

Heterogeneity in School Sector Effects on Student Performance*

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Abstract

In the first analysis of school sector effects on the achievement of a representative national longitudinal survey of kindergarteners (U.S. Department of Education Early Childhood Longitudinal Survey - Kindergarten Cohort [ECLS-K]), effects are found to be heterogeneous, depending on subject matter, student initial ability, and ethnicity. Overall, private schooling between grades 1 and 8 is found to have a positive (0.13 standard deviations, equivalent to about a third of a year worth of schooling) effect on 8th-grade students' performance in reading but no significant effect in mathematics. Private schooling has a noticeably larger effect for students with lower initial test scores as well as for black and Hispanic students. Results are robust to different model specifications and analytical strategies.

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Much of the theoretical discussion concerning the relative effects of public and private schools on student performance has had a dichotomous ring. Scholars have argued that either competition produces higher achievement levels in the private sector (Friedman, 1955; Chubb and Moe, 1990), or that the commonalities in the educational practice yield similar effects, regardless of sector (Elmore and Fuller, 1996). However, the reality in the United States may be more complex than that.

In the first analysis of school sector effects on the achievement of a representative national longitudinal survey of kindergarteners (U.S. Department of Education Early Childhood Longitudinal Survey - Kindergarten Cohort [ECLS-K]), effects are found to be heterogeneous, depending on subject matter, student initial ability, and ethnicity. Overall, private schooling is found to have a beneficial effect on the reading performance of eighth-graders but no effect on their math performance. By the end of eighth grade, a private school student is estimated to score 0.13 standard deviations higher in reading than his or her counterpart in a public school. This is equivalent to the average progress made by a student in about a third of a year. The benefits of a private school education on 8th-grade reading test scores are estimated to be larger for students with low initial ability, and for blacks or Hispanics. A student with low initial test scores is estimated to score 0.27 standard deviations higher in reading than his or her counterpart in a public school (equivalent to almost two thirds of a year of schooling). A black student is estimated to score 0.34 percent of a standard deviation above that of his or her counterpart in a public school (equivalent to 77 percent of a year of schooling). And, a Hispanic student is estimated to score 0.16 standard deviations higher than a similar student in a public school (equivalent to 36 percent of a year of schooling). Results do not differ importantly regardless of the analytical strategy used.

In the remainder of the paper, we first review the existing literature on school sector effects. Then, we describe the characteristics of the data employed in the analyses, the three different model specifications used, as well as the three different analytical strategies

pursued. Finally, we present our results, discuss their potential bias due the exclusion of students switching sectors, and provide our own interpretation and concluding remarks.

Literature Review

If the theoretical discussion on the relative effectiveness of the different school sectors has generally assumed effects on student outcomes to be homogeneous, prior empirical research has often reported the effects to be heterogeneous, especially depending upon the student background characteristics. Up until now, however, most of that research has focused on the impact of high schools.

School sector effects on high school performance and educational attainment. The most important early study of school sector effects across the United States, carried out by James Coleman and his colleagues at the University of Chicago, focused on test-score performance in the last two years of high school. Using information from the High School and Beyond (HSB) study, scholars identified positive Catholic school effects on the performance of all students in both reading and math, but larger effects for blacks, Hispanics, students from low socioeconomic backgrounds, and for those with low initial test scores (Coleman, Hoffer and Kilgore, 1982; Coleman and Hoffer, 1987; Hoffer, Greeley and Coleman, 1985).^{1,2} Secondary analyses disagreed about the magnitude and substantive significance of such effects (Alexander and Pallas, 1985; Willms, 1985), but, in a balanced assessment, Jencks (1985) concluded that the weight of the evidence indicated a small, positive effect on the performance of the general student population, and, possibly, a more substantial effect for disadvantaged students, though observations were thought to be too few to be certain.

¹At the time Colemans study was undertaken, a high percentage of all private school students attended Catholic schools, and non-Catholic schools were less likely to participate in the survey, and the number of observations of other private schools was quite small, so Coleman paid little attention to results for non-Catholic schools.

²In our analysis, we found no evidence of a differential effect of private schools based on the socioeconomic background of the students. The results are available upon request.

Subsequent research built on that original discussion. Making use of the same HSB data, Evans and Schwab (1995) bypassed the debate over Catholic high school effects on achievement and instead focused on the effects on educational attainment. Using instrumental variables to correct for selection bias, they found positive effects on the probability of completing high school and on the probability of starting college, with especially large effects for blacks, students in urban areas, and students with low initial test scores. Similarly, Neal (1997), in his instrumental variable analysis of the National Longitudinal Survey of Youth (NLSY79), found small, if any, Catholic high school effects on the probability of graduating from high school and on the probability of graduating from college for urban whites and all suburban students, but substantial effects for urban blacks and Hispanics.

More recently, Grogger and Neal (2000), using instruments to analyze the National Education Longitudinal Study (NELS88), detected positive Catholic high school effects on the attainment of urban students, especially urban minorities. No significant attainment gains were found for suburban whites, and suburban minorities were found to be more likely to go to college but equally likely to complete high school as a result of attending a Catholic high school. Utilizing different instruments (labor laws rather than indicators of Catholicity) and expanding the analysis to include all private schools, Figlio and Stone (1999) found religious schools to have positive effects on the performance of minority students but not others; however, non-religious private schools were said to have positive effects on the performance of all students, but especially on those of low-achieving students and low-socioeconomic status families. Also analyzing NELS88 but introducing an alternative method of handling selection bias, Altonji, Elder and Taber (2005) found a substantial positive Catholic high school effect on the probability of graduating from high school but no effect on test scores and little distinctive effect on minority students. Finally, Morgan (2001), also using NELS88 data, estimated Catholic school effects on test-score performance by means of a propensity-score matching strategy. He found that Catholic sector effects were smaller for those with

the greatest propensity to attend Catholic school and larger for socioeconomically disadvantaged minorities who have the lowest propensity to opt for a Catholic education. In sum, empirical studies of secondary schooling tend to find larger effects on disadvantaged students than advantaged ones as well as larger effects on educational attainment than on educational achievement.

Sector effects at the elementary school level. As of now, there have been no longitudinal studies of elementary school achievement based upon a nationally representative sample of U. S. public and private elementary school students. Studies are either cross-sectional or track only a segment of the population. Among students participating in the federal compensatory education program, Jepsen (2003), found no sector effects on either reading or math student achievement. Nor did he find any differential effect for blacks, Hispanics, or low-socioeconomic status students. However, Howell and Peterson (2006), in an experimental study of the effect of school vouchers in New York, Dayton (Ohio), and Washington D.C., detected differential sector effects on achievement-positive ones for blacks in grades 1 to 4 but no effects on whites or Hispanics (for methodological discussions, see Krueger and Zhu, 2004; Peterson and Howell, 2004; Howell and Peterson, 2004). When taking into consideration both the noncompliance and missing data issues of the New York program, positive effects were found on the math scores of students applying from low-achieving schools, especially for blacks (Barnard et al., 2003). Other experimental studies have also found positive effects of private schooling on low-income minority students in urban areas (Greene, Peterson and Du, 1998; Rouse, 1998; but also see Witte, 2000).

Few studies have found differential effects by subject matter. For example, Peterson and Llaudet (2006), drawing upon a recently collected, nationwide, cross-sectional data set, found larger private sector effects in reading than in mathematics on the performance of fourth and eighth-grade students. However, in the absence of longitudinal data, the authors were unable to control for initial test scores, so they warn against drawing any causal conclusions

since their estimates might suffer from selection bias. But, if the bias is constant across categories, the observed pattern of differential sector effects is informative.

In sum, the pattern of effects identified by prior researchers suggests that, the private sector, and, more specifically, the Catholic sector, the predominant form of private schooling in the United States, has a more positive effect on disadvantaged students than advantaged ones, on school attainment than on school achievement, on secondary than on elementary school achievement, and on reading than on math performance. Findings are reasonably robust for secondary students, but effects on elementary and middle school students have yet to be estimated from a nationally representative longitudinal survey.

The Data

The Early Childhood Longitudinal Survey - Kindergarten Class of 1998-99 (ECLS-K) is the first longitudinal study to track the educational experiences of a nationally representative sample of kindergarteners all the way from the moment they entered school until eighth grade. The survey provides measures of numerous characteristics of participating students, parents, teachers, and schools, allowing for analyses of factors that play a role in childrens education.

The sample of students followed by the ECLS-K is a nationally representative sample of kindergartners who began school in the fall of 1998, augmented by a sample of first graders who started their schooling in the U.S. in the fall of 1999. However, the sample does not include representatives of those children who started their schooling in the U.S. in second, third, fourth, fifth, or eighth grade. Nor were *all* the initially surveyed children tracked through subsequent grades.³

³There are four reasons for which a student who was sampled in the base year would not have been included in the Spring-2004 data collection: (1) if the student became ineligible (because he died or moved out of the country), (2) if the student moved out of his original school and was not included in the randomly selected sub-sample of such students to be followed, (3) if the students parents refused to cooperate in one or

Of the 18,249 first-graders who were actively sought to participate in the ECLS-K survey, 17,324 or 95 percent complied.⁴ The response rate was the same in both sectors. By the Spring of 2007, when most students were in eighth grade, only 9,465 students (or 55 percent of the first-grade respondents) were still being tracked by the survey. The attrition rate was similar in both sectors, albeit a little lower in the private school sector (55 percent of the public school first-graders were still in the survey by 2007 as compared to 59 percent of the private school first-graders). Although lower performing and disadvantaged students were less likely to continue to participate in the survey, the pattern of attrition was similar for students in the two sectors (see Table A1 in Appendix A). For example, the average public school student who remained in the survey had 2.7 points (or 0.19 standard deviations) higher first-grade reading scores and 2.1 points (or 0.23 standard deviations) higher first-grade math scores than the average public school student who did not. Similarly, the average private school student who remained in the survey had 2.3 points (or 0.17 standard deviations) higher first-grade reading scores and 1.9 points (or 0.21 standard deviations) higher first-grade math scores than the average private school student who did not. The differences in the average socioeconomic status of the students who remained versus those who did not were 0.15 points (or 0.19 standard deviations) for the public school sector and 0.09 points (or 0.11 standard deviations) for the private school sector. In order to adjust for the loss of students from the sample, weights were developed by ECLS-K so that one could use them to make the remaining sample representative of the initial kindergarten cohort.

For the analysis, we use the test score information collected in 2000 and in 2007, when most of the students in the cohort were in first and eighth grade, respectively. We do not use the cohorts test performance in kindergarten because experts have questioned whether

more of the subsequent surveys, or (4) if there was neither first-grade nor third-grade data for that student. (ECLS-K 5th Grade User Manual, 4-17)

⁴In 2000, the survey aimed to sample 21,357 first-graders. After finding 258 of those students ineligible, and randomly choosing not to follow a sub-sample of the students who had moved out of the original schools, the targeted sample got reduced to 18,249 students.

it is possible to obtain valid assessments of a child's academic performance before the age of six (Shepard, Kagan and Wurtz, 1998).

We exclude from the main analysis the 177 public school students and the 514 private school students who switched sectors during the period under study. This is because, presumably, the effect of the schools might take a few years to materialize, thus, only by focusing on those children who stayed in the same school sector can one be sure of which sector is responsible for the students' progress. In addition, non-observable characteristics of switchers are likely to differ from those of non-switchers in numerous ways (Hoxby and Murarka, 2006). The exclusion of the switchers from the analysis, however, might bias our results if the reason for switching is related to the students' performance. We will further explore this complication in section VI. For now, see Table A2 in Appendix A for the summary statistics of the switchers and non-switchers in both sectors.

All told, the main analysis includes 8,109 first-graders, of which 1,376 attended a private school from first until eighth grade. Table A3 provides weighted and unweighted summary statistics.⁵ First and eighth-grade test scores in reading and math are standardized to have a mean of zero and a standard deviation of 1.0 using the weighted mean and standard deviation of all students in the entire ECLS-K sample by the Spring of 2007. As a result, all sector effect coefficients can be interpreted as effect sizes expressed in standard deviations. For example, a sector effect of 0.1 means that a private sector student is estimated to have a test score performance that is 0.1 standard deviations higher than a comparable student in the public sector, a magnitude equivalent to 10 percent of a standard deviation of the

⁵The data on the students' performance, school sector, region, and location type at the Spring of 2007, come from the *ECLS-K Eighth Grade Restricted-Use Data File*. Because our analysis uses first grade as the starting point, the students' background characteristics come from the *ECLS-K First Grade Restricted-Use Data File*. The disability status indicator was updated to correct for errors in the original data. See *Early Childhood Longitudinal Study, Kindergarten Class of 1998-99 (ECLS-K) Child Disability Composite Errata and ECB Functionality Errata for Data Products Released 2000 through 2006* for details.

distribution of test scores from the entire sample of ECLS-K participants. The socioeconomic status indicator is standardized in the same manner.

Thee Different Model Specifications

To estimate the effect of private schools on 8th-grade students' performance, we utilize various model specifications so as to test different heterogeneity hypotheses. First, we run a simple model without any interactions, estimating the effect of private schools overall. Second, we run a model where we allow the effect of private schools to vary depending on the initial ability of the student (as indicated by his or her test score performance in first grade in the corresponding subject matter). And, third, we run a model where we allow the effect of private schools to vary depending on the race or ethnicity of the students. In all cases, the effect on reading and math performance are estimated separately.

All models control for numerous student background characteristics as measured in first grade, including prior test scores in both math and reading, gender, ethnicity (white, black, Asian, Hispanic, or other), presence of a disability, language spoken in the home, whether or not the student came from a home whose income was below the poverty line, several indicators of mothers education, number of siblings, whether or not the student lives with both parents, region (Northeast, Midwest, West, South), community type (city, large town, or small town/rural), whether the student changed regions or the community type over the period under study, and a socioeconomic status (SES) index, a composite that jointly measures parental education, income, and occupational prestige.⁶

⁶Background characteristics selected for inclusion in our models are similar to those used by Hoffer, Greeley and Coleman (1985). The SES index is a continuous variable ECLS-K constructed from (1) fathers education, (2) mothers education, (3) fathers occupation, (4) mothers occupation, and (5) household income. (ECLS-K 5th Grade User Manual, 7-25.) To standardize the index, the weighted mean and weighted standard deviation for the entire sample of ECLS-K students in the Spring of 2007 was used.

Three Different Analytical Strategies

To make sure that our results are robust, we use three different analytical strategies to estimate each model specification. First, we use plain Ordinary Least Squares (OLS) regression. Second, we use Weighted Least Squares (WLS) regression, which uses the weights provided by the survey to correct the variance estimates. And, third, we use matching to reduce the sample under study to those observations from the control and treatment groups (in this case, public and private school students) with similar background characteristics.⁷

While the OLS analysis provides results that can be generalized to the population represented by the sample of non-switchers that stay in the survey until Spring of 2007, the WLS analysis provides results that supposedly (that is, if the weights were properly constructed) can be generalized to the population of kindergarteners in 1998 who would also fall into the category of non-switchers. However, the results from both of these analyses may not be robust to different model specifications. That is, they may suffer from what is known as extrapolation bias if the distribution of characteristics for the two groups under consideration—control and treatment—varies significantly, a problem of some concern when comparing students attending schools in the public and private sector. For example, only a small number of very low socioeconomic status students attend private schools, while many attend public schools.

To minimize extrapolation bias, we use matching to limit the sample under analysis to those observations from the control and treatment groups (in this case, public and private school students) with similar background characteristics. For each student attending a private school a comparable student attending a public school is identified. Only the matched pairs private and public students are then included in the analysis, thus, ensuring that the

⁷For the estimation, we use the Matching, MatchIt and Zelig packages in R (Kosuke Imai, Gary King, and Oliva Lau. 2007. “normal: Normal Regression for Continuous Dependent Variables” and Nicholas Carnes. 2008. “normal.survey: Survey-Weighted Normal Regression for Continuous Dependent Variables”).

inferences will not be the result of extrapolating from domains where there is no overlap of data.

For the matching procedure, we use nearest neighbor matching, which uses propensity scores to match students.⁸ Propensity scores are estimates of the probability that an individual, given his or her observed characteristics, will be a member of the treatment group. A student with a propensity score close to 1, for example, is a student with a set of background characteristics that taken together suggests that he is highly likely to attend a private school. Similarly, a student with a propensity score close to zero is a student who is estimated to be highly likely to attend a public school.

After matching, we end up with 1,240 pairs of private and public students. As can be seen in Table A3, the effect of the technique is to narrow the observed background differences between students in the two sectors. For example, sector differences in first grade reading test scores are of almost half a standard deviation (0.41 sd) amongst all the students in the study, but only 1 percent of a standard deviation in the matched sample. Similarly, the difference in the percentage of mothers who did not finish high school is 13 percentage points among all the students in the study, but only one percentage point in the matched sample. The plots provided in Figure C1 also are indicative of how much matching improves the balance between the two sectors. While before matching most public school students had propensity scores near zero, after matching the distribution of the propensity scores of the public school students closely resembles that of the private school students.

⁸When generating the propensity scores, we use all the explanatory variables of the models (details are provided in the appendix), including the initial test scores from both subjects: math and reading. We follow Willms (1985) in taking the students initial test scores to be good proxy measures of the ability of the student overall. Therefore, the specified matching procedure looked for pairs of students who were similar based on all of the provided characteristics, including similar initial cognitive abilities as measured by both their math and reading test scores. To implement the matching procedure, we specify a caliper equal to .25 using the `matchit` command within the `MatchIt` and `matching` libraries in R authored by Daniel Ho, Kosuke Imai, Gary King, and Elizabeth Stuart.

The gains in the reliability of the inferences that come from pre-processing the data with matching occur at the expense of ones capacity to generalize the results to the national population that the ECLS-K sought to survey. For example, the average matched public school student has a higher socioeconomic status and higher initial ability level than does the average public school students in the sample under study. (For more details see Table A3).

Results

Because each of the analytical strategies has its own advantages, we report all three results in our tables. However, to simplify the presentation, we discuss in the text only the results from the analyses of the matched students, as they are the most robust results and, in most cases, do not vary much from the results obtained from the other two analyses (whenever they do, we indicate it).

Effect on Reading Test Scores. Overall, private schooling is found to have a beneficial effect on the reading performance of eighth-graders. By the end of eighth grade, a private school student is estimated to score 0.13 standard deviations higher in reading than his or her counterpart in a public school. (See the results of the model without interactions in Table 1).⁹ This is equivalent to the average progress made by a student in about 30 percent of a year.¹⁰

The benefits of a private education on eighth-grade reading test scores are estimated to vary depending on the initial level of ability of the student as measured by his or her test scores in first grade. (See the results of the model with private school interacted with initial test scores in Table 1.)¹¹ While students with high initial ability appear to get little

⁹For all the coefficients generated by this model, see Table B1 in Appendix B.

¹⁰The average student in the survey gained 89 points in the reading test between first and eighth grade. This is equivalent to an annual rate of gain of .44 percent per year of a standard deviation of the eighth-grade reading test score data.

¹¹For all the coefficients generated by this model, see Table B2 in Appendix B.

or no benefit from a private education, a student with average initial abilities is estimated to score 0.17 standard deviations higher in reading than a comparable student in a public school (equivalent to almost 40 percent of a year of schooling), and a student with low initial abilities is estimated to score 0.27 standard deviations higher in reading than his or her counterpart in a public school (equivalent to almost two thirds of a year of schooling).^{12,13}

Similarly, the effect of a private education on reading test scores is also estimated to vary depending on the race or ethnicity of the student. (See the results of the model with private school interacted with race/ethnicity in Table 1).¹⁴ According to the analysis of the matched sample of students, black students are the ones that benefit the most from a private education. Their reading test scores are estimated to be 0.34 percent of a standard deviation above those of their counterparts in public schools (equivalent to 77 percent of a year of schooling). Hispanics come second, with average test scores 0.16 standard deviations above those of their counterparts in public schools (equivalent to 36 percent of a year of schooling). And, white students come third, an estimated private school effect of 0.11 standard deviations (equivalent to 25 percent of a year of schooling). Based on the analysis on the matched students, neither Asian students nor students of another race or ethnicity are estimated to get any effect on their reading test scores from attending a private school.¹⁵

Effect on Math Test Scores. Overall, private schooling is found to have no significant effect on the math performance of eighth-graders. In fact, in all of our models and analyses we only found one instance in which a private education consistently appears to have an

¹²Throughout this paper, “low” initial test scores is defined as one standard deviation below average and “high” initial test scores is defined as one standard deviation above average.

¹³Based on the analysis of matched students, private schools have a significant positive effect on the reading test scores of high initial ability students but the other two analyses do not find a significant effect.

¹⁴For all the coefficients generated by this model, see Table B3 in Appendix B.

¹⁵Notice that here the results vary somewhat based on the analytical strategy used. When using WLS, for example, the estimated effects are smaller and the only statistically significant one is that on white students. Because private school students were more likely to remain in the survey than public school students, using the weights in the analysis reduces the proportion of private school observations. This appears to make our standard errors bigger, which in turn makes most of the estimated coefficients not statistically significant.

effect on 8th-grade math test scores. Students with high initial ability are estimated to score 0.06 standard deviations lower in math than their counterparts in public schools (equivalent to 13 percent of a year of schooling).^{16,17,18}

In summary, school sector effects are found to be different depending on subject matter, initial ability, and race/ethnicity. While private schools seem to improve 8th-graders reading test scores, especially those of students with low initial ability, black, or Hispanic, they have no effect in most of the 8th-graders' math test scores, and a small negative effect on students with high initial ability.

Why Did Private School Students Switch Sectors?

Had there been no students who switched sectors during the period of time under study, this would have been the end of our analysis. However, between first and eighth grades, there were 177 public school students and 514 private school students who switched sectors. This switching between sectors presents a problem in as much as it threatens the internal validity of our analysis. If, for example, the private school students who switched sectors did so because they were doing poorly in school, then our analysis, which focuses only on the non-switchers, would suffer from what is called sample selection bias. Intuitively, if the only students who remained in private schools are those for whom a private education is beneficial, then we would expect our estimates of the private school effect to be upwardly

¹⁶Based on the OLS model, students with low initial test scores seem to benefit from a private education. Their math test scores are estimated to be 0.18 standard deviations higher than their counterparts in public school (equivalent to 38 percent of a year of schooling). However, neither the WLS nor the analysis after matching found a statistical significant effect, so we do not think that the results are consistent enough to draw a clear conclusion.

¹⁷The average student in the survey gained 77 points in the math test between first and eighth grade. This is equivalent to an annual rate of gain of .47 percent per year of a standard deviation of the eighth-grade math test score data.

¹⁸Table 2 presents all of the estimated effects and Tables B1, B2, and B3 in Appendix B present all of the coefficients generated by the models.

biased. The same would be true if the reason for the public school students to transfer to a private school was systematically related to their high performance.

Given that only 3 percent of the public school first-graders switched sectors but fully 27 percent of the private school first-graders transferred to a public school at some point before reaching 8th grade, we are more concerned of the potential bias originated by the private school switchers. For this reason, in this section we explore whether the private school students who switched sectors did so for reasons related to their recent test score performance. More specifically, we run several models to find whether the progress (or lack thereof) in the test score performance of the private school students between two test periods is a good predictor of the decision to leave for a public school at some point before the next test period. Due to data availability limitations, we ignore the 125 private school students who transferred to a public school before 3rd grade.¹⁹

In Table D1 of Appendix D, we present the results of the different linear probability models that we ran trying to explain the decision of switching sectors by private school students.²⁰ For both sets of switchers (those who switched between 3rd and 5th grades and those who switched between 5th and 8th grade), we estimate three different models. Model 1 includes the student's change in test scores in the two preceding test periods as well as any changes experienced in the student's background characteristics between 1st and 8th grade that would be unlikely to be affected by the switching of sectors.²¹ That is, model 1 is constructed in such a way as to be unlikely to suffer from post-treatment bias. Model 2,

¹⁹For the reasons explained in the data section, we do not trust the test score data in kindergarten, which means that we do not have data on the progress that the students were making in school before 3rd grade.

²⁰All the analyses presented in the table were estimated using linear probability models so as to make the interpretation of the coefficients more straightforward. Notice, however, that we also performed the same analyses using both probit and logit and the substantive results did not change. The results are available upon request.

²¹The reason for including the change in the background characteristics from 1st until 8th is because those changes might have been foreseen way in advance by the parents (e.g., events like the arrival of a new child or the retirement of one of the parents are usually long-foreseen and can affect the decision of pulling a child out of a private school and into a public one).

however, includes everything that Model 1 includes plus two dummies indicating whether the student changed the type of locality or the region he or she lived in between first and eighth grade. In this case, it is difficult to know whether the decision to move preceded the decision to switch sectors or whether it was the other way around, so this model is more likely to suffer from post-treatment bias. Finally, model 3 includes all the variables of model 2 plus the set of controls used throughout our main analysis. This model is probably best interpreted as descriptive only.

Based on this analysis, the decision to transfer to a public school seems related to the lack of progress made by the students in their reading test scores but not related to their gains or losses in math scores. Based on model 1, students whose reading test scores decreased by 1 standard deviation from first to third grade were 2 percentage points more likely to have left the private school sector by the beginning of fifth grade, holding everything else constant. Students whose reading test scores decreased by 1 standard deviation from third to fifth grade were 2 percentage points more likely to have left the private school sector by the beginning of eighth grade, holding everything else constant. In our view, these effects on the probability to switch sectors appear rather small for such a large change in test scores, but they are, nevertheless, significant. However, it is noteworthy that neither model does well in predicting the switchers. As shown in Table D1, we were not able to correctly predict any of the switchers or, at best, we were only able to correctly predict 6 percent of them.²² This suggests that none of the observed information (including the progress of test scores) is able to explain why private school students decide to leave for a public school. Therefore, our concerns about the potential sample selection bias are somewhat mitigated.

²²When using probit, the percent of switchers correctly predicted ranges from zero to 4 percent. And, when using logit, the percent of switchers correctly predicted ranges from zero to 8 percent.

Interpretation and Future Research

Given the observational nature of the data, results should be interpreted cautiously. Having said that, the data does provide some evidence of the heterogeneous effects of school sectors. Different phenomena may explain such heterogeneity. In the future, we hope to explore various hypotheses using the rich data set provided by ECLS-K.

Methodological considerations. Although the estimations are based on a carefully designed survey conducted by the National Center for Education Statistics, and although the analysis controls for initial ability as well as a large set of background characteristics, uses the weights to make the sample representative, and uses matching techniques to pre-process the data, thus, making the inferences more reliable, there remains a possibility that some unobserved traits of students not fully captured by their observed traits are both determinants of their performance and systematically different in the two sectors. Depending on the nature of such traits, the estimates presented in this paper may be either upwardly or downwardly biased.

Theoretical considerations. Despite these limitations, results offer enough support for the heterogeneity hypothesis that questions arise as to what might be the causal factors at work. Differential sector effects on advantaged and disadvantaged students have been the subject of prior theoretical discussions.²³ Howell and Peterson (2006) attribute the greater private sector effect on black students to the fewer public school choices available to a residentially isolated minority. Hoffer, Greeley and Coleman (1985) attribute the positive effect of Catholic schools on disadvantaged secondary students (i.e., students with low initial ability, from a low socioeconomic background, blacks or Hispanics) to the higher demands such schools place upon them. As compared to public schools, private schools were more likely to place disadvantaged students in academic tracks and demand more homework and advanced

²³In this discussion, we define a disadvantaged student as a student who is black or Hispanic or with a low initial ability.

coursework. For these students, the lack of structure, lower demands, and lower expectations found in many public schools are especially harmful (Hoffer, Greeley and Coleman, 1985, p. 97)

Although Hoffer et al.s suggestions are most pertinent for explaining sector effects in high schools, comparable hypotheses might explain the differential effect on advantaged and disadvantaged students in elementary and middle schools. For one thing, the institutional structure of the two sectors differs from one another. On average, private elementary schools are found to be smaller (National Center for Education Statistic, 1997), less bureaucratized (Chubb and Moe, 1990), create a greater sense of community (Bryk, Lee and Holland, 1993), and organized into a bipartite elementary-secondary structure that eliminates the need for a middle school (National Center for Education Statistics, 2004); all of which have been found to be associated with higher levels of student achievement (Cotton, 1996; Fox, 1981; Moore, 1983; Becker, 1987; Simmons and Blyth, 1987; Wihry, Coladarci and Meadow, 1992; Franklin and Glascock, 1996; Offenber, 2001). In addition, private schools have the authority to remove disruptive students from classrooms quickly, while public schools are usually legally required to follow complex procedures before suspending or dismissing students (Thernstrom, 1999; Grant, 1988). All those factors are likely to have a greater effect on the effectiveness of schools serving the disadvantaged.

The reasons for sector heterogeneity by subject matter have been less fully explored, particularly the poorer performance of private schools in math. It could be that private schools concentrate more on reading than on mathematics. Teaching students how to read may be a high priority for religious schools (which predominate within the private sector) interested in sustaining their religious traditions. High quality instruction in math and science may be a secondary consideration. Another possibility is that phonics, rather than whole-word reading instruction, is both more effective and more prevalent in the private sector. Another, quite different type of explanation isolates a major public-sector strength,

namely its access to greater fiscal support, an asset of greater value in domains where skills are in short supply. In the United States, there is a shortage of effective math teachers, in part because of the market demand for math skills elsewhere in a technologically-driven economy and in part because those who go into teaching have lower math than verbal ability (Angrist and Guryan, 2004; Henke, Chen and Geis, 2000). The public sector pays teachers and administrators salaries that are roughly 40 percent higher than those in the private sector on average, giving them a market advantage when it comes to recruiting math teachers and others with technical skills in short supply.²⁴

The ECLS-K data set includes information that will allow us to test these and other hypotheses by including specific school characteristics in the models and observing whether the advantage of private or public schools disappears as a result. Information is available on the size of the school, the grade levels at the school (K-4, 5-8, K-8, etc.), class size, both time spent at school on as well as the amount of homework in math and in reading, whether or not the teacher majored in math or reading and language arts, number of college courses in teaching methods separately for both subjects, teacher certification as either a math or a reading specialist, instructional style in the classroom, student participation in tutoring programs, language of instruction for both subjects, and so forth. In ongoing research we plan to examine whether or not some combination of these factors explain the observed private and public school advantages.

²⁴According to U.S. Department of Education surveys (2005), average public school expenditures in 2003 were \$9,929 per pupil, while private school expenditures were only \$5,634 per pupil. Results from those surveys are open to a variety of interpretations, as public schools expend more on ancillary activities—transportation, school lunch, administrative overhead, and other undertakings distantly related to classroom instruction (Levin, 1998). However, another U. S. Department of Education survey finds private school teachers earnings in 2000 to be, on average, less than \$30,000, while public school teachers reported earnings that were close to \$43,000 a year (Snyder and Tan, 2005, table 76). Salaries of private-school principals also trailed their public-school counterparts. Their average salary in 2000 was little more than \$43,000 annually, while that of public-school principals was over \$66,500 (Snyder and Tan, 2005, table 84). Overall, the differential between the math and verbal performance on the SAT of those who became private school teachers is greater than the differential for public school teachers (Henke, Chen and Geis, 2000, table c26). Class size is similar across sectors (Choy, 1996; Howell and Peterson, 2006). If the educational climate across sector is similar, then teaching conditions may be roughly the same.

Concluding Remarks

Whatever the causes of sector heterogeneity, it is ironic that the private sector is less likely to serve the segment of the population for which it would be most beneficial, as disadvantaged students disproportionately attend the public sector. Yet one cannot assume that the observed, heterogeneous advantages of private and public schools would remain were the regulatory or financial conditions to change. For example, public schools might be able to serve the disadvantaged population more effectively if they were freed from certain legal and regulatory constraints. Or the effectiveness of private schools might change if attendance at private schools were facilitated by school vouchers or tax credits for students from low-income families. Those are questions that can be only answered by continued research on school deregulation, school choice, and other policy innovations.

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TABLES

**Table 1: Private School Effect on 8th-Grade Reading Test Scores
(in Standard Deviations), by Analytical Strategy, Model,
Initial Test Scores, and Race/Ethnicity**

	Analytical Strategies		
	OLS	WLS	OLS after Matching
<u>Model without Interactions</u>			
Overall Effect	0.13*	0.11*	0.13*
<u>Model with Private School Interacted with Initial Test Scores</u>			
Effect on Students with High Initial Test Scores	0.01	0.02	0.06*
Effect on Students with Average Initial Test Scores	0.20*	0.18*	0.17*
Effect on Students with Low Initial Test Scores	0.39*	0.33*	0.27*
<u>Model with Private School Interacted with Race/Ethnicity</u>			
Effect on White Students	0.12*	0.10*	0.11*
Effect on Black Students	0.35*	0.25	0.34*
Effect on Hispanic Students	0.16*	0.09	0.16*
Effect on Asian Students	<0.01	-0.03	0.14
Effect on Students of Other Race/Ethnicity	0.24*	0.19	0.11

Notes:

“Low” is defined as one standard deviation below average and “high” as one standard deviation above average.

All models control for initial test scores on both subjects, SES, gender, race & ethnicity, disability status, whether the home language is not English, poverty status, mother’s educational attainment, number of siblings, whether the student lives with both parents, school’s region & location type in first grade, and whether the student changed either regions or localities.

To see all the coefficients generated by the models, see tables B1, B2, and B3 in Appendix B

In the Weighted Least Squares (WLS) model, the longitudinal weights recommended for this type of analysis were used (C4_7CW0).

* Denotes significance at the 5 percent level.

**Table 2: Private School Effect on 8th-Grade Math Test Scores
(in Standard Deviations), by Analytical Strategy, Model,
Initial Test Scores, and Race/Ethnicity**

	Analytical Strategies		
	OLS	WLS	OLS after Matching
<u>Model without Interactions</u>			
Overall Effect	-0.03	-0.05	-0.03
<u>Model with Private School Interacted with Initial Test Scores</u>			
Effect on Students with High Initial Test Scores	-0.12*	-0.12*	-0.06*
Effect on Students with Average Initial Test Scores	0.03	-0.01	-0.01
Effect on Students with Low Initial Test Scores	0.18*	0.10	0.04
<u>Model with Private School Interacted with Race/Ethnicity</u>			
Effect on White Students	-0.04	-0.06	-0.03
Effect on Black Students	0.19	0.03	0.15
Effect on Hispanic Students	-0.05	-0.11	-0.07
Effect on Asian Students	-0.05	-0.10	<0.01
Effect on Students of Other Race	0.09	0.06	-0.04

Notes:

“Low” is defined as one standard deviation below average and “high” as one standard deviation above average.

All models control for initial test scores on both subjects, SES, gender, race & ethnicity, disability status, whether the home language is not English, poverty status, mother’s educational attainment, number of siblings, whether the student lives with both parents, school’s region & location type in first grade, and whether the student changed either regions or localities.

To see all the coefficients generated by the models, see tables B1, B2, and B3 in Appendix B

In the Weighted Least Squares (WLS) model, the longitudinal weights recommended for this type of analysis were used (C4_7CW0).

* Denotes significance at the 5 percent level.

APPENDIX A: SUMMARY STATISTICS

Table A1. Characteristics of the Attrition by School Sector

Unweighted summary statistics of the students who were in the survey by the Spring of 2000 (“First-Grade Respondents”), the subset of those who remained in the survey by the Spring of 2007, when most students were in eighth grade (“Remained until 8th Grade”), and the subset of those who had left the survey by the Spring of 2007 (“Had Left by 8th Grade”), by school sector.

	Students in Public School in First Grade				Students in Private School in First Grade			
	First-Grade Respondents	Remained until 8th Grade	Had Left by 8th Grade	First-Grade Respondents	Remained until 8th Grade	Had Left by 8th Grade		
Reading: 1st Grade (Not Standardized)	54.53 (13.83)	55.71 (13.7)	53.04 (13.85)	60.44 (12.9)	61.38 (12.21)	59.07 (13.73)		
Math: 1st Grade (Not Standardized)	42.61 (9.35)	43.5 (9.18)	41.48 (9.44)	46.2 (7.99)	46.99 (7.67)	45.06 (8.3)		
Male	0.52	0.51	0.52	0.5	0.5	0.5		
Female	0.48	0.49	0.48	0.5	0.5	0.5		
White	0.53	0.58	0.47	0.72	0.75	0.67		
Black	0.16	0.12	0.21	0.07	0.04	0.12		
Hispanic	0.19	0.19	0.19	0.12	0.12	0.11		
Asian	0.07	0.06	0.08	0.05	0.05	0.06		
Other	0.06	0.06	0.06	0.04	0.04	0.04		
Disability	0.11	0.1	0.12	0.07	0.06	0.09		
Home Language: Non English	0.15	0.15	0.15	0.07	0.07	0.06		
SES (Not Standardized)	-0.13 (0.78)	-0.07 (0.79)	-0.22 (0.76)	0.49 (0.73)	0.52 (0.73)	0.43 (0.72)		
Poverty	0.23	0.2	0.27	0.04	0.03	0.04		
Mother did not finish HS	0.16	0.14	0.19	0.02	0.02	0.03		
Mother finished HS	0.31	0.3	0.33	0.19	0.18	0.2		
Mother with some college years	0.33	0.33	0.32	0.36	0.34	0.38		
Mother finished college	0.13	0.15	0.11	0.28	0.29	0.26		
Mother with more than college	0.07	0.08	0.05	0.15	0.17	0.13		
Number of siblings	1.55 (1.17)	1.54 (1.15)	1.56 (1.21)	1.42 (1.13)	1.46 (1.13)	1.36 (1.14)		
Living with both parents	0.75	0.79	0.7	0.87	0.88	0.85		
Midwest	0.25	0.26	0.17	0.33	0.34	0.25		
Northeast	0.18	0.19	0.17	0.2	0.2	0.21		
South	0.34	0.33	0.36	0.25	0.26	0.22		
West	0.23	0.22	0.3	0.22	0.2	0.32		
Large Town	0.4	0.4	0.42	0.32	0.32	0.32		
City	0.34	0.33	0.4	0.52	0.51	0.59		
Small Town or Rural Area	0.26	0.28	0.17	0.16	0.17	0.09		
Stayed in the Survey	0.55	1	0	0.59	1	0		
Number of Observations	13,543	7,493	6,050	3,339	1,972	1,367		

Notes: Standard deviations are provided in parentheses.

Table A2. Characteristics of the Switchers & the Non-Switchers by School Sector

Unweighted summary statistics of the students who were still part of the survey by the Spring of 2007 (“Survey Respondents”), the subset of those who remained in the same sector throughout the whole period (“Remained in Same Sector”), and the subset of those who switched sectors at some point (“Switched Sectors”), by school sector.

	Students in Public School in First Grade			Students in Private School in First Grade		
	Survey Respondents	Remained in Same Sector	Switched Sectors	Survey Respondents	Remained in Same Sector	Switched Sectors
Reading: 1st Grade (Not Standardized)	56.01 (13.58)	55.95 (13.53)	58.41(15.1)	61.42 (12.02)	61.98 (11.54)	59.91(13.09)
Math: 1st Grade (Not Standardized)	43.7 (9.12)	43.66 (9.12)	45.21(9.05)	47.01 (7.59)	47.46 (7.4)	45.8 (7.97)
Male	0.5	0.5	0.5	0.49	0.5	0.48
Female	0.5	0.5	0.5	0.51	0.5	0.52
White	0.59	0.59	0.59	0.75	0.77	0.69
Black	0.12	0.12	0.08	0.04	0.03	0.07
Hispanic	0.18	0.18	0.16	0.12	0.11	0.14
Asian	0.06	0.06	0.06	0.05	0.05	0.05
Other	0.05	0.05	0.1	0.04	0.03	0.04
Disability	0.1	0.1	0.05	0.06	0.05	0.09
Home Language: Non English	0.15	0.15	0.12	0.07	0.07	0.09
SES (Not Standardized)	-0.05 (0.79)	-0.06 (0.78)	0.46 (1.03)	0.53 (0.73)	0.59 (0.72)	0.35 (0.73)
Poverty	0.19	0.2	0.12	0.03	0.03	0.04
Mother did not finish HS	0.14	0.14	0.07	0.02	0.01	0.03
Mother finished HS	0.3	0.3	0.19	0.18	0.17	0.2
Mother with some college years	0.34	0.33	0.35	0.34	0.33	0.38
Mother finished college	0.15	0.15	0.16	0.29	0.31	0.25
Mother with more than college	0.08	0.08	0.23	0.17	0.18	0.15
Number of siblings	1.53 (1.13)	1.53 (1.13)	1.55 (1.16)	1.47 (1.14)	1.53 (1.18)	1.29 (0.99)
Living with both parents	0.8	0.8	0.85	0.88	0.9	0.84
Midwest	0.27	0.27	0.18	0.34	0.35	0.33
Northeast	0.19	0.19	0.23	0.2	0.2	0.23
South	0.33	0.33	0.38	0.25	0.25	0.27
West	0.21	0.21	0.21	0.2	0.21	0.17
Large Town	0.4	0.4	0.38	0.32	0.32	0.32
City	0.32	0.32	0.42	0.51	0.53	0.46
Small Town or Rural Area	0.28	0.28	0.2	0.17	0.15	0.23
Changed Regions	0.01	0.01	0.02	0.02	0	0.05
Changed Localities	0.23	0.22	0.46	0.17	0.1	0.37
Stayed in the Same Sector	0.97	1	0	0.73	1	0
Number of Observations	6,910	6,733	177	1,890	1,376	514

Notes: Standard deviations are provided in parentheses.

Table A3. Characteristics of the Sample under Study

Unweighted and weighted summary statistics of the 8,109 students who were in the ECLS-K survey by the Spring of 2007 and did not switch sectors between grades 1 and 8, and the unweighted summary statistics of the subset of 1,240 pairs of private and public school students who were matched ("Matched Students").

	Unweighted Sample			Weighted Sample			Matched Students		
	All	Public	Private	All	Public	Private	All	Public	Private
Reading: 1st Grade	0.07 (0.97)	0 (0.95)	0.41 (0.95)	-0.03 (0.97)	-0.07 (0.95)	0.45 (0.95)	0.4 (0.97)	0.39 (1.01)	0.4 (0.93)
Reading: 3rd Grade	0.10 (0.96)	0.02 (0.97)	0.51 (0.77)	-0.02 (0.96)	-0.07 (0.97)	0.46 (0.77)	0.5 (0.83)	0.48 (0.88)	0.51 (0.77)
Reading: 5th Grade	0.11 (0.96)	0.03 (0.97)	0.54 (0.74)	-0.02 (0.96)	-0.07 (0.97)	0.51 (0.74)	0.52 (0.78)	0.49 (0.82)	0.54 (0.73)
Reading: 8th Grade	0.15 (0.94)	0.05 (0.97)	0.61 (0.63)	-0.03 (0.94)	-0.08 (0.97)	0.55 (0.63)	0.54 (0.70)	0.47 (0.77)	0.61 (0.62)
Math: 1st Grade	0.10 (1.01)	0.03 (1.01)	0.44 (0.96)	-0.03 (1.01)	-0.07 (1.01)	0.42 (0.96)	0.45 (0.97)	0.46 (0.99)	0.45 (0.95)
Math: 3rd Grade	0.10 (0.98)	0.05 (0.99)	0.37 (0.85)	-0.01 (0.98)	-0.04 (0.99)	0.31 (0.85)	0.43 (0.88)	0.49 (0.90)	0.37 (0.85)
Math: 5th Grade	0.12 (0.95)	0.06 (0.98)	0.4 (0.74)	-0.02 (0.95)	-0.05 (0.98)	0.38 (0.74)	0.45 (0.77)	0.5 (0.81)	0.41 (0.73)
Math: 8th Grade	0.15 (0.94)	0.08 (0.97)	0.47 (0.69)	-0.02 (0.94)	-0.05 (0.97)	0.41 (0.69)	0.48 (0.73)	0.49 (0.76)	0.47 (0.68)
Male	0.5	0.5	0.5	0.53	0.53	0.49	0.49	0.48	0.49
Female	0.5	0.5	0.5	0.47	0.47	0.51	0.51	0.52	0.51
White	0.62	0.59	0.77	0.55	0.54	0.76	0.77	0.76	0.78
Black	0.1	0.12	0.03	0.18	0.19	0.06	0.04	0.04	0.03
Hispanic	0.17	0.18	0.11	0.2	0.2	0.11	0.11	0.11	0.11
Asian	0.06	0.06	0.05	0.03	0.03	0.03	0.05	0.04	0.05
Other	0.05	0.05	0.03	0.04	0.04	0.04	0.04	0.04	0.04
Disability	0.09	0.1	0.05	0.12	0.12	0.06	0.05	0.05	0.05
Home Language: Non English	0.13	0.15	0.07	0.13	0.14	0.05	0.06	0.07	0.06
SES	0.11 (1.01)	-0.03 (0.97)	0.78 (0.90)	-0.06 (1.01)	-0.13 (0.97)	0.76 (0.90)	0.75 (0.91)	0.73 (0.94)	0.76 (0.87)
Poverty	0.17	0.2	0.03	0.22	0.23	0.03	0.03	0.02	0.02
Mother did not finish HS	0.11	0.14	0.01	0.15	0.16	0.01	0.02	0.02	0.01
Mother finished HS	0.28	0.3	0.17	0.3	0.31	0.19	0.18	0.18	0.17
Mother with some college years	0.33	0.33	0.33	0.32	0.32	0.32	0.33	0.32	0.34
Mother finished college	0.18	0.15	0.31	0.15	0.14	0.3	0.31	0.31	0.31
Mother with more than college	0.09	0.08	0.18	0.07	0.07	0.17	0.17	0.17	0.17
Number of siblings	1.53 (1.14)	1.53 (1.13)	1.53 (1.18)	1.51 (1.14)	1.51 (1.13)	1.57 (1.18)	1.52 (1.08)	1.51 (0.98)	1.53 (1.17)
Living with both parents	0.81	0.8	0.9	0.75	0.73	0.9	0.9	0.9	0.91
Midwest	0.28	0.27	0.35	0.23	0.22	0.36	0.35	0.36	0.35
Northeast	0.19	0.19	0.2	0.18	0.17	0.19	0.18	0.17	0.19
South	0.32	0.33	0.25	0.39	0.4	0.29	0.25	0.25	0.25
West	0.21	0.21	0.21	0.2	0.21	0.16	0.21	0.21	0.21
Large Town	0.39	0.4	0.32	0.43	0.43	0.33	0.34	0.35	0.33
City	0.35	0.32	0.53	0.36	0.34	0.53	0.49	0.48	0.51
Small Town or Rural Area	0.26	0.28	0.15	0.22	0.23	0.15	0.17	0.17	0.16
Changed Regions	0.01	0.01	0	0.02	0.02	0	0.01	0.01	0
Changed Localities	0.2	0.22	0.1	0.03	0.31	0.17	0.01	0.11	0.1
Private	0.17	0	1	0.08	0	1	0.5	0	1
Number of Observations	8,109	6,733	1,376	8,109	6,733	1,376	2,480	1,240	1,240

Notes: The test scores and the socioeconomic status (SES) indicator were standardized with the weighted mean and standard deviation of the entire sample of students in the ECLS-K survey by the Spring of 2007. Standard deviations are provided in parentheses.

APPENDIX B: TABLES OF COEFFICIENTS

Table B1. Models without Interactions

	Dependent Variable: Standardized 8th-Grade Reading Test Scores			Dependent Variable: Standardized 8th-Grade Math Test Scores		
	OLS Model	WLS Model	OLS after Matching	OLS Model	WLS Model	OLS after Matching
Private	0.13 (0.02)*	0.11 (0.04)*	0.13 (0.02)*	-0.03 (0.02)	-0.05 (0.04)	-0.03 (0.02)
(Intercept)	-0.02 (0.05)	-0.08 (0.1)	0.22 (0.11)*	-0.02 (0.04)	-0.08 (0.08)	0.18 (0.1)
Reading: 1st Grade	0.26 (0.01)*	0.29 (0.02)*	0.19 (0.01)*	0.4 (0.01)*	0.47 (0.02)*	0.33 (0.01)*
Math: 1st Grade	0.23 (0.01)*	0.25 (0.02)*	0.18 (0.02)*	0.16 (0.01)*	0.15 (0.02)*	0.12 (0.01)*
SES	0.09 (0.02)*	0.08 (0.03)*	0.09 (0.02)*	0.07 (0.01)*	0.07 (0.03)*	0.08 (0.02)*
Black	-0.36 (0.03)*	-0.3 (0.06)*	-0.36 (0.06)*	-0.33 (0.03)*	-0.33 (0.05)*	-0.28 (0.06)*
Hispanic	-0.13 (0.03)*	-0.05 (0.05)	-0.12 (0.04)*	-0.03 (0.03)	0.06 (0.05)	-0.05 (0.04)
Asian	-0.03 (0.04)	-0.02 (0.06)	-0.08 (0.06)	0.09 (0.04)*	0.03 (0.08)	0.07 (0.06)
Other	-0.17 (0.04)*	-0.08 (0.07)	-0.1 (0.06)	-0.11 (0.04)*	-0.06 (0.07)	-0.06 (0.06)
Female	0.15 (0.02)*	0.18 (0.03)*	0.11 (0.02)*	-0.08 (0.02)*	-0.09 (0.03)*	-0.09 (0.02)*
Disability	-0.16 (0.03)*	-0.1 (0.06)	-0.16 (0.05)*	-0.16 (0.03)*	-0.18 (0.06)*	-0.19 (0.05)*
Home Language: Non English	0.11 (0.03)*	0.17 (0.06)*	0.01 (0.05)	0.1 (0.03)*	0.18 (0.05)*	0.07 (0.05)
Poverty	-0.17 (0.03)*	-0.18 (0.05)*	-0.19 (0.07)*	-0.11 (0.03)*	-0.1 (0.05)	-0.06 (0.07)
Mother finished HS	0.15 (0.03)*	0.12 (0.06)	<0.01 (0.10)	0.12 (0.03)*	0.14 (0.06)*	-0.08 (0.10)
Mother with some college years	0.19 (0.04)*	0.16 (0.07)*	0.03 (0.1)	0.2 (0.03)*	0.24 (0.06)*	0.01 (0.1)
Mother finished college	0.29 (0.04)*	0.35 (0.08)*	0.15 (0.1)	0.28 (0.04)*	0.38 (0.07)*	0.09 (0.1)
Mother with more than college	0.28 (0.05)*	0.28 (0.09)*	0.16 (0.11)	0.22 (0.05)*	0.26 (0.09)*	0.06 (0.11)
Number of siblings	-0.03 (0.01)*	-0.04 (0.02)*	-0.04 (0.01)*	<0.01 (0.01)	-0.02 (0.01)	-0.01 (0.01)
Living with both parents	0.03 (0.02)	0.03 (0.05)	0.01 (0.04)	0.07 (0.02)*	0.05 (0.05)	0.13 (0.04)*
Northeast	0.07 (0.02)*	0.09 (0.05)	0.03 (0.03)	0.08 (0.02)*	0.12 (0.04)*	-0.02 (0.03)
South	-0.09 (0.02)*	-0.04 (0.04)	-0.05 (0.03)	-0.06 (0.02)*	-0.04 (0.04)	-0.11 (0.03)*
West	-0.06 (0.02)*	-0.03 (0.05)	-0.06 (0.03)	-0.01 (0.02)	-0.01 (0.05)	-0.02 (0.03)
City	-0.01 (0.02)	-0.05 (0.04)	0.01 (0.03)	0.01 (0.02)	-0.04 (0.03)	0.03 (0.03)
Small Town or Rural Area	-0.01 (0.02)	-0.01 (0.04)	0.02 (0.04)	-0.02 (0.02)	-0.02 (0.04)	0.09 (0.03)*
Changed Regions or Localities	0.03 (0.02)	-0.01 (0.04)	-0.04 (0.04)	0.04 (0.02)*	0.05 (0.04)	-0.04 (0.04)

Baseline category: Public school student with average 1st-grade scores on both subjects, with average SES, male, white, without a disability, with English as his home language, not living in poverty, with a mother who did not finish high school, with no siblings, not living with both parents, and attending a school in a large town in the mid west without having changed region or localities from 1st until 8th grade.

Notes: "Average" is equivalent to the weighted average of the entire ECLS-K sample of students who participated in the Spring of 2007 survey.

In the Weighted Least Squares (WLS) model, the longitudinal weights recommended for this type of analyses were used. Standard errors in parentheses and * denotes significance at the 5% level.

Table B2. Models with Private School Interacted with Initial Test Scores

	Dependent Variable: Standardized 8th-Grade Reading Test Scores			Dependent Variable: Standardized 8th-Grade Math Test Scores		
	OLS Model	WLS Model	OLS after Matching	OLS Model	WLS Model	OLS after Matching
Private	0.2 (0.02)*	0.18 (0.05)*	0.17 (0.02)*	0.03 (0.02)	-0.01 (0.05)	-0.01 (0.02)
Private * Initial Test Scores	-0.19 (0.02)*	-0.16 (0.04)*	-0.11 (0.02)*	-0.15 (0.02)*	-0.11 (0.05)*	-0.05 (0.02)*
(Intercept)	-0.02 (0.05)	-0.08 (0.1)	0.21 (0.11)*	-0.02 (0.04)	-0.07 (0.08)	0.18 (0.1)
Reading: 1st Grade	0.3 (0.01)*	0.3 (0.02)*	0.24 (0.02)*	0.43 (0.01)*	0.48 (0.02)*	0.35 (0.02)*
Math: 1st Grade	0.22 (0.01)*	0.25 (0.02)*	0.18 (0.01)*	0.16 (0.01)*	0.15 (0.02)*	0.12 (0.01)*
SES	0.09 (0.02)*	0.08 (0.03)*	0.09 (0.02)*	0.07 (0.01)*	0.07 (0.03)*	0.08 (0.02)*
Black	-0.35 (0.03)*	-0.3 (0.06)*	-0.36 (0.06)*	-0.32 (0.03)*	-0.33 (0.05)*	-0.27 (0.06)*
Hispanic	-0.13 (0.03)*	-0.05 (0.05)	-0.11 (0.04)*	-0.03 (0.03)	0.06 (0.05)	-0.06 (0.04)
Asian	-0.03 (0.04)	-0.03 (0.06)	-0.08 (0.06)	0.09 (0.04)*	0.03 (0.08)	0.07 (0.06)
Other	-0.16 (0.04)*	-0.08 (0.07)	-0.1 (0.06)	-0.11 (0.04)*	-0.06 (0.07)	-0.06 (0.06)
Female	0.15 (0.02)*	0.18 (0.03)*	0.11 (0.02)*	-0.09 (0.02)*	-0.09 (0.03)*	-0.09 (0.02)*
Disability	-0.15 (0.03)*	-0.1 (0.06)	-0.16 (0.05)*	-0.15 (0.03)*	-0.17 (0.06)*	-0.19 (0.05)*
Home Language: Non English	0.11 (0.03)*	0.17 (0.06)*	0.02 (0.05)	0.1 (0.03)*	0.18 (0.05)*	0.07 (0.05)
Poverty	-0.16 (0.03)*	-0.17 (0.05)*	-0.17 (0.07)*	-0.1 (0.03)*	-0.09 (0.05)	-0.05 (0.07)
Mother finished HS	0.14 (0.03)*	0.11 (0.06)	-0.01 (0.1)	0.12 (0.03)*	0.14 (0.06)*	-0.08 (0.1)
Mother with some college years	0.17 (0.04)*	0.15 (0.07)*	0.03 (0.1)	0.18 (0.03)*	0.24 (0.06)*	<0.01 (0.1)
Mother finished college	0.27 (0.04)*	0.34 (0.08)*	0.15 (0.1)	0.27 (0.04)*	0.38 (0.07)*	0.09 (0.1)
Mother with more than college	0.26 (0.05)*	0.28 (0.09)*	0.15 (0.11)	0.2 (0.05)*	0.26 (0.09)*	0.06 (0.11)
Number of siblings	-0.03 (0.01)*	-0.04 (0.02)*	-0.04 (0.01)*	<0.01 (0.01)	-0.02 (0.01)	-0.01 (0.01)
Living with both parents	0.03 (0.02)	0.03 (0.05)	<0.01 (0.04)	0.07 (0.02)*	0.05 (0.04)	0.13 (0.04)*
Northeast	0.07 (0.02)*	0.09 (0.05)	0.03 (0.03)	0.08 (0.02)*	0.12 (0.04)*	-0.02 (0.03)
South	-0.09 (0.02)*	-0.03 (0.04)	-0.05 (0.03)	-0.05 (0.02)*	-0.03 (0.04)	-0.1 (0.03)*
West	-0.06 (0.02)*	-0.03 (0.05)	-0.06 (0.03)	-0.01 (0.02)	<0.01 (0.05)	-0.02 (0.03)
City	<0.01 (0.02)	-0.05 (0.04)	0.01 (0.03)	0.02 (0.02)	-0.04 (0.03)	0.03 (0.03)
Small Town or Rural Area	<0.01 (0.02)	-0.01 (0.04)	0.02 (0.04)	-0.01 (0.02)	-0.02 (0.04)	0.08 (0.03)*
Changed Regions or Localities	0.03 (0.02)	-0.01 (0.04)	-0.04 (0.04)	0.04 (0.02)*	0.05 (0.04)	-0.04 (0.04)

Baseline category: Public school student with average 1st-grade scores on both subjects, with average SES, male, white, without a disability, with English as his home language, not living in poverty, with a mother who did not finish high school, with no siblings, not living with both parents, and attending a school in a large town in the mid west without having changed region or localities from 1st until 8th grade.

Notes: "Average" is equivalent to the weighted average of the entire ECLS-K sample of students who participated in the Spring of 2007 survey.
In the Weighted Least Squares (WLS) model, the longitudinal weights recommended for this type of analyses were used. Standard errors in parentheses and * denotes significance at the 5% level.

Table B3. Models with Private School Interacted with Race/Ethnicity

	Dependent Variable: Standardized 8th-Grade Reading Test Scores		Dependent Variable: Standardized 8th-Grade Math Test Scores	
	OLS Model	WLS Model	OLS after Matching	WLS Model
Private * White	0.12 (0.03)*	0.1 (0.04)*	0.11 (0.03)*	-0.06 (0.05)
Private * Black	0.35 (0.11)*	0.25 (0.2)	0.34 (0.12)*	0.03 (0.13)
Private * Hispanic	0.16 (0.06)*	0.09 (0.11)	0.16 (0.07)*	-0.11 (0.07)
Private * Asian	<0.01 (0.1)	-0.03 (0.1)	0.14 (0.11)	-0.1 (0.12)
Private * Other	0.24 (0.11)*	0.19 (0.22)	0.11 (0.12)	0.06 (0.19)
White	-0.02 (0.05)	-0.08 (0.1)	0.24 (0.11)*	-0.08 (0.08)
Black	-0.4 (0.05)*	-0.38 (0.1)*	-0.23 (0.13)	-0.41 (0.09)*
Hispanic	-0.15 (0.05)*	-0.13 (0.11)	0.1 (0.12)	-0.01 (0.09)
Asian	-0.03 (0.06)	-0.09 (0.11)	0.14 (0.13)	-0.04 (0.11)
Other	-0.21 (0.06)*	-0.17 (0.12)	0.14 (0.13)	-0.14 (0.11)
Reading: 1st Grade	0.26 (0.01)*	0.29 (0.02)*	0.19 (0.01)*	0.47 (0.02)*
Math: 1st Grade	0.23 (0.01)*	0.25 (0.02)*	0.18 (0.02)*	0.15 (0.02)*
SES	0.09 (0.02)*	0.08 (0.03)*	0.09 (0.02)*	0.07 (0.03)*
Female	0.15 (0.02)*	0.18 (0.03)*	0.11 (0.02)*	-0.09 (0.03)*
Disability	-0.16 (0.03)*	-0.1 (0.06)	-0.16 (0.05)*	-0.18 (0.06)*
Home Language: Non English	0.11 (0.03)*	0.16 (0.06)*	0.01 (0.05)	0.18 (0.05)*
Poverty	-0.16 (0.03)*	-0.17 (0.05)*	-0.18 (0.07)*	-0.1 (0.05)
Mother finished HS	0.15 (0.03)*	0.12 (0.06)	-0.01 (0.1)	0.14 (0.06)*
Mother with some college years	0.19 (0.04)*	0.16 (0.07)*	0.02 (0.1)	0.24 (0.06)*
Mother finished college	0.29 (0.04)*	0.35 (0.08)*	0.14 (0.1)	0.38 (0.07)*
Mother with more than college	0.28 (0.05)*	0.28 (0.09)*	0.15 (0.11)	0.27 (0.09)*
Number of siblings	-0.03 (0.01)*	-0.04 (0.02)*	-0.04 (0.01)*	-0.02 (0.01)
Living with both parents	0.03 (0.02)	0.03 (0.05)	0.01 (0.04)	0.05 (0.05)
Northeast	0.07 (0.02)*	0.09 (0.05)	0.03 (0.03)	0.12 (0.04)*
South	-0.09 (0.02)*	-0.04 (0.04)	-0.05 (0.03)	-0.03 (0.04)*
West	-0.06 (0.02)*	-0.03 (0.05)	-0.06 (0.03)	<0.01 (0.05)
City	-0.01 (0.02)	-0.05 (0.04)	0.01 (0.03)	-0.04 (0.03)
Small Town or Rural Area	-0.01 (0.02)	-0.01 (0.04)	0.02 (0.04)	-0.02 (0.04)
Changed Regions or Localities	0.03 (0.02)	-0.01 (0.04)	-0.04 (0.04)	0.05 (0.04)

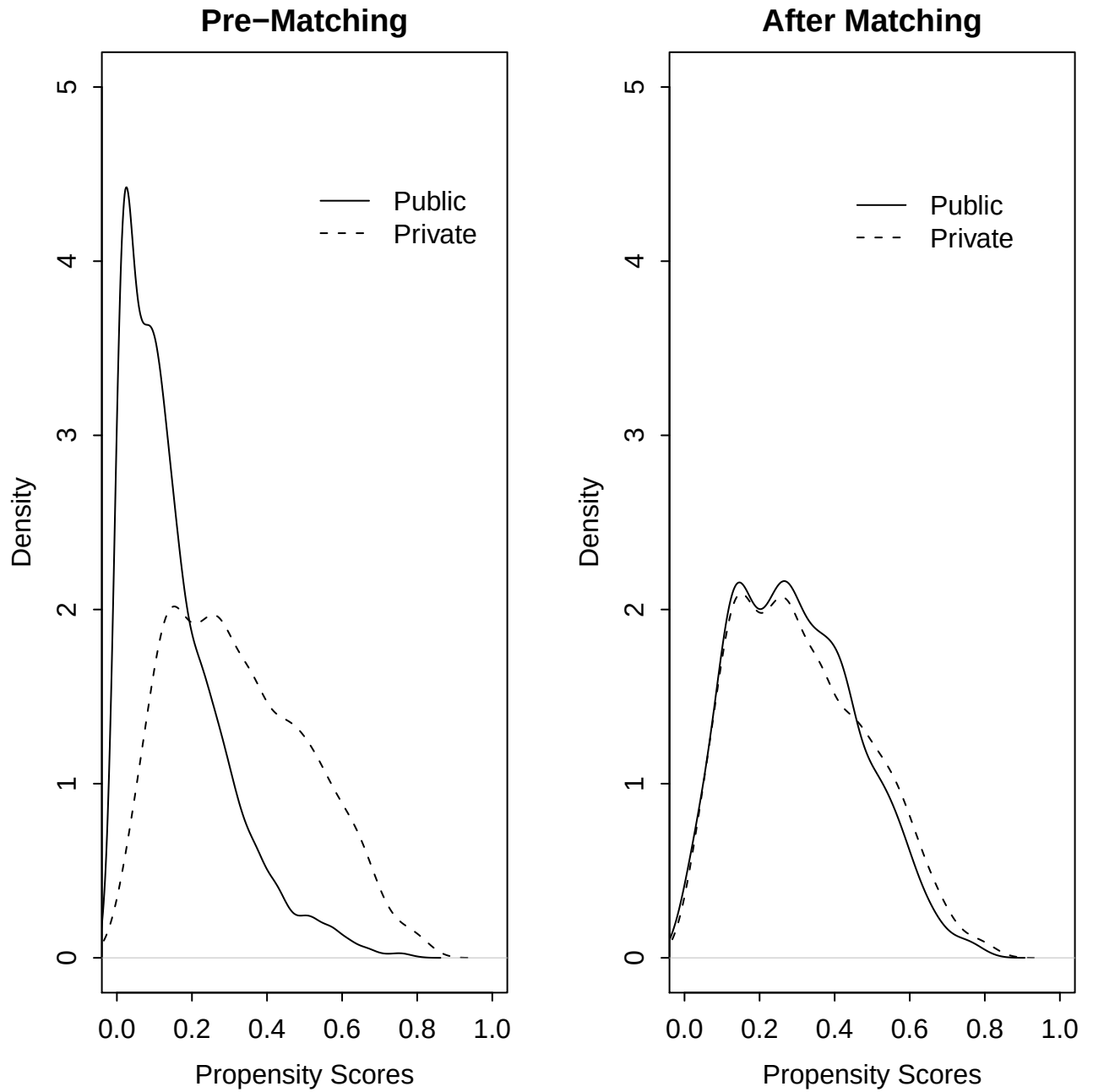
Baseline category: Public school student with average 1st-grade scores on both subjects, with average SES, male without a disability, with English as his home language, not living in poverty, with a mother who did not finish high school, with no siblings, not living with both parents, and attending a school in a large town in the mid west without having changed region or localities from 1st until 8th grade.

Notes: "Average" is equivalent to the weighted average of the entire ECLS-K sample of students who participated in the Spring of 2007 survey.

In the Weighted Least Squares (WLS) model, the longitudinal weights recommended for this type of analyses were used. Standard errors in parentheses and * denotes significance at the 5% level.

APPENDIX C: MATCHED SAMPLE

Figure C1: Balance plots



APPENDIX D: WHY DID PRIVATE SCHOOL STUDENTS SWITCH SECTORS?

Table D1. Linear Probability Models

	Dependent Variable: Left Private School between 3rd and 5th Grade			Dependent Variable: Left Private School between 5th and 8th Grade		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Change in Reading Scores 1-3 or 3-5	-0.02*	-0.01*	-0.02*	-0.02*	-0.02*	-0.02*
Change in Math Scores 1-3 or 3-5	<0.01	<0.01	<0.01	-0.01	-0.01*	-0.01
(Intercept)	0.06*	0.04*	0.01	0.18*	0.14*	0.18*
Change in SES 1-8	0.02*	0.01*	<0.01	0.05*	0.03*	<0.01
Change in Disability 1-8	0.01*	0.01*	0.01	-0.01	-0.01	-0.01
Change in Poverty 1-8	0.06*	0.05*	0.1*	0.11*	0.1*	0.09*
Change in Number of Siblings 1-8	0.02*	0.02*	0.01*	0.01	0.01	<0.01
Change in Living with both parents 1-8	0.02*	0.02*	0.03*	-0.03*	-0.03*	-0.04*
Change in Regions 1-8		<0.01	-0.08*		0.54*	0.56*
Change in Locality Type 1-8		0.11*	0.11*		0.19*	0.18*
Reading: 1st Grade (Standardized)			-0.01*			<0.01
Math: 1st Grade (Standardized)			-0.01*			0.02*
SES (Standardized)			-0.01*			-0.03*
Black			0.02*			0.06*
Hispanic			0.01			-0.01
Asian			0.05*			-0.03
Other			0.02*			-0.08*
Female			0.01*			-0.01
Disability			0.02			0.01
Home Language: Non English			0.04*			-0.04*
Poverty			0.13*			0.05
Mother finished HS			0.03			-0.05
Mother with some college years			0.02			0.01
Mother finished college			0.02			-0.02
Mother with more than college			0.04			-0.02
Number of siblings			-0.01*			-0.01*
Living with both parents			0.01			-0.01
Northeast			0.06*			0.04*
South			0.04*			-0.01
West			0.01			-0.03*
City			-0.03*			0.02*
Small Town or Rural Area			-0.02*			0.12*
Percent Correctly Predicted - all	0.947	0.947	0.947	0.827	0.834	0.835
Percent Correctly Predicted - zeros	1	1	1	1	0.998	0.994
Percent Correctly Predicted - ones	0	0	0	0	0.05	0.057

Notes:

In the analyses of the switchers between grades 3 and 5 (5 and 8), the changes in test scores included in the model are those between grades 1 and 3 (3 and 5). All other changes were measured between 1st and 8th grades.

All other controls were measured in 1st grade.

All of the analyses here presented were estimated using linear probability models so as to make the interpretation of the coefficients more straightforward. Notice, however, that we performed the same analyses using both probit and logit and the substantive results did not change.

* Denotes significance at the 5% level