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Educating bright students in urban schools

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ABSTRACT

Our study analyzes the impact of the International Baccalaureate Diploma Programme, a college-preparatory educational program designed for higher-achieving students, on high school academic achievement in Chicago Public Schools. We exploit exogenous variation in the offering of the program across schools over time with a difference-in-differences framework. We estimate a positive effect of the program on the probability of obtaining a B average or better in coursework, with most of the effect accruing to performance in mathematics. Most importantly, the program led to a decrease in the likelihood of high school dropout and an increase in the probability of high school graduation.

1. Introduction

Chicago Public Schools (CPS) is one of the largest urban public school districts in the United States, currently serving over 400,000 students of predominantly racial/ethnic minorities and largely from lower-income families. In the 2011–2012 school year, 87 percent of CPS students were low-income, in comparison to 49 percent across all Illinois public school students (Illinois State Board of Education, 2013). Blacks and Hispanics comprised 42 and 44 percent, respectively, of the CPS student body; in contrast, only 18 percent of all Illinois public school students were black, and 24 percent were Hispanic. CPS also serves an extremely mobile student population: the CPS mobility rate is 18 percent, while that of Illinois public schools is 13 percent.[3] Moreover, residents of Chicago tend to live in lower-income and higher-poverty neighborhoods than do Illinois residents: in 2011, the median family income for Chicago was $49,442 versus $65,579 for all Illinois families, and the family poverty rate for Chicago was close to 20 percent, relative to 11 percent for the entire state of Illinois (United States Census Bureau, 2011).

These key socioeconomic characteristics indicate that, as a whole, CPS serves an extremely disadvantaged student population. In addition, high school academic achievement in CPS has been poor on several critical measures of performance, including letter grades in school coursework, graduation rates, and dropout rates, impeding access to higher education for many students.[4] To improve academic

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[3] The mobility rate for the 2011–2012 school year is defined as the total number of students who transferred into and out of a particular school from October 2011 to the end of the academic year, divided by the average daily enrollment.

[4] For 1993 through 2006, average course grades were in the low-C/high-D range (authors' calculation using administrative data). For 1999 through 2012, the five-year graduation rate has ranged from 47 percent to 61 percent, while the five-year dropout rate has ranged from 35 percent to 51 percent (CPS, 2012a).

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performance, CPS implemented high school reforms beginning in the late 1990s. Curriculum reform efforts have included the requirement that each student complete a college-preparatory curriculum (Lee & Ready, 2009), the introduction of two-period (“double-dose”) Algebra courses in 9th grade for students who performed below grade level on their 8th grade mathematics examination (Cortes, Goodman, & Nomi, 2013a, 2013b; Nomi & Allensworth, 2009), as well as increased offerings of honors, Advanced Placement (AP), and International Baccalaureate (IB) coursework for higher-achieving students (Coca et al., 2012; Lee & Ready, 2009).

Our study uses detailed administrative data from CPS to estimate the impact of the IB Diploma Programme on various high school student outcomes. We exploit exogenous variation in the offering of the program across CPS high schools over time with a difference-in-differences estimation strategy. The IB Diploma Programme is a two-year (11th and 12th grade), college-preparatory, academic program offered to higher-achieving students in IB World Schools, high schools accredited by the International Baccalaureate Organization (IBO) to offer the program. Prior to the 1999–2000 academic year, Lincoln Park High School was the only IB World School in CPS, having offered the IB Diploma Programme since 1981. Based on the documented success of the program in preparing Lincoln Park students for higher education, beginning with the 1999–2000 school year, the IB Diploma Programme expanded to additional CPS high schools located throughout the city of Chicago (Roderick, Nagaoka, Coca, & Moeller, 2009).

Overall, we find that the IB Diploma Programme in CPS improved academic achievement along multiple dimensions for this disadvantaged group of students. Our course performance results indicate that the program increased the probability of obtaining a B average or better in 11th grade coursework by 2.6 percentage points, relative to a mean of 18.7 percent. Most of this overall boost in achievement accrued to course performance in mathematics, with smaller effects in English, social science, and science. Most importantly, the IB Diploma Programme improved educational attainment, as measured by high school dropout and graduation rates. Students were less likely to drop out of high school by 2.6 percentage points, compared with the mean of 19.1 percent, and were more likely to graduate from high school by 3.9 percentage points, in relation to a mean of 76.4 percent. Most promising, for black students, their graduation rate increased by 5.3 percentage points, an improvement of seven percent off of the mean graduation rate of 73.8 percent for this high-achieving and low-income group of students.

In an era of school accountability in the United States, educational policies are often focused on improving the academic performance of lower-achieving students. However, it is also very important to design and implement programs that benefit higher-achieving students in urban school districts, as such programs have the potential to better prepare these students for postsecondary education and ultimately help them develop the necessary skills to be more competitive in the labor market.

2. IB Diploma Programme and previous research in CPS

In CPS, a student submits an application for the IB Diploma Programme during 8th grade. Minimum eligibility is based on the student’s performance in the previous school year on standardized examinations in reading comprehension and mathematics, as well as in coursework. At the present time, to be minimally eligible a student must score at or above the 40th percentile on both the reading and mathematics standardized examinations, as well as have a GPA of 2.5 or higher in reading, mathematics, social science, and science coursework.[5] Students accepted to the program complete honors coursework in 9th and 10th grades, offered through the IB Middle Years Programme at some schools, in preparation for the formal program that begins in 11th grade.[6]

As stipulated by the IBO, to earn an IB Diploma a student must complete coursework in six subject areas (studies in language and literature, language acquisition, individuals and societies, experimental sciences, mathematics and computer science, and the arts), a critical-thinking course (Theory of Knowledge), an independent research project (Extended Essay), and service learning projects to complement their academic studies (Creativity, Action, Service).[7] Students are evaluated on their performance in written examinations, which are scored by external IB-certified examiners, and school-level assessments, which are graded by teachers at the students’ schools and then sent to external examiners or are sent directly to the external examiners. Participants in the program earn a maximum of 45 points: one to seven points based on their performance in each of the six subject areas and up to three additional points for their performance in the Theory of Knowledge course and the Extended Essay. Students must receive a minimum of 24 points to be awarded an IB Diploma, provided that they

[5] CPS (2012b) contains more information about IB Diploma Programme eligibility requirements in CPS for the 2013–2014 school, as described on the 2013–2014 school year student application form. A student may apply to multiple IB World Schools; it is not required that a student attend her neighborhood (i.e., local attendance area) school. Prior to the 2012–2013 school year, a student had to score at or above the 60th percentile in both reading and mathematics to be eligible for the IB Diploma Programme. This is described in the 2009–2010 school year CPS high school program handbook (CPS, 2008), which contains additional information about program eligibility requirements in CPS for this school year.

[6] CPS (2012c) contains the scoring guide for program admission in the 2013–2014 school year. For applicants that meet the minimum eligibility requirements, admissions scores are determined based on standardized examination percentile scores (225 points for each of the two examinations, for a total of 450 points) and coursework grades (112.5 points for each of the four subjects, for a total of 450 points). If a student applies to an IB World School that is her neighborhood school, then she receives an additional 50 points. Each school sets a cutoff score for admission, though the requirements for an IB Diploma are set by the IBO for all IB World Schools.

[7] A student must complete coursework in each of the first five subject areas. A student must also complete coursework in the arts or additional coursework in one of the first five subject areas. IBO (2013) contains additional information about the curriculum.

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meet the Creativity, Action, Service requirement and other performance standards.[8]

As part of their study on college readiness and attendance for CPS students enrolled in academically challenging high school programs, Roderick et al. (2009) compared overall high school GPAs for 2003–2006 graduates of the IB Diploma Programme in CPS to GPAs for graduates of a comparison group of schools (selective enrollment schools) using a two-level (student and high school) hierarchical linear model. The authors found that IB Diploma Programme graduates had higher GPAs than graduates in the comparison group.

Saavedra (2011) looked at the impact of the IB Diploma Programme in CPS on high school and post-high school academic achievement for students who entered the program in 2002, 2003, 2004, and 2006. Outcomes included the propensity to take the ACT college entrance examination and ACT examination scores, high school graduation, and two- or four-year college enrollment. The author used a propensity score matching strategy to form a weighted comparison group of students who attended the same schools as the IB Diploma Programme students, had very similar observable baseline characteristics as these students, but did not enroll in the program themselves. Relative to this weighted comparison group, the author estimated that students enrolled in the program in 11th grade were more likely to take the ACT examination, performed better on the ACT examination, were more likely to graduate from high school, and had a higher propensity to enroll in college. Disaggregating by gender, the author found that the effects of the program on achievement were larger for boys.

Lastly, Coca et al. (2012) examined the impact of the IB Diploma Programme in CPS on postsecondary academic outcomes, including the probability of entering college and persistence in college, for students who graduated from CPS between 2003 and 2009. To account for non-random student selection into the IB Diploma Programme, the authors used propensity score matching to create a comparison group of students who would have enrolled in the program based on their propensity scores but did not. Relative to the matched comparison group, the authors found that students enrolled in the program in 11th grade were more likely to attend a four-year college, attend a more selective college, and persist for two years in a four-year college.

While our research and the three aforementioned studies analyze the same educational policy, there are key differences. First, instead of primarily investigating the longer-term effects of the IB Diploma Programme on postsecondary outcomes, we focus on an earlier stage of the life course, examining more-immediate impacts of the program on student academic achievement in high school, including both overall and subject-specific course performance in 11th grade and outcomes related to high school completion. These outcomes are particularly important when studying academic achievement in CPS because of the district's overall poor course performance, as well as its low graduation and high dropout rates. Second, while Roderick et al. (2009), Saavedra (2011), and Coca et al. (2012) used data from after the expansion of the IB Diploma Programme in CPS, we instead use a difference-in-differences identification strategy, comparing, before and after the expansion of the program, outcomes for students at schools that offered the program to outcomes for students at schools that did not.

3. Empirical strategy

To determine whether the IB Diploma Programme had an effect on high school academic outcomes, we use a difference-in-differences framework, exploiting exogenous variation in the offering of the program across CPS high schools over time. In other words, with IB World Schools as the treatment group and non-IB World Schools as the control group, we compare changes in outcomes for students at IB World Schools, prior to and subsequent to the expansion of the IB Diploma Programme, to changes in outcomes for students at schools that never offered the program, over the same time period. To that end, we estimate the following model on repeated cross sections of 11th grade CPS students:

$$Y_{ijt} = \alpha + \beta \cdot IB_{jt} + \delta' X_{ijt} + \eta_j + \lambda_j \cdot t + \gamma_t + \varepsilon_{ijt}, \quad (1)$$

where Y_{ijt} is an indicator variable for an academic outcome for student i enrolled in high school j in academic year t: B or better overall course performance in 11th grade ($\geq$3.0 GPA), B or better performance in one of four 11th grade subjects (mathematics, English, social science, or science), high school dropout, or high school graduation.

The explanatory variable of interest is IB_{jt}, an indicator for whether high school j offered the IB Diploma Programme in academic year t. As we will show later, only a portion of the students in an IB World School in a particular academic year are actually in the IB Diploma Programme. The remaining students in an IB World School are typically in that school because it is their neighborhood (i.e., local attendance area) school. Because the decision to enroll in the IB Diploma Programme is endogenous to student outcomes, we model the effects of attending a high school that offered the program, regardless of whether a student herself was actually enrolled in the program at the school. For example, if higher-achieving and/or intellectually motivated students selected into the program, then comparing students in the program to students not in the program, in the same school or across schools, would overstate the true impacts of the program on academic achievement. Essentially, part of the estimated effects of the program would be attributable not to the program itself but to differences in baseline performance and/or motivation across program

[8] IBO (2011) contains more information about the requirements for an IB Diploma. In 2012, 119,000 students worldwide were enrolled in the IB Diploma Programme, with a passing rate of 78 percent and an average program score of 30 (IBO, 2012a).

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participants and non-participants.[9] For policymakers to properly assess whether the expansion of the IB Diploma Programme improved student outcomes, they must be able to separate the causal impacts of the program from the characteristics of the students who select into it. Moreover, because of shared school facilities, the presence of IB Diploma Programme students in a school may have spillovers to students who attend the same school but are not enrolled in the program, potentially confounding the estimated effects of the program when comparing program enrollees to non-enrollees at a particular school.

X_{ijt} is a vector of student-level and neighborhood-level (census block group) demographic characteristics. η_j are high school fixed effects, $\lambda_j \cdot t$ are high school-specific linear academic year time trends, γ_t are academic year fixed effects, and ε_{ijt} is an idiosyncratic error term that allows for clustering at the high school level. The fixed effects and time trends are crucial in ensuring that our coefficient of interest, β, correctly measures the impact of the IB Diploma Programme on student outcomes. The school fixed effects capture any time-invariant (permanent) differences between high schools that offered the program and those that did not, such as permanent differences in school infrastructure and in teacher quality across schools. The year fixed effects control for any trend in student achievement that is common across all high schools, such as curriculum changes that apply to all high schools. Finally, the school-specific linear time trends further capture linear trends in student outcomes that are specific to a particular school, such as an upward trend in graduation rates at a given school over the entire period of our analysis.

Under the standard difference-in-differences identifying assumption of parallel trends in student outcomes, β is an unbiased estimator of the effect of the IB Diploma Programme on student outcomes. That is, had the program not expanded, it must be the case that trends in student outcomes would have been identical across high schools that actually were going to offer the program and those that were not. This assumption ensures that $\hat{\beta}$ measures the underlying effect of the program on academic performance and does not simply reflect variation in student outcomes due to, say, different trends over time in the demographic characteristics of students who attended IB World Schools versus students who attended other CPS high schools.

4. Data and descriptive statistics

The data for this study come from CPS administrative student records, covering the universe of 11th grade students in CPS from the 1993–1994 to the 2005–2006 academic years. We link each student's record to her individual transcript file, which includes course titles and course letter grades. The data also include a detailed set of descriptive variables about each student, as well as 1990 and 2000 neighborhood characteristics for the census block group of residence. Moreover, we can determine whether a student dropped out of or graduated from a CPS high school.[10]

We focus on students enrolled in regular high schools (i.e., excluding vocational, full magnet, and alternative schools). We also restrict the analytic sample to first-time 11th grade students; for consistency, if a student repeated 11th grade one or more times, we only use her first instance of 11th grade in the data.[11] Thirteen high schools offered the IB Diploma Programme in at least one academic year of our data (i.e., were IB World Schools); we count a high school as having offered the program in a particular academic year if it offered at least one IB Diploma Programme course in that academic year.

Fig. 1 shows the fraction of students enrolled in the IB Diploma Programme by academic year, constructed using all students in our analytic sample. Prior to the 1999–2000 academic year, only Lincoln Park High School offered the IB Diploma Programme. Beginning with the 1999–2000 academic year, the program was offered at additional CPS high schools. Other than at Lincoln Park, only a small portion of an IB World School serves students in the IB Diploma Programme, with generally one or two classrooms of program participants in each grade (Coca et al., 2012). This is reflected in Fig. 1, as one half of one percent of students were enrolled in the IB Diploma Programme before the 1999–2000 school year, whereas 2–3.5 percent were enrolled in the program from the 1999–2000 school year onwards.[12]

Summary statistics for our analytic sample are reported in Table 1. Panel A represents the descriptive statistics for the outcome variables of interest. The academic performance of the students in our full sample is such that 19 percent achieved at least a B average in

[9] Recall that, while a student receives an extra 50 points towards her admissions score if she applies to an IB World School that is her neighborhood school, students can apply to non-neighborhood IB World Schools, and the great majority of the points (900) are based on academic performance. Fig. 1 in Coca et al. (2012) shows the locations of all IB World Schools in CPS, as of 2006. Schools are not clustered in one particular area: some schools are located in neighborhoods with majority black residents, while others are located in neighborhoods with majority Hispanic or majority white residents. Hence, for many families IB World Schools are available close to their homes, reducing the need for educationally motivated households to relocate in response to the expansion of the program in CPS.

[10] For a student who leaves CPS, our data contain the reason for leaving, such as graduation, dropout, transferring to a private school, or moving out of Chicago. We construct our high school graduation and dropout variables using these leave reasons, implying that our estimated effects of the IB Diploma Programme on graduation are not simply the opposites of the effects on dropout, due to the presence of alternative reasons for not continuing enrollment in CPS.

[11] For the dropout and graduation outcome variables, we drop students in the final two years of our data because we do not know whether these students ultimately dropped out of or graduated from high school.

[12] The pattern in IB Diploma Programme enrollment over time is similar if we include only the students who attended one of the 13 IB World Schools in any year. Approximately one percent of students in the 13 IB World Schools were enrolled in the program prior to the 1999–2000 academic year, while 5–10 percent were enrolled in the program starting with the 1999–2000 academic year.

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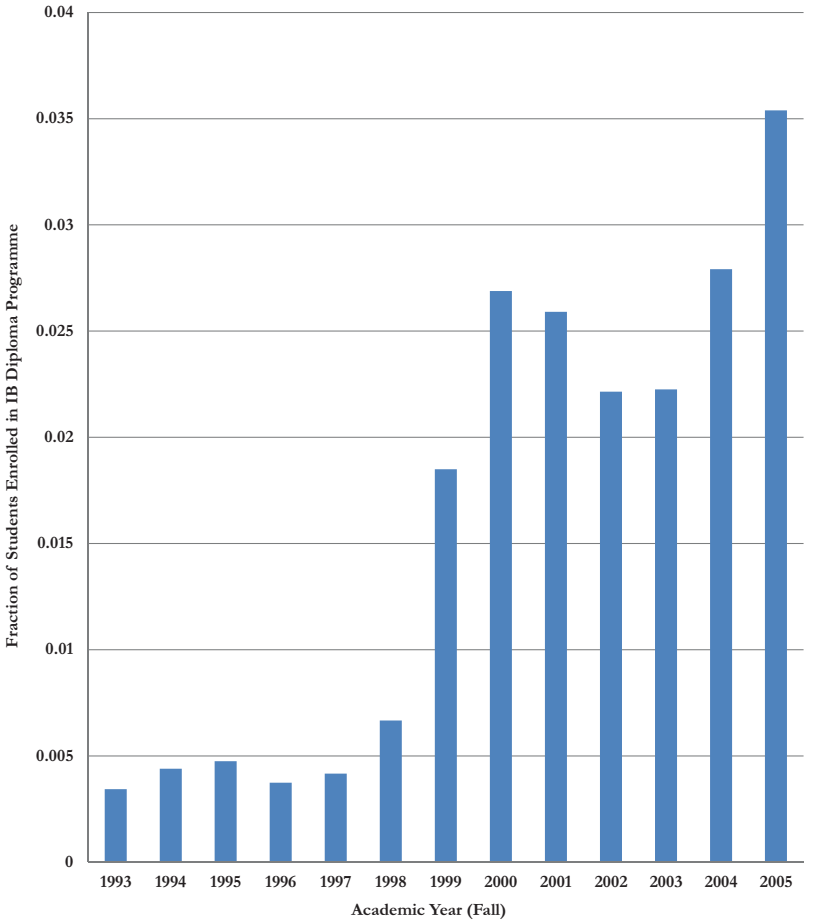

Fig. 1. IB Diploma Programme enrollment.

their 11th grade coursework, 19 percent dropped out of high school at some point in time, and 76 percent graduated from high school. Panels B and C display descriptive statistics for the student-level and neighborhood-level demographic characteristics, respectively, used in our analysis.

Table 1 also disaggregates the full sample into the subsample of students who attended one of the 13 IB World Schools in any year (column (2)) and the subsample of students who attended one of the remaining high schools (column (3)). Comparing the summary statistics for the outcome variables across students in IB World Schools and non-IB World Schools, we find that students in IB World Schools, on average, received higher course grades, were less likely to drop out of high school, and were more likely to graduate from high school.

For student-level characteristics, students in IB World Schools were more likely to be white, Hispanic, or Asian and were less likely to be black, relative to students in non-IB World Schools. Students in IB World Schools were also more likely to receive bilingual education. Age, gender, and parental guardian status were very similar for students in both groups. Finally, for neighborhood-level characteristics, as compared to students in non-IB World Schools, students in IB World Schools lived in neighborhoods with higher family incomes, lower percent school-age individuals, smaller percent Hispanic individuals, lower percent black individuals, higher mean education levels, and smaller poverty rates.[13]

However, the differences in demographic characteristics across IB World Schools and non-IB World Schools generally do not vary with the expansion of the program. For each demographic characteristic in Table 1, Table 2

[13] While our analysis does not compare outcomes across IB Diploma Programme participants and non-participants in IB World Schools, due to issues with non-random selection of students into the program and spillover effects, we can examine the characteristics of program participants, relative to the characteristics of the remaining students in the IB World Schools. As compared to non-participants, participants, on average, earned higher grades, were less likely to drop out of high school, and were more likely to graduate from high school. They were also more likely to be white, Asian, or bilingual but less likely to be black, Hispanic, male, or living with a biological parent. Participants also resided in neighborhoods with greater family incomes, smaller percent school-age individuals, higher percent Hispanic individuals, lower percent black individuals, greater mean education levels, and smaller poverty rates.

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Table 1
Summary statistics for 11th grade Chicago public high school students, 1993–1994 to 2005–2006.

	Full sample	IB World Schools	Non-IB World Schools
	(1)	(2)	(3)
Panel A: outcome variables			
B or better overall (≥3.0 GPA)	0.187	0.213	0.173
Observations	179,002	63,688	115,314
High school dropout	0.191	0.149	0.214
High school graduation	0.764	0.807	0.741
Observations	149,629	53,041	96,588
Panel B: student characteristics			
Age	16.330	16.272	16.362
	(0.706)	(0.673)	(0.722)
Male	0.463	0.463	0.464
White	0.112	0.184	0.072
Black	0.492	0.388	0.549
Hispanic	0.354	0.366	0.348
Asian	0.041	0.061	0.029
American Indian	0.001	0.002	0.001
Bilingual education	0.402	0.461	0.369
Lives with biological parent	0.844	0.847	0.842
Observations	179,002	63,688	115,314
Panel C: neighborhood characteristics			
Median family income	33,181	38,494	30,247
	(15,907)	(17,681)	(13,998)
Percent school age (5–18)	0.231	0.211	0.241
	(0.074)	(0.070)	(0.073)
Percent Hispanic	0.273	0.259	0.281
	(0.319)	(0.284)	(0.337)
Percent black	0.448	0.337	0.509
	(0.447)	(0.417)	(0.451)
Mean education	11.897	12.099	11.785
	(1.253)	(1.273)	(1.228)
Percent in poverty	0.232	0.167	0.267
	(0.187)	(0.150)	(0.195)
Observations	179,002	63,688	115,314

Notes: The full sample consists of all first-time 11th grade students in regular high schools (i.e., excluding vocational, full magnet, and alternative schools) in the 1993–1994 through 2005–2006 school years. The IB World Schools subsample is the subset of students who attended one of the 13 high schools that offered the IB Diploma Programme in at least one academic year of our data. For the non-binary variables, standard deviations are in parentheses.

reports the coefficient on the IB Diploma Programme indicator from separate difference-in-differences regressions, with each demographic characteristic as the dependent variable, controlling for high school fixed effects, school-specific linear time trends, and year fixed effects. For almost all of the characteristics, there is a very small and statistically insignificant change in the characteristic over time between IB World Schools and non-IB World Schools. The only exception is a marginally significant (p-value = 0.096) positive correlation between the IB Diploma Programme and neighborhood median family income, though the coefficient estimate in Table 2 ($1087) is much smaller than the raw difference in neighborhood median family income between the last two columns of Table 1 ($8247). Overall, the findings in Table 2 support the validity of our difference-in-differences estimation strategy, helping to ensure that we estimate the underlying impact of the IB Diploma Programme on student achievement.[14]

5. Empirical results and discussion

Tables 3 and 4 report the ordinary least squares estimates of β from our difference-in-differences empirical specification, giving the impact of the IB Diploma Programme (attending a high school that offered the IB Diploma Programme in a particular academic year) on several high school academic outcomes. Table 3 presents the course performance results, and Table 4 reports the high school dropout and graduation findings. Within each table, the top set of results is for the full sample of students, the second set is for the black subsample, and the third set is for the Hispanic subsample. We focus on these two student subgroups because they together comprise 85 percent of our analytic sample.

Each column cell contains the difference-in-differences estimate for a different regression specification. All specifications include high school fixed effects, high school-specific linear academic year time trends, and academic year fixed effects. Column (1) does not contain additional control variables, column (2) adds in student-level demographic characteristics, and, lastly, column (3) controls for both student-level and neighborhood-level demographic characteristics. Because our estimated IB Diploma Programme effects are similar across columns, for brevity we present only the columns (1) and (3) specifications in panel B of Table 3.

As a point of comparison and for ease of interpretation, we discuss not only the coefficient estimates, which give the effect of the program on the probability that each outcome variable is equal to one, but also the semi-elasticity estimates, obtained by dividing each coefficient estimate by the sample mean of the outcome variable. Semi-elasticities are useful in this context for understanding and comparing the magnitudes of the program effects because they describe the impacts of the program as percentage changes in the outcome variables, relative to their means.

[14] Our high school fixed effects control for permanent differences in teacher quality across schools; for example, they would account for the tendency of some schools to attract highly productive teachers in every year. We have shown that differences in student and neighborhood characteristics across schools are generally stable over time, but we do not have teacher characteristics data to test whether potential differences in teacher quality across schools vary with the expansion of the program. This may happen as a result of demand-side factors, including school principals' selecting high-quality instructors to teach in the IB Diploma Programme, and/or supply-side factors, such as more motivated teachers' choosing to teach in the program. While at least some of the benefits of the program should be attributed to the quality of instruction, to the extent that high-quality teachers in the program improved student achievement over and above the impacts of the program itself, the above types of teacher selection would overstate the true effects of the program on student outcomes. However, this bias would likely be mitigated by the fact that major program assessments are scored by external examiners, and the requirements for an IB Diploma, set by the IBO, are consistent across schools.

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Table 2
Difference-in-differences estimates – the effect of the IB Diploma Programme on demographic control variables.

	Panel A: student characteristics		
	Age	Male	White
IB Diploma Programme	−0.007 (0.018)	−0.007 (0.008)	0.015 (0.020)
	Black	Hispanic	Asian
IB Diploma Programme	−0.008 (0.024)	−0.010 (0.012)	0.003 (0.006)
	American Indian	Bilingual education	Biological parent
IB Diploma Programme	0.000 (0.001)	−0.003 (0.018)	−0.003 (0.014)
	Panel B: neighborhood characteristics		
	Median family income	Percent school age	Percent Hispanic
IB Diploma Programme	1087* (644)	0.002 (0.004)	0.020 (0.018)
	Percent black	Mean education	Percent in poverty
IB Diploma Programme	−0.008 (0.019)	0.070 (0.087)	0.000 (0.007)

Notes: Each regression is estimated using the full sample of 179,002 students, consisting of all first-time 11th grade students in regular high schools (i.e., excluding vocational, full magnet, and alternative schools) in the 1993–1994 through 2005–2006 school years. All regressions include high school fixed effects, year fixed effects, and school-specific linear time trends. Standard errors (in parentheses) are clustered at the school level.
* Significance at the 10 percent level.

5.1. Course performance and educational attainment results

Because we are studying the academic impacts of a program designed for higher-achieving students, we may expect to see a large impact of the IB Diploma Programme on course performance when looking at the upper tail of the letter grade distribution. As such, panel A of Table 3 reports the results for obtaining a B average or better overall. For the full sample of students, we observe in every column a positive and statistically significant effect of the program on the probability of earning a B average or higher in 11th grade coursework. Specifically, the program increased this measure of overall course performance by 2.6–2.9 percentage points. These estimates represent a sizeable improvement of 14–16 percent in the probability of receiving a B or better, relative to the mean of 18.7 percent.[15]

For black students, overall course performance increased by 1.5–1.9 percentage points, with the magnitudes and statistical significances somewhat dependent on the chosen specification. Each coefficient estimate is approximately 35–40 percent smaller than corresponding estimate for the full sample, but only the estimate in column (1) is marginally significant. For Hispanic students, every specification implies a 3.1 percentage point improvement in course performance, which is marginally significant and about 10–20 percent larger than the corresponding effects for the full sample. However, for both student subsamples, the coefficient estimates translate into gains of 11–16 percent in course performance, relative to their means, which are very similar to the estimated improvements for the full sample.

Panel B disaggregates the effect of the IB Diploma Programme on overall course performance by four subject-specific core courses: mathematics, English, social science, and science. Interestingly, most of the increase in the overall likelihood of earning at least a B stems from performance in mathematics coursework, which in 11th grade generally focuses on topics in advanced algebra and trigonometry. In contrast, the estimated impacts for the other subjects are positive but usually much smaller in magnitude and insignificant. Based on our preferred specification (column (3)), we estimate that the IB Diploma Programme increased the proportion of students obtaining a B or higher in mathematics by 6.2 percentage points for the full student sample, by 4.5 percentage points for black students, and by 7.0 percentage points for Hispanic students. Irrespective of race and ethnicity, these point estimates translate into sizeable and similar program effects in the percentage of students receiving a B or higher in mathematics. Specifically, for black and Hispanic students, the IB Diploma Programme led to improvements of 26 and 31 percent, respectively, in the likelihood of earning a B or better in their mathematics courses, over base means of 17.1 and 22.9 percent, respectively. These program effects are at least double the corresponding program effects for the other three subjects.

[15] We also looked at the effect of the program on the probability of obtaining a D average or better overall (≥1.0 GPA), finding positive but statistically insignificant impacts that are generally smaller in magnitude than the corresponding impacts for B average or better overall. This is consistent with the hypothesis of small and imprecise effects of the program at the lower tail of the grade distribution, as the program is designed for higher-achieving students.

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Table 3
Difference-in-differences estimates – the effect of the IB Diploma Programme on course performance.

	Panel A:			Panel B: B or better (subject specific)							
	B or better overall			Mathematics		English		Social Science		Science	
	(1)	(2)	(3)	(1)	(3)	(1)	(3)	(1)	(3)	(1)	(3)
Full student sample											
IB Diploma Programme	0.029**	0.026**	0.026**	0.063***	0.062***	0.020	0.017	0.040*	0.033	0.018	0.016
	(0.014)	(0.011)	(0.011)	(0.017)	(0.015)	(0.020)	(0.017)	(0.022)	(0.021)	(0.019)	(0.016)
R^2	0.00	0.07	0.07	0.00	0.05	0.01	0.06	0.01	0.06	0.01	0.05
Outcome variable mean		0.187		0.222		0.263		0.297		0.258	
Observations		179,002		153,013		176,271		153,686		136,828	
Black student subsample											
IB Diploma Programme	0.019*	0.015	0.015	0.047***	0.045***	0.018	0.013	0.024	0.017	0.015	0.012
	(0.010)	(0.010)	(0.009)	(0.014)	(0.014)	(0.015)	(0.015)	(0.030)	(0.027)	(0.023)	(0.021)
R^2	0.00	0.04	0.04	0.01	0.03	0.01	0.05	0.01	0.06	0.01	0.03
Outcome variable mean		0.135		0.171		0.223		0.256		0.207	
Observations		88,034		74,576		86,040		73,730		67,044	
Hispanic student subsample											
IB Diploma Programme	0.031*	0.031*	0.031*	0.069***	0.070***	0.027	0.027	0.032	0.030	0.034	0.034
	(0.019)	(0.018)	(0.018)	(0.022)	(0.022)	(0.026)	(0.025)	(0.031)	(0.029)	(0.027)	(0.026)
R^2	0.01	0.04	0.04	0.01	0.03	0.01	0.05	0.01	0.05	0.01	0.03
Outcome variable mean		0.194		0.229		0.260		0.297		0.262	
Observations		63,442		54,051		62,876		55,339		47,860	
Controls:											
School fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
School-specific trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Student characteristics		Yes	Yes		Yes		Yes		Yes		Yes
Neighborhood characteristics			Yes		Yes		Yes		Yes		Yes

Notes: The full sample consists of all first-time 11th grade students in regular high schools (i.e., excluding vocational, full magnet, and alternative schools) in the 1993–1994 through 2005–2006 school years. All regressions include high school fixed effects, year fixed effects, and school-specific linear time trends. Student characteristics include age, male, race/ethnicity, bilingual education, and guardian status. Neighborhood (census block group) characteristics include median family income, percent school age (5–18), percent Hispanic, percent black, mean education, and percent in poverty. Standard errors (in parentheses) are clustered at the school level.

* Significance at the 10 percent level.
** Significance at the 5 percent level.
*** Significance at the 1 percent level.

Our course performance findings are consistent with other studies that provide evidence of larger impacts on achievement in mathematics than in English or reading, including research in school accountability, charter schools, instructional technology, peer effects, special education, and teacher effects.[16] A potential explanation for why educational program evaluation studies tend to find larger effects in mathematics versus reading is that mathematics performance is chiefly influenced by the school, while reading performance is likely affected by both school and non-school (such as family) elements (see, for example, Boyd, Grossman, Lankford, Loeb, & Wyckoff, 2009; Jacob, 2005).[17]

Improved course performance is an important benefit of the IB Diploma Programme in and of itself, as poor letter grades in high school coursework can impede access to postsecondary education (Roderick, Nagaoka, & Allensworth, 2006). We now turn to high school educational attainment as another crucial measure of the impact of the IB Diploma Programme. Table 4 explores the impact of the program on high school dropout and graduation, key indicators for quantifying academic achievement and motivating the need for educational reform in many urban

[16] There is a large literature that has found these effects; we provide a non-exhaustive list of papers below. For school accountability, see Jacob (2005) and Rockoff and Turner (2010). For charter schools, see Hoxby and Murarka (2009) and Angrist, Dynarski, Kane, Pathak, and Walters (2012). For instructional technology, see Clariana (1994) and Underwood, Cavendish, Dowling, Fogelman, and Lawson (1996). For peer effects, see Hoxby (2000) and Carman and Zhang (2012). For special education, see Hanushek, Kain, and Rivkin (2002). For teacher effects, see Decker, Mayer, and Glazerman (2004) and Boyd et al. (2009).

[17] Moreover, achievement in mathematics may better predict future productivity (Aaronson, Barrow, & Sander, 2007). Bishop (1992) finds a positive relationship between mathematical ability and job performance in the United States. Grogger and Eide (1995) estimate that the labor market returns to mathematical ability have increased over time in the United States. Hanushek and Kimko (2000) show that there is a positive effect of labor-force quality, measured by performance in mathematics and science examinations, on economic growth across countries.

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Table 4
Difference-in-differences estimates – the effect of the IB Diploma Programme on dropout and graduation.

	Panel A: high school dropout			Panel B: high school graduation		
	(1)	(2)	(3)	(1)	(2)	(3)
Full student sample						
IB Diploma Programme	−0.029*	−0.027*	−0.026*	0.041***	0.040***	0.039***
	(0.015)	(0.014)	(0.014)	(0.014)	(0.012)	(0.013)
R^2	0.01	0.07	0.07	0.01	0.08	0.08
Outcome variable mean		0.191			0.764	
Observations		149,629			149,629	
Black student subsample						
IB Diploma Programme	−0.046**	−0.038**	−0.038**	0.062***	0.054***	0.053***
	(0.018)	(0.017)	(0.017)	(0.017)	(0.016)	(0.016)
R^2	0.01	0.07	0.07	0.01	0.07	0.07
Outcome variable mean		0.221			0.738	
Observations		73,426			73,426	
Hispanic student subsample						
IB Diploma Programme	−0.019	−0.018	−0.018	0.021	0.019	0.018
	(0.020)	(0.019)	(0.019)	(0.019)	(0.017)	(0.017)
R^2	0.02	0.10	0.10	0.02	0.12	0.12
Outcome variable mean		0.172			0.785	
Observations		52,412			52,412	
Controls:						
School fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
School-specific trends	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Student characteristics		Yes	Yes		Yes	Yes
Neighborhood characteristics			Yes			Yes

Notes: The full sample consists of all first-time 11th grade students in regular high schools (i.e., excluding vocational, full magnet, and alternative schools) in the 1993–1994 through 2003–2004 school years. All regressions include high school fixed effects, year fixed effects, and school-specific linear time trends. Student characteristics include age, male, race/ethnicity, bilingual education, and guardian status. Neighborhood (census block group) characteristics include median family income, percent school age (5–18), percent Hispanic, percent black, mean education, and percent in poverty. Standard errors (in parentheses) are clustered at the school level.

* Significance at the 10 percent level.
** Significance at the 5 percent level.
*** Significance at the 1 percent level.

school districts, given their extremely high dropout rates and very low graduation rates (Murnane, 2009).

Panel A shows the dropout results for the pooled sample of students; we find that the IB Diploma Programme decreased the probability of dropping out of high school by 2.6–2.9 percentage points. These point estimates imply substantially large program effects of 14–15 percent in the likelihood of dropping out of high school, relative to the mean of 19.1 percent. The coefficient estimates are larger in magnitude for black students, ranging from 3.8–4.6 percentage points depending on the specification. Given that almost one quarter (22.1 percent) of the black subsample dropped out of high school, the estimates represent large decreases of 17–21 percent in the probability of dropping out of high school for these at-risk youths.

The IB Diploma Programme also led to a dramatic improvement in high school graduation, with an increase of 3.9–4.1 percentage points in the probability of graduation, a five percent increase over the mean graduation rate of 76.4 percent. Nearly all of this increase can be attributed to the black student subsample; specifically, the proportion of black students who graduated from high school increased by 5.3–6.2 percentage points, a 7–8 percent improvement from a base graduation rate of 73.8 percent. For Hispanic students, on the other hand, the coefficient estimates remain positive but are approximately half the magnitude of the corresponding estimates for the full sample and are always insignificant.

The beneficial effects of the IB Diploma Programme on graduation and dropout for CPS students are of great policy relevance because of the large difference in the average earnings between high school graduates and high school dropouts. The high school wage premium, that is, the degree to which the wages of high school graduates with no completed college education exceed the wages of non-high school graduates, rose from 21 percent in 1979 to 28 percent in 2011 (Mishel, Bivens, Gould, & Shierholz, 2012). Moreover, the employment gap between high school graduates and dropouts, measured as the share of the workforce with only a high school diploma, relative to the share without a diploma, increased over this period (Mishel, Bivens, Gould, & Shierholz, 2012).

As a whole, our results imply that the expansion of the IB Diploma Programme in CPS improved academic achievement, including better course performance, a lower likelihood of high school dropout, and, most importantly, an increased probability of high school graduation.

5.2. Parallel trends assumption

Our primary results indicate that the IB Diploma Programme improved student achievement; we now

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Table 5
Pre-expansion difference-in-differences estimates - testing the parallel trends assumption.

	Panel A: B or better overall		Panel B: B or better in mathematics		Panel C: High school dropout		Panel D: High school graduation	
	(1)	(3)	(1)	(3)	(1)	(3)	(1)	(3)
Full student sample								
IB Diploma Programme	0.017	0.016	0.010	0.007	0.010	0.012	−0.005	−0.006
	(0.016)	(0.013)	(0.025)	(0.024)	(0.019)	(0.017)	(0.018)	(0.017)
R^2	0.01	0.06	0.01	0.05	0.02	0.08	0.02	0.09
Observations	81,434		61,790		81,434		81,434	
Black student subsample								
IB Diploma Programme	0.012	0.013	−0.023	−0.021	0.019	0.020	0.009	0.009
	(0.016)	(0.017)	(0.037)	(0.037)	(0.021)	(0.021)	(0.022)	(0.021)
R^2	0.01	0.04	0.01	0.03	0.01	0.07	0.02	0.08
Observations	41,142		30,954		41,142		41,142	
Hispanic student subsample								
IB Diploma Programme	−0.020	−0.011	0.015	0.018	0.020	0.006	−0.034	−0.016
	(0.027)	(0.027)	(0.034)	(0.034)	(0.027)	(0.025)	(0.023)	(0.021)
R^2	0.01	0.04	0.01	0.02	0.02	0.10	0.02	0.14
Observations	27,385		20,309		27,385		27,385	
Controls:								
School fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
School-specific trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Student characteristics		Yes		Yes		Yes		Yes
Neighborhood characteristics		Yes		Yes		Yes		Yes

Notes: The full sample consists of all first-time 11th grade students in regular high schools (i.e., excluding vocational, full magnet, and alternative schools). We restrict the analysis to the 1993–1994 through 1998–1999 school years, prior to the expansion of the IB Diploma Programme in CPS, and assign to IB World Schools (dropping Lincoln Park High School because it offered the IB Diploma Programme throughout the time period of this study) a false program implementation date of the 1996–1997 school year. All regressions include high school fixed effects, year fixed effects, and school-specific linear time trends. Student characteristics include age, male, race/ethnicity, bilingual education, and guardian status. Neighborhood (census block group) characteristics include median family income, percent school age (5–18), percent Hispanic, percent black, mean education, and percent in poverty. Standard errors (in parentheses) are clustered at the school level.

further explore the validity of these findings. We showed in Section 4 that differences in student and neighborhood demographic characteristics across IB World Schools and non-IB World Schools are quite stable prior to and subsequent to the expansion of the program, which is encouraging for the validity of our difference-in-differences identification strategy. In addition, our estimated effects of the IB Diploma Programme on student outcomes in Tables 3 and 4 are rather robust to the inclusion of demographic characteristics.

In this subsection, we present the results of a placebo test as a more direct check of the identifying assumption of parallel trends in student outcomes in the absence of the program. The purpose of this test is to determine whether there were differential, pre-existing trends in student outcomes across schools that offered the program and those that did not. If such trends existed, then our estimated impacts of the program might be spurious, in that they would not pick up the effects of the program itself but rather would be artifacts of diverging trends in student outcomes between students slated to attend IB World Schools versus not *before the actual expansion of the program*.

To perform the test, we first restrict the analytic sample to the 1993–1994 through 1998–1999 school years, prior to the expansion of the program in CPS. We drop students who attended Lincoln Park High School because it offered the program in every year of our data and hence cannot be used to examine pre-existing trends in student achievement. To the remaining 12 IB World Schools, we assign a false program implementation date of the 1996–1997 school year, instead of the actual year of implementation. We chose this date because it is the midpoint of the six-year period prior to the expansion of the program in CPS, given the school years in our sample. Findings are similar when the date is set to other years in the period prior to the expansion of the program. Finally, we re-estimate Eq. (1) using the sample of students from before the expansion of the program with the false program implementation date.

Table 5 reports the ordinary least squares estimates of β from the empirical specification described in the previous paragraph, giving the effect of the false implementation of the IB Diploma Programme on academic achievement for our key outcome variables. If the incorrect program implementation date were to influence student achievement, then it would indicate that, prior to the expansion of the program, student outcomes in schools that were going to offer the program were trending differently than student outcomes in the remaining schools. This would imply that we would falsely attribute to the actual expansion of the program, say, the improvements in course performance and educational attainment from Tables 3 and 4.

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Hence, if our difference-in-differences estimation strategy is valid, then we should not see an impact of the false implementation of the program on student outcomes. The findings in Table 5 support this premise, as there is always a statistically insignificant effect of the false implementation on student outcomes. The coefficient estimates are generally smaller in magnitude than the corresponding estimates in Tables 3 and 4, and some have opposite signs. These findings suggest that differential, pre-existing trends in student outcomes across students in IB World Schools and non-IB World Schools are unlikely to explain our estimated impacts of the program on student outcomes in Tables 3 and 4, lending additional credence to our use of difference-in-differences to identify the effect of the IB Diploma Programme on academic performance.

6. Conclusion

Our study analyzed the impact of the IB Diploma Programme on high school coursework performance and educational attainment in CPS. Exploiting exogenous variation in the offering of the program across schools over time, we showed that the expansion of the program in CPS improved student outcomes, through better performance in 11th grade coursework, a lower likelihood of high school dropout, and a higher probability of high school graduation. These findings are especially promising for this urban school district, given its overall disadvantaged student population, which may otherwise constrain access to postsecondary education and impede successful labor market outcomes even for the program's target population of higher-achieving students. The enhanced educational attainment is policy relevant in light of the increases in the high school wage premium and employment gap over the past 30 years (Mishel, Bivens, Gould, & Shierholz, 2012).

Saavedra (2011) performed a cost-benefit-analysis, comparing the expected boost in lifetime earnings caused by enrollment in the IB Diploma Programme in CPS, by virtue of an increased likelihood of high school graduation, to the approximate costs of implementing the program. She found that the benefits of the program outweigh its costs by at least a factor of 78–1, supporting the notion that the expansion of the IB Diploma Programme is desirable from a social efficiency perspective. Indeed, the program has grown rapidly in recent years, allowing more students across the world to participate in its college-preparatory, academic curriculum. Between 2002 and 2012, the number of schools worldwide that offered the program rose by 131 percent, from 1025 to 2368. Over the same period, the number of students who received an IB Diploma increased by 177 percent, from 16,185 to 44,858 (IBO, 2006, 2012b). Because the requirements for an IB Diploma are determined by the IBO for all IB World Schools, and written examinations and other major program assessments are externally graded, our empirical results for CPS students suggest that the IB Diploma Programme may have positive effects on course performance and educational attainment in other large, urban school districts that serve at-risk student populations, ultimately leading to better preparation for matriculating in and succeeding in higher education.

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References

Aaronson, D., Barrow, L., & Sander, W. (2007). Teachers and student achievement in the Chicago public high schools. *Journal of Labor Economics, 25*(1), 95–135.

Angrist, J. D., Dynarski, S. M., Kane, T. J., Pathak, P. A., & Walters, C. R. (2012). Who benefits from KIPP? *Journal of Policy Analysis and Management, 31*(4), 837–860.

Bishop, J. (1992). The impact of academic competencies on wages, unemployment, and job performance. *Carnegie-Rochester Conference Series on Public Policy, 37*(1), 127–194.

Boyd, D. J., Grossman, P. L., Lankford, H., Loeb, S., & Wyckoff, J. (2009). Teacher preparation and student achievement. *Educational Evaluation and Policy Analysis, 31*(4), 416–440.

Carman, K. G., & Zhang, L. (2012). Classroom peer effects and academic achievement: Evidence from a Chinese middle school. *China Economic Review, 23*(2), 223–237.

Chicago Public Schools. (2008). *Options for knowledge guide: 2009–2010*. Chicago: Chicago Public Schools. Available at http://www.cps.edu/Programs/academic_and_enrichment/documents/OptionsforKnowledgeHandbook_English.pdf.

Chicago Public Schools. (2012a). *Chicago Public Schools: School data*. Chicago: Chicago Public Schools. Available at http://www.cps.edu/SchoolData/Pages/SchoolData.aspx.

Chicago Public Schools. (2012b). *International Baccalaureate (IB) high school application: 2013–2014 school year*. Chicago: Chicago Public Schools. Available at http://www.cps.edu/SiteCollectionDocuments/OAEapplications/IBApplicationHS_English.pdf.

Chicago Public Schools. (2012c). *Scoring rubric: International Baccalaureate (IB) high schools*. Chicago: Chicago Public Schools. Available at http://www.cpsoae.org/Scoring Rubric – IB High Schools 2013-2014.pdf.

Clariana, R. B. (1994). The effects of an integrated learning system on third graders' mathematics and reading achievement. *Journal of Computer-Based Instruction, 21*(1), 12–17.

Coca, V., Johnson, D. W., Kelley-Kemple, T., Roderick, M., Moeller, E., Williams, N., et al. (2012). *Working to my potential: The postsecondary experiences of CPS students in the International Baccalaureate Diploma Programme*. Chicago: University of Chicago Consortium on Chicago School Research.

Cortes, K. E., Goodman, J. S., & Nomi, T. (2013a). A double dose of algebra. *Education Next, 13*(1), 70–76.

Cortes, K. E., Goodman, J. S., & Nomi, T. (2013b). Intensive math instruction and educational attainment: Long-run impacts of double-dose algebra. *Working Paper, Harvard University*.

Decker, P. T., Mayer, D. P., & Glazerman, S. (2004). *The effects of Teach For America on students: Findings from a national evaluation*. Washington, DC: Mathematica Policy Research.

Grogger, J., & Eide, E. (1995). Changes in college skills and the rise in the college wage premium. *Journal of Human Resources, 30*(2), 280–310.

Hanushek, E. A., Kain, J. F., & Rivkin, S. G. (2002). Inferring program effects for special populations: Does special education raise achievement for students with disabilities? *Review of Economics and Statistics, 84*(4), 584–599.

Please cite this article in press as: Cortes, K. E., et al. Educating bright students in urban schools. *Economics of Education Review* (2013), http://dx.doi.org/10.1016/j.econedurev.2013.07.002

Hanushek, E. A., & Kimko, D. D. (2000). Schooling, labor-force quality, and the growth of nations. *American Economic Review, 90*(5), 1184–1208.

Hoxby, C. M. (2000). Peer effects in the classroom: Learning from gender and race variation. *National Bureau of Economic Research Working Paper No. 7867*.

Hoxby, C. M., & Murarka, S. (2009). Charter schools in New York City: Who enrolls and how they affect their students' achievement. *National Bureau of Economic Research Working Paper No. 14852*.

Illinois State Board of Education. (2013). *Illinois state report card – Student assessment*. Springfield: Illinois State Board of Education. Available at http://www.isbe.net/assessment/report_card.htm.

International Baccalaureate Organization. (2006). *Diploma Programme statistical bulletin, May 2006 examination session*. Cardiff: International Baccalaureate Organization. Available at http://www.ibo.org/facts/statbulletin/documents/DiplomaProgrammestatisticalbulletinMay2006.pdf.

International Baccalaureate Organization. (2011). *General regulations: Diploma Programme*. Cardiff: International Baccalaureate Organization. Available at http://ibo.org/become/guidance/documents/DPGeneralregulations_e_FINALFILE.pdf.

International Baccalaureate Organization. (2012a). *IB Diploma Programme 2012 results released*. Cardiff: International Baccalaureate Organization. Available at http://www.ibo.org/announcements/2012/ib-diploma-programme-2012-results-released.cfm.

International Baccalaureate Organization. (2012b). *The IB Diploma Programme statistical bulletin, May 2012 examination session*. Cardiff: International Baccalaureate Organization. Available at http://www.ibo.org/facts/statbulletin/dpstats/documents/may_2012_statistical_bulletin.pdf.

International Baccalaureate Organization. (2013). *IB Diploma Programme curriculum*. Cardiff: International Baccalaureate Organization. Available at http://www.ibo.org/diploma/curriculum/index.cfm.

Jacob, B. A. (2005). Accountability, incentives and behavior: The impact of high-stakes testing in the Chicago Public Schools. *Journal of Public Economics, 89*(5/6), 761–796.

Lee, V. E., & Ready, D. D. (2009). U.S. high school curriculum: Three phases of contemporary research and reform. *Future of Children, 19*(1), 135–156.

Mishel, L., Bivens, J., Gould, E., & Shierholz, H. (2012). *The state of working America* (12th ed.). Ithaca: Cornell University Press.

Murnane, R. J. (2009). Educating urban children. In R. P. Inman (Ed.), *Making cities work: Prospects and policies for urban America* (pp. 269–296). Princeton: Princeton University Press.

Nomi, T., & Allensworth, E. (2009). "Double-dose" algebra as an alternative strategy to remediation: Effects on students' academic outcomes. *Journal of Research on Educational Effectiveness, 2*(2), 111–148.

Rockoff, J., & Turner, L. J. (2010). Short-run impacts of accountability on school quality. *American Economic Journal: Economic Policy, 2*(4), 119–147.

Roderick, M., Nagaoka, J., & Allensworth, E. (2006). *From high school to the future: A first look at Chicago Public School graduates' college enrollment, college preparation, and graduation from four-year colleges*. Chicago: University of Chicago Consortium on Chicago School Research.

Roderick, M., Nagaoka, J., Coca, V., & Moeller, E. (2009). *From high school to the future: Making hard work pay off*. Chicago: University of Chicago Consortium on Chicago School Research.

Saavedra, A. R. (2011). The academic impact of enrollment in International Baccalaureate Diploma Programs: A case study of Chicago Public Schools. *RAND Corporation Working Paper No. WR-867-EDU*.

Underwood, J., Cavendish, S., Dowling, S., Fogelman, K., & Lawson, T. (1996). Are integrated learning systems effective learning support tools? *Computers & Education, 26*(1–3), 33–40.

United States Census Bureau. (2011). *2011 American Community Survey 1-year estimates; using American FactFinder*. Available at http://factfinder2.census.gov.

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