The Effects of Private School Competition on Student Achievement

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Abstract: This paper examines the contentious claim that increased competition between public and private high schools results in increased student achievement. Much of the recent literature on school competition focuses on competition and student achievement measured at the district or county level. In this paper, I investigate whether the level of aggregation of the competition variable affects the results by using zip code, county and metropolitan area level measures of competition. The results suggest that private school competition does not have a consistent effect on individual high school student achievement.

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Introduction

The quality of public high schools in the United States is of much concern. Standardized test scores have declined, and American high school graduates supposedly do not possess the skills needed to be successful in the workplace. Countless reforms have been suggested for improving public high schools. One hotly contested reform is expanded school choice opportunities. One proposed benefit of this plan is increased competition between schools, resulting in increased student performance for all students.

The main sources of competition for public high schools are private high schools, since students often have limited choices among public high schools. Several recent papers measure competition as the percentage of elementary and secondary students in the county or district who attend private school. Hoxby (1994) is only one of two papers that use student-level outcome data. She finds a positive effect of MSA level percentage private school on educational attainment and wages. Arum (1996) also uses student-level outcome data, but he finds an insignificant effect of state-level private school competition on student achievement. Papers that investigate the effect of competition on county or district average test scores for public high school students also have mixed results. Dee (1998), Borland and Howsen (1996) and Couch et al. (1993) find a positive effect of private school competition, while Sander (forthcoming), Simon and Lovrich (1996) and Newmark (1995) find no effect.

I extend this literature in three ways. First, I use two student-level data sets, the National Longitudinal Survey of 1972 (NLS72) and the National Educational Longitudinal Survey of 1988 (NELS) in order to compare the effects of private school competition on high school student populations in the 1970s and 1990s. Other papers focus on one time period and one data set, usually containing aggregate student data. Each of these papers only defines competition over one level of aggregation, like the county or MSA level. My second contribution to the literature is that I investigate whether the level of aggregation for the competition variable affects the results by estimating models where competition is defined at the zip code, county, and MSA levels. While disaggregate measures of competition like the zip code are more flexible (and more precise), they are also more likely to be correlated with unobservable student achievement. Third, I use several different outcome measures, including standardized test scores, education attainment variables, and log hourly wages. These outcomes are highly correlated with future labor-market success, and they are often used to evaluate the performance of high schools. Unlike Hoxby (1994), I do not find a consistent effect of private school competition – measured at the metropolitan area level – on student achievement or wages. The size and significance of the private school competition coefficient varies with the level of aggregation and the outcome, suggesting that the present literature on private school competition provides few conclusive findings.

The structure of the paper is as follows. The second section contains a literature review. The third section presents a basic model of school competition. The fourth section explains the data, and the fifth section presents the results. The sixth section discusses the implications of the model. The seventh section is the conclusion.

Literature Review

Most studies of private school competition investigate the effects of private school competition on aggregate public school student achievement, usually measured by district or county average test scores. With the exception of Dee's (1998) work on high school graduation rates, these papers contain observations from only one state. The use of school or district average test scores should be interpreted with caution, as Meyer (1997) points out that average test scores are "highly flawed" measures of school performance (pg. 283). In addition, aggregate data usually lack extensive information on socioeconomic status, a crucial input in the education production function (Hanushek, 1986), potentially biasing the estimates of private school competition.

The most comprehensive analysis of private school competition using aggregate data is the work by Dee (1998). He finds a positive effect of county percentage of students attending private school on district high school graduation rates. The data come from the Common Core of Data (CCD), where the dependent variable is a definition of high school dropout that is consistent across 18 states. He estimates ordinary least squares (OLS) regressions, as well as two-stage least squares (2SLS) models with measures of Catholic population density as instruments. However, these models contain limited control variables, especially compared to the extensive school competition models estimated by Hoxby (1994).[1] In fact, the OLS results in Dee (1998) are sensitive to the choice of included socioeconomic control variables, suggesting that his 2SLS models also may be affected by omitted-variables bias.

The most recent work on private school competition using aggregate data is by Sander (forthcoming). He uses school-level data from a single state (Illinois) to estimate the effect of the district percentage of students attending private school on average school achievement. He uses several dependent variable to measure school achievement, including standardized math tests, high school graduation rates, and the percent of seniors taking the ACT (as a proxy for the percent intending to attend college). He estimates OLS models, as well as 2SLS to correct for the endogeneity of the competition variable (again, with Catholic population density as instruments). For both models, Sander (forthcoming) finds no effect of private school competition on any of the dependent variables. Like Dee (1998), Sander's (1999) data contain limited demographic control variables, and therefore his findings may be driven by omitted-variables bias.

Earlier work by several authors utilizes county- or district-level student data from individual states. Couch et al. (1993) find that the county percentage of students attending private schools has a positive and significant effect on county mathematics test scores for 100 counties in North Carolina. Simon and Lovrich (1996) find little effect of private school competition on public student test scores, using district-level data from the state of Washington. Borland and Howsen (1996), with district-level data from Kentucky, find marginally significant, positive effects of private school competition in district test score regressions. These three papers do not account for the possible endogeneity of the private school competition variable, so the validity of their results is highly questionable.[2] In fact, all the literature using school- or district-level dependent variables suffers from the reliance on aggregate measures of student achievement, along with limited demographic data. These shortcomings are of particular concern when aggregate test score regressions (Meyer, 1997).

In addition to an analysis of private school competition on state-level high school graduation rates, Arum (1996) also uses individual-level from High School and Beyond. When the dependent variable is a dummy variable for graduating from high school, the effect

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[1] The model estimated by Dee (1998) contains only 15 explanatory variables (excluding state dummy variables), compared with Hoxby (1994), who includes over 25 demographic variables and several individual-level variables (as well as state dummy variables) as explanatory variables.

[2] Couch et al. (1993) attempt to control for the endogeneity of the competition variable by estimating a two-stage model, but the equation predicting private school competition contains important socioeconomic variables that should be included in the test score equation. Thus, Newmark's (1995) finding that the OLS results in Couch et al. (1993) are not robust to alternative model specifications is not surprising.

of private school competition is insignificant once Arum (1996) includes state-level education variables.

Hoxby (1994) provides the only detailed, individual-student level investigation of the claim that the competition provided by the presence of private schools positively affects student performance. She defines private school competition as the percentage of secondary school students attending private school. For students in metropolitan areas (MSAs) at age 14, she uses the MSA percentage, while she uses the county percentage for all other students. By linking the National Longitudinal Study of Youth (NLSY) to other data sources, she finds that private competition improves individual students' years of schooling, wages, high school graduation rates, and college attendance rates. These results use instrumental variables (again, with Catholic population density variables as instruments) to control for possible endogeneity of private school competition and unobserved public student achievement. She finds similar results when her measure of competition is the percent of students in the MSA attending Catholic secondary school.

Hanushek, Rivkin and Taylor (1996) investigate the role of aggregation in the estimation of the effect of school resources on outputs of the educational production function. The authors show that aggregation at the state or district level tends to increase the size of the school resources coefficients in student achievement regressions. Their model is consistent with an omitted-variables hypothesis but not with an error-in-variables one. Loeb and Bound (1996) also believe that aggregating to the state level inflates the size of the coefficients.[3] Due to differences in educational policies across states, important state effects exist, and the

[3] Loeb and Bound (1996) also cite similar results in Betts (1995) and Grogger (1996).

omission of them in most models creates an upward bias in the effect of school resources on student achievement.[4]

Hence, one concern with previous research on private school competition is that the level of aggregation of the competition variable may affect the results. Since each paper only includes one level of aggregation, the effects of aggregation on the results are unknown. I investigate this issue by estimating separate models for zip code, county, and MSA level definitions of the private school competition variables as well as the demographic variables. In order to avoid the problems of using aggregate measures of student achievement, I use two individual-level data sets.

Basic Model

In a survey of the school resource literature, Hanushek (1986) argues that schools use inputs like per-pupil expenditures and student-teacher ratios to produce educational outputs. Since the exact outputs of the education production function are highly debated in the literature, I use a variety of outcomes, all measured at the individual student level.[5]

The first outcome measures are standardized test scores in math. These tests often are used to measure school quality, and they are administered in high school. I also include measures of educational attainment, such as a dummy variable for graduating from high school, as dependent variables. Educators and policy makers use high school graduation rates as indicators of school quality, and the labor market options for high school dropouts has gotten worse (Blank, 1997). I also use measures of educational attainment that incorporate post-secondary education as dependent variables. In one data set (NLS72), I measure

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[4] Hoxby (1994) and Dee (1998) both include state dummies in order to eliminate this bias, while the other authors (except Arum (1996)) each use data from only one state.

[5] The choice of school inputs and their effectiveness are also highly controversial (Hanushek, 1996 and Hedges et al., 1996).

educational attainment by years of schooling after grade 12, the grade in which the NLS72 survey began. In the other data set (NELS), the post-secondary educational attainment outcome is a dummy variable for college attendance as of the most recent follow-up survey, two years after most respondents graduated from high school. One drawback of the post-secondary education variables is that they are influenced by many non-school factors (like parental resources). However, these variables are also excellent predictors of labor-market success. Finally, a direct measure of labor market success, log hourly wages, is included as a dependent variable.

Equation (1) represents a linear model for measuring continuous outcomes like standardized test scores:[6]

$$(1) \qquad Y_{ij} = X_{ij}'\beta + Z_j'\gamma + P_j\alpha + \varepsilon_{ij}$$

In this equation, Y is one of the observed dependent variables mentioned above, X is a vector of individual characteristics, Z is a vector of local demographic variables, P is a measure of private-school competition, ε is the unobservable term, i indexes individuals, and j indexes local demographic area (zip code, county or MSA, depending on the model). The model represented in equation (1) is estimated by OLS regression. Since unobservable student quality is probably correlated among students in the same geographic area, all equations are estimated with standard errors that allow for correlation of ε for students in the same geographic area (zip code, county or MSA). This error structure is similar to a random-effects model, where the unobserved component has two parts, a geographic part and an individual component ($\varepsilon_{ij} = \eta_j + \nu_{ij}$). I do not constrain the structure of ε_{ij}.[7]

[6] Probit models are estimated for all binary outcomes.
[7] Another popular model for panel data is a fixed-effects model. However, in such a model the researcher cannot identify variables that do not vary within panels. In my case, the panel is a geographic area (zip code, county, or

The measure of private school competition varies in the literature. I use multiple definitions based on two distinct concepts. The first concept is that a higher percentage of elementary and secondary school children attending private school measures greater competition. I create three competition variables based on this concept: the zip code, county and MSA percentages.[8] The second concept is that the distance to the nearest private school also measures private-school competitiveness. Therefore, the fourth measure of private school competition is the distance to the nearest Catholic high school, where greater distance is taken to be a linear measure of less competition.[9] Location is very important for school choice. The vast majority of Catholic school students attend a school near their home, although this finding is stronger for elementary school than for high school students (James, 1987). For Catholic high school students, almost 80 percent of the students live within 10 miles of the school, and only 5 percent live more than 20 miles from the school (Yeager et al., 1985).

The distance to the nearest Catholic high school is an effective way to measure the competitive influence of neighborhood private high schools. Catholic schools are chosen, rather than all private schools, because they are a homogenous set of schools, and over half of the private school students attend Catholic schools. The tuition of the nearest Catholic school is another measure of the competitiveness of local private schools, but many unobservable local conditions, like the amount of funding from the local Catholic church, directly affect

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MSA). Since the competition variable does not vary within each geographic area, I would not be able to identify the effects of private school competition in a fixed-effects model.

[8] Due to data limitations, I am unable to obtain separate percentages for elementary students and secondary students. Also, the NELS and NLS72 data do not contain more micro-level information than at the zip code level.

[9] I would like to thank Todd Elder for providing data on distances to Catholic high schools.

tuition. Therefore, tuition data are endogenous, in addition to being difficult to obtain.[10] However, Catholic school location data are available, and the presence of a Catholic school clearly indicates competition from private schools (even though the tuition and quality of the Catholic school may influence the level of competition).

The percentage of students in private high schools is also an important measure of school competition. Public schools care about losing students, especially given the increasing popularity of school voucher plans. Under such plans, the government would take funding away from public schools and give it to private schools in areas with high percentages of private school students. Since public schools care about revenue, these private-school enrollment variables are useful.

One concern with OLS regression is that endogeneity problems often exist for the regressors in equation (1). For example, private schools' location decisions are a function of many community characteristics, including local public school quality. If some of these characteristics are not observable, like community tastes for private schooling, private school competition and unobservable student achievement are correlated. Another concern is that parents may send their children to private school *because* the local public school is low quality. Since public school quality is difficult to measure in these data, I am unable to measure this effect. Instead, I wish to estimate the effect of the competitiveness of the private school market, net of public or private school quality. I cannot use OLS estimates derived from equation (1), since they are affected by local private and public school quality. One way to control for the effect of unobservable school quality is the use of two-stage least squares

[10] Quality of the nearest Catholic high school is also important for determining competitiveness, but reliable quality data are not readily available.

(2SLS) estimation.[11] In the 2SLS model illustrated by equations (2) and (3) below, I use predicted (rather than actual) private school competition, where predicted competition is a function of observable demographic characteristics:

(2) $$P_j = Z_j'\lambda + C_j'\mu + \nu_j$$

(3) $$Y_{ij} = X_{ij}'\varphi + Z_{ij}'\gamma + \hat{P}_j'\alpha + \eta_{ij}$$

In these equations *P, X, Z, i* and *j* are defined as in equation (1). As mentioned above, $\hat{P}$ is the predicted percentage of students in private schools or distance to nearest private school obtained from equation (2), and *C*, the instrument, is a strong predictor of private school location/enrollment that is uncorrelated with student outcomes. Obviously, the choice of the variable or variables to include in *C* is crucial to the performance of the model. In order for an element of *C* to be a valid instrument, it must be uncorrelated with η and correlated with *P*. If the independent variables in equation (2), especially those in *C*, provide a poor fit, then the outcome equation (2) will be poorly estimated. Bound, Jaeger and Baker (1995) show that a weakly correlated instrument can lead to biased parameter estimates. Therefore, the results section includes an analysis of the fit of equation (2).

Following the methodology used by many researchers studying private schooling, I use demographic religious composition variables as instruments. Specifically, the six instruments are percentage of the county/MSA population that is Catholic, the density of Catholics in the county/MSA, the density of Catholic churches in the county/MSA, and the squares of these three variables.[12] The conventional argument for the use of these variables as

[11] Again, when the outcome variable in equation (3) is a binary variable, a probit is estimated in equation (3). See Murphy and Topel (1985) for a more detailed explanation of two-stage estimation when the second stage is non-linear.
[12] Note that these instruments are highly correlated with each other by definition, since they all depend on the number of Catholics (or Catholic churches) in the county/MSA.

instruments is that over half of all private schools students are in Catholic schools. Since the Catholic church supports these schools, areas with more Catholics, and specifically areas with concentrations of Catholics, are more likely to have more private schools. These areas then have higher percentages of private school students and lower distances to nearest private schools, all else equal. Furthermore, the argument for the use of these religious densities as instruments is that they have no direct effect on student achievement. Because researchers are concerned that a student's religion may have an effect on student achievement, the outcome equation includes the religion of the student as an independent variable. The argument that county level measures of Catholic population and density has a direct effect on student achievement is a weak one, especially since equations (2) and (3) include extensive individual and community controls. Likewise, I assume that the instruments contain no direct effect of private or public school quality.

Because zip code level estimates are the most micro-level measurements of competition and local demographic characteristics, they should be the most precise. However, if one believes that parents choose the zip code of residence within a community in part due to public school quality, then 2SLS estimates produce biased parameter estimates. County level estimates provide less precise estimates, since the researcher has to assume that the effect of private school competition is the same for every student in the county. Also, if parents choose counties based in part on local public school quality, then these estimates would also be biased. MSA level estimates should be free of these endogeneity concerns, as long as the researcher is willing to assume that parents choose metropolitan areas on the basis of employment, not public school quality. This assumption seems plausible. Unfortunately, the researcher also assumes that the effect of private school competition is the same for each and every student in the metropolitan area, and that competition can be measured as the metropolitan area mean. This precision-endogeneity tradeoff is discussed in more detail later.

Data

All individual and school data come from two longitudinal data sets. One data set is the National Longitudinal Survey of 1972 (NLS72). In the spring of 1972, a nationally representative sample over 17,000 high school seniors participated in the survey.[13] These students completed follow-up surveys in the springs of 1973, 1974, 1976, 1979 and 1986. The second student-level data set is the National Educational Longitudinal Survey of 1988 (NELS). This data set began in 1988, when over 20,000 eighth-grade students were surveyed. Both the sample of schools and students in the NELS data are nationally representative in 1988.

In order to create a data set with the wide variety of variables needed, I combine each individual-level data set with demographic data from several sources. Each individual level data set includes the zip code of the baseline school or of the student. These zip codes are then matched with demographic data from the Center for International Earth Science Information Network to determine the county and, for students in MSAs, the MSA.

For the NLS72 data, I calculate the distance from the student's zip code to the nearest Catholic school using the list of zip codes of schools in the Universe of Private Schools, 1976-1980.[14] For the NELS, I calculate the distance from the eighth grade school zip code to the

[13] The goal of the NLS72 was to obtain a representative sample of students, and to follow these students as they made the transition from high school to work and/or college. Therefore, the data contain little information about these students before their senior year, the first year in which they completed surveys. Therefore, no school-level data is included in the analysis. Also, the 1986 sample is not used, since the educational attainment is one of the determinants of whom to include in the 1986 sample.

[14] While a substantial number of private high schools are not in the data, the missing schools do not seem to follow much of any pattern (U.S. Department of Education, 1980).

nearest Catholic high school, using location data from the *Catholic Schools in America – 1988*, which has the address of every Catholic high school in the country.

I utilize county-level religious demographic data, including the Catholic population density variables used as instruments, from the Survey of Churches and Church Membership.[15] To create MSA-level variables, I aggregate county level data, as each metropolitan county is usually part of only one MSA. I combine data from the 1970 survey with the NLS72, while I match the 1990 data with the NELS.

The source of non-religious demographic information, including the percentage of students attending private school, is the U.S. Census. The 1972 City and County Data Book has demographic and private school enrollment data at the county and MSA level from the 1970 Census.[16] I merge these data with the NLS72. The 1990 Census includes several summary files that contain separate zip code, county and MSA level files. I match these files with the NELS data.

Results

Descriptive statistics for the NLS72 data are presented in Appendix Table 1, while Appendix Table 2 contains summary statistics for the NELS data. The NLS72 data provide a nationally representative sample of the high school population for the class of 1972, and sample attrition is not systematic. Although the baseline NELS data are a nationally representative sample of eighth grade students in 1988, sample attrition is not random by the second and the third follow-ups. Therefore, all regression results using NELS data are weighted, using weights for students who participated in every wave of the survey.[17]

[15] Zip code level data on religious affiliation would be better, but they are not available.
[16] Zip code level demographic data from the 1970 Census are not available.
[17] Since the high school graduation and grade 12 math test score models use data from the baseline through second follow-up survey, the weights for these models are calculated as of the second follow-up survey. The

OLS and Probit Results

OLS coefficients and probit marginal effects are presented in Tables 1-3, where all standard errors are corrected for possible correlation between students in the same demographic area (zip code, county or MSA). Table 1 shows that private school competition has no effect on standardized math test scores, whether the sample is high school students from the 1970s (NLS72) or the 1990s (NELS). These results do not depend on the level of aggregation of the competition variable, nor whether I measure competition as enrollment percentages or the distance to the nearest Catholic school. Similarly, in Table 2 I find no effect of competition on 1977 log hourly wages in all OLS models, although these models have low R-squareds.

In contrast, the effects of competition on educational attainment depend on the sample and the definition of competition. As Table 2 illustrates, competition has no effect on years of schooling, for all measures of competition for students in the NLS72. For NELS88 students, the results in Table 3 are more sensitive to the choice of the private school competition variable. When the dependent variable is a dummy variable for high school graduation, I find that the MSA percent of students attending private school has a large, positive significant effect. Increasing the MSA percent attending private school by one standard deviation (6.4) increases the probability of graduating from high school by almost 3 percent. This result is larger than the effect of most of the student demographic variables. However, when the measure of competition is county or zip code level, or distance to nearest private high school, the coefficient on the competition variable is small and insignificant. Hence, the validity of the MSA results in Table 3 is questionable.

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college attendance model, which is based on the third follow-up survey, uses weights from the baseline through third follow-up survey.

The percentage of students attending private school at the county and MSA level both have positive and significant effects on the probability of attending college. For the county percentage, a one standard-deviation increase in private school share (in either the county or MSA model) results in slightly more than a 3 percent increase in the probability of attending college. The zip code and distance coefficients are small and insignificant, although these two coefficients are the most likely to be correlated with unobservable student achievement.

The level of aggregation of the private school competition coefficients also affects the size of the standard errors. As the level of aggregation increases, so do the standard errors. The coefficients of student and demographic characteristics vary little across levels of aggregation, but the coefficients of student characteristics vary somewhat across outcomes. Holding all else constant, females and minorities have lower test scores and wages. In the 1970s, females have lower years of schooling, but in the 1990s they are more likely to attend college. Parental income has a strong positive effect on all outcomes in both time periods, and parental education and expectations have strong positive effects on test scores and years of schooling.

As in Tables 1-3, the current literature on private school competition provides mixed single-equation results. Using the NLSY, Hoxby (1994) finds no effect of private school competition on years of schooling. Arum (1996) also finds insignificant results of state-level private school competition on test scores in the High School and Beyond data. With aggregate data, Couch et al. (1993) and Borland and Howsen (1996) find positive and significant effects of private school competition on aggregate test scores, while Newmark (1995), Simon and Lovrich (1996), and Sander (forthcoming) find insignificant results. The significance of the private school coefficient in Dee (1998) depends on the model.

As stated earlier, researchers have many reasons to doubt the exogeneity of the effect of private school competition variables on student achievement. In OLS models, researchers cannot distinguish the effects of private school enrollment/location due to competition from the effects due to private school "flight" resulting from poor public school performance. In theory, the former effect on student achievement is positive, while the latter effect is negative. Given these confounding effects, the lack of significant results in Tables 1 through 3 is not surprising. In order to estimate competitive effects of private schooling independent of "flight" from low-quality public schooling, I estimate two-stage least squares (2SLS) as modeled in equations (2) and (3).

Hoxby (1994) uses the MSA (county for non-MSA students) as the level of aggregation for demographic variables in order to avoid the possible endogeneity of choice of location. In other words, parents can choose (to differing degrees) zip codes or counties within a metropolitan area, but they choose metropolitan areas based solely on employment.[18] If parents make this choice based in part on the quality of local public (or private) schools, then private school enrollment/location is correlated with unobservable student achievement. Under this scenario, zip code or county level 2SLS would be biased.

While the choice of MSA level competition variables eliminates this endogeneity, this choice still has drawbacks. As Tables 1 through 3 illustrate, MSA level demographic variables are less precise than county or zip code measures, leading to larger standard errors. In addition, the researcher implicitly assumes that the effects of the competition variable and demographic variables are constant within a given metropolitan area. In Chicago, for example, this assumption implies that the effect of greater private school attendance on

[18] An implicit assumption is made that people in rural areas choose to live in the county where they will work, or that the choice of where to live is not affected by the quality of the local public schools.

student achievement is the same in the impoverished South Side as it is in the affluent North Shore suburbs. Given the absence of many markets in extremely poor neighborhoods, this assumption is questionable. In order to minimize the reliance on this assumption, I estimate 2SLS models for each level of aggregation included in the OLS models.

First-Stage Results

Table 4 contains first-stage results for the NLS72 from equation (2). This equation uses Catholic density variables to predict private school competition. The dependent variable in column 1 is the distance to the nearest Catholic high school, while the dependent variables in columns 2 and 3 are the county and MSA percentages of students attending private schools, respectively. The instruments – the independent variables included in this equation but not in the outcome equation – are six measures of Catholic density: percentage of the county/MSA population that is Catholic, the density of Catholics in the county/MSA, the density of Catholic churches in the county/MSA, and the squares of these three variables. Because over half of the private school children in the country attend Catholic schools, Catholic schools have higher demand and lower costs in areas with high concentrations of Catholics. Therefore, these instruments are good predictors of private school competition. The independent variables in each model are the independent variables included in Table 1, as listed in the footnote to Table 4.

In order to minimize the possibility of omitted-variable bias, the first-stage equations, as well as the OLS and 2SLS student achievement equations, contain extensive demographic controls, many of which do not have obvious economic interpretations. For example, I include the religious homogeneity index and the percentage of the county population that regularly attends Christian religious services of any denomination as independent variables, so that the coefficients on the instruments reflect Catholic density, rather than the effects of other religions. Other examples are the inclusions of population density, population and area variables.

The county and MSA models presented in Table 4 fit over 80 percent of the variation in percent attending private school. The instruments have the predicted sign and are highly significant. The F statistic for the instruments is significant at one percent both models, well above the lower bound set by Bound, Jaeger and Baker (1995) for poorly fitted models. The general significance of the squared terms suggests that the relationship between these variables and private school competition is not linear.[19] While the coefficients in Table 4 are not large, they are over double those reported in Hoxby (1994) and Sander (forthcoming).[20] The most powerful instrument in Table 4 is the Catholic percentage of the population. Increasing this percentage by one percent increases the percentage of students attending private school in the county by 0.36 percent (0.31 percent for the MSA model). Because all the instruments are measurements of Catholic religious density, they are highly correlated with each other. Each instrument plays an important role in predicting the level of private school competition, but the significance and magnitude of the coefficients for the instruments varies from model to model. In all models, I estimate F-tests for the joint significance of subsets of the instrument and can reject the hypothesis that many subsets of the instruments are jointly zero.

[19] An intuition for a quadratic relationship between Catholic population/density and private school competition is as follows. As Catholic population density increases, the support for a Catholic school increases. However, at some point, the high percentage of Catholic residents influences the (secular) behavior of the public schools, somewhat reducing the demand for Catholic schooling. While this intuition is a simplification of the situation, it does suggest that a quadratic relationship may be more appropriate than a linear one.

[20] While the instruments for Catholic population and density in the first-stage models estimated by Dee (1998) differ slightly from the models estimated here, he also finds large, highly significant effects of the instruments in his first-stage models.

Many of the coefficients that are not instruments are significant in Table 4. In the MSA model, the percent of the population that attends church has a negative effect on percent attending private school, perhaps suggesting that MSAs with more church members are "safer" and therefore have "safer" public schools (reducing the demand for private schools). In contrast, the religious homogeneity index (larger indices indicating more homogeneity) has a positive impact. Areas with more homogenous religious populations are more likely to have concentrated demand for private schooling, perhaps increasing supply (and therefore attendance). Not surprisingly, urban areas and areas with more people have higher percentages of students attending private schools. Areas with more female-headed households, AFDC recipients or low-income households have lower private school student percentages.[21] The presence of "flight" into private schools in integrated neighborhoods is illustrated by the negative coefficient on percent white. As areas become more non-white (percent white falls), the percent attending private school increases.

In the first column of Table 4, the dependent variable is the distance to nearest Catholic high school. The coefficients for this model differ noticeably from the results for percent attending private school models in columns 2 and 3. The reader should keep in mind that the two measures of competition are inversely related. As distance to nearest high school decreases, the level of private school competition increases. As the percentage of students attending private school increases, the level of private school competition increases. While few of the instruments have significant coefficients, the F statistic on the instruments is highly significant. Also, the R-squared on the regression is nearly 0.5. As in the percent attending private school models, many of the coefficients that are not instruments are also significant.

[21] Strangely, percent attending private school has an inverse relationship with median income, but this effect may be influenced by the presence of per capita income and household income dummies.

The percent of households with low incomes has a strong, positive effect on distance to nearest Catholic school. Hence, poor neighborhoods have fewer Catholic high schools, all else equal.

Table 5 contains first-stage results from equation (2) for NELS data. These results are similar to the NLS72 results in Table 4, suggesting that the predictors for private school competition have not changed much between 1970 (NLS72) and 1990 (NELS). Again, the F statistics for the instruments are all significant at one percent, with values ranging from 4.3 to over 20. As in Table 4, the Catholic percent of the area population has a large and highly significant effect on the dependent variable, although all the instruments help determine private school competition.

Second-Stage Results

The second-stage results from equation (3) are summarized in Table 6. Individual student characteristics, local demographic variables, and predicted private school competition (from equation (2)) are regressed on a measure of student achievement or labor market success. For each outcome, the first column defines competition as the distance to nearest Catholic high school, while the remaining columns define competition as the percent of students attending private school.[22] I present only the coefficients on the instrumented competition variables, although all specifications include all other independent variables from the single-equation models.

In the top section of Table 6, the dependent variable is math test score. For this variable, the effects of competition depend on the data set as well as the measure of competition. For the NLS72 data of high school seniors in 1972, private school competition

[22] In the models where distance is the measure of competition, the demographic variables are defined at the county level, since the instruments for this model are defined at the county level.

measured at the county level has a significant, positive effect. However, this effect is quite small in magnitude, since the coefficient is less than 0.1 and the test score has a mean of 50 and a standard deviation of 10. For all other measures of competition, the private school competition coefficient is small and insignificant. For the NELS data of eighth graders in 1988, the effects of private school competition on the standardized math test score are negative but insignificant, regardless of the level of aggregation of the competition variable. Hence, the results suggest that private school competition has little if any effect on standardized test scores once I control for possible endogeneity. These results are consistent with those of Sander (forthcoming), who finds insignificant 2SLS results of competition on district-level math test scores in Illinois. In contrast, Hoxby (1994) finds positive effects of MSA level competition on standardized test scores in the NLSY.

While not reported in Table 6, the other coefficients in the test score model are nearly identical to the OLS results reported in Table 1. Females, blacks and Hispanics have lower test scores. Parental education, income and expectations have strong positive effects. Similar to McLanahan and Sandefur, (1994), I find a strong positive effect for children growing up in two-parent homes. The demographic variables are generally insignificant, and the standard errors increase as the area of aggregation increases.

In the left half of the middle section of Table 6, the dependent variable is post-secondary years of schooling in the NLS72 data. I find no effect of private school competition on years of schooling for all definitions of private school competition. These results again contradict Hoxby (1994), who finds a significant, positive effect for 14 to 21 year-olds in 1979. The insignificant effects of private school competition on years of schooling and math test scores for the NLS72 data imply that that private school competition does not have an effect on educational attainment for high school seniors in 1972.

The dependent variable in the right half of the middle section of Table 6 is a measure of labor market success: log hourly wage in 1977 (for NLS72). In this model, the private school competition coefficient is sensitive to the definition of competition. When competition is defined as distance to nearest private school, the private school competition coefficient is small and insignificant. The effect of private school competition, when competition is defined as the county percent of students attending private school, is larger and significant: increasing the private school percentage by one standard deviation (7.6) increases hourly wages by a non-trivial 4 percent. However, when the percent of students attending private school is measured at the MSA level, the competition coefficient decreases and the standard error increases, resulting in an insignificant effect for MSA level private school competition. Hoxby (1994) finds a positive effect of MSA level private school competition on log wages of roughly 0.5 for NLSY data.

While not reported, the other coefficients for the years of schooling and log wage models are very similar to the OLS results in Table 2. Females have significantly less education and hourly wages than men do. Consistent with Cook and Ludwig (1997), I find an insignificant Black race effect when controls for socioeconomic status (SES) are included. The effect of being Hispanic is insignificant in the years-of-schooling model, similar to the results from Ganderton and Santos (1995) using High School and Beyond Data. However, I do find that Hispanics earn approximately 4 percent less than whites. Parental income, education, and expectations variables continue to have strong positive effects. Being Jewish corresponds with an extra year of schooling compared to the omitted religion, Methodist. The schooling effect for Catholics is only one-tenth of a year. Neither religion has a significant effect on wages.

The bottom section of Table 6 contains probit marginal coefficients for competition on educational attainment using NELS data. The dependent variable in the left half is a dummy variable for high school graduation. Regardless of the measure of private school competition, I find no effect of competition on graduating from high school. Again, these results are not consistent with the 2SLS results from Hoxby (1994), who finds a positive effect for high school graduation. In 2SLS models, Dee (1998) finds positive and significant effects of competition on district graduation rates, while Sander (forthcoming) finds insignificant effects.

When the dependent variable is college attendance, the private school competition results depend on the measure of competition.[23] The zip code percent attending private school and the distance to nearest private school produce small, insignificant marginal effects for private school competition. The county percent attending private school has a positive impact on college attendance (conditional on graduating from high school). The magnitude of this effect is tremendous, as a one-percent increase in county percent private school results in an increase in the probability of attending college by more than one percent. The validity of this effect is questionable, as the MSA level private school coefficient is much smaller. Given the increase in standard errors due to aggregation, the MSA level marginal effect is insignificant. Hence, the evidence that the level private school competition has a positive effect on educational attainment for eighth graders in 1988 is questionable. For students who attended

[23] While not reported, the results for college attendance do not change when I include the distance to the nearest college as an independent variable.

high school in the late 1970s, Hoxby (1994) finds positive and significant effects of MSA percent attending private school on both these outcomes.

The unreported marginal effects for the NELS educational attainment models in the bottom panel of Table 6 are similar to the probit marginal effects in Table 3. Females are significantly more likely to attend college, as are students from two-parent families, families with higher income and higher educated parents. The role of religion is interesting in this model. For every outcome, being "very religious" has a strong, positive effect.[24] Most of the student religion variables, including Catholic, are insignificant.

Discussion

While I find some positive effects of county level competition on student achievement and wages, the combination of smaller MSA level coefficients and larger standard errors makes the MSA estimates generally insignificant.[25] Hoxby (1994) finds a positive, MSA-level effect of competition on several outcomes in the NLSY, including math test scores, years of schooling and wages. Several possible explanations exist for the differences between the results in Tables 1 through 6 and those in Hoxby (1994). She defines competition as the percentage of *high school* students attending private school, while I, along with the majority of the literature, use the percentage of elementary and secondary students attending private school.[26] Perhaps part of the reason for the large standard errors in Tables 1 through 6 is that the percentage of elementary school students attending private school has little or no effect on high school student achievement, but its inclusion in the conventional measure of private

[24] Hence, the use of religiousness as a possible instrument for private school competition is not valid for the NLS72 or the NELS data.
[25] Similarly, Arum (1996) generally finds positive but insignificant results of state-level competition on student-level outcomes in High School and Beyond data.
[26] Unfortunately, Census data from 1970 and 1990 do not allow researchers to compute percentages of students attending elementary and secondary private schools separately.

school competition adds considerable noise. Another explanation for the difference between my MSA level results and those in Hoxby (1994) is that the effects of private school competition vary over time. I look at high school seniors in 1972 (NLS72) and 1992 (NELS88), while Hoxby (1994) considers students aged 14 to 21 in 1979.

The choice of the appropriate level of aggregation of the competition variable in unclear. More disaggregate measures of competition are more precise and less noisy, since they cover a smaller geographic area. However, they are more likely to be correlated with unobservable school quality, since the location decision of parents – at a micro level – are determined in part by the quality of the local public school system. The endogeneity of the zip code competition variable is of particular concern, since parents probably choose the neighborhood based largely on the local schools (sometimes reflected indirectly in the housing prices of the area). Since parents also pick which school districts in which to reside, the district-level data of Borland and Howsen (1996) and Sander (forthcoming) may also be affected by this endogeneity.

The endogeneity-precision trade off at the county and MSA levels is less obvious. In fact, for rural students who do not live in an MSA, the MSA variables *are* the county variables. Still, the difference in precision, at least in NLS72 and NELS data, can be seen by comparing the standard errors of the coefficients in Table 6. Part of the difference in precision comes from the accompanying assumption regarding the unobserved term, since, in all models, I allow for correlation of the unobserved terms for students living in the same geographic area. Hence, as the geographic area becomes larger, the number of students in a given geographic area also becomes larger, resulting in larger standard errors. A loss of precision also occurs because I implicitly assume a constant effect of each demographic variable for all students in a given geographic area. As the geographic area becomes larger, like a county or an MSA, this assumption becomes more restrictive. Hence, the smaller magnitude and larger standard errors of the MSA coefficients relative to the county coefficients is expected.

The main advantage of the MSA level variables is the lack of endogeneity between MSA competition variables and unobserved public school quality. The assumption that people choose the MSA of residence, or the county of residence in rural areas, based on job choice rather than school choice is a plausible one. Extending that choice to counties within metropolitan areas is not as clear. For example, over 15 percent of 1990 Census respondents who live in multi-state MSAs work in a different state from where they live (author's calculations based on 1990 Census data, five percent sample). This finding suggests that people in MSAs make location decisions, in terms of counties or zip codes, based on factors other than employment, like local school quality. Hence, the MSA estimates in the tables are the most reliable, and they show no effect of private school competition once I control for endogeneity.

Conclusion

The conclusions that can be drawn from the private school competition literature are limited. The effect of private school competition on student achievement and wages varies, depending on the data set, the outcome, and the choice of the competition variable; no consistent pattern emerges. Hence, either competition has no effect on student achievement, or an effect exists but my data and models are too imprecise to find it. I use two extensive, student-level data sets, matched with demographic data. I define several different measures of competition and student achievement, and I estimate OLS models and 2SLS models that correct for endogeneity of unobservable student achievement. I find that metropolitan area measures of competition are unlikely to be correlated with unobservable student achievement, but these MSA-level measures have moderate coefficients and large standard errors, resulting in generally insignificant effects of private school competition.

The lack of consistent effects of private school competition found here call into question the universality of the positive findings in Hoxby (1994) using individual data and Dee (1998) using aggregate data. Much work remains to be done before policy makers can reach any conclusions about the effects of private school competition on student achievement and wages. To the extent that existing private school competition can be used as a guide for the effectiveness of vouchers, the results to date suggest that school voucher plans may not be the most effective way to improve public schools.

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Table 1

OLS Results for Math Standardized Test Scores

	Dependent Variable: NLS72 Standardized Math Test			Dependent Variable: NELS Grade 12 Standardized Math Test			
	Measure of Competition			Measure of Competition			
	Nearest Cath. High School	Percent Attending Private School in: County	Percent Attending Private School in: MSA	Nearest Cath. High School	Percent Attending Private School in: Zip Code	Percent Attending Private School in: County	Percent Attending Private School in: MSA
Private School Competition	-0.0002	-0.0067	-0.0009	0.0004	-0.0222	-0.0241	-0.0351
	(0.0035)	(0.0204)	(0.0222)	(0.0076)	(0.0286)	(0.0609)	(0.0662)
Female	-1.902	-1.902	-1.890	-1.250	-1.276	-1.295	-1.263
	(0.144)	(0.151)	(0.144)	(0.330)	(0.340)	(0.350)	(0.319)
Black	-7.026	-7.024	-7.067	-5.539	-5.569	-5.478	-5.472
	(0.248)	(0.275)	(0.245)	(0.652)	(0.675)	(0.647)	(0.670)
Hispanic	-5.544	-5.549	-5.618	-3.765	-3.792	-3.657	-3.890
	(0.395)	(0.420)	(0.394)	(0.726)	(0.637)	(0.859)	(0.623)
Years of Parental Education	0.541	0.541	0.553	1.494	1.421	1.509	1.511
	(0.033)	(0.035)	(0.033)	(0.074)	(0.081)	(0.077)	(0.073)
Catholic Religion	-0.275	-0.269	-0.286	-0.934	-0.997	-0.925	-0.677
	(0.180)	(0.183)	(0.180)	(0.639)	(0.619)	(0.680)	(0.669)
Jewish Religion	1.733	1.736	1.804	0.812	0.152	0.733	1.203
	(0.489)	(0.462)	(0.487)	(1.859)	(1.793)	(1.989)	(2.110)
Other Religion	-1.837	-1.836	-1.813	-0.020	-0.150	0.220	0.018
	(0.353)	(0.346)	(0.353)	(0.890)	(0.968)	(0.942)	(0.934)
No Religion	-1.220	-1.219	-1.257	-0.823	-1.152	-0.728	-0.720
	(0.331)	(0.357)	(0.331)	(0.948)	(0.999)	(1.040)	(0.955)
Log Parental Income (1990$)	1.060	1.060	1.097	1.299	1.130	1.249	1.306
	(0.141)	(0.141)	(0.141)	(0.201)	(0.196)	(0.213)	(0.179)
Two Parent Household				1.391	1.455	1.440	1.439
				(0.382)	(0.412)	(0.401)	(0.382)
Parents Expect College	6.057	6.056	6.086	6.632	6.559	6.661	6.579
	(0.177)	(0.206)	(0.177)	(0.483)	(0.483)	(0.503)	(0.471)
Observations	13,646	13,646	13,647	12,212	12,212	9,703	12,212
R-squared	0.34	0.34	0.34	0.30	0.31	0.31	0.30

Notes: Robust standard errors that allow within area (zip code, county or MSA) correlation are in parentheses. In addition to variables shown, all models include variables for number of siblings, dummy variables for religiousness, and dummy variables for missing. All models also include the following demographic variables: percent attending religious services, religious homogeneity index, various racial deomgraphic variables, percent high school graduate, percent college graduate, percent male, percent urban, area, area squared, population density, percent female headed households, percent of households on public assistance, percent low-income households, per-capita income, median income, percent of households with incomes under $7,000 (NLS72)/$20,000 (NELS) and percent of households with incomes over $15,000 (NLS72)/$40,000 (NELS). NELS models also include dummies for Baptist, Lutheran and other Christian religions, as well as grade 8 student/teacher ratios and percent of teachers with Master's degrees. State dummies are included.

Table 2

OLS Results for NLS72

	Dependent Variable: Years of Schooling			Dependent Variable: Log Hourly Wage in 1977		
	Measure of Competition			Measure of Competition		
	Nearest Cath. High School	Percent Attending Private School in: County	MSA	Nearest Cath. High School	Percent Attending Private School in: County	MSA
Private School Competition	-0.0005	0.0013	0.0036	0.0002	9.53E-06	-0.001
	(0.0006)	(0.0032)	(0.0034)	(0.0002)	(0.0010)	(0.0011)
Female	-0.093	-0.093	-0.088	-0.207	-0.207	-0.207
	(0.022)	(0.022)	(0.022)	(0.007)	(0.008)	(0.007)
Black	0.013	0.014	0.031	-0.007	-0.007	-0.006
	(0.038)	(0.042)	(0.038)	(0.013)	(0.014)	(0.013)
Hispanic	-0.038	-0.036	-0.027	-0.046	-0.046	-0.045
	(0.064)	(0.062)	(0.064)	(0.021)	(0.021)	(0.021)
Years of Parental Education	0.161	0.161	0.163	-0.003	-0.003	-0.003
	(0.005)	(0.006)	(0.005)	(0.002)	(0.002)	(0.002)
Catholic Religion	0.069	0.068	0.067	0.011	0.011	0.013
	(0.029)	(0.031)	(0.029)	(0.010)	(0.010)	(0.010)
Jewish Religion	1.000	1.000	1.026	-0.008	-0.009	-0.004
	(0.079)	(0.086)	(0.079)	(0.027)	(0.029)	(0.026)
Other Religion	-0.133	-0.133	-0.133	0.017	0.016	0.016
	(0.060)	(0.052)	(0.060)	(0.020)	(0.018)	(0.020)
No Religion	-0.137	-0.137	-0.142	-0.001	-0.002	-0.002
	(0.054)	(0.048)	(0.055)	(0.018)	(0.020)	(0.018)
Log Parental Income (1990$)	0.149	0.149	0.152	0.055	0.055	0.054
	(0.023)	(0.021)	(0.023)	(0.007)	(0.008)	(0.007)
Parents Expect College	1.462	1.463	1.478	0.008	0.008	0.007
	(0.028)	(0.031)	(0.028)	(0.009)	(0.009)	(0.009)
Observations	16,429	16,429	16,432	13,783	13,783	13,786
R-squared	0.35	0.35	0.35	0.09	0.09	0.09

Notes: Robust standard errors that allow within area (zip code, county or MSA) correlation are in parentheses. In addition to variables shown, all models include variables for number of siblings, dummy variables for religiousness, and dummy variables for missing. All models also include the following demographic variables: percent attending religious services, religious homogeneity index, percent white, percent high school graduate, percent college graduate, percent male, percent urban, area, area squared, population density, percent female headed households, percent of households on AFDC, percent low-income households, per-capita income, median income, percent of households with incomes under $7,000 and percent of households with incomes over $15,000. Finally, state dummies are included.

Table 3

Weighted Probit Marginal Effects for NELS

	Dependent Variable: High School Graduation				Dependent Variable: College Attendance			
	Measure of Competition				Measure of Competition			
	Nearest Cath. High School	Percent Attending Private School in: Zip Code	County	MSA	Nearest Cath. High School	Percent Attending Private School in: Zip Code	County	MSA
Private School Competition	-0.0001	-0.0012	0.0007	0.0045	-0.0002	0.0014	0.0044	0.0053
	(0.0003)	(0.0010)	(0.0020)	(0.0023)	(0.0003)	(0.0010)	(0.0018)	(0.0024)
Female	0.010	0.007	0.010	0.009	0.074	0.072	0.074	0.074
	(0.011)	(0.012)	(0.011)	(0.011)	(0.012)	(0.012)	(0.012)	(0.012)
Black	0.035	0.043	0.035	0.033	0.029	0.038	0.028	0.030
	(0.025)	(0.024)	(0.025)	(0.027)	(0.024)	(0.025)	(0.025)	(0.024)
Hispanic	-0.020	-0.022	-0.020	-0.018	0.004	0.002	0.006	0.006
	(0.021)	(0.021)	(0.021)	(0.023)	(0.022)	(0.021)	(0.022)	(0.022)
Years of Parental Education	0.023	0.023	0.023	0.023	0.039	0.037	0.039	0.039
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Catholic Religion	0.011	0.013	0.011	0.015	-0.024	-0.025	-0.026	-0.023
	(0.025)	(0.027)	(0.025)	(0.024)	(0.022)	(0.022)	(0.021)	(0.024)
Jewish Religion	-0.053	-0.038	-0.054	-0.046	0.050	0.044	0.047	0.049
	(0.083)	(0.058)	(0.083)	(0.088)	(0.072)	(0.066)	(0.072)	(0.080)
Log Parental Income (1990$)	0.032	0.031	0.032	0.033	0.055	0.055	0.055	0.055
	(0.005)	(0.006)	(0.005)	(0.005)	(0.007)	(0.007)	(0.007)	(0.008)
Two Parent Household	0.118	0.121	0.118	0.119	0.040	0.041	0.040	0.039
	(0.014)	(0.015)	(0.014)	(0.014)	(0.014)	(0.015)	(0.014)	(0.014)
Parents Expect College	0.193	0.189	0.193	0.192	0.217	0.214	0.217	0.217
	(0.020)	(0.020)	(0.020)	(0.021)	(0.021)	(0.022)	(0.021)	(0.020)
Observations	13,697	13,697	13,697	13,697	11,392	11,392	11,392	11,392
(Pseudo) R-squared	0.23	0.23	0.23	0.23	0.17	0.18	0.18	0.17

Notes: Robust standard errors that allow within area (zip code, county or MSA) correlation in parentheses. In addition to variables shown, all models include variables for number of siblings, dummy variables forBaptist, Lutheran,and otherChristian religions,dummy variablesfor religiousness,grade 8student/teacher ratios and percent of teachers with Masters' degrees, and dummy variables for missing. All models also include the following demographic variables: percent attendingreligiousservices,religiousandracial homogeneityindices, percentblack, percentHispanic, percentAsain, percentNative American,percent highschool graduate,percentcollegegraduate,percentmale,percenturban,area,areasquared, populationdensity, percentfemale headedhouseholds, percentof householdson public assistance, percent low-income households, per-capita income, median income, percent of households with incomes under $20,000 and percent of households with incomes over $40,000. State dummies are included.

Table 4

First Stage Results from NLS72
Dependent Variable Is Measure of Private School Competition

	Nearest Cath. High School	Percent Attending Private School in: County	MSA
Catholic Percent of Population	-0.2752	0.3559	0.3102
	(0.1609)	(0.0403)	(0.0426)
Cath Pct of Pop Squared	-0.0006	-0.0025	-0.0021
	(0.0023)	(0.0008)	(0.0007)
Catholics per Square km	0.0018	0.0012	-0.0211
	(0.0030)	(0.0012)	(0.0082)
Cath per sq km Squared (1000s)	-0.0002	-0.0001	0.0218
	(0.0001)	(0.00001)	(0.0011)
Catholic Churches per Square km	10.66	8.5439	89.02
	(14.28)	(4.6455)	(25.08)
Cath Chur per Sq km Squared	0.7193	-0.0292	-106.80
	(2.6604)	(0.9390)	(32.12)
Percent Church Adherents	-0.0554	0.0061	-0.0320
	(0.0737)	(0.0122)	(0.0138)
Religious Homogeneity Index	0.2255	-0.0129	0.0260
	(0.0681)	(0.0132)	(0.0070)
Percent White	-0.0090	-0.0905	-0.0927
	(0.0935)	(0.0169)	(0.0184)
Percent High School Graduates	-0.1986	-0.1503	-0.1047
	(0.1345)	(0.0272)	(0.0340)
Percent College Graduates	0.7223	0.0446	-0.0869
	(0.3460)	(0.0491)	(0.0568)
Percent Urban	-0.0979	0.0566	0.0498
	(0.0441)	(0.0096)	(0.0102)
People per Square km	-0.0004	-0.0003	-0.0016
	(0.0007)	(0.0003)	(0.0013)
Pct Female Headed HH	-1.7411	-0.0985	0.0380
	(0.5484)	(0.1069)	(0.1408)
Observations	16,429	16,429	16,432
R-squared	0.47	0.82	0.81

Notes: Robust standard errors that allow within area (zip code, county or MSA) correlation are in parentheses. In addition to the variables shown, all models contain individual controls for gender, race, parental education, log parental income, parental expectations, number of siblings, student religion, student religiousness, and dummy variables for missing. All models also include the following demographic variables: percent male, area, area squared, percent of households on public assistance, percentlow-income households,per-capita income,median income,percent ofhouseholds withincomesunder$7,000andpercentof householdswith incomesover $15,000. State dummiesare included.

Table 5

Weighted First Stage Results from NELS
Dependent Variable Is Measure of Private School Competition

	Nearest Cath. High School	Percent Attending Private School in: Zip Code	County	MSA
Catholic Percent of Population	-0.3590	0.2264	0.2775	0.2189
	(0.2179)	(0.0617)	(0.0413)	(0.0431)
Cath Pct of Pop Squared	0.0027	-0.0022	-0.0019	-0.0018
	(0.0032)	(0.0008)	(0.0006)	(0.0007)
Catholics per Square km	0.0424	-0.0047	-0.0016	-0.0399
	(0.0162)	(0.0042)	(0.0046)	(0.0201)
Cath per sq km Squared (1000s)	-0.0046	-0.0001	0.0002	0.0366
	(0.0007)	(0.0002)	(0.0001)	(0.0067)
Catholic Churches per Square km	-13.99	74.66	51.91	288.54
	(56.19)	(19.74)	(17.11)	(114.23)
Cath Chur per Sq km Squared	88.46	-23.03	-21.29	-1512
	(57.48)	(21.37)	(18.09)	(1826)
Percent Church Adherents	0.2328	0.0376	-0.0164	-0.0468
	(0.1344)	(0.0267)	(0.0183)	(0.0149)
Religious Homogeneity Index	0.0197	-0.0463	-0.0098	0.0099
	(0.1556)	(0.0269)	(0.0193)	(0.0064)
Racial Homogeneity Index	-0.1243	-0.0359	-0.0487	0.0218
	(0.2078)	(0.0156)	(0.0281)	(0.0345)
Percent Black	-0.2300	-0.0655	0.0568	0.1215
	(0.2965)	(0.0288)	(0.0448)	(0.0552)
Percent Hispanic	-0.3286	-0.0429	-0.0640	-0.0280
	(0.1873)	(0.0284)	(0.0314)	(0.0315)
Percent High School Graduates	-0.6552	-0.0011	-0.1375	-0.1277
	(0.3574)	(0.0367)	(0.0490)	(0.0530)
Percent College Graduates	0.6449	-0.0199	0.0692	-0.0136
	(0.3676)	(0.0473)	(0.0657)	(0.0674)
Percent Urban	-0.0506	0.0500	0.0221	0.0120
	(0.0751)	(0.0103)	(0.0115)	(0.0119)
People per Square km	-0.0084	0.0002	-0.0009	0.0022
	(0.0033)	(0.0002)	(0.0008)	(0.0048)
Pct Female Headed HH	-1.0179	-0.1525	-0.0184	0.1524
	(0.6426)	(0.0920)	(0.1091)	(0.1106)
Observations	13,697	13,697	13,697	13,697
R-squared	0.61	0.63	0.80	0.86

Notes: Robust standard errors that allow within area (zip code, county or MSA) correlation are in parentheses. In addition to the variables shown, all models contain individual controls for gender, race, parental education, log parental income, parental expectations, number of siblings, student religion, student religiousness, two parent household status, grade 8 student/teacher ratios, percentage of teachers with Master's degrees, and dummy variables for missing. All models also include the following demographic variables: percent male, area, area squared, percent of households on public assistance, percent low-income households, per-capita income, median income, percent of households with incomes under $20,000 and percent of households with incomes over $40,000, percent Asian and percent Native American. State dummies are included.

Table 6: Second Stage Results from NLS72 and NELS

	Dependent Variable: NLS72 Math Test				Dependent Variable: NELS Math Test			
	Measure of Competition				Measure of Competition			
	Nearest Cath. High School	Percent Attending Private School in:			Nearest Cath. High School	Percent Attending Private School in:		
		Zip Code	County	MSA		Zip Code	County	MSA
Private School Competition	0.0050	N/A	0.0855	0.0560	-0.0768	-0.1225	-0.1394	-0.1003
	(0.0253)	N/A	(0.0417)	(0.0508)	(0.0670)	(0.0656)	(0.1087)	(0.1578)
Observations	13,646		13,646	13,647	12,212	12,212	12,212	12,212
R-squared	0.34		0.34	0.34	0.29	0.30	0.30	0.30

	Dependent Variable: NLS72 Years of Schooling				Dependent Variable: NLS72 Log Wage			
	Measure of Competition				Measure of Competition			
	Nearest Cath. High School	Percent Attending Private School in:			Nearest Cath. High School	Percent Attending Private School in:		
		Zip Code	County	MSA		Zip Code	County	MSA
Private School Competition	0.0072	N/A	0.0054	0.0009	0.0006	N/A	0.0054	0.0037
	(0.0055)	N/A	(0.0065)	(0.0075)	(0.0015)	N/A	(0.0021)	(0.0024)
Observations	16,429		16,429	16,432	13,783		13,783	13,786
R-squared	0.35		0.35	0.35	0.09		0.09	0.09

	Dependent Variable: NELS High School Graduation				Dependent Variable: NELS College Atttendance			
	Measure of Competition				Measure of Competition			
	Nearest Cath. High School	Percent Attending Private School in:			Nearest Cath. High School	Percent Attending Private School in:		
		Zip Code	County	MSA		Zip Code	County	MSA
Private School Competition	-0.0026	-0.0050	-0.0008	0.0023	-0.0023	0.0021	0.0110	0.0066
	(0.0024)	(0.0025)	(0.0040)	(0.0042)	(0.0020)	(0.0020)	(0.0033)	(0.0043)
Observations	13,697	13,697	13,697	13,697	11,392	11,392	11,392	11,392
Pseudo R-squared	0.23	0.23	0.24	0.24	0.18	0.19	0.19	0.19

Notes:Robust standarderrors thatallow withinarea (zipcode, countyor MSA)correlation arein parentheses. In additionto thevariables shown,all modelscontain controls for gender, race, parental education, log parental income, parental expectations, number of siblings, student religion, student religiousness, and dummy variables for missing. All NELS models include indicator variable for two parenthousehold, grade8 student/teacherratios andpercentage of teachers withMaster's degrees. All models alsoinclude thefollowing demographicvariables: percentattending religiousservices, religioushomogeneity index,various racialdemographic variables,percenthighschoolgraduate,percentcollegegraduate,percentmale,percenturban,area,areasquared,populationdensity,percentfemale headedhouseholds, percent of households on public assistance, percent low-income households, per-capita income,median income,percent ofhouseholds withincomes under$7,000 (NLS72)/$20,000 (NELS) and percent of households with incomes over $15,000 (NLS72)/ $40,000 (NELS). State dummies are included.

Table A1: Descriptive Statistics for NLS72 Data

	Obs	Mean	Std Dev	Min	Max
Standardized Math Test	13,653	50.2506	9.9871	26	67
Standardized Reading Test	13,653	50.2899	9.9940	22	71
Years after High School (1979)	16,437	1.6367	1.7288	0	8
1977 Log Hourly Wage (1990$)	13,789	0.0647	0.4392	-5.0536	3.9083
Distance to Nearest Catholic School	19,527	17.8615	28.4649	0	879.85
Cnty Pct Attending Private School	19,527	10.4619	7.6066	0	48.1
MSA Pct Attending Private School	19,527	9.9128	6.3825	0	48.1
White/Other	19,527	0.8115	0.3911	0	1
Female	19,527	0.5152	0.4998	0	1
Black	19,527	0.1456	0.3527	0	1
Hispanic	19,527	0.0429	0.2026	0	1
Parental Education (years)	19,527	12.9919	2.4167	10	18
Number of Siblings	19,527	3.1575	1.9906	0	20
Catholic Religion	19,527	0.2742	0.4461	0	1
Other Christian Religion	19,527	0.5334	0.4989	0	1
Jewish Religion	19,527	0.0215	0.1449	0	1
Other Religion	19,527	0.0361	0.1866	0	1
No Religion	19,527	0.0473	0.2122	0	1
Missing Religion	19,527	0.0875	0.2826	0	1
Very Religious	19,527	0.1476	0.3548	0	1
Somewhat Religious	19,527	0.1429	0.3500	0	1
Not At All Religious	19,527	0.5862	0.4925	0	1
Missing Religiousness	19,527	0.1233	0.3288	0	1
Log Parental Income (1990$)	19,527	7.8014	0.5632	6.2354	8.7203
Parents Expect 2 Years of College	19,527	0.5565	0.4968	0	1
County Demographic Variables					
Catholic Percent of Population	19,527	20.3115	16.2270	0	87.289
Catholics per Square km	19,527	769.5005	2471.3170	0	17649
Caholic churches per Square km	19,527	0.1781	0.5043	0	3.5438
Percent Church Adherents	19,527	48.4354	13.6630	1.7898	100
Religious Homogeneity Index	19,527	38.8262	17.2077	9.2392	98.794
Percent White	19,527	86.9817	12.6446	18.6023	100
Percent Black	17,148	13.2735	11.9499	0.1837	81.104
Percent Hispanic	14,769	6.2372	10.3413	0.1	91.9
Percent High School Graduates	19,527	51.9162	10.7670	17.9	79.6
Percent College Graduates	19,527	10.7827	4.3226	1.9	33.2
Percent Male	19,527	48.8721	1.9082	44.5	82.2
Percent Urban	19,527	69.7614	27.8156	0	100
Area	19,527	1156.6	1914.0	10	40064
Area Squared	19,527	5.E+06	5.E+07	100	2.69E+09
Total Persons	19,527	739,216	1,357,034	868.5	7036463
People per Square km	19,527	2391.5	7332.2	0.5	52047.5
Pct Female Headed HH	19,527	10.8799	3.1009	3.1	25.2
Percent on AFDC	19,516	6.2754	8.7841	0.0442	59.057
Percent Low Income	19,527	11.8200	7.4412	2.6	59
Per Capita Income	19,527	10.1433	2.2801	3.3046	18.3452
Median Income	19,527	31.4191	6.7192	10.1899	56.2819
Pct HH w/ income <7,000	19,527	34.2308	13.0163	10.4	83.4
Pct HH w/ income 7,000-15,000	19,527	46.5253	6.7679	13.5	61.9
Pct HH w/ income >15,000	19,527	19.2439	8.7619	1.8	56.1

Table A2: Weighted Descriptive Statistics for NELS Data

	Obs	Mean	Std Dev	Min	Max
Grade 12 Standardized Math Test	11,136	47.8464	14.4528	16.97	78.1
High School Graduation	13,697	0.7785	0.4153	0	1
College Attendance	9,831	0.7273	0.4454	0	1
Distance to Nearest Catholic School	13,697	19.7156	27.4093	0	210.635
Zip Code Pct Attending Priv. School	13,697	9.5103	8.7218	0	73.998
Cty Pct Attending Private School	13,697	9.2556	5.5877	0	34.470
MSA Pct Attending Private School	13,697	9.3836	4.9834	0	24.970
Female	13,697	0.4913	0.4999	0	1
White/Other Race	13,697	0.7807	0.4138	0	1
Black	13,697	0.1234	0.3289	0	1
Hispanic	13,697	0.0953	0.2936	0	1
Missing Race	13,697	0.0007	0.0260	0	1
Parental Ecuation	13,697	14.0253	2.4469	10	20
Missing Parental Education	13,697	0.0061	0.0781	0	1
Number of Siblings	13,697	2.2876	1.5756	0	6
Catholic Religion	13,697	0.2934	0.4553	0	1
Lutheran Religion	13,697	0.0648	0.2462	0	1
Baptist Religion	13,697	0.2239	0.4169	0	1
Methodist Religion	13,697	0.0950	0.2933	0	1
Other Christian Religion	13,697	0.2107	0.4078	0	1
Jewish Religion	13,697	0.0197	0.1391	0	1
Other Religion	13,697	0.0428	0.2024	0	1
No Religion	13,697	0.0328	0.1780	0	1
Missing Religion	13,697	0.0168	0.1285	0	1
Very Religious	13,697	0.4237	0.4942	0	1
Somewhat Religious	13,697	0.3860	0.4868	0	1
Not At All Religious	13,697	0.1218	0.3270	0	1
Missing Religiousness	13,697	0.0686	0.2528	0	1
Log Parental Income (1990$)	13,697	10.1945	1.0514	2.3026	12.6115
Two Parent Family	13,697	0.6466	0.4781	0	1
Parent Expects Some College	13,697	0.8533	0.3538	0	1
Missing Parental Expectations	13,697	0.0031	0.0555	0	1
Grade 8 Sstudent-Teacher Ratio	13,697	17.7999	4.8044	5	50
Pct Grade 8 Teachers w/ Masters	13,697	46.7268	24.6459	0	100
School Grade 8 Percent White	13,697	75.3591	29.9948	0	100
Grade 8 Starting Teacher Salary	13,697	17654	2832	5500	25428
Grade 8 Number of Students	13,697	660.8772	365.2984	38	3940
Zip Code Demographic Variables					
Racial Homogeneity Index	13,697	76.9606	18.5497	26.279	100
Percent White	13,697	77.9550	26.3136	0.429	100
Percent Black	13,697	10.5756	19.1786	0	99.387
Percent Hispanic	13,697	8.5037	17.8627	0	97.499
Percent Asian/Pacific Islander	13,697	2.0696	5.1266	0	78.930
Percent Native American	13,697	0.8079	4.9416	0	96.044
Percent High School Graduates	13,697	73.8322	13.2506	0	97.547
Percent College Graduates	13,697	18.5720	12.3180	0	69.141
Percent Male	13,697	48.4910	1.8901	41.705	62.522
Percent Urban	13,697	68.8776	37.7167	0	100
Area	13,697	238.6	559.6	0.607	7997
Area Squared	13,697	370,107	3,134,141	0.36845	6.40E+07
Total Persons	13,697	24,128	17,602	15	107197
People per Square km	13,697	999.0	2391.9	0.37749	49360
Pct Female Headed HH	13,697	15.7773	8.6851	0	63.288
Percent Receiving Public Asst.	13,697	7.6763	5.5569	0	47.155
Percent Poor	13,697	13.4058	9.6233	0	87.9630
Per Capita Income	13,697	13.9792	6.4006	2.008	79.237
Median Income	13,697	30.8508	12.5748	6.255	113.738
Pct HH w/ income <20,000	13,697	34.3209	14.4607	4.6252	100
Pct HH w/ income 20,000-40,000	13,697	31.4735	6.3124	0	49.785
Pct HH w/ income >40,000	13,697	34.2056	16.5408	0	85.811
County Demographic Variables					

Catholic Percent of Population	13,697	20.9863	17.4081	0	81.001
Catholics per Square km	13,697	161.1853	592.7980	0	9495.4
Caholic Churches per Square km	13,697	0.0351	0.1016	0	1.6975
Percent Church Adherents	13,697	57.0551	15.0252	22.7	100
Religious Homogeneity Index	13,697	30.2517	15.0968	7.790	97.026
Racial Homogeneity Index	13,697	70.5205	19.2532	32.423	99.556
Percent White	13,697	77.9270	19.4278	2.414	99.778
Percent Black	13,697	10.7223	12.1523	0	65.32
Percent Hispanic	13,697	8.2367	14.2765	0.02585	97.54
Percent Asian/Pacific Islander	13,697	2.1822	4.2229	0	60.02
Percent Native American	13,697	0.8455	4.1478	0	77.23
Percent High School Graduates	13,697	74.4979	8.7205	31.561	92.86
Percent College Graduates	13,697	18.9985	7.4391	4.628	49.94
Percent Male	13,697	48.7092	1.1874	45.811	54.43
Percent Urban	13,697	70.2031	28.6090	0	100
Area	13,697	3369.79	5490.63	59.5	51247
Area Squared	13,697	4.E+07	2.E+08	3540.1	2.63E+09
Total Persons	13,697	757,454	1,562,387	2251.5	8863164
People per Square km	13,697	497.67	1579.77	0.71213	25001
Pct Female Headed HH	13,697	15.4948	5.0769	3.925	41.554
Percent Receiving Public Asst.	13,697	7.6438	3.6344	1.782	25.995
Percent Poor	13,697	13.6283	6.8911	2.709	59.979
Per Capita Income	13,697	13.8205	3.6535	4.152	28.381
Median Income	13,697	29.7515	8.0323	10.182	59.284
Pct HH w/ income <20,000	13,697	34.5248	10.6931	7.905	76.335
Pct HH w/ income 20,000-40,000	13,697	31.6183	3.8894	17.054	41.625
Pct HH w/ income >40,000	13,697	33.8570	12.1510	5.650	73.131
MSA Demographic Variables					
Catholic Percent of Population	13,697	21.3108	16.5422	0	81.001
Catholics per Square km	13,697	60.2422	100.4633	0	398.001
Caholic Churches per Square km	13,697	0.0152	0.0191	0	0.0703
Percent Church Adherents	13,697	57.8837	14.4112	22.745	100
Religious Homogeneity Index	13,697	64.6591	34.9758	7.790	100
Racial Homogeneity Index	13,697	68.0465	18.6741	33.905	99.556
Percent White	13,697	77.3472	17.1709	2.414	99.778
Percent Black	13,697	11.1832	10.3033	0	54.644
Percent Hispanic	13,697	8.2819	13.4541	0.0258	97.539
Percent Asian/Pacific Islander	13,697	2.2546	3.9779	0	60.020
Percent Native American	13,697	0.8482	4.1339	0	77.229
Percent High School Graduates	13,697	74.4653	7.8441	31.561	91.882
Percent College Graduates	13,697	19.0948	6.2500	4.628	38.462
Percent Male	13,697	48.6786	1.0888	45.811	54.431
Percent Urban	13,697	71.5463	26.2190	0	98.865
Area	13,697	10,996	16,502	417.1	87217
Area Squared	13,697	4.E+08	1.E+09	173971	7.61E+09
Total Persons	13,697	2878128	4941774	2252	1.81E+07
People per Square km	13,697	194.05	224.05	0.7121	896.69
Pct Female Headed HH	13,697	15.7254	3.5951	3.925	27.426
Percent Receiving Public Asst.	13,697	7.7652	3.0121	1.782	25.995
Percent Poor	13,697	13.7770	6.0598	6.424	59.979
Per Capita Income	13,697	13.7672	3.0208	4.152	21.416
Median Income	13,697	29.3346	6.4669	10.182	46.884
Pct HH w/ income <20,000	13,697	34.8406	9.3227	15.320	76.335
Pct HH w/ income 20,000-40,000	13,697	31.6986	3.4705	17.054	41.625
Pct HH w/ income >40,000	13,697	33.4607	10.3614	5.650	59.101

MSA Demograpic Variables					
Catholic Percent of Population	19,527	20.4976	15.7166	0	87.289
Catholics per Square km	19,527	143.8292	232.8758	0	880.07
Caholic churches per Square km	19,527	0.0412	0.0518	0	0.5049
Percent Church Adherents	19,527	49.2974	13.4153	6.6193	100
Religious Homogeneity Index	19,527	69.5830	31.7585	9.2392	100
Percent White	19,527	87.0562	11.4200	18.602	100
Percent Black	17,455	12.9438	10.6566	0.235	81.104
Percent Hispanic	15,681	5.6467	9.8850	0	91.9
Percent High School Graduates	19,527	52.1199	10.1220	17.9	75.9
Percent College Graduates	19,527	10.7870	3.9906	1.9	28.4
Percent Male	19,527	48.9319	1.5689	44.5	71.1
Percent Urban	19,527	69.9161	24.9924	0	100
Area	19,527	3666.51	6693.67	10	40064
Area Squared	19,527	6.E+07	2.E+08	100	2.69E+09
Total Persons	19,527	2,489,332	4,245,823	868.5	1.62E+07
People per Square km	19,527	674.82	1036.90	0.5	4312.0
Pct Female Headed HH	19,527	10.4776	2.1235	3.1	21.2
Percent on AFDC	19,520	5.1350	2.3188	0.0442	32.89611
Percent Low Income	19,527	11.5052	7.3679	4.5333	59
Per Capita Income	19,527	10.0968	2.1145	3.3046	14.340
Median Income	19,527	31.6970	6.5564	10.1899	45.779
Pct HH w/ income <7,000	19,527	33.6541	12.7843	17.3	83.4
Pct HH w/ income 7,000-15,000	19,527	47.0475	6.7053	13.5	61.9
Pct HH w/ income >15,000	19,527	19.2985	8.2852	1.8	43.2