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Testing for sample selection in the Milwaukee school choice experiment

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Abstract

We examine data collected from the Milwaukee Parental Choice Program to determine whether students with unobserved characteristics correlated with achievement are more likely to apply to the voucher program. We first estimate probit models for application to the choice program, and then math and reading achievement models. By comparing students randomly rejected from the program with students who did not apply, we can test whether applicants and non-applicants have unobservable characteristics that are correlated both with the choice of school sector and with the included explanatory variables. We do not find strong evidence that students who apply to participate in the Milwaukee choice program have unmeasured characteristics, such as motivation, which systematically differ from non-applicants [JEL C12, I21]. © 1999 Elsevier Science Ltd. All rights reserved.

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1. Introduction

Over the past decade numerous reforms have been offered to give parents more freedom in selecting their childrens' school: charter schools, magnet schools and educational vouchers. All these programs expand parental choice. One of the most hotly debated reforms is choice among public and private schools. Advocates argue that a "market-based" educational system would increase the accountability of schools to the consumers of education, students and parents, and that this increased accountability will help to reduce inefficiency, leading to better educational outcomes. Theoretically, if schools are granted funds based on the number or type of students who choose to attend them, then "good" schools would prosper and "bad" schools would be forced to either improve or shut down.

Underlying the argument for choice that includes private schools is the notion that they outperform their public school counterparts. At first glance, this seems a sensible notion. Private school students do have higher standardized test scores, graduation rates and college-going rates than their public school counterparts. However, differences in performance between public and private school students may be attributed to several factors: (1) the resources available to the schools in each sector, (2) the efficiency with which the schools use their resources, and (3) the types of students attending the schools in each sector. School choice advocates generally argue that the second explanation, that private schools are more efficient, plays a significant role in explaining public–private differences. Opponents, in contrast, say the third factor explains public–private differences in performance.

The issue of sample selection has arisen in the context of analyzing public and private school performance in a school choice experiment in Milwaukee, Wisconsin.

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Researchers who have analyzed the effect, on math and reading tests, of participating in the Milwaukee school choice program have reached divergent conclusions. One possible explanation for the divergent findings is that there are important differences, that cannot easily be quantified in the data, between students in the Milwaukee public schools and those who elect to participate in the choice program and attend a private school in Milwaukee. In this paper we shed some light on this issue by investigating the "Milwaukee school choice experiment" to determine whether students with unobserved characteristics correlated with achievement are more likely to apply to private schools.

The Milwaukee data are unique given that there are public school students who had the opportunity to apply to participate in a voucher program but chose not to, and students in the public sector who applied for the voucher program but were randomly rejected. This unique feature of the data allows us to test for the existence of sample selection associated with the decision to participate in the choice experiment. Our findings indicate that there is not a statistically significant difference in unobservable characteristics between applicants and non-applicants to the choice program. This suggests that there are not important sample selection issues associated with the take-up of the choice program.

2. Methodological issues

Evidence on the relative efficiency of public and private schools is inconclusive. A number of studies have analyzed differences between public and private school achievement using non-experimental data from large-scale longitudinal surveys. While many studies, such as those of Coleman (1990), Hoffer et al. (1985), Chubb, & Moe (1990) and Neal (1997), find statistically significant differences in achievement (on standardized tests) favoring private schools, others, including Willms (1985), Alexander, & Pallas (1983), Goldhaber (1996), Gamoran (1996) and Figlio, & Stone (1997a), find little or no private school advantage[1].

Many of the differences between the studies cited above can be explained by differences in the data analyzed or model specification, including the variables used and controls (or lack thereof) for selection into private schools. The fact that parents freely choose to spend additional money to send their children to a private school suggests that they may be quite different from other parents, but in ways that are difficult to identify. For instance, these parents demonstrate a willingness to support education which could indicate that they also provide an environment in the home that is conducive to educational achievement[2]. These factors are difficult to account for because they are not readily observable in existing data. And, if there are important unobservable characteristics of students or their families that influence achievement and are systematically related to the school sector in which they are enrolled, then ordinary least-squares models of achievement are inadequate because we cannot determine whether differences in achievement between public and private school students are due to genuine differences in performance attributable to school type or to underlying differences in motivation, home environment, etc. of public and private school students. Thus, central to the debate over school choice is the issue of selection.

Researchers have attempted to account for unobservable differences between public and private school students in a variety of ways (see Goldhaber and Brewer, 1997, for a discussion of unobservables). One methodology used in examining sectoral differences in performance in earlier choice studies is to fit a single achievement equation which includes a dichotomous right-hand side variable identifying private school attendance. A positive significant coefficient on this variable is taken as evidence that private schools outperform their public school counterparts. There are two problems with this methodology. The first is that the coefficients on the schooling variables in each sector are restricted to being equal. There are numerous reasons why this might not be the case. For example, if one of the impediments to teaching in the public sector is bureaucracy, we might expect a teacher with a given set of observable characteristics to show a higher return to those characteristics in the private sector. The second problem is that this methodology does not deal explicitly with the selection issue.

Several studies attempt to address selection by estimating achievement models separately by school sector and including in the models a correction for sample selection. This is a two-stage procedure. In the first stage, the selection of school sector is modeled. From this equation, an Inverse Mill's Ratio is calculated and used as an additional regressor in the second-stage estimation of achievement. However, the empirical effectiveness of this procedure rests on identification of suitable instruments—variables included in the first stage but excluded from the second stage (Heckman, 1979). However, the variables often used by researchers may be inappropri-

[1] Due to a lack of longitudinal data, earlier works by Coleman et al. (1982), Cain, & Goldberger (1983) and Noell (1983) do not use a "value-added" methodology, so are not discussed here.

[2] Many parents are also likely to select private parochial schools for religious reasons. For a discussion of determinants of school choice and related issues such as "cream skimming", see Levin (1998), Figlio, & Stone (1997b) and Lankford, & Wyckoff (1992).

ate[3]. Recent studies by Goldhaber (1996) and Figlio, & Stone (1997a) use a richer set of instruments which may be more appropriate[4]; however, no matter how sophisticated non-experimental econometric techniques are, they are a "second-best" alternative to good experimental data.

There have been several small-scale experiments with school choice; however, there have been relatively few studies that directly examine the effect of allowing parents to use a voucher to send their children to private schools. The major reason for this is a lack of quality data on school choice programs. Most programs are small in scale, or do not allow parents to select among private schools, and thus do not provide a full test of market-based theory of choice. The choice program in Milwaukee is an exception.

3. School choice in Milwaukee

The Milwaukee Parental Choice Program began in the fall of 1990. Students living in Milwaukee who came from families with incomes not exceeding 1.75 times the national poverty line were eligible to attend private nonsectarian schools in the district. Further, students enrolling in the choice program could not have been in a private school in the immediate prior year or enrolled in public schools in districts outside Milwaukee (Witte, 1997). The total number of choice students in any year was limited to 1% of the Milwaukee public school membership in the first four years, and was increased to 1.5% for the 1994–95 school year[5]. For each choice student enrolled, a private school received a payment equivalent to the Milwaukee public school per-student state-aid. Private schools were required to limit choice students to 49% of their enrollment (this figure rose to 65% beginning in the 1994–95 school year) and schools that were oversubscribed were required to accept students based on a random selection[6]. This last provision provides a natural experiment since several of the schools were oversubscribed, resulting in the random assignment of students between the public and private sectors. In other words, in several cases there was a greater demand for participation in private schools in the choice program than there were slots available (given the specifications of the program) in those schools[7]. The randomness of program participation allows researchers to compare students who applied for admission, were rejected and therefore attended a public school to those who applied, were accepted and attended a private school. In theory, this approach avoids the selection problem discussed in the previous section.

A great deal of effort has been spent collecting student-level data for the evaluation of the Milwaukee experiment. Family background information was solicited from all participating students and for a large random sample of non-participating public school students, and tests were administered in the spring to both program participants and non-participants in grades K through 8[8]. The tests administered are the Iowa Tests of Basic Skills (ITBS), which is a nationally normed standardized test with scores ranging from 1 to 99 with a national mean of 50.

Most students in the Milwaukee public schools were tested only in the 2nd, 5th and 7th grades. Only those public school students who qualified for Title 1 aid were required to be tested every year (Title 1 status corresponds roughly to eligibility for the voucher given that, in order to qualify for reduced/free lunch, a family had to be below 185% of the poverty line). We restrict our sample to those who were tested every year; thus most Milwaukee public school students who were not eligible for the choice program are excluded from our sample[9].

Table 1 lists selected sample statistics for the dataset that we analyze. In order to ensure a pre- and post-test score for each student, we restricted the students to those who were tested in each year (this closely corresponds to those who were eligible for free and reduced lunch). Thus, our sample of public school students roughly reflects those public school students who were eligible to participate in the choice program.

Public school non-applicants score better in both the math and reading achievement tests, come from families

[3] For a brief summary and discussion of the typical instruments used in studies of private versus public school performance, see Figlio, & Stone (1997a). Ludwig (1997) provides a critique of the validity of the instruments commonly used in this literature.

[4] Figlio, & Stone (1997a) use a richer set of instruments and illustrate (statistically) the appropriateness of the instruments they use.

[5] The program began with an enrollment of 341 students in seven schools. By 1995, enrollment had risen to 830 students and 12 schools participating in the program (Witte, 1997).

[6] Schools were required to admit choice students without discrimination based on race, ethnicity or prior academic performance, but were not required to admit disabled students (Witte, 1997).

[7] The school choice program was amended in a number of ways in June 1995. For details of the changes to the program see Witte (1997), who was contracted to evaluate the program. He has made the data publically available.

[8] In total, approximately 4000 student-year observations were collected. However, students who were observed in multiple years contributed more than a single observation.

[9] One caveat is that schools with a large majority of Chapter 1 students sometimes tested the whole school. Thus, it is possible that some students not eligible for the choice program who were attending high-poverty schools, that elected to test the whole student population, are in our sample.

Table 1
Means (standard deviations)

Variables	Non-applicants	Applicants	
	Public school	Non-selected-public school	Choice program
Base year reading score	42.44	36.16	39.60
	(17.53)	(13.88)	(16.50)
Post reading score	43.45	36.78	38.71
	(17.23)	(15.99)	(14.89)
Base year math score	44.56	37.36	41.29
	(20.50)	(19.83)	(18.68)
Post math score	44.73	38.91	42.31
	(20.45)	(21.91)	(17.25)
Female	0.506	0.524	0.540
Black	0.622	0.837	0.821
Hispanic	0.127	0.115	0.129
Catholic	0.217	0.180	0.125
Current grade level	3.72	3.23	3.40
	(1.94)	(1.86)	(1.96)
Family income	14 586	9823	11 609
	(12 361)	(7559)	(7689)
Single parent household	0.639	0.754	0.747
Parent graduated college	0.080	0.033	0.092
Parent graduated high school	0.750	0.787	0.846
Foreign language spoken at home	0.022	0.033	0.012
Sample size	1392	61	487

with higher family income, and have more educated parents than public school applicants. It is interesting to note that applicants to the choice program are more likely to be from single-parent families. Although public school students (both those who applied and those who did not apply to the choice program) gained more than a point on the reading test score, private school choice students scored lower in the spring on the reading test than they did in the fall.

Several studies have examined the effects of participation in the Milwaukee choice program on student achievement. Witte (1997) compares the students who enrolled in the choice program to a sample of students enrolled in the Milwaukee public school system. He controls for the possibility that students applying to the choice program and attending a choice school systematically differ from the Milwaukee public school students by employing the Heckman two-step methodology[10]. He finds no case where private schools outperform public and, in one specification of the model, public school students outperform the choice students in reading.

Greene et al. (1996) use an alternative methodology, comparing students who participated in the choice program with those who applied through the choice program to attend a private school but were rejected due to over subscription and thus attended a Milwaukee public school. In theory, the comparison of "selected" private school students and those students who applied for the program but were non-selected based on a lottery (the "rejects") avoids the problems associated with selection. The hypothesis is that the rejects do not have unobservable characteristics that are systematically different from those who applied to the program and were accepted.

Greene et al. (1996) find little evidence of a private school effect for students in the first two years of the program but a large private school advantage in years three and four. Controlling for family background, Greene et al. estimate a statistically significant private school advantage on standardized tests of 7 percentile points in math in year three, and 6 percentile points in reading year three of the program[11]. Rouse (1998) uses instrumental variable estimation techniques to address the possibility that selection bias exists due to the fact that not all those who are selected to participate in the choice program actually attend, and program take-up is

[10] As he notes in the footnote to his Table III, Witte (1997) uses distance to present school as an instrument.

[11] Both the year three math and reading results are only statistically significant at the 10% level for one-tail tests. They find positive but statistically insignificant private school.

not likely to be random. Her instrument is the initial selection into the program, which is assumed to be correlated with attendance at a choice school, but uncorrelated with achievement. She finds that students who attended a choice school scored about 1 to 2 percentage points per year higher in math than students who were not selected.

Although Rouse's paper controls for the non-random take-up of the choice program, it does not deal explicitly with the possibility of non-random attrition from the choice program, which was extensive among the reject group. Also, the methodology used by Greene et al. and Rouse, where choice participants and rejects are compared, does not allow for inference outside of those students who applied to participate in the choice program[12]. In other words, the effect of attending a private school may be different for the average student and the student who chooses to apply to the choice program.

Students who are rejected from the choice program may elect to attend an alternative private school, in which case they do not show up in the sample, or attend the Milwaukee public schools. Students who are rejected and end up back in the public school system are in the sample, but these students may be representative of the full sample of those who applied to participate in the choice program. The reason is that only three of the schools participating in the program are oversubscribed and it is unlikely that the schools to which students apply are random. For instance, parents who are particularly dissatisfied with the current situation are more likely to enroll in the choice program. As a result, it may be that oversubscribed choice schools tend to be located in those areas where dissatisfaction with the Milwaukee public schools is particularly great. This may also explain the high attrition rate from the reject sample used by Greene et al. and Rouse. As Witte notes, attrition from the reject group averaged about 30% annually and attrition students tended to have lower test scores.

Witte, & Thorn (1996) examine the type of students who participate in the Milwaukee choice program. They find that choice parents were more likely to be involved with their children's schooling prior to participating in the choice program, rated their prior school lower, and have higher educational expectations for their children than do non-participants. These results suggest that choice participants may differ from non-participants in important ways that are difficult to empirically quantify.

In this paper we re-examine the Milwaukee data to investigate whether students with unobserved characteristics correlated with achievement are more likely to apply to the voucher program. We first estimate probit models for application to the choice program, and then math and reading achievement models. The theoretical and empirical models are discussed below.

[12] This point is also made by Rouse.

4. Model

Consider the following achievement model:

$$A_{iK} = \alpha_K X_i + \eta_{iK}, \quad i = 1,2,\ldots,n \tag{1}$$

where A is student achievement, X is a vector of student and family background variables, and η is the error term. The returns to family background characteristics, represented by α_K, are allowed to vary among three categories of students: public school students who did not apply for the choice program, private school students who are part of the choice program, and public school students who applied to be a part of the choice program but were randomly rejected (the "reject" group)[13]. If one assumes the error term η to be i.i.d. normal, the estimation of sectoral achievement equations and comparison of sectors are straightforward. However, if η is correlated with the category of student then simple estimation techniques (e.g., OLS on each sector) will lead to biased coefficient estimates.

To clarify matters, write the linear projection of η, the error term in Eq. (1) on X, the vector of observable variables:

$$\eta_{iL} = a_L X_i + \epsilon_i \tag{2}$$

We let a_1 represent the vector of coefficients on X for the public school group, a_2 be the vector of coefficients for the private school group and a_3 be the vector of coefficients for the reject group.

Substituting Eq. (2) into Eq. (1), we obtain:

$$A_{iK} = (\alpha_K + a_L)X_i + \epsilon_i \tag{3}$$

If we were to estimate Eq. (3) separately for each category of students, we could only observe $\delta_1 = (\alpha_1 + a_1)$, $\delta_2 = (\alpha_2 + a_2)$ and $\delta_3 = (\alpha_1 + a_3)$.

Note here that the only difference between δ_1 and δ_3 is due to selection since both the public school students and rejects are in the public school where the true returns are α_1. In other words, if our models are correctly specified, the estimated effects of all variables should be the same for the public school students who did and did not apply, since both sets of students are being educated in the Milwaukee public schools. Differences in estimated coefficients between these two groups can be attributed to systematic differences in unobservables between the two groups. This is the key insight of this paper.

We can test empirically what observable characteristics affect the probability of applying to the choice program by estimating a probit regression of the binary decision to apply:

[13] There are, of course, private school students who did not participate in the choice program but no data are available for this category.

$$D_i = \gamma_1 V_i + u_i$$

$$\text{and define } D_i = 1 \text{ if } D_i^* > 0 \text{ (applied for voucher)} \quad (4)$$

$$D_i = 0 \text{ if } D_i^* \leq 0 \text{ (didn't apply)}$$

where V is a vector of variables assumed to affect the choice to enroll in the program, and may include all of the variables in X.

To determine whether unobservable differences exist between applicants and non-applicants, we estimate achievement models for public school students who applied for the choice program (and who were rejected from the program) and non-applicants, which allow the coefficients between the two groups of students to vary:

$$A_{iK} = \beta_K X_i + B_K(X_i \cdot D_i) + \epsilon_i \quad (5)$$

We test whether unobservables affect the returns to observable characteristics by examining the B_K coefficients to see whether the differences in returns between the two groups are jointly equal to zero—that is, whether H_0:$B_K = 0$. This is a straightforward F-test to see if a restricted model that does not allow the coefficients to differ between groups is significantly different from the more flexible specification. Rejection of the null hypothesis indicates that unobservables systematically differ between applicants and non-applicants.

5. Results

5.1. Application to the choice program

Before we investigate whether the unobservable characteristics differ between applicants and non-applicants, we present results of the probit model for the decision to apply to the choice program (Table 2); this shows how observable differences in student and family characteristics affect the decision to apply to the choice program.

Table 2
Probit of application to the Choice Program (standard error)

Intercept	− 1.055* (0.160)
Distance (in miles) to the nearest choice school	− 0.025* (0.011)
Base year math score	− 0.003* (0.001)
Base year reading score	− 0.002 (0.002)
Foreign language spoken in home	− 0.271 (0.202)
Family income (in thousands)	− 0.014* (0.003)
Catholic	− 0.094 (0.089)
Single parent household	0.029 (0.068)
Female	0.083 (0.053)
Black	0.882* (0.095)
Hispanic	0.964* (0.120)
Current grade level	− 0.067* (0.013)
Parent graduated college	0.393* (0.107)
Parent graduated high school	0.371* (0.071)
Log likelihood	− 1524
Sample size	3050

*Variable is significant at the 0.05 level.

We find students from lower-income families were significantly more likely to apply to the choice program, as were black and Hispanic students. And, as might be expected, students with more educated parents (those who had at least one parent who went to college or at least one parent who went to high school) were more likely to apply. Students in higher grades are less likely to apply to the program (as evidenced by the negative coefficient on current grade level) and, interestingly, the coefficient on Catholic was insignificant indicating that Catholics were no more likely to apply. This conflicts with most previous studies that find Catholics are significantly more likely to attend a private school. However, this result is not all that surprising given that most of the Milwaukee program restricted participation to non-religious schools. Finally, the coefficient on the distance variable is negative and statistically significant, suggesting that, as expected, the further away a student lives from a choice school, the less likely it is the student will apply for the choice program.

5.2. Test for unobservable differences between applicants and non-applicants

The results of the probit regression clearly show that several observable characteristics are correlated with the decision to apply to the choice program. To test whether there are unobservable characteristics that are correlated with the decision to apply to the choice program, we compare public school students who applied for the choice program and were rejected, with public school students who were eligible for the choice program but did not apply. We estimate models where the achievement on math and reading tests is modeled as a function of student and family background variables, including the previous year's achievement in math and reading[14]. In these equations, we allow the returns to observable characteristics to vary by application status by (1) allowing the intercept for each category of students to differ, and (2) by including interaction terms between application and the observable characteristics that allow the coefficients to differ.

Since all students in these models (those who applied to the program and were rejected and those who did not apply) went to Milwaukee public schools, in theory, there should be no significant differences in the returns

[14] Our sample includes multiple observations of individual students. We estimated additional models, in which the sample was restricted to one observation of each student, and the results were not substantively different. We report heteroskedasticity-corrected standard errors.

to individual and family background characteristics. The existence of differences in these coefficients provides evidence that there are unobservable variables that are correlated with the decision to apply to the program and, thus, sample selection exists.

Table 3 shows the estimated coefficients of the yearly math and reading achievement models. Columns (1) and (3) are the estimates for math and reading, respectively, when the intercept is allowed to differ—that is, we include the interaction term $B{\cdot}D$. In both math and reading, parental education and base year test scores, both within and across subjects, positively affect achievement. Also, it is interesting to note that the negative significant coefficient, in both subjects, on current grade implies that as students progress through the Milwaukee public school system, they fall behind. The intercept was not found to differ between applicants and non-applicants, which provides cursory evidence that there are no significant unobservable effects that are correlated with application status.

Columns (2) and (4) of Table 3 show the results, for math and reading, when the more flexible specifications of the model are estimated. Several of the interaction terms are significantly different from zero. In math those applicants to the choice program had a higher return to their initial level of math achievement (the base math score), and single-parent households who are choice applicants do better on the math achievement test than do non-applicants. Likewise, applicant children from single-parent households do better in reading than do non-applicants (though this variable is only significant at the 0.10 level).

Despite these differences in individual coefficients, on the math and reading tests, we could not reject an F-test (at the 95% confidence level) of the hypothesis that the interaction terms are jointly equal to zero. However, although it does not meet the generally accepted statistical significance level of 95%, in mathematics we could reject the null hypothesis at about the 90% confidence level. This provides some indication that applicants differ systematically from non-applicants in terms of their unobservable characteristics.

Table 3
OLS estimates of achievement for public school students (standard errors)

	Math		Reading	
	(1)	(2)	(3)	(4)
Intercept	19.110*	19.548*	16.634*	16.958*
	(1.992)	(2.008)	(1.771)	(1.793)
Base year math score	0.584*	0.575*	0.168*	0.167*
	(0.024)	(0.024)	(0.022)	(0.022)
Base year reading score	0.117*	0.125*	0.483*	0.484*
	(0.028)	(0.029)	(0.025)	(0.025)
Foreign language spoken in home	− 3.066	− 2.769	− 0.148	− 0.304
	(2.653)	(2.720)	(2.295)	(2.355)
Family income (in thousands)	0.073	0.065	0.036	0.036
	(0.039)	(0.039)	(0.035)	(0.034)
Catholic	0.416	0.083	0.401	0.393
	(1.100)	(1.127)	(0.993)	(1.012)
Single parent household	0.275	− 0.147	0.347	0.073
	(0.922)	(0.933)	(0.817)	(0.830)
Female	0.661	0.785	1.898*	1.753*
	(0.749)	(0.760)	(0.668)	(0.679)
Black	− 4.885*	− 4.976*	− 4.173*	− 4.078*
	(1.074)	(1.083)	(0.963)	(0.974)
Hispanic	− 2.585	− 2.663	− 2.991*	− 3.052*
	(1.414)	(1.423)	(1.265)	(1.277)
Current grade level	− 1.336*	− 1.305*	− 0.454*	− 0.450*
	(0.196)	(0.198)	(0.174)	(0.177)
At least one parent went to college	3.080*	3.022*	3.277*	3.031*
	(1.594)	(1.612)	(1.405)	(1.423)
At least one parent went to high school	1.479	1.453	1.406	1.268
	(0.928)	(0.941)	(0.825)	(0.840)

(continued on next page)

Table 3 *(continued)*

	Math		Reading	
	(1)	(2)	(3)	(4)
Interactions with application for the Milwaukee Choice Program				
Intercept	− 0.518	− 27.289	− 1.631	− 10.050
	(2.076)	(15.054)	(1.894)	(13.092)
Base year math score		0.450*		0.074
		(0.175)		(0.154)
Base year reading score		− 0.386		− 0.117
		(0.205)		(0.189)
Foreign language spoken in home		− 12.318		− 4.008
		(13.898)		(12.986)
Family income (in thousands)		0.447		0.060
		(0.335)		(0.291)
Catholic		5.592		− 1.692
		(7.405)		(8.590)
Single parent household		16.828*		10.616
		(6.571)		(5.872)
Female		− 7.635		2.080
		(5.179)		(4.532)
Black		2.358		− 9.953
		(11.982)		(10.770)
Hispanic		12.782		− 2.343
		(15.438)		(14.301)
Current grade level		1.217		1.052
		(1.529)		(1.195)
Parent graduated college		10.022		13.007
		(13.629)		(12.792)
Parent graduated high school		3.656		6.725
		(5.971)		(5.467)
F-statistic of the joint significance of the interaction terms		1.489		0.676
Prob. > *F*		0.114		0.788
Adjusted R^2	0.544	0.546	0.489	0.488
Sample size	1431	1431	1440	1440

*Variable is significant at the 0.05 level.

6. Conclusion

The debate over the effectiveness of school choice has become heated within both academic and political circles. Much of the debate is centered on the methodology used to address the important problems associated with student selection into private schools. The central issue is the extent to which researchers account for the potential that public and private school students differ in terms of characteristics that are not readily observable in data.

In this paper, we have utilized the unique nature of the data from the Milwaukee choice experiment to test for non-random application to the Milwaukee Parental Choice Program which, should it exist, indicates sample selection in the Milwaukee experiment. This is important, because one of the potential explanations for the divergent findings in achievement in the Milwaukee experiment is sample selection associated with the decision to apply to the program. We address this issue by examining differences in achievement between choice applicants and non-applicants who were both in public schools.

We find that students applying to the choice program differ markedly from non-applicants in terms of observable characteristics. However, in reading, there is no evidence suggesting systematic differences in unobservables between the two groups of students, and, in math, there is only weak evidence that differences exist. Hence, our findings indicate there is little evidence of sample selection associated with the decision to participate in the choice experiment. Therefore, the divergent findings of earlier research on the achievement effects of enrollment in the Milwaukee Parental Choice Program cannot be explained by unobservable differences between applicants who attend private schools in Mil-

waukee and non-applicant Milwaukee public school students.

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