ARTICLES

School Sector, School Poverty, and the Catholic School Advantage

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Equality of educational opportunity is threatened by long-standing gaps in student achievement by race, gender, and student poverty, as well as by school sector and school poverty. The true magnitude of these gaps cannot be understood, however, unless these factors are considered simultaneously. While accounting for the effects of demographic characteristics, this article focuses on the effects of school sector and school poverty on gains in academic achievement. Analyses from a longitudinal study of public and Catholic middle school students in and around the city of Chicago show that neither the public nor Catholic sector has a consistent advantage in increasing student achievement in sixth and eighth grade reading and mathematics. School poverty has a deleterious effect on student achievement, although this effect is considerably mitigated for students in Catholic schools.

In 1983, *A Nation at Risk* (National Commission on Excellence in Education, 1983) brought to light the poor performance of students in American elementary and secondary schools. Regarded as a call to action, the report engendered an intense interest in student achievement. Educators began to focus most of their instructional time on increasing student test scores, and many parents selected their child's school based on the school's reputation for improving academic achievement.

Most research on determinants of student achievement focuses on characteristics of students (e.g., DiMaggio, 1982; Hanushek, 1997; Lareau, 2000, 2003; Steinberg, Brown, & Dornbusch, 1996). However, school level characteristics also influence student gains in achievement. Two primary characteristics of schools that are associated with achievement gains are school sector (Bryk, Lee, & Holland, 1993) and school poverty (Kahlenberg, 2001).

Insufficient attention has focused on the effects of these school variables on student learning for two reasons. First, since the goal of many parents and students is to increase students' future occupational mobility, educators and researchers have concentrated on student rather than school characteristics

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as determinants of learning. Other than early research on school level effects on student outcomes (Coleman & Hoffer, 1987; Coleman, Hoffer, & Kilgore, 1982a, 1982b, 1982c; Hoffer, Greeley, & Coleman, 1985), few subsequent studies have examined school level determinants of student achievement.

Second, appropriate statistical models for analyzing school level effects on student outcomes, such as hierarchical linear modeling, have been developed only recently. Most models previously estimated were unable to take into account properly the simultaneous effects of school and student characteristics. Newer models can identify correctly the effects of school characteristics, and, in this case, school sector and school poverty, on the achievement growth of students in U.S. public and private schools (e.g., Bryk & Raudenbush, 1992; Raudenbush & Bryk, 1986).

This study addresses the gap in research on school effects by comparing student achievement gains in schools that vary by sector and poverty level. The analyses examine the achievement of students in the city of Chicago using the Chicago School Study data, a survey of the majority of students and schools in the public and Catholic sectors in the city. The analyses are limited to a comparison between Catholic and public schools due to the difficulty of collecting data from other private schools. However, Catholic schools represent the largest private school system in the United States (McDonald & Schultz, 2009), thus the great majority of students in the city are either in public or Catholic schools.

School Sector and Student Achievement

Several researchers have found that students in Catholic high schools achieve higher standardized test scores than those in public high schools. In analyzing the High School and Beyond (HSB) data, a large national sample of high school students, Coleman, Hoffer, & Kilgore (1982a), Coleman and Hoffer (1987), and Greeley (1982) reported that Catholic high school students had greater achievement gains from sophomore to senior year than public high school students. This difference became known as the Catholic school advantage. The researchers attributed these findings to characteristics of Catholic schools, including rigorous academic courses, strict discipline, high teacher expectations, a safe and orderly environment, closely monitored student attendance, regularly assigned homework, close teacher-student relationships, and a faith-based community of learners.

These researchers also found that Black and Hispanic students in Catholic schools had greater achievement gains than comparable minority students in public schools and that socioeconomic status (SES) had a smaller effect on

minority student outcomes in Catholic high schools than in public high schools. Similarly, in an earlier study, Greeley (1982; see also, Greeley & Rossi, 1966) found that the academic advantage of Catholic schools is greatest for disadvantaged and minority students. Bryk, Lee, and Holland (1993) reached the same conclusion based on their analyses of HSB data. Morgan's (2001) analysis of the National Education Longitudinal Study (NELS), a large national sample similar to HSB collected 10 years later, supports these findings.

Other studies examining sector effects on student achievement and on the influence of race and ethnicity on student outcomes yielded mixed results. Controlling for prior achievement and background variables in NELS, Hoffer (1998) found no special academic advantage for minority or low-SES students in Catholic schools. Based on data from the Educational Longitudinal Survey (ELS), the most recent national survey similar to HSB and NELS, Carbonaro and Covay (2010) reported that SES, race, and ethnicity have the same effect on availability of courses and student achievement in both Catholic and public schools.

Yet, most of the studies that relate school sector to academic achievement were conducted under earlier and different societal conditions and were limited to high school students. The few later studies that investigated sector effects on middle and elementary school students show mixed results (e.g., Carbonaro 2003, 2006 [Grades K and 1 in the Early Childhood Longitudinal Program-K]; Lubienski & Lubienski, 2006 [Grades 4 and 8 in the National Assessment of Educational Progress]; Reardon, Cheadle, & Robinson, 2009 [Grades 3 and 5 in the Early Childhood Longitudinal Program-K]). These findings suggest that the earlier studies do not accurately portray the contribution of school sector to current student outcomes in the primary grades.

Recent educational school reforms may have changed the impact of school sector on student achievement. One such reform was implemented in the Chicago public schools several years ago and continues to transform Chicago school organization and governance. The reform is based on a theoretical model formulated by Bryk, Sebring, Allensworth, Luppescu, and Easton (2010). The model has five components, referred to as essential supports. The first component is leadership, which emphasizes instruction and strategic orientation. Leadership serves as a catalyst for the remaining four core organizational supports, namely, parent-community ties, professional capacity of faculty and staff, a student-centered learning climate, and ambitious instruction. Since the implementation of improvements based on this model, student achievement in the Chicago public schools has increased significantly, especially in schools that most completely embraced the recommended changes (Bryk et al., 2010).

Administrators in the Catholic schools in the Archdiocese of Chicago and elsewhere also have undertaken fundamental changes in the structure and organization of their schools since the 1980s. These changes include replacing parish-based schools with area or regional schools and consortia, instituting governance boards of limited jurisdiction, adopting a president-principal model of governance, appointing development directors, introducing a technology-supported curriculum, and providing teachers with new opportunities for professional development (Hamilton, 2008). Part of the motivation leading to these changes in the archdiocesan schools was the severe financial crisis facing most urban Catholic schools. In response to a dire need for funding to preserve a Catholic school system in the United States, a number of dioceses have been forced to close some schools and combine others (Center for Applied Research in the Apostolate, 2006; McDonald & Schultz, 2009; O'Keefe & Scheopner, 2009; White House Domestic Policy Council, 2008). In addition, in order to increase their tuition base and maintain their inner-city schools, many Catholic school administrators began accepting more non-Catholic students than they had in the past (Center for Applied Research in the Apostolate, 2006; McDonald & Schultz, 2009). This policy also reflects the teachings of the Second Vatican Council as presented in the Declaration on Christian Education, *Gravissimum Educationis* (Vatican Council II, 1965). This policy led to an increase in the number of minority students enrolled in Catholic schools in the Archdiocese of Chicago. Because Catholic schools strive to provide a rigorous academic curriculum for all their students, extending admission to non-Catholic minority students may have given these students better educational opportunities than they would have had otherwise. Today, the race and ethnic composition of urban Catholic schools is more similar to that of urban public schools than in the past, with both school systems serving the inner-city poor (Hunt, Joseph, & Nuzzi, 2001).

The school reforms implemented in both public and Catholic schools since the 1980s may have altered the Catholic school advantage observed in earlier empirical studies of student achievement gains. Furthermore, while previous research indicates a Catholic school advantage at the high school level, it does not provide a clear answer to the question of whether this advantage holds at the elementary school level.

School Poverty and Student Achievement

A number of studies that include public and Catholic schools demonstrate the effects of school poverty on student test scores. School poverty can be measured as the percentage of students in a school who qualify for the federal

free- or reduced-lunch program. While this is not a comprehensive measure of school poverty, it is widely accepted by educational researchers as valid and likely more accurate than measures based on student reports of family income and assets. In his landmark study on educational opportunity, Coleman et al. (1966) concluded that the educational characteristics of a student's classmates influence a student's achievement. Since high-SES students tend to have higher test scores than low-SES students, this finding implies that the poverty level of a school affects the mean achievement of the school. Schools with a low level of poverty show greater gains in achievement than high-poverty schools. Replicating Coleman's work, Jencks (1985) showed that the benefits of a low poverty-level school extend to students at all SES levels. He found that poor sixth graders in middle-class schools were 20 months ahead of poor sixth graders in high poverty-level schools while the effects of other school characteristics made no more than 1 month's difference in sixth-grade test scores (Kahlenberg, 2001).

Several other studies found a relationship between school poverty and student achievement. Chubb and Moe (1990) reported a strong positive effect of the mean SES of a school on the achievement gains of high school students in public and private schools. They concluded that the gains were due to the influence of students' peers and the peers' families. In a study of Scottish students, Willms (1986) reported that controlling for student SES, an increase in school poverty had a significantly negative effect on student achievement across school sector. These results are consistent with the findings of a study of California schools by Rumberger and Willms (1992) and in an analysis of eighth grade students in the NELS data by Sui-Chu and Willms (1996). In a recent study, Rumberger and Palardy (2005) found that the SES of a school has at least as much impact on achievement gains as the student's individual economic background. Palardy (2008) also reported that students attending high-poverty schools learn at significantly slower rates than those in wealthier schools, even when extensive individual background characteristics are controlled. Orfield and Eaton (1996) claim that the effect of school poverty on student outcomes is among the most consistent finding in educational research. This conclusion is well supported in Sirin's (2005) meta-analysis of poverty effects.

Several mechanisms transmit the effects of school poverty to student achievement. One mechanism links family income to student academic outcomes. Economically advantaged parents often provide enhanced learning opportunities for their child both outside of school and through greater involvement in their child's school (Lareau, 2000, 2003). These parents tend to cooperate with the efforts of their child's school to set high standards for

student achievement. As a result, the more high-SES families in a school, that is, the lower the poverty level of a school, the higher the school's mean achievement. In contrast, parents with limited economic resources face significant constraints on their time due to employment and familial demands and, as a result, have less time to devote to their child's education. Often, they are unable to attend school meetings, supervise homework, and provide out-of-school cultural and educational activities for their child (Chin & Phillips, 2004). Hence, high-poverty schools are more likely to have lower mean achievement than low-poverty schools.

School poverty also affects the number of academic role models in a school. High-SES students are more likely to have higher achievement expectations, educational aspirations, and educational attainment than low-SES students (Kahlenberg, 2001). Given their academic orientation, more advantaged students are more likely to serve as academic role models for their peers. They serve as examples of commitment to academic excellence and have the potential to influence their peers by their words and actions. Academic role models demonstrate how a student achieves academic success through study, discipline, engagement, and effort (Ryan, 2000). The more academic role models in a school, the more likely students will be influenced positively by their behavior. Therefore, low-poverty schools, which are characterized by a larger number of academic role models, are likely to have a more positive effect on student achievement gains than higher-poverty schools.

Another mechanism linking school poverty to academic achievement is normative and comparative peer group processes (Merton, 1957). Schools vary in their normative climates. In a school where parents support and demand educational excellence, teachers can establish and enforce strong academic norms and count on parents to encourage their children to adopt these norms. Students are then likely to rely on these norms to guide their behavior. In a school without strong academic norms, students may be influenced to behave in ways that do not support learning. High-poverty schools are less likely to have strong academic norms, which in turn leads to smaller achievement gains. In addition, students serve as comparative references for their peers. If a student is attracted to the academic success of another classmate, the student may imitate that classmate's behavior in order to achieve the same goals and win the esteem of respected peers. Since academically oriented students are more apt to attend low-poverty schools, the comparative influence processes that occur in these schools are likely to lead to greater achievement gains.

Finally, the racial and ethnic composition of a school is related to achievement gains. Coleman, Hoffer, and Kilgore (1982a, 1982b, & 1982c) and Jencks (1985) showed that minority students attain higher test scores in majority White

schools than in majority Black or Hispanic schools. Since race and ethnicity correlate with SES, this research suggests that all students, regardless of demographic characteristics or ability level, will have higher achievement in low-poverty schools than in high-poverty schools. Low-poverty schools benefit both high- and low-achieving students, leading to higher student test scores.

The effects of race, poverty, and sector are particularly important given the achievement gap between majority and minority students and earlier findings on sector effects. As noted above, research has shown that minority students benefit from attending Catholic schools, many of which enroll middle- and low-SES students. Contemporary Catholic schools in urban areas tend to enroll a large number of poor students. Thus, if the benefit to racial minorities of Catholic school attendance is dependent on enrollment of a critical mass of middle-class students, the Catholic school advantage is likely to have decreased. Although there was an "eliting" of Catholic schools during the 20th century (Baker & Riordan, 1998), this trend was reversed in urban Catholic schools at the end of the century. Urban Catholic schools enroll more high-poverty students today than in the past, resulting in more high-poverty schools with fewer high- and middle-SES students (Hunt, Joseph, & Nuzzi, 2001).

The research presented here has two aims. First, it examines the effects of school sector on student growth in achievement to determine whether Catholic and public schools differ in the extent to which they increase student gains and decrease the effects of race, ethnicity, and social class on growth in achievement. Second, the research investigates whether, and to what extent, the level of school poverty affects student learning. These are critical equity issues because they relate to differences in student opportunities to learn.

Methods

The Chicago School Study data were collected by the Consortium on Chicago School Research (CCSR). The public school data were collected as part of their founding imperative, which is to monitor and advise on the significant reforms to the Chicago public schools that began in 1990. The data collected include primarily quantitative information collected annually from school records and biennially from student, teacher, and principal surveys. The CCSR's work examines a large number of factors that lead to improvements in student test scores, including the effects of school leadership, teacher capacity and instructional practices, student school experiences, school communities, and neighborhood context (Bryk et al., 2010). Information taken from school

records included the student demographic and test score data while all other information was collected via surveys.

For the Chicago School Study, the CCSR collected similar data from the Catholic schools, students, teachers, and principals in the Archdiocese of Chicago. The archdiocese includes the city of Chicago and some of the Chicago suburbs, and is one of the largest Catholic school districts in the United States in terms of enrollment. Information taken from school records included test score and some demographic data, while all other information, including some demographic information, was collected by survey.

Sample

Only elementary school and student data are used in these analyses. The target population for the data analyzed here included all sixth, seventh, and eighth grade public elementary schools and students in the Chicago school district and all sixth, seventh, and eighth grade Catholic elementary schools and students in the Archdiocese. The school principals decided whether their school would participate in the surveys. Approximately 75% of public elementary schools and 85% of Catholic elementary schools participated. Students in participating schools could opt out of the survey if they wished, but most students participated. Of the entire targeted student population in all schools (both participating and nonparticipating), 65% of public and 75% of Catholic school students participated in the survey.

Since standardized testing was required for all students in the upper elementary grades in public schools, student test score information was available almost universally for the public school students. The school system reported test scores for 98% or more of these students in each grade. Standardized testing was not required for all Catholic school students. However, a voluntary test was administered, and 90% of those who participated in the survey also took the standardized test.

Based on analyses of participation by gender, race, poverty, and achievement, no significant within-school response bias is evident in the public school data between students who participated in the study and those who did not (CCSR, 2004). Between-school bias is possible because lower-achieving schools were less likely to participate than higher-achieving schools, but multilevel modeling techniques can control for this possible bias. Analyses of gender, race, poverty, and achievement distributions in responding Catholic schools show no between-school bias. Analyses of gender and achievement show no significant within-school bias other than a slight tendency for higher sixth grade mathematics test scores among the participating students when

compared with all sixth grade Catholic school students (results not shown). Most of this difference is controlled for in the models by controlling for previous test score.

Two public and three Catholic schools were dropped from the analyses because the gender distribution of student respondents was highly skewed, usually because the school was a single-sex school. Schools with no students in a grade were dropped from the analyses for that grade. Students who entered either school system during the previous year were dropped because previous test score information was not available. Students were matched across years within sector, and therefore students who moved from one Chicago public school to another, or from one Chicago Catholic school to another, were retained. However, students could not be followed between sectors, and such students would be dropped. Since the number of Asian and Native American students in the Chicago schools is too small to allow estimates of racial effects for these groups, they were also dropped from the analysis.

Statistical Model

These analyses use multilevel models, with separate analyses by student grade (sixth and eighth grades) and subject (reading/language and mathematics). Multilevel models are preferable to the models used in most early research on school effects. Those simpler models assume the cases are selected from a population where the errors are independent and identically distributed. When students are grouped within schools, this assumption is likely to be violated, resulting in incorrect estimates of the standard errors (Bryk & Raudenbush, 1992). A multilevel model can also control for the possibility of biased estimates due to non-random school participation. A more extensive discussion of modeling considerations and the equations for the final model are shown in the Appendix.

Dependent Variable

The dependent variable for the analyses is student achievement as measured by standardized test scores. Unfortunately, the two sectors administered different tests to their students. The public elementary school students took the Iowa Test of Basic Skills (ITBS) while Catholic school students took the Terra Nova (TN). Test scores are never strictly comparable between tests produced by different testing companies due to differences in content and format (National Research Council, 1999). Thus, comparisons of sector effects based on these different tests can never be precise. However, it is possible to compare test scores by linking one set of scores to another. The degree to which

such a linkage, and thus test score comparison, is suitable and useful depends on how similar the tests are. Kolen and Brennan (2004) suggest four features on which to assess this similarity. These include the measurement conditions of the test, the constructs measured by the tests, the inferences made from the tests, and the populations for whom the tests are designed. The ITBS and TN are highly similar on all four of these features. Both are standardized tests, divided into specific content areas. Both tests are designed for U.S. elementary school students, with items selected to be appropriate for the range of achievement among students of that grade level. Both tests are designed to be used by schools and teachers to measure levels of student achievement and to identify particular content areas in which students are excelling or struggling (see, for example, the reviews in Impara & Plake, 1998 and Plake & Impara, 2001, or the websites for the ITBS and the TN). Because of these similarities on all four features, comparisons of ITBS and TN scores are appropriate and useful.

The metric used in these analyses are the scale scores from the ITBS. Scale scores have several advantages over other types of test scores. They are designed as equal interval scales throughout the full range of scores. Scaling is both horizontal and vertical, so that scores from different test forms and across grades can be compared.

Public school test scores are already in this metric. Catholic school test scores on the TN were converted to ITBS scale scores using equi-percentile equating methods (Kolen & Brennan 2004). Both the ITBS and the TN provide nationally normed percentiles for their scale scores based on very large national samples (Hoover et al., 2003; CTB/McGraw-Hill, 2001). The conversion used here maps each TN scale score to the ITBS scale score at that same national percentile.

Because the ITBS and TN are normed using different national samples, estimates of mean sector differences may reflect sampling differences and not true achievement differences. The 95% confidence interval for the difference between sector mean test scores can be calculated using the standard deviations and sample sizes given in the technical manuals (Hoover et al., 2003; CTB/McGraw-Hill, 2001). For the eighth grade reading test, this interval is ±0.80 points, with the confidence interval for the other tests being somewhat smaller. Thus, sector differences estimated to be smaller than that may not reflect true sector differences. This concern applies only to comparisons of the overall sector means. Within-sector comparisons are not affected, nor are between-sector comparisons of within-sector comparisons (e.g., the effect of gender by sector).

Independent Variables: Student Level

Previous achievement. The models estimated in this study examine growth in achievement by controlling for the previous year's achievement. A student's fifth grade scale score is used in the analyses of sixth grade achievement and a student's seventh grade scale score is included in analyses of eighth grade achievement. TN scale scores were converted to ITBS scale scores via the same procedure as the dependent variable.

Demographics. Student gender was obtained from administrative records for both public and Catholic schools and is a dummy variable coded "1" for female and "0" for male. Race was obtained from administrative records for public schools and from student self-reports for Catholic schools. It is coded as two dummy variables, indicating Black and Hispanic with White as the comparison group.

Socioeconomic status. SES is measured by students' survey responses indicating the presence of various resources in their home, including a quiet place to study, a daily newspaper, a magazine subscription, an encyclopedia, an atlas, a dictionary, a computer, Internet access, more than 50 books in the house, and having one's own room. The number of these resources is summed and values of this variable range from 0 to 10. The use of variables such as these to measure SES, either as individual variables or as a summed indicator, is common practice, particularly when other indicators of SES are not in the data or deemed unreliable (see, for example, Coleman et al., 1982b; Gamoran & Kelly, 2003).

Independent Variables: School Level

School poverty. The indicator of school poverty used in these analyses is the proportion of students in the school who receive free- or reduced-price lunch. This proportion includes all students in the school, and not just the sixth and eighth graders used in these analyses.

Catholic. School sector is measured by two dummy variables. The first is coded "0" if the student is in a public school and "1" if the student is in a Catholic school. The second is coded "1" if the student is in a suburban Catholic school and "0" otherwise. This construction permits analysis of differences between Catholic and public schools and differences between urban and suburban Catholic schools.

Missing Data. Cases with missing data were dropped from the analyses. For the most part, the amount of randomly missing data is small. No data were missing at the school level. Almost no students were missing gender information. Less than 1% of students were missing SES information in the Catholic schools and only 2.2% of students were missing SES information in the public schools.

The one exception is student race. In public schools, race was available from administrative records, recorded in the usual five categories, with only a trivial amount of missing data. In Catholic schools, student race was not recorded in school records, and was collected on the student surveys. A seven-category response was allowed, with the five standard categories supplemented by "Biracial/Multiethnic" and "Other." Almost a quarter of Catholic students marked one of the latter two responses or left the item blank.

For eighth grade students, information from an earlier survey was used to assign a single-race classification for such students. Unfortunately, there is no accurate method of determining the single-race classification of sixth grade students or those eighth grade students who did not provide a single-race classification on an earlier survey, and thus these students were dropped from these analyses. Approximately 7% of eighth grade Catholic students and 23.5% of sixth grade Catholic students were dropped for this reason.

The descriptive statistics regarding race, then, will be biased estimates of the population distribution for Catholic schools. A comparison with the racial distributions provided by the schools indicates that the great majority of these self-identified biracial students would be recorded as Black under a single-race classification, some would be recorded as Hispanic, and a small proportion would be recorded as White. Thus, the descriptive statistics for the sample underestimate the proportion of Black students in Catholic schools, slightly underestimates the proportion of Hispanic, and overestimates the proportion of White.

The parameter estimates for race will also be affected. Students who self-identify as biracial are likely to have slightly higher achievement than students who self-identify as Black or Hispanic (Herman, 2009). The race effects in Catholic schools are estimated for students who self-identify as a single race. Public school race effect estimates include students who would self-identify as biracial. Race effects on achievement are generally negative, and thus the race effect estimates in public schools are likely to be slightly less negative than they would be if that sample included only self-identified single-race students.

Results

Tables 1, 2, and 3 show some of the many different achievement gaps one could present as "the" achievement gap. These results are illustrative rather than definitive, and therefore questions of statistical significance and bias will be ignored here. Table 1 presents the mean test scores of students by subject, grade, and school sector. Perhaps the most commonly discussed gap by sector is a simple comparison of public and Catholic school means. Catholic school students have considerably higher test scores than public school students in the same grade. On the sixth grade reading test, public school students have a mean test score of 218.0. Students in urban Catholic schools have a mean test score of 241.9 while those in suburban Catholic schools have the highest test score mean of 252.5. This result is repeated in eighth grade reading where public, urban Catholic, and suburban Catholic schools show test score means of 242.4, 267.0, and 278.1, respectively. The same pattern appears in sixth and eighth grade mathematics and in fifth and seventh grade reading and mathematics.

Table 1

Mean Current Year Achievement, Previous Year Achievement, and Achievement Gains by Subject, Grade, and Sector

Reading Grade 6

	Public *N* = 16,457			Urban Catholic *N* = 1,722			Suburban Catholic *N* = 2,058		
	6th Grade Score	5th Grade Score	Gain	6th Grade Score	5th Grade Score	Gain	6th Grade Score	5th Grade Score	Gain
M	218.0	207.1	10.9	241.9	232.2	9.7	252.5	243.7	8.8
SD	*31.9*	*26.1*		*27.4*	*28.2*		*24.3*	*25.1*	

Reading Grade 8

	Public *N* = 15,207			Urban Catholic *N* = 2,296			Suburban Catholic *N* = 2,715		
	8th Grade Score	7th Grade Score	Gain	8th Grade Score	7th Grade Score	Gain	8th Grade Score	7th Grade Score	Gain
M	242.4	230.5	11.9	267.0	256.3	10.7	278.1	268.9	9.3
SD	*35.3*	*31.1*		*32.3*	*29.9*		*30.4*	*26.8*	

Mathematics Grade 6

	Public *N* = 16,442			Urban Catholic *N* = 1,719			Suburban Catholic *N* = 2,019		
	6th Grade Score	5th Grade Score	Gain	6th Grade Score	5th Grade Score	Gain	6th Grade Score	5th Grade Score	Gain
M	218.9	208.9	10.0	237.8	224.1	13.7	251.4	235.8	15.7
SD	*25.7*	*24.1*		*27.0*	*24.2*		*25.2*	*22.6*	

Mathematics Grade 8

	Public *N* = 15,180			Urban Catholic *N* = 2,295			Suburban Catholic *N* = 2,717		
	8th Grade Score	7th Grade Score	Gain	8th Grade Score	7th Grade Score	Gain	8th Grade Score	7th Grade Score	Gain
M	242.9	230.4	12.5	260.3	252.5	7.9	273.4	265.9	7.5
SD	*31.1*	*28.3*		*31.5*	*29.4*		*30.2*	*27.6*	

However, the sector differences in level of achievement in fifth and seventh grade suggest that the sixth and eighth grade differences are primarily due to differences in previous achievement. Examining the gaps in level of achievement at sixth and eighth grade thus conflates existing student differences with sector effects. Thus, a more accurate indication of any sector differences in achievement would remove previous student differences.

One way to do this is by looking at annual gains in achievement. Compared with sector differences in level, sector differences in gains show quite a different pattern. In reading, public school students show greater gains than Catholic school students from fifth grade to sixth grade, increasing their scores by an average of 10.9 points. Urban Catholic school students gain about a point less with a mean gain of 9.7 points, and suburban Catholic school students have the smallest gain of 8.8 points. Tests were administered in the spring of the year, so these achievement gains primarily reflect sixth grade learning. Reading achievement gains from seventh grade to eighth grade show a similar pattern and numeric difference between sectors.

Gains in sixth grade mathematics achievement show the opposite pattern. Test score gains range from 10.0 points for public school students to 13.7 points for urban Catholic school students and 15.7 points for suburban Catholic school students. For seventh to eighth grade achievement gains in mathematics, however, the average test score of public school students increases 12.5 points over the school year compared with urban and suburban Catholic school students who gain fewer than 8 points.

Examining levels of achievement and gains in achievement gives two very different pictures of the achievement gap. The first, based on level of achievement, indicates that Catholic school students have a considerable advantage over public school students in fifth through eighth grade reading and mathematics. The second, based on growth in achievement, indicates Catholic school students are generally at a disadvantage, making smaller gains in sixth and eighth grade reading and in eighth grade mathematics. However, in sixth grade mathematics, Catholic school students have a greater advantage in gains. The first picture leads to the conclusion of a simple, consistent "Catholic school advantage," while the second shows a more complicated and not completely consistent "public school advantage."

Different achievement gaps are more evident when examining sector differences in achievement gains by demographic factors. Table 2 presents differences in reading and mathematics gains by sector and gender. For sixth grade reading, the only large gender difference is in public schools, where females gain noticeably more than males. The gains of males and females in urban and suburban Catholic schools are quite similar. In contrast, for eighth

grade reading, Catholic school females have considerably greater gains than males. In public schools, males and females have similar gains with males doing somewhat better. The small reading gains of males in Catholic schools are of concern and suggest that reading is a serious learning challenge for eighth grade boys in these schools. In sixth and eighth grade mathematics, a small but consistent dominance of males over females can be seen. The largest differences are in suburban Catholic schools. The gender gap in achievement, therefore, varies by grade, subject, sector, and even within sector.

Table 2

Mean Achievement Gains by Subject, Grade, Sector, and Gender

Reading Grade 6

	Public		Urban Catholic		Suburban Catholic	
	Males	Females	Males	Females	Males	Females
M	9.4	12.4	9.5	9.9	8.8	8.8
SD	*20.7*	*20.2*	*19.7*	*18.4*	*19.1*	*18.0*
N	7,959	8,498	829	893	975	1,083

Reading Grade 8

	Public		Urban Catholic		Suburban Catholic	
	Males	Females	Males	Females	Males	Females
M	12.4	11.5	7.5	14.0	4.5	13.6
SD	*22.0*	*21.3*	*24.1*	*20.5*	*23.3*	*21.2*
N	7,302	7,905	1,140	1,156	1,295	1,420

Mathematics Grade 6

	Public		Urban Catholic		Suburban Catholic	
	Males	Females	Males	Females	Males	Females
M	10.2	9.9	13.8	13.6	16.8	14.6
SD	*13.4*	*13.0*	*16.2*	*14.9*	*15.6*	*15.4*
N	7,944	8498	827	892	952	1067

Mathematics Grade 8

	Public		Urban Catholic		Suburban Catholic	
	Males	Females	Males	Females	Males	Females
M	13.3	11.7	8.4	7.4	8.8	6.3
SD	*16.2*	*15.8*	*20.1*	*17.9*	*18.8*	*17.6*
N	7,284	7,896	1,139	1,156	1,294	1,423

Differences in achievement gains by sector are also apparent by race. Table 3 shows that for reading, Black and Hispanic students in public schools have smaller average achievement gains than White students. In Catholic schools, on the other hand, either Blacks or Hispanics or both show greater gains than Whites. In mathematics, little consistency of minority effects in public schools is seen. Hispanics always gain less than Whites. Blacks gain the least in sixth grade and the most in eighth grade. In Catholic schools, there is more but not absolute consistency. Blacks always show the smallest gains, and Hispanics generally show the greatest gains.

Table 3

Mean Achievement Gains by Subject, Grade, Sector, and Race

Reading Grade 6

	Public			Urban Catholic			Suburban Catholic		
	Whites	Blacks	Hispanics	Whites	Blacks	Hispanics	Whites	Blacks	Hispanics
M	14.9	10.0	10.9	8.5	9.4	12.2	8.7	11.3	8.6
SD	*21.0*	*20.5*	*20.2*	*19.2*	*18.4*	*18.8*	*18.7*	*17.6*	*17.8*
N	1,963	7,903	6,591	975	277	470	1,743	102	213

Reading Grade 8

	Public			Urban Catholic			Suburban Catholic		
	Whites	Blacks	Hispanics	Whites	Blacks	Hispanics	Whites	Blacks	Hispanics
M	15.0	12.7	10.1	10.4	9.8	11.9	9.0	10.2	11.4
SD	*20.6*	*22.0*	*21.4*	*21.9*	*21.8*	*24.2*	*22.4*	*21.4*	*25.5*
N	1,937	7,187	6,083	1,192	399	705	2,333	119	263

Mathematics Grade 6

	Public			Urban Catholic			Suburban Catholic		
	Whites	Blacks	Hispanics	Whites	Blacks	Hispanics	Whites	Blacks	Hispanics
M	11.5	8.9	10.9	13.8	12.3	14.5	16.2	13.3	12.5
SD	*14.6*	*12.7*	*13.3*	*15.5*	*14.2*	*16.2*	*15.6*	*14.4*	*15.0*
N	1,962	7,880	6,600	974	277	468	1,707	103	209

Mathematics Grade 8

	Public			Urban Catholic			Suburban Catholic		
	Whites	Blacks	Hispanics	Whites	Blacks	Hispanics	Whites	Blacks	Hispanics
M	13.6	16.1	12.3	7.7	6.4	9.0	7.4	6.8	8.6
SD	*15.4*	*15.7*	*16.0*	*19.2*	*17.1*	*19.7*	*18.1*	*19.7*	*18.5*
N	1,935	7,173	6,072	1,191	398	706	2,334	119	264

The previous tables illustrate the difficulty of considering any achievement gap as a single number. The size and direction of the gender and race achievement gaps vary by grade and by subject. Females and minority race students are sometimes advantaged and sometimes disadvantaged, and the amount of advantage or disadvantage varies by sector, grade, and subject.

As will be shown below, multivariate models do not resolve this issue. Every achievement gap varies in size by grade, subject, and sector. Thus, representing the Black-White achievement gap or the male-female achievement gap by, say, the difference in eighth grade mathematics achievement, is an oversimplification.

Table 4 shows the demographic composition of the sectors by grade for the sample used in the multivariate analyses. The results are shown only for the sample for the sixth grade reading analysis. The mean and standard deviation of background characteristics of students in the eighth grade reading analysis sample and the samples for both grades for the mathematics analyses are similar to the sixth grade reading sample. While the public and Catholic schools have nearly identical gender compositions, with slightly over half the sixth and eighth grade students being female, the sectors differ considerably in racial composition. In the public schools, almost half the students are Black, 40% are Hispanic, and approximately 12% are White. In the urban Catholic schools in sixth grade, 16% of the students are Black, 27% are Hispanic, and 57% are White. In the suburban Catholic schools, 5% of the students are Black, 10% are Hispanic, and 85% are White. Recall that the racial classifications for public and Catholic schools were originally different, and that public schools include biracial students who would have been dropped from the Catholic school sample. As for SES, students in public schools have on average the fewest home resources while students in suburban Catholic schools have the most.

Table 4

Student Level Descriptive Statistics

Reading Grade 6

	Public		Urban Catholic		Suburban Catholic	
	N = 16,457		*N* = 1,722		*N* = 2,058	
	M	*SD*	*M*	*SD*	*M*	*SD*
Female	0.52	0.50	0.52	0.50	0.53	0.50
Black	0.48	0.50	0.16	0.37	0.05	0.22
Hispanic	0.40	0.49	0.27	0.45	0.10	0.30
SES	5.27	2.69	7.45	2.37	8.24	1.84

Note. Student level means and standard deviations for the eighth grade reading and sixth and eighth grade mathematics analyses are similar to the above.

Table 5

School Proportion of Students in Poverty by Sector

Public				Urban Catholic				Suburban Catholic			
Mdn	*M*	*SD*	*N*	*Mdn*	*M*	*SD*	*N*	*Mdn*	*M*	*SD*	*N*
0.93	0.86	0.18	16,457	0.18	0.33	0.34	1,722	0.01	0.07	0.15	2,058

Note. These statistics are taken from the sixth grade reading analyses and do not vary substantively from the eighth grade reading or sixth and eighth grade mathematics summary statistics.

The greatest difference in school composition by sector is in the proportion of students who are in poverty, that is, who receive free or reduced lunch, as shown in Table 5. Since the distribution of school poverty is skewed, the median is a better representation of central tendency than the mean. In public schools, the typical student is in a school where 93% of the students are in poverty. In urban Catholic schools, the typical student is in a school where 18% of the students are in poverty. In suburban Catholic schools, the typical student is in a school where 1% of the students are in poverty.

Research has consistently shown that the level of poverty in a school is associated with lower student achievement. This is not always the case in these data, however. Table 6 reports the school-level correlation between mean test score gains and school poverty by sector. For sixth grade reading, the correlation for public schools is negative, statistically significant, and substantial: The higher the level of school poverty, the lower the gains in achievement. The correlations for Catholic schools, however, are not statistically significant. No overall association between school poverty and mean gains are seen in Catholic schools. This pattern holds for eighth grade as well, both in reading and in mathematics. Thus, in the public schools in the sample, greater school poverty is associated with lower mean test score gains while Catholic schools do not show this simple association of poverty and achievement.

The gains in achievement by gender and race and the correlation of gains with poverty provide simple summary measures of achievement gaps. Yet, these may be oversimplifications, obscuring differences that affect understanding or policy. Multivariate analyses can provide better estimates of achievement gap size, as they assess the effects of multiple factors simultaneously. This gives a truer estimate of the gap than is due to any single factor. Furthermore, multilevel analyses can simultaneously control for student-level and school-level factors. As shown above, school-level factors vary greatly by sector.

Multilevel models of achievement growth were estimated controlling for the above factors. The estimates from the models are shown in the Appendix. The achievement gains reported in Tables 7 and 8 are based on those parameter

Table 6

School Level Correlations between Mean Achievement Gains and School Poverty

	Reading Grade 6			Reading Grade 8		
	Public	Urban Catholic	Suburban Catholic	Public	Urban Catholic	Suburban Catholic
r	-0.31	0.18	0.02	-0.25	0.01	0.08
p	*0.00*	*0.08*	*0.83*	*0.00*	*0.89*	*0.47*
N	341	94	85	338	91	93

	Mathematics Grade 6			Mathematics Grade 8		
	Public	Urban Catholic	Suburban Catholic	Public	Urban Catholic	Suburban Catholic
r	-0.23	-0.11	-0.26	-0.19	0.05	0.13
p	*0.00*	*0.30*	*0.02*	*0.00*	*0.62*	*0.21*
N	341	94	84	338	91	93

estimates. Table 7 presents the within-sector gaps in achievement for sixth and eighth grade reading and mathematics. These estimates show the gap due to poverty, gender, and race within each school sector, controlling for the effects of the other factors. The difference between urban Catholic and suburban Catholic schools is statistically significant in all cases except for the effects of gender in sixth grade reading. The difference between public schools and all Catholic schools is statistically significant in all cases. Because these gaps are based on within-sector estimates, they are not affected by any bias due to the conversion of test scores. The estimates in Table 7 can be used to compare the size of the gaps between sectors. They can reveal whether the Black-White achievement gap in gains is larger in public schools, in urban Catholic schools, or in suburban Catholic schools. They cannot, however, be used to determine which students grew more over the year. That is, they do not reveal whether Blacks in Catholic schools had greater gains in achievement than Blacks in public schools.

Each row of the table presents the total estimated gains associated with a particular factor. For example, a student with a test score and SES at the overall mean, who is in a public school with 100% poverty, will on average score 7.83 points lower on the sixth grade reading test than an identical student who is in a public school with 0% poverty, all else constant. A typical student in an urban Catholic school with 100% poverty will score 0.36 points higher than the same student would in an urban Catholic school with 0% poverty. That is, in public schools, school poverty has a strong negative effect on achievement,

Table 7

Within-Sector Gaps in Achievement Gains by Subject and Grade

	Reading Grade 6			Reading Grade 8		
	Public	Urban Catholic	Suburban Catholic	Public	Urban Catholic	Suburban Catholic
Effect of School Poverty	-7.83	0.36	-7.28	-9.39	-5.17	-4.54
Effect of Gender (Female)	3.49	1.73	1.73	-0.72	7.59	9.19
Effect of Race (Black)	-4.56	-6.77	-2.25	-2.69	-1.66	-2.56
Effect of Race (Hispanic)	-2.67	-1.23	-2.77	-3.52	-0.41	-0.08
	Mathematics Grade 6			Mathematics Grade 8		
	Public	Urban Catholic	Suburban Catholic	Public	Urban Catholic	Suburban Catholic
Effect of School Poverty	-6.02	-3.47	-14.94	-5.67	1.56	-0.51
Effect of Gender (Female)	-0.24	-0.65	-2.45	-1.77	-1.41	-2.81
Effect of Race (Black)	-3.37	-2.61	-5.04	-1.60	-6.36	-3.71
Effect of Race (Hispanic)	-0.88	-0.10	-1.88	-1.28	-2.67	-1.16

while in urban Catholic schools, school poverty has no effect on achievement. Yet, the same is not true in suburban Catholic schools. Students attending a suburban Catholic school with 100% poverty score 7.28 points lower than those attending a suburban Catholic school student with 0% poverty.

The difference between the strong negative effect of poverty in suburban Catholic schools observed here and the lack of association seen in Table 6 illustrates the necessity of controlling for multiple factors simultaneously. Only by controlling for the effects of student demographic characteristics are the effects of poverty in suburban Catholic schools revealed. However, any relationship between school poverty and achievement in suburban Catholic schools observed in the tables must be interpreted cautiously. There are so few students in suburban Catholic schools in poverty that calculated estimates of suburban poverty effects are primarily due to small differences in achievement among students in schools with little to no poverty, rather than being due to large differences in achievement among schools with large differences in poverty. In addition, predicting gaps and gains for students in suburban Catholic schools with 100% poverty is purely hypothetical, since such schools do not exist in these data. With that understood, however, estimates of gaps and predictions of gains in these schools can provide a useful benchmark.

The effects of school poverty are consistently negative for gains in eighth grade reading and sixth grade mathematics. Students in schools with 100% poverty are estimated to score anywhere from 3.5 to 15 points lower than students in schools with 0% poverty. In eighth grade mathematics, however, the effects of school poverty are absent in Catholic schools, although they remain strong in public schools.

As shown in Table 7, once the effects of other factors are controlled, the gender gap in achievement gains generally favors females in reading and always favors males in mathematics at both grade levels. The female advantage in eighth grade reading in Catholic schools is quite large. Recall from Table 2 that much of this will be due to the very small overall gains made by males in these schools, and not due to unusually large gains made by females themselves. In terms of race, the Black-White achievement gap is ubiquitous, with Black students consistently obtaining noticeably smaller gains than White students within each sector. Hispanics also consistently show smaller gains than Whites, although the difference is trivial in eighth grade reading in suburban Catholic schools and in sixth grade mathematics in urban Catholic schools.

The estimates from the model shown in the Appendix can also be used to generate predicted gains for all combinations of race, gender, and school sector, at any level of school poverty. These are not "predictions" in the sense of a hypothetical forecast, but rather are the adjusted average achievement gains for students in the sample with certain characteristics. They are the multivariate version of the mean gains shown in Tables 2 and 3. The predictions are shown in Tables 8a and 8b for 0% and 100% school poverty. Since these predictions include the overall estimated sector effect, they are comparable between as well as within sectors. Recall that there is the possibility of sampling error, and thus public and Catholic gains that are less than ±0.80 points apart may not truly be different. However, very few of the differences in predicted gains fall within that range.

All comparisons can be made in these tables within grade and subject. Thus, one can see that for sixth grade reading in 0% poverty schools, White males have the greatest gains in public schools (15.19), the next greatest gains in suburban Catholic schools (13.67), and the lowest gains in urban Catholic schools (11.31). White females have the same pattern of gains in these 0% poverty schools, and White females invariably outgain males within each sector. Blacks have the same gender pattern of females, outgaining males in every sector. Blacks show only low gains in urban Catholic schools relative to their public school counterparts, but Black gains in suburban Catholic schools are similar to those in public schools. Hispanics in 0%

Table 8a

Predicted Gains in Reading Achievement by School Poverty, Sector, Race, and Gender

Reading Grade 6

		0% Poverty			100% Poverty		
		Public	Urban Catholic	Suburban Catholic	Public	Urban Catholic	Suburban Catholic
White	Males	15.19	11.31	13.67	7.37	11.67	6.39
	Females	18.69	13.04	15.39	10.86	13.40	8.12
Black	Males	10.64	4.54	11.42	2.81	4.89	4.14
	Females	14.13	6.27	13.14	6.30	6.62	5.87
Hispanic	Males	12.52	10.08	10.89	4.69	10.44	3.62
	Females	16.01	11.81	12.62	8.18	12.17	5.35

Reading Grade 8

		0% Poverty			100% Poverty		
		Public	Urban Catholic	Suburban Catholic	Public	Urban Catholic	Suburban Catholic
White	Males	20.14	10.79	7.75	10.75	5.61	3.21
	Females	19.43	18.37	16.94	10.03	13.20	12.40
Black	Males	17.45	9.13	5.19	8.06	3.95	0.65
	Females	16.73	16.71	14.38	7.34	11.54	9.84
Hispanic	Males	16.62	10.38	7.67	7.23	5.20	3.13
	Females	15.91	17.96	16.86	6.51	12.79	12.32

poverty schools show the same sector and gender pattern of gains in sixth grade reading as Whites. Unlike Whites or Blacks, however, Hispanics in 0% poverty urban Catholic schools gain almost as much as Hispanics in 0% poverty suburban Catholic schools.

In schools with 100% poverty in both sectors, females continue to outgain males of the same race in sixth grade reading. However, for all races, students in urban Catholic schools have greater gains than their counterparts in public schools and in suburban Catholic schools. This is particularly true for Whites and Hispanics. Unfortunately, Black males in 100% poverty schools do poorly in both sectors, though worse in public schools compared to Catholic schools. The estimated gains in 100% poverty suburban Catholic schools may be unreliable as noted above.

While such comparisons can be made for gains by race and gender in both grades and both subjects, the focus of this paper is on the effects of poverty and sector on the achievement gap. For sixth grade reading, the predicted gains show that for almost every combination of race and gender in 0% poverty schools, students in public schools are predicted to have greater gains

Table 8b

Predicted Gains in Mathematics Achievement by School Poverty, Sector, Race, and Gender

Mathematics Grade 6

		0% Poverty			100% Poverty		
		Public	Urban Catholic	Suburban Catholic	Public	Urban Catholic	Suburban Catholic
White	Males	14.87	15.07	19.79	8.85	11.59	4.85
	Females	14.64	14.42	17.34	8.62	10.94	2.40
Black	Males	11.50	12.46	14.75	5.48	8.99	-0.19
	Females	11.26	11.81	12.30	5.24	8.34	-2.64
Hispanic	Males	13.99	14.96	17.91	7.97	11.49	2.97
	Females	13.75	14.31	15.45	7.74	10.84	0.52

Mathematics Grade 8

		0% Poverty			100% Poverty		
		Public	Urban Catholic	Suburban Catholic	Public	Urban Catholic	Suburban Catholic
White	Males	17.09	10.15	9.85	11.42	11.71	9.34
	Females	15.32	8.74	7.04	9.65	10.30	6.53
Black	Males	15.49	3.79	6.14	9.82	5.35	5.63
	Females	13.72	2.38	3.33	8.05	3.94	2.82
Hispanic	Males	15.81	7.48	8.69	10.14	9.04	8.18
	Females	14.04	6.07	5.88	8.37	7.63	5.37

than students in Catholic schools. The sole exception is Black males who do best in suburban Catholic schools. In schools with 100% poverty, students in urban Catholic schools are predicted to have greater gains than students in public schools. The result is similar for eighth grade reading in 0% poverty schools. Students in public schools generally outgain students in Catholic schools. Here, the exception is Hispanic females. In 100% poverty schools, males of any race have greater gains in public schools than their Catholic school counterparts, but among females, those in urban Catholic schools outgain those in public schools.

In sixth grade mathematics, students in urban Catholic schools almost always outgain their public school counterparts, whether they are in schools with 0% or 100% poverty. The difference is generally small in 0% poverty schools and large in 100% poverty schools. In eighth grade mathematics, public school students outgain their Catholic school counterparts in 0% poverty schools. In 100% poverty schools, racial minorities in public schools

outgain their urban Catholic school counterparts, but Whites in public schools gain slightly less than Whites in urban Catholic schools.

Overall, Table 1 shows that Catholic school students begin sixth and eighth grades with higher mean test scores in reading and mathematics than public school students. Tables 8a and 8b demonstrate that students in public schools with little poverty have greater gains in sixth and eighth grade reading and in eighth grade mathematics than students in urban Catholic schools with little poverty. In other words, in low-poverty schools, public school students are generally catching up to Catholic school students.

However, in high-poverty schools, sixth grade Catholic school students have greater achievement gains than do public school students. In eighth grade, some students show greater gains in Catholic schools than in public schools while others do not. In high-poverty schools, then, many students in public schools are falling further behind their Catholic school counterparts. Unfortunately, students in poor public schools are falling further behind their counterparts in wealthier public schools, but in the Catholic sector, this is not always the case. In some grades and subjects, students in high-poverty Catholic schools gain as much as students in low-poverty Catholic schools.

Conclusions

This article presents analyses of the effects of school sector and school poverty on student achievement gains. No compelling evidence of a Catholic or public school advantage was found. For the most part, the mean test scores of Catholic school students were considerably higher in sixth and eighth grade reading and mathematics than the mean scores of public school students. However, this was due to the higher mean test scores for Catholic school students in fifth and seventh grade. In terms of gains in achievement over a school year, neither public nor Catholic schools achieved consistently higher gains in sixth and eighth grade reading and mathematics.

These analyses revealed a deleterious effect of school poverty on student achievement. Generally, the greater the proportion of students in a school who qualify for the free- or reduced-lunch program, the smaller the students' growth in achievement. School-level poverty has a negative effect on an individual student's achievement gains, regardless of the student's socioeconomic status. This finding is consistent with the theory that schools do better at raising student test scores when the school has a sufficiently large number of students who serve as academic role models to their peers and who set positive norms of achievement.

The exceptions to this result are in urban Catholic schools for sixth grade reading and eighth grade mathematics gains. For those schools, grades, and subjects, no deleterious effects of school poverty were observed. It may be that Catholic schools, with their emphasis on academic success for all, have large numbers of academically oriented students even in the poorest schools. However, that explanation, in its strongest form, does not allow for the negative effect of school poverty found in urban Catholic schools in eighth grade reading and sixth grade mathematics. Yet, the negative effects of poverty in Catholic schools in those subjects and years are smaller than the effects of poverty in public schools. The academic orientation of Catholic schools may be mitigating the effects of poverty in those cases.

The absence of an academic advantage in contemporary Catholic middle schools contrasts with the findings of Coleman and his colleagues in national surveys of high schools in the 1980s. The test scores of students in Catholic high schools in their studies grew faster than test scores in public high schools. A possible explanation for the absence of a Catholic school advantage in this study may be that a Catholic school advantage has never been seen in middle schools. An alternative or possibly complementary explanation is that public school students have benefited from recent public school reforms implemented in these schools. Since the early 1990s, the Chicago public schools have undertaken instructional and curricular changes aimed at improving student test scores. Evidence indicates these reforms have had positive effects (Bryk et al., 2010). Chicago Catholic schools, on the other hand, have been forced to close a number of schools and consolidate others in an effort to remain financially viable. Fewer resources have been available to these Catholic schools to improve instruction and strengthen the curriculum. The public school reforms and Catholic school financial difficulties of the past two decades could well have dissipated any advantage Catholic schools may have held in the past.

The general equality of student gains found here raises an important educational question. One may ask how two school systems, different in many ways, produce similar gains in student achievement. Research on school factors affecting achievement often has focused on what Catholic schools do well, such as establishing a school community, enforcing order and discipline, and creating a strong academic culture. Yet, if these are areas in which Catholic schools have an advantage, a different set of factors must explain the equal, and in some cases superior, performance of the public schools found here.

In comparative analyses of school sectors, another consideration is relevant. Schools provide benefits to students other than academic achievement. Both public and Catholic schools foster students' social and emotional

development as well as their cognitive growth. Given the current prominence of academic achievement in school research, practice, and policy, other school effects have received less attention. Yet, they remain an integral part of a student's school experience and have an enduring impact on students' attitudes and values.

Both public and Catholic schools seek to instill appropriate norms and values in their students, yet they do so in different ways. Public schools aim to create a broadly defined democratic citizenship (Tyack, 1974) while Catholic schools explicitly train for citizenship in reference to a strong, specific faith tradition (Bryk et al., 1993). Differences in student growth in these matters are not revealed from standardized test scores. Many parents may be willing to ignore small sector differences in achievement in order for their children to benefit either from norms of equality stressed in public schools or from the sense of community and faith vision that encompasses a Catholic school education.

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Appendix

Model Building

Four models are estimated in these analyses: achievement growth in reading and in mathematics in sixth and in eighth grade. The initial model estimated for each was identical in form and is shown in Table A1. This model estimates fixed effects, with a separate Catholic and suburban Catholic effect for each Level 1 variable.

Table A1

Equations for Multilevel Model of Growth in Achievement

Level 1 equation

All variables are indexed by i, where $i = 1, ..., N$, the total number of students.
All coefficients are indexed by j, where $j = 1, ..., J$, the number of schools.
Previous Test Score and SES are grand-mean centered.
Female, Black, and Hispanic are uncentered.

$$\text{Test Score} = b_{0j} + b_{1j}(\text{Previous Test Score}) + b_{2j}\text{Female} + b_{3j}\text{Black} + b_{4j}\text{Hispanic} + b_{5j}\text{SES} + e$$

Level 2 equation 2

All variables are indexed by j, where $j = 1, ..., J$, the number of schools.
The Catholic and Suburban Catholic variables are uncentered.
The Proportion Students on Free Lunch variable is centered at 0.70.

$$b_{0j} = g_{00} + g_{01}\text{Catholic} + g_{02}\text{Suburban Catholic} + g_{03}(\text{Proportion Students on Free Lunch}) + g_{04}(\text{Proportion Students on Free Lunch}) * \text{Catholic} + g_{05}(\text{Proportion Students on Free Lunch}) * \text{Suburban Catholic} + u$$

$$b_{1j} = g_{10} + g_{11}\text{Catholic} + g_{12}\text{Suburban Catholic}$$
$$b_{2j} = g_{20} + g_{21}\text{Catholic} + g_{22}\text{Suburban Catholic}$$
$$b_{3j} = g_{30} + g_{31}\text{Catholic} + g_{32}\text{Suburban Catholic}$$
$$b_{4j} = g_{40} + g_{41}\text{Catholic} + g_{42}\text{Suburban Catholic}$$
$$b_{5j} = g_{50} + g_{51}\text{Catholic} + g_{52}\text{Suburban Catholic}$$

We attempted to remove the separate sector effects of SES, female, Black, and Hispanic from the model, in that order. First, the suburban Catholic effect was tested to determine whether it significantly improved the fit of the model. If it did not, it was removed and the Catholic effect was then tested to determine if it significantly improved the fit of the model.

For all four grade/subject combinations, estimating separate sector effects for SES did not significantly improve the fit of the model. For three of the grade/subject combinations, estimating both separate sector effects for female did significantly improve the fit of the model. The exception is sixth grade reading, where the Catholic effect improves the fit of the model but the suburban Catholic effect does not. For all four grade/subject combinations,

estimating separate sector effects for race (Black and Hispanic effects assessed jointly) significantly improved the fit of the model (results not shown).

The estimates for the final models are shown in Table A2. These are the estimates used to generate the total effects in Table 7 and the predicted gains in Table 8.

Table A2

Multilevel Models of Achievement Growth

	Reading		Mathematics	
	Grade 6	Grade 8	Grade 6	Grade 8
Student *N*	20,237	20,218	20,180	20,192
School *N*	520	522	519	522
Level 1 effects in normal font				
Level 2 effects in italics	*b*	*b*	*b*	*b*
Constant (mean achievement)	226.22	254.38	225.55	252.70
Catholic vs. Public	*1.85*	*-6.40*	*1.98*	*-1.88*
Suburban Catholic vs. Catholic	*-2.99*	*-2.59*	*-3.30*	*-1.75*
School Prop. Free Lunch [0.70]	-7.83	-9.39	-6.02	-5.67
Prop. Free Lunch X Catholic	*8.18*	*4.22*	*2.55*	*7.23*
Prop. Free Lunch X Suburb Catholic	*-7.63*	*0.64*	*-11.47*	*-2.07*
Previous test score [grand]	0.87	0.84	0.88	0.91
Catholic vs. Public	*-0.19*	*-0.10*	*-0.02*	*-0.05*
Suburban Catholic vs. Catholic	*-0.03*	*0.02*	*-0.05*	*0.01*
Female [un]	3.49	-0.72	-0.24	-1.77
Catholic vs. Public	*-1.76*	*8.30*	*-0.41*	*0.36*
Suburban Catholic vs. Catholic		*1.60*	*-1.80*	*-1.40*
Black [un]	-4.56	-2.69	-3.37	-1.60
Catholic vs. Public	*-2.22*	*1.03*	*0.77*	*-4.76*
Suburban Catholic vs. Catholic	*4.52*	*-0.90*	*-2.44*	*2.65*
Hispanic [un]	-2.67	-3.52	-0.88	-1.28
Catholic vs. Public	*1.45*	*3.11*	*0.78*	*-1.39*
Suburban Catholic vs. Catholic	*-1.54*	*0.33*	*-1.78*	*1.51*
SES [grand]	0.87	0.95	0.40	0.54
Catholic vs. Public				
Suburban Catholic vs. Catholic				
Log Likelihood	-88768.8	-90208.2	-80427.7	-84643.1

Note. [grand] = variable is grand-mean centered, (un) = variable is uncentered, [.70] = variable is centered around the value 0.70