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Citation

Paul, J. D., & Greene, J. P. (2022). Investigating the Relationship Between Negative Selection into Online Schooling and Achievement Growth. *Education Reform Faculty and Graduate Students Publications*. Retrieved from <https://scholarworks.uark.edu/edrepub/133>

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WORKING PAPER SERIES

Investigating the Relationship Between Negative Selection into Online Schooling and Achievement Growth

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February 24, 2022

EDRE Working Paper 2022-02

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Abstract

Program evaluations that measure the effects of online charter schools on student achievement will be biased if they fail to account for unobserved differences between online students and students in the comparison group. There are theoretical and empirical reasons to believe that students who enroll in online schools disproportionately face challenges that are not accounted for in administrative data. This paper investigates some of the negative factors that motivate parents to enroll in online schools. We combine data from an online charter school survey—that asked why parents decided to enroll in online schooling—with three years of achievement and demographic data. We find that students whose parents indicated they selected online schools for negative reasons made statistically significantly lower ELA gains, even after controlling for prior achievement, race, gender, free lunch status, and special education status. We conclude that other observational analyses of online charter schools, such as CREDO (2015), will be biased and unreliable if they fail to properly control for reasons students select those schools.

Keywords: online charter schools, online, virtual, negative selection, achievement growth, CREDO, bias

Investigating the Relationship Between Negative Selection into Online Schooling and Achievement Growth

What should researchers and policy analysts do when they cannot evaluate a program using a rigorous, causal research design? While the credibility revolution, with its advances in experimental and quasi-experimental methods, has fundamentally altered what social scientists consider reliable or publishable (Angrist & Pischke, 2010), there remain many policy interventions that cannot, or have not, been studied with such techniques.

Consider the example of charter schools, which are tuition-free, independently operated public schools that receive regulatory exemptions and increased autonomy in exchange for increased accountability. These schools operate under a contract with a charter school authorizer, and if the school does not live up to the obligations outlined in its “charter,” the school may be shut down. Charter schools serve students in traditional brick-and-mortar buildings as well as in online settings.

Charters have been the subject of considerable scholarly research over the past several decades. Researchers have primarily sought to understand whether charter students demonstrate higher academic growth relative to students in traditional public schools (Betts & Tang, 2011). But there have been few randomized controlled trials or studies that use quasi-experimental methods, such as instrumental variables, regression discontinuities, or difference-in-differences approaches. The handful of rigorous studies that do exist (Cheng et al., 2017) may not be generalizable to the many types of charter schools that exist across the United States.

Policy analysts have largely relied on charter school studies that use traditional observational approaches to examine outcomes while controlling for a handful of observable characteristics. Online charter schools, in particular, tend to be evaluated with observational

methods. Of course, this research design cannot control for unobservable characteristics, which may bias the estimates of charter school effects.

The purpose of this study is to assess the price that researchers and analysts pay when they forgo rigorous research design. Social scientists broadly agree that estimating effects while merely controlling for observable characteristics is prone to bias, but few have attempted to estimate how large the bias might be in the context of online schooling.

This study sheds light on negative factors that might motivate parents to choose online charter schools for their children. We investigate how strongly these factors are associated with academic outcomes, even when controlling for variables commonly found in observational charter school evaluations. To the extent that these negative selection factors are associated with students who enroll in online schools, our results provide a conservative estimate of the omitted variable bias in observational research. Our results suggest this bias is quite large, rendering other analyses of online charter schools unreliable.

Background

In 2015, the Center for Research on Education Outcomes (CREDO) at Stanford University released a study that found students enrolled in online charter schools gained 0.10 standard deviations less in reading and 0.25 standard deviations less in math, each year, compared to students they deemed to be “virtual twins” who remained in traditional public schools (Woodworth et al., p. 23). This study received considerable attention and shaped decisions of policymakers nationwide, even though it lacked causal design. The study did not actually examine twins—virtual or otherwise. Instead, researchers used a standard observational analysis that controlled for student characteristics readily available in administrative data sets, such as prior achievement, race, sex, and free-or-reduced price lunch (FRPL) eligibility.

Importantly, the CREDO study cannot control for factors associated with why some students might enroll in an online charter school as opposed to traditional brick-and-mortar district or charter options. There are theoretical and empirical reasons to believe that students drawn to online charter schools are more likely to have pre-existing, unobserved educational challenges. Those who rely on CREDO results may believe controlling for prior achievement accounts for the challenges associated with enrolling in online education. But if students drawn to online schools have systemically lower rates of test score growth, controlling for prior test score levels will be inadequate to parse out the independent effect of online schooling on academic growth.

In this study we collect information about the reasons families choose online charter schools. We demonstrate that those reasons are strongly and negatively associated with academic outcomes, even when controlling for observable student characteristics, including prior test scores.

Literature Review

Observational models that estimate academic growth typically control for previous achievement to account for students' accumulated knowledge and, perhaps, innate ability (Koedel et al., 2015). These growth models condition on demographic controls, plus a variable for the students' prior year achievement level. However, controlling for lagged test score levels is unlikely to produce an unbiased comparison among students that have other unobserved differences. Campbell (1969) cautioned researchers about the *selection-maturation interaction*, which holds that "selection differences in the natural aggregations involve not only differences in mean level, but differences in maturation rate" (p. 418). In other words, controlling for prior

achievement *levels* may not adequately net out the disadvantage between two groups if one group has a lower rate of achievement *growth*.

To the extent that online students are systematically different from traditional public school students in ways that might predict lower growth, models comparing achievement across sectors will be biased in favor of traditional public school students. There is empirical evidence that students who were victims of bullying, suffer from depression, or otherwise had poor experiences in a previous school have worse academic outcomes than their peers. And there are theoretical reasons to suspect that, on average, students enrolled in online schools are systematically more likely than their peers to have some of these experiences or traits and thus be negatively selected.

In 2017, more than one in five American students between the ages of 12 and 18 reported being bullied at school, and 25 percent of fifth graders attended schools where at least one physical conflict occurred each month (Wang et al., 2020). A meta-analytic review of 33 studies found a negative relationship between peer victimization and concurrent achievement (Nakamoto & Schwartz, 2010). Researchers have also found that bullying predicts future academic problems. For example, a longitudinal study of urban middle school students found that self-perceived victimization predicted a decline in academic performance (Juvonen et al., 2011). International research also finds a negative relationship between bullying and achievement (Kibriya et al., 2016; Oliveira et al., 2018; Erikson et al., 2014) as well as attainment (Ponzo, 2013; Brown & Taylor, 2008). Moreover, Kochenderfer and Ladd (2014) found that victimized children had higher future rates of absenteeism.

Much like bullying, depression and social anxiety are associated with lower academic achievement (Diaconu-Gherasim & Măirean, 2020) and attainment. Seven percent of children in

the United States have diagnosed anxiety, and three percent have diagnosed depression, according to the Centers for Disease Control and Prevention (2021). A longitudinal study in Sweden found that children diagnosed with social anxiety disorder were less likely to pass all subjects in their last year of compulsory schooling (Vilaplana-Pérez et al., 2021). Using data from the National Longitudinal Study of Adolescent Health, Fletcher (2008) revealed that depressive symptoms predict lower rates of high school completion and lower rates of college enrollment. And a study of Canadian youth found that anxiety disorders were associated with reduced attainment (Van Ameringen et al., 2003).

Online schools are a popular option for students who experienced bullying or academic issues at previous schools. In 2018, 38 percent of parents enrolled in a large network of online schools indicated bullying was their reason for enrolling in online education (Maranto et al., 2021). Another survey conducted by an online school operator found that nearly one quarter of parents turned to online school because of bullying, and more than one-third switched to online school because they wanted a safer environment (Yowell, 2019). Some researchers speculate that parents seek online schools because of shocks in a previous school that were correlated with test score drops (Beck et al., 2014; Leuken et al., 2015). Notably, there is some early evidence that bullying decreased during the pandemic, when many brick and mortar schools transitioned to virtual instruction (Patchin, 2021; Davis, 2020).

Data & Method

An online charter school operator provided responses to a parent satisfaction survey that were matched to student achievement data from 2016 through in 2018. The web-based survey was administered to all legal guardians of students who were enrolled in one of the network's online schools in the Fall of 2017. The survey response rate was 18.5 percent. In total, there were

4,225 observations in the dataset. There were indicators for race, gender, free and reduced-price lunch eligibility, and special education status.

A question in the parent survey asked respondents to explain why they left their previous school and decided to enroll in an online school. The exact wording of the question was: “In your own words, please tell us why your chose [School Name] for [Student Name].” One example of a response to this question was:

“My daughter is able to complete work when it is most convenient for her. She has medical issues that made it difficult to complete schoolwork without taking breaks or being in a comfortable position in a brick-and-mortar school. She can also spend more time as needed trying to learn what is being taught. She can learn at her own pace.”

Another parent responded:

“There was a lot of bullying at his old school, that was not handled. He was sent to the office instead, to simply get him away from his bullies. He missed a lot of classes because of this. We chose this school because it allows us to have him at home, and it is accredited.”

We systematically analyzed responses to this survey item by searching for eight key terms:

anxiety, bullied, depressed, fail, health, medical, negative, stress, and trouble. We used abbreviated search phrases to ensure that we captured all variations of the key words. For example, we searched “depress” to capture “depression,” “depressing,” and “depressed.” If parents used any variation of these eight words in response to the question, we coded the student as negatively selected. Moreover, we coded a student as negatively selected if the parent did not submit a response to the item. We hypothesize that failing to answer the question is a form of a negative selection because it indicates the parent is not comfortable talking about their child’s previous schooling experiences.

In addition to the dichotomous measure of negative selection, we developed a negative selection index which represents how many of the eight key words were mentioned in the open-

ended response to the question about why they enrolled. A parent who mentioned *anxiety* and *trouble* in their response would have a value of 2 in the negative selection index. A parent who did not respond to the question would have a value of 1, and a parent who responded but did not use any of the eight keywords would have a value of 0.

Table 1 provides descriptive statistics on our measure of negative selection. More than 10 percent of respondents used the word “bullied” in response to the question about why they chose to enroll in an online school. The second most common key term was “anxiety,” at six percent.

Table 1. Negative Selection Terms

	N	%
Bullied	477	11%
Anxiety	237	6%
No Response	187	4%
Health	114	3%
Stress	83	2%
Medical	78	2%
Trouble	77	2%
Depression	57	1%
Fail	50	1%

n= 4225

Table 2 provides statistics on the negative selection index. Approximately 28 percent of the sample was coded as negative selected, and it was uncommon for parent responses to include multiple key terms.

Table 2. Negative Selection Index

Number of Key Words Used	N	%
0	3,054	72%
1	1,016	24%
2	127	3%
3	22	1%
4	6	0%

n= 4225

Test scores in English language arts (ELA) and math were reported in standard deviation units. These scores were normed, by grade and year, against the national student population who took the NWEA or STAR assessments. An average of 28 percent of ELA test scores and 27 percent of Math test scores were missing during the three-year period. However, missing data were not strongly related to our dichotomous measure of negative selection, which was the explanatory variable of interest. Students who were negatively selected were 3 percentage points less likely to have missing ELA test scores, and this difference was statistically significant in two of the three years. Students who were negatively selected were 2 percentage points less likely to have missing math test scores, and this difference was statistically significant in only one of the three years. Accordingly, there is little reason to worry that moderate rates of missing outcome data will bias the findings.

To determine whether negative selection is associated with statistically significant differences in student growth, we regress student test scores on a measure of negative selection, while controlling for prior year achievement, race, gender, FRPL eligibility, and special education status. We present results separately for ELA, math, and combined test scores using both the dichotomous measure of negative selection as well as the negative selection index. Accordingly, there are six regression outputs.

Results

Students whose parents indicated they were negatively selected into online schooling made statistically significantly lower ELA gains, even after controlling for prior year test scores, race, gender, FRL status, and special education status. Table 3 presents the association between a dichotomous measure of negative selection and test score growth. Negatively selected students had 0.07 standard deviations less growth on ELA relative to students who were not negatively

selected. Students who were negatively selected also had slightly less growth in Math, although this estimate was not statistically significant. Table 4 presents the association between our negative selection index and test score growth. We find that each additional negative selection term volunteered by parents in response to the open-ended question about enrolling in online schooling is associated with 0.05 standard deviations less growth on ELA. Each additional term was associated with 0.03 standard deviations less growth on combined (ELA and Math) achievement, but this estimate was not statistically significant.

Table 3. Association Between Negative Selection (Dichotomous) and Achievement Growth

	(1) Combined	(2) ELA	(3) Math
Negatively Selected	-0.03 (0.02)	-0.07** (0.03)	-0.01 (0.03)
Prior Achievement	0.74*** (0.02)	0.75*** (0.03)	0.65*** (0.03)
Female	0.00 (0.02)	0.02 (0.03)	0.00 (0.03)
Black	-0.00 (0.03)	-0.01 (0.04)	-0.05 (0.03)
Latino	0.00 (0.04)	-0.01 (0.04)	-0.05 (0.06)
FRPL	-0.04 (0.02)	-0.04 (0.03)	-0.06** (0.03)
SPED	-0.06** (0.03)	-0.08* (0.04)	-0.06* (0.04)
Observations	1,122	830	846
R-squared	0.56	0.58	0.51

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 4. Association Between Negative Selection Index and Achievement Growth

	(1) Combined	(2) ELA	(3) Math
Negative Selection Index	-0.02 (0.02)	-0.05** (0.02)	0.00 (0.02)
Prior Achievement	0.74*** (0.02)	0.75*** (0.03)	0.65*** (0.03)
Female	0.00 (0.02)	0.02 (0.03)	0.00 (0.03)
Black	-0.00 (0.03)	-0.01 (0.04)	-0.05 (0.03)
Latino	0.00 (0.04)	-0.01 (0.04)	-0.05 (0.06)
FRPL	-0.04* (0.02)	-0.04 (0.03)	-0.06** (0.03)
SPED	-0.06** (0.03)	-0.08** (0.04)	-0.06* (0.04)
Observations	1,122	830	846
R-squared	0.55	0.58	0.51

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Discussion

The negative selection factors identified in this paper are rarely, if ever, accounted for in other observational research. We estimate the omitted variables bias that would result without accounting for reasons that students enroll in online charter schools. These results are conservative and likely understate the extent to which observational analyses of online charter schools are biased in favor of the comparison group. Our measure of negative selection is based on reasons for enrollment that parents volunteered in a survey. Accordingly, some parents may prefer not to mention negative reasons, even if negative selection did in fact occur. Also, parent who do mention negative reasons may not list all of them. Moreover, we relied on eight key terms when searching for negative selection in parent responses. If parents described negative

reasons without using these key terms, we would not have captured it. All these sources of imprecision would bias our estimates toward zero.

In many respects, the findings in this paper should be uncontroversial among empirical social scientists. It is widely accepted that omitted variable bias is a significant problem in observational analyses. When it comes to online charter schools, however, some researchers and analysts have disregarded well-established concerns about omitted variable bias. Our findings are a reminder that failing to account for unobserved differences between two groups will lead to biased and unreliable estimates. Observational analyses that omit information about negative reasons that families select online schools—like the CREDO findings, as well as value-added models that states like Tennessee and Louisiana use to evaluate public schools—should be interpreted with caution.

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