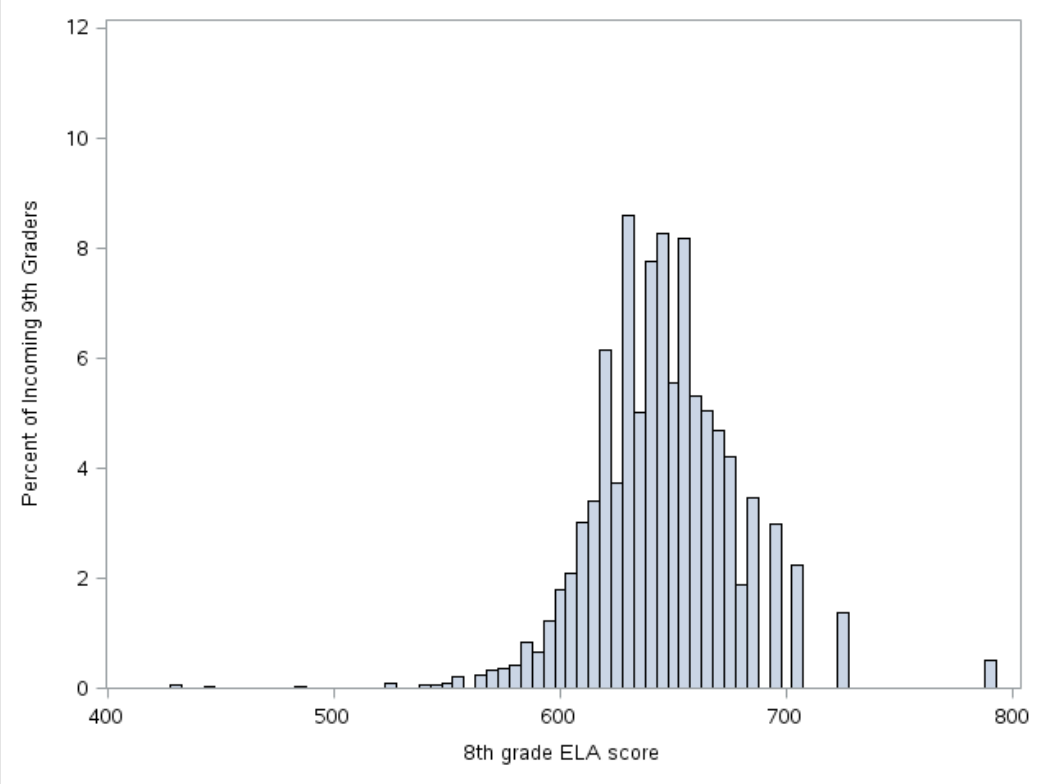
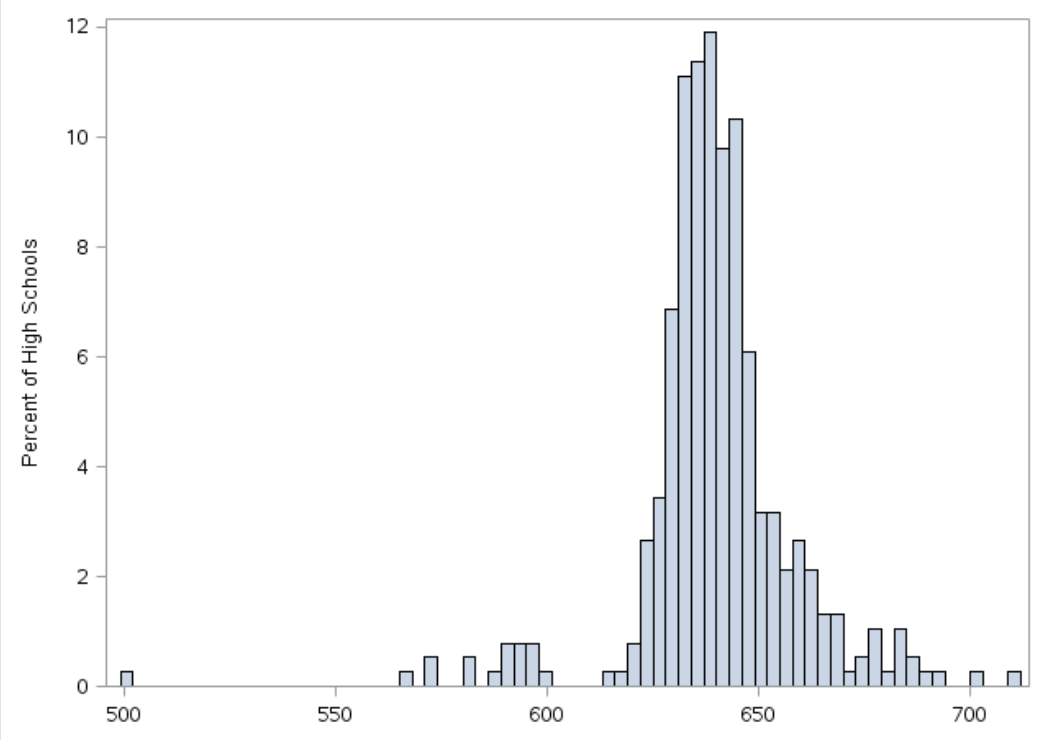


Figure A-2: Distribution of Average Incoming 8th Grade ELA Scores by High School



NOTES

[1] In fact, there is strong evidence for this phenomenon in New York City in the distribution of student eighth-grade English Language Arts (ELA) examination scores. Although individual exam scores are normally distributed with an average score of 646 (see Appendix Figure A-1), most high schools' average incoming ELA exam scores are well below the system average, and only a few high schools have incoming cohorts with above average ELA exam scores (see Appendix Figure A-2). These results suggest a fair amount of "creaming" or "skimming" of high achieving eighth graders into relatively few high schools.

[2] https://nces.ed.gov/surveys/hsls09/tables/educationalexpectations2009_01.asp

[3] http://schools.nyc.gov/AboutUs/default.htm

[4] http://schools.nyc.gov/NR/rdonlyres/BF952AB6-FD22-4E0B-94A4-713B7472B359/0/DemographicSnapshot201011to201415Public_FINAL.xlsx

[5] Raudenbush and Willms (1995) caution that this method produces school effects estimates that are highly sensitive to model specification—a challenge that is of particular concern to the present study because of the wide range of information about schools available in our data set. For example, this line of work has produced widely divergent results, with some studies finding as much as 30-40 percent of the variance in student outcomes accounted for by schools (Borman & Dowling, 2010; Bryk & Raudenbush, 1988), and others estimating that schools account for a far more modest portion of variance in test scores, less than 10% on average (Lauen & Gaddis, 2013).

[6] Some of these students entered a Bachelor's degree program in a local "comprehensive" college that offers Associate's and Bachelor's degrees. We refer to these students has entering a "four-year college" if they entered a Bachelor's degree program.

[7] In 2015, Mayor Bill de Blasio's "Equity and Excellence" speech defined his goals and strategies for improving college access and readiness for New York City students.

[8] Many of the limitations described here have also been documented in the larger body of work on school effects, including the sensitivity of school-level estimates to model specification (Raudenbush & Willms, 1995), the heterogeneity of school effects by student race-ethnicity and socio-economic status (Jennings et al., 2015; Lauen & Gaddis, 2013; Legewie & DiPrete, 2012; Bryk & Driscoll, 1988), and the difficulty of differentiating between the effects of selection and the effects of school practices (Jennings, et al., 2015; Lauen & Gaddis, 2013; Raudenbush & Willms, 1995). This final issue is a matter of particular concern in NYC and other contexts of high school choice, which present additional challenges but also a greater range of opportunities to measure and control for selection.

[9] Eighth-grade test scores and survey data were imputed to the grand mean, which may have downwardly biased our estimates of between-school variance. The 5 percent of students who were missing multiple markers of academic performance in high school were simply dropped from the sample.