School Performance of Schools Assigned to HUD-Assisted Households

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Opinions expressed in this introduction are those of the author and do not necessarily reflect the views and policies of the U.S. Department of Housing and Urban Development or the U.S. government.

Abstract

This study examines school performance of schools assigned to households in four U.S. Department of Housing and Urban Development (HUD) rental assistance programs: The Tenant-Based Voucher (TBV); Project-Based Voucher (PBV); Public Housing (PH); and Project-Based Section 8 (PBS8).

School performance is measured by the percentage of fourth grade students proficient in math and reading according to state standardized tests. Past studies have examined performance of schools near, but not assigned to HUD assisted households. Public schools are matched to HUD households by geocoding the household addresses to Maponics school attendance zone data. School zones are then matched to school performance data from GreatSchools.

Results indicate that for households in each program, school performance is well below national averages and below national averages for students eligible for free or reduced-price lunches. Adjusting for differences in the proportion of students that are economically disadvantaged, school performance of schools assigned to assisted households is greater but still below national averages.

Results from statistical models controlling for differences across states in proficiency standards indicate that schools assigned to TBV and PBS8 households are significantly more proficient in reading and math compared to schools assigned to PBV and PH households. Comparisons of schools assigned to TBV and PBS8 households are sensitive to the sample of households analyzed. When all households are analyzed, schools assigned to PBS8 households outperform those assigned to TBV households on average. When the analysis is limited to households with elementary age children, average performance of schools assigned to TBV households is greater than that of schools assigned to PBS8 households.

For each HUD program, average school performance of schools assigned to all assisted households is markedly greater than that of schools assigned to households with elementary age children, which raises questions regarding HUD's ability to place households with children in opportunity neighborhoods.

Introduction

One of HUD's strategic goals has been to use housing as a platform to improve quality of life (HUD, 2018c). Researchers have measured HUD's success in achieving this goal by measuring the quality of neighborhoods with HUD-assisted households. Past studies of neighborhoods characteristics for HUD assisted households have focused heavily on poverty and minority concentration (Newman and Schnare, 1997; McClure, 2010).

More recently, researchers examined other neighborhood metrics. For example, Lens et al. (2011) examined crime rates in neighborhoods of Housing Choice Voucher (HCV) households. Numerous studies have also examined school performance of households receiving federal housing assistance (Deng, 2007; Ellen and Horn, 2012; Horn et al., 2014; Ellen et al., 2016, Mast and Hardiman, 2017). HUD's Affirmatively Furthering Fair Housing (AFFH) rule requires Public Housing Agencies (PHAs) and other program participants to perform a fair housing analysis, which includes analyzing HUD provided data on seven neighborhood opportunity indicators, including a school proficiency index (HUD, 2018b).

This article examines school performance of public schools assigned to HUD assisted households. Past studies have examined schools near, but not assigned to, federally assisted households. Such analysis is suboptimal because students may not attend or be assigned to their closest school. In the five cities studied by Blagg et al. (2018), less than half of students attended their closest school. In 13 metropolitan areas for which Ellen et al. (2016) had data on elementary school attendance zones, the nearest school for 64 percent of HCV households was their zoned school.

I match public schools to HUD households by geocoding the household addresses to Maponics school attendance zone data. School boundaries are a policy choice of school boards, which are elected local governments. The school of assignment may differ from the nearest school for either practical or political reasons, yet the school of assignment will be the default school for most elementary school students. In 2007, nearly three-fourths of students in the United States attended their assigned public school (National Center for Education Statistics, 2015).

School zones are then matched to school performance data from GreatSchools. I measure school performance based on the percentage of fourth grade students proficient in math and reading according to state standards.

The proportion of students proficient on state exams may vary due to factors beyond the school's control, particularly student demographics. To control for student socioeconomic status, I compute an adjusted school performance measure that controls for the percentage of economically disadvantaged students in a school. The adjusted performance index attempts to measure schools' "value added" to standardized test scores. The adjusted performance index may be particularly policy relevant in high-poverty areas, where most or all public schools have high percentages of low-income students.

I analyze data for households in HUD's three largest rental assistance programs: The HCV program; PH; and the PBS8 program. Data for HCV households are reported separately for TBV and PBV households.

Data are reported for all households in each program and separately for only those households with children ages 6-12 (elementary school age). Results for households with elementary age children are most policy relevant. Results for all households may also be of interest, however, because households without elementary age children may have them in the future. For example, 13.9 percent of households without elementary age children have children age 5 and under. A school performance measure for all households may also be useful as an indicator of neighborhood quality, as children with greater academic achievement may be less likely to engage in delinquent behavior.

The main hypothesis I test is whether school performance for schools assigned to TBV households is greater on average compared to households receiving project-based assistance. This is because TBV, unlike the other three programs, is a tenant-based rather than unit-based subsidy designed to provide residents with mobility. TBV tenants can choose units in neighborhoods of their choice, provided the unit meets HUD housing quality standards and the family's portion of rent at move-in is no more than 40 percent of adjusted income. The affordability requirement implies that a unit's rent must be close to the PHA's payment standard, which is typically between 90 and 110 percent of fair market rent.

Given the ability of TBV households to choose locations with higher performing schools, they might be expected to be assigned to higher performing schools compared to households in housing projects. Constraints that prevent TBV households from choosing neighborhoods with better performing schools may exist, however. For instance, there might be a lack of affordable rental units in areas with higher performing schools. Ellen et al., (2016) found that families with vouchers were more likely to move toward a better school in metropolitan areas with a relatively high share of affordable rental units located near higher performing schools.

Factors other than affordability may prevent TBV households from locating in attendance zones of high performing schools. As DeLuca and Rosenblatt (2010) note, social networks of low-income households may limit their ability to locate good schools (Horvat et al., 2003; Schneider et al., 2000; Neild, 2005); and minority and low-income households are less likely to consider schools based on academic achievement (Sapporito and Lareau, 1999; Henig, 1995; Teske and Schneider, 2001).

To test the hypothesis, I estimate regression models with state fixed effects to control for differences across states in proficiency standards. Results indicate that—

- TBV and PBS8 households tend to be residentially assigned to higher performing schools than PH and PBV households.
- When all households are included in the analysis, school performance of schools assigned to PBS8 households tends to be greater as compared to those assigned to TBV households.
- When the analysis is limited to households with elementary age children, schools assigned to TBV households tend to outperform those assigned to PBS8 households.

Other findings from the regression analysis include the following:

- In all HUD assistance programs, average fourth grade performance levels of schools assigned to HUD assisted households are well below national averages.

- Regression adjusted school performance rates are higher when controlling for differences across schools in the proportion of students who are economically disadvantaged, although they remain below state averages.
- For households in each HUD program, school performance tends to be lower when the analysis is limited to households with elementary age children.

In subsequent sections, I review the relevant literature, describe the data, present national and state summary statistics, and report results from regression models. I discuss regression results, as well as limitations and areas for further research. The final section summarizes the study.

Literature Review

In this section, I review the literature regarding poverty and academic achievement and school performance of schools near federally assisted households. This section draws heavily from Sackett (2016).

Poverty and Academic Achievement

The income-based achievement gap has always been large since it was first measured decades ago, and it's been growing in recent years (Reardon, 2011). In 2015, fourth graders eligible for free or reduced-price lunches (FRPL) scored on average about two grade levels lower on National Assessment of Academic Progress math tests compared to their higher income peers (Dynarski and Kainz, 2015). Low-income students who attend high-poverty schools face significant academic challenges (Kahlenberg, 2001).

School impacts can conceptually be analyzed as the joint product of peer effects (effects on lower income students attending schools with higher performing students), teacher effects, and schoolwide effects such as curriculum and management. A large literature supports the existence of peer effects (Boozer and Cacciola, 2001; Barrera-Osorio et al., 2008; Brunello et al., 2010; Duflo et al., 2011; De Giorgi et al., 2009; Lugo, 2011; Kiss, 2011; Sojourner, 2011; Luppino, 2012; Antecol et al., 2013; Bursztyn and Jensen, 2014; Feld and Zölitz, 2015).

Several studies have examined peer effects and neighborhood effects (effects on lower income students who move to higher income neighborhoods with better chances of attending higher performing schools).

Schwartz (2012) compared academic achievement of children who lived in PH in Montgomery County, Maryland, where PH families are randomly assigned to neighborhoods. She compared outcomes for student assigned to lower poverty schools (0–20 percent of students FRPL eligible) to students assigned to higher poverty schools (20–85 percent of students FRPL eligible). After 2 years, students in lower poverty schools became more proficient in math and reading compared to students assigned to higher poverty schools. After 7 years, students in lower poverty schools cut the math income achievement gap in half; there was no improvement in the math achievement gap for students assigned to higher poverty schools.

Evidence from the Gautreaux mobility program in Chicago supports Schwartz's findings. From 1976 through the late 1990s, households in PH or on waiting lists moved from high-poverty, high-minority neighborhoods in the city. About four-fifths moved to higher income, less segregated neighborhoods (Duncan and Zuberi, 2006), including over 115 suburbs (Rosenbaum and DeLuca, 2008). The Gautreaux evidence is less rigorous than Schwartz's 2012 study because households had some control over where they moved.

Among the group who relocated to the suburbs, 88 percent attended schools with average ACT scores of 20 or higher (out of 36 possible), compared to 6 percent for the group that moved to neighborhoods in the city (Rosenbaum, 2005). Eight years later, 54 percent of students that moved to the suburbs attended college, compared to 21 percent of students that moved to the city (Rosenbaum, 2005).

Neighborhood Effects

The most rigorous evidence regarding neighborhood effects comes from the Moving to Opportunity (MTO) study. MTO examined the impact of residents receiving TBVs to move out of PH in distressed high-poverty neighborhoods in five cities between 1994 and 1998. The experiment included three groups of residents: A traditional voucher group, a low poverty voucher group, and a control group. The traditional voucher group received a normal voucher with no special counseling to help them locate to lower poverty neighborhoods. The low poverty voucher group received intensive housing search and counseling services to help them relocate to low poverty neighborhoods.

A followup study performed 4–7 years after random assignment found that "MTO had no detectable effects on the math and reading achievement of children" (National Bureau of Economic Research, 2017). This finding contradicts many studies that found evidence of peer effects. Possible explanations include the following:

- Many of the MTO treatment kids went to better neighborhoods but not measurably better schools (Sanbonmatsu et al., 2011).
- The testing was zero stakes, with no rewards for doing well.
- Subsequent findings are that despite the lack of measured impact on cognitive skills, MTO treatment children who moved before age 13 had higher earnings and college matriculation, more marriages, and less out of wedlock births than controls (Chetty et al., 2016). This could result from either peer or neighborhood effects.

School Performance of Schools Near Assisted Households

Most directly relevant to this study, five studies have examined school quality of schools near, but not assigned to, federally assisted households.

Deng (2007) analyzes schools near HCV households, Low-Income Housing Tax Credit (LIHTC) households, and the broader population of rental households. She finds that both HCV and LIHTC

households tend to live near lower performing schools compared to the average renting household, with variation in outcomes across metropolitan areas.

Using similar data, Ellen and Horn (2012) and Horn et al. (2014) examine school performance of schools nearest federally assisted households with children. Performance data for the 2008-2009 school year were matched to data on assisted households with children for 2008.

Ellen and Horn (2012) compare households in the PH, HCV, PBS8, and LIHTC programs. As a proxy for LIHTC units with children, Ellen and Horn (2012) utilize data on LIHTC units with two or more bedrooms.

Ellen and Horn (2012) and Horn et al. (2014) did not have access to sufficient school boundary data to examine schools assigned to federally assisted households. They also examine school performance of schools nearest larger populations based on American Community Survey census tract data; distance was calculated using census tract centroids.

Similar to this study, Ellen and Horn (2012) and Horn et al. (2014) measure school performance based on the share of elementary school students proficient in math and reading according to state exams.

Ellen and Horn's findings include the following:

- Schools nearest federally assisted households have much lower performance on average compared to state averages.
- HCV households live, on average, near lower performing schools compared to PBS8 and LIHTC households.
- Schools nearest HCV and PBS8 households are higher performing on average compared to those nearest PH households.

Ellen and Horn (2012) expected a priori that, due to the ability of voucher households to choose neighborhoods with better performing schools, performance of schools near HCV households should compare favorably to schools nearest households receiving project-based assistance. They provide the following possible explanations for their findings to the contrary:

- An insufficient stock of affordable units near high performing schools may exist.
- A lack of information on affordable units available near good schools may exist.
- Administrative constraints may prevent HCV households from crossing into higher performing school districts.
- Most voucher holders are non-White, and patterns of residential segregation and discrimination may preclude minority HCV tenants from living near higher performing schools.

Horn et al. (2014) compare schools nearest HCV households with children to schools nearest other assisted households within the same state and metropolitan area, and to schools matched to other

poor households with children in the same state and metropolitan area. In addition to proficiency rates, they examined school poverty and racial composition.

Horn et al. (2014) report that although HCV families with children live in neighborhoods with higher performing schools than PH households, they live in neighborhoods with lower performing schools than LIHTC households and poor households overall.

Ellen et al. (2016) match HCV household data in 15 states between 2003 and 2012 to school data for school years 2001–2002 through 2010–2011. They match HCV households to their nearest school within the school district and the two schools that are second and third closest.

Ellen et al. (2016) examine whether HCV households living in areas with high performing schools nearby and slack housing markets move towards higher performing schools when their oldest child becomes school eligible. They report that HCV households are more likely to move toward a higher performing school in the year before their oldest child meets the eligibility cut-off for kindergarten. The effect is larger in metropolitan areas with a relatively high share of affordable rental units located near high performing schools and in neighborhoods closer to better schools.

Mast and Hardiman (2017) compared school performance for schools near PBV households to a matched sample of TBV households. They measured school performance with a block-group index (on a scale of 1–100) of fourth grade math and reading performance from HUD's AFFH database for school year 2011–2012 (HUD, 2018a). The AFFH school index is based on proficiency rates in a maximum of three schools within 1.5 miles of the block-group centroid.

Mast and Hardiman (2017) found that school performance was slightly higher for PBV households with children than for TBV households with children. The median school performance index was 28 (mean was 33.5) for PBV households and 27 (mean was 32.1) for the matched sample of TBV households.

This paper extends the literature by examining proficiency rates in schools assigned to HUD assisted households. Compared to analysis of nearest schools, this approach reduces measurement error because the majority of public school students attend their zoned school (National Center for Education Statistics, 2015).

Data Description

I analyze school performance data on fourth grade state math and reading tests from GreatSchools for school year 2012–2013 or 2013–2014 (whichever is most recently available for each school). The GreatSchools data includes each state's main tests, covering all levels of schools (elementary, middle, and high). In the majority of states, the results are broken down by grade and subject. About 88 percent of observations are for school year 2013–2014. Kansas and West Virginia are excluded from the analysis because they did not report fourth grade performance data for either school year. I analyze data on all fourth grade students and subgroups of students that are and are not economically disadvantaged where available (discussed subsequently).

PH, PBV, and TBV data are from HUD's Inventory Management System (IMS)/PIH Information Center (PIC) data system; PBS8 data are from HUD's Tenant Rental Assistance Certification System (TRACS) data. Household data for December 2012 were matched to GreatSchools data for school year 2012–2013, and household data for December 2013 were matched to GreatSchools data for school year 2013–2014. Data are reported separately for all HUD households in each program and for those with children ages 6-12 (elementary school age).

Public schools were matched to HUD households by geocoding the household addresses to Maponics school attendance zone data for 2016. The Maponics database includes locally sourced school boundaries within school districts to delineate which students within the district will go to what school. Maponics school attendance zone data cover over 94 percent of the U.S. student enrollment.

In some areas (Boston, for example), schools are unzoned within school districts. Magnet schools can also be unzoned. In such cases, the Maponics dataset makes individual elementary school attendance zones equal to district attendance zones. School attendance zones can also overlap (in Fairfax County, Virginia, for example).

I handle the problem of multiple assignment in two ways. First, when such cases occur, households can be matched to multiple schools with districts; this is the case for 18.4 percent of households analyzed. For households matched to multiple schools, all school-household pairs receive equal weight in statistical computations, inversely proportional to the number of matched schools per household. The sum of weights for each household is 1.

Alternatively, to test sensitivity of my statistical estimates to inclusion of households assigned to multiple schools, I also report regression estimates, excluding these households (discussed subsequently).

To combine math and reading proficiency into a single index per school, I construct a school performance index for each school based on the percentage of fourth grade students proficient in math and reading according to state standards. In the formula shown here, i denotes the i^{th} school, r denotes the proportion of fourth grade students proficient in reading, and m denotes the proportion of fourth grade students proficient in math. To adjust for differences across states in proficiency standards and differences across schools years, the index is percentile ranked by school year and state.

$$Index_i = \left[\tfrac{1}{2} * r_i + \tfrac{1}{2} * m_i\right]$$

I also compute an adjusted school performance index that controls for differences across schools in student socioeconomic status. The National Center for Education Statistics (2014) defines high-poverty schools as those with at least 75 percent of students eligible for FRPL.

Following the National Center for Education Statistics, I define the school poverty rate by the percentage of students FRPL eligible. Exhibit 1 reports four categories of school poverty by HUD program: 0–24.9 percent, 25–49.9 percent, 50–74.9 percent, and 75 percent and above. Schools assigned to HUD-assisted households are overrepresented in the highest category of school poverty. Following the National Center for Education Statistics, I refer to schools with at least 75 percent of students FRPL eligible as high poverty. Of schools assigned to HUD-assisted households,

54.7 percent are high poverty. Among schools assigned to TBV households, 54.3 percent are high poverty; for schools assigned to PH households, the percentage is 58.8. The corresponding percentages for PBS8 and PBV households are 52.1 percent and 56.2 percent, respectively. School poverty is even higher for schools assigned to HUD households with children ages 6-12. For PH households with elementary age children, 65.1 percent of schools are high poverty, while less than 2 percent are in the lowest category of school poverty.

Exhibit 1

Categories of School Poverty by HUD Program

		Category of School Poverty			
Sample	**Program**	**0%–24.9%**	**25%–49.9%**	**50%–74.9%**	**75% and above**
All households	PH	2.6%	16.5%	22.1%	58.8%
	PBS8	5.8%	16.8%	25.4%	52.1%
	PBV	6.8%	14.8%	22.2%	56.2%
	TBV	4.6%	15.7%	25.4%	54.3%
	All	4.5%	16.2%	24.6%	54.7%
Households with children ages 6-12	PH	1.8%	13.3%	19.7%	65.1%
	PBS8	2.8%	12.8%	23.7%	60.8%
	PBV	5.6%	14.7%	21.1%	58.5%
	TBV	3.6%	13.7%	24.9%	57.8%
	All	3.1%	13.5%	23.5%	59.9%

PH = Public Housing. PBS8 = Project Based Section 8. PBV = Project Based Voucher. TBV = Tenant Based Voucher.
Note: The school poverty rate is defined as the percentage of students eligible for free or reduced-price lunches.
Sources: Common Core of Data, 2013–2014; IMS/PIC 2012, 2013; TRACS 2012, 2013; GreatSchools 2012–2013, 2013–2014; Maponics 2016.

To account for differences in school demographics, I created an adjusted school performance index to control for the proportion of students that are economically disadvantaged.[1] The adjusted index attempts to measure schools' value added to student proficiency—that is, to separate performance of the school from the initial human capital of the students (as proxied by economic disadvantage). Note that the school proficiency index captures peer effects (discussed in the subsequent literature review section), while the adjusted school proficiency index is intended not to.

The adjusted school performance index is an enrollment weighted average of indices for two subgroups of students, percentile ranked separately by school year and state for both groups. In the formula that follows, j=1 denotes economically disadvantaged students, and j=2 denotes students that are not economically disadvantaged. $s_{i,j}$ denotes the count of group j fourth grade students in school i, and s_i denotes total fourth grade enrollment in school i.

$$Adjusted\ Index_i = \sum_{j=1}^{2} \frac{S_{i,j}}{S_i} Index_{i,j}$$

Where $Index_{i,j}$ is a performance index, percentile ranked by school year and state, for group j in school i:

$$Index_{i,j} = \left[\tfrac{1}{2} * r_{i,j} + \tfrac{1}{2} * m_{i,j}\right]$$

[1] For Colorado, I used data for students that are and are not eligible for FRPL.

$m_{i,j}$ denotes the fraction of group j fourth grade students proficient in math in school i, and $r_{i,j}$ denotes the fraction of group j fourth grade students proficient in reading in school i.

For example, consider a school where a quarter of students are economically disadvantaged. Assume that compared to economically disadvantaged students in other schools across the state, the school's disadvantaged students rank in the 80th percentile. Also, assume that compared to other non-disadvantaged students in other schools across the state, the schools' non-disadvantaged students rank in the 60th percentile. The school's adjusted school performance index is (1/4)*80 + (3/4)*60 = 65.

The adjusted school performance index is only available for schools that report test scores for students that are economically disadvantaged to GreatSchools. The adjusted index is not available for any schools in Alabama, Arkansas, Georgia, Hawaii, Illinois, Louisiana, Maryland, Maine, Michigan, Mississippi, Oklahoma, or Utah.[2]

Summary Statistics

Exhibit 2 reports summary statistics on the school performance index and adjusted school performance index by HUD program. Note that the statistics in this section are not adjusted for differences in state proficiency standards. The mean school performance for all HUD programs is 36.7, which is well below the national average (approximately 50) and below the national average for schools assigned to FRPL-eligible students of 40.3.[3]

TBV households tend to be assigned to higher performing schools than HUD households receiving project-based assistance. In contrast to findings from Mast and Hardiman (2017), the mean school performance for TBV households (37.2) is well above the mean for PBV households (34.7). The mean index for PH households is 35.7, and the mean for PBS8 households is 36.8.

Exhibit 2

School Performance Index Descriptive Statistics

Variable: school performance index

Sample	Program	Households	25th percentile	Median	Mean	75th percentile	Std Dev
All households	PH	838,110	9	26	35.724	57	18.356
	PBS8	1,114,907	12	30	36.764	58	17.266
	PBV	64,071	9	27	34.731	57	15.661
	TBV	1,694,162	12	31	37.220	58	19.223
	All	3,711,250	11	30	36.702	58	18.304

[2] An alternative approach for creating an adjusted index would be to regress the unadjusted index on the percentage of economically disadvantaged students and base the adjusted index on the residuals. While this approach would result in the adjusted index being available for more schools, I prefer using actual data on proficiency of economically disadvantaged students.

[3] I computed the national mean for FRPL-eligible students as a weighted mean of the school proficiency index for each school, where the weight is each school's number of FRPL-eligible students.

Exhibit 2

School Performance Index Descriptive Statistics

Variable: school performance index

Sample	Program	Households	25th percentile	Median	Mean	75th percentile	Std Dev
Households with children ages 6-12	PH	188,011	7	22	32.326	50	18.504
	PBS8	162,872	9	25	32.077	50	16.092
	PBV	11,638	9	24	33.384	56	16.255
	TBV	516,994	11	28	34.725	54	18.831
	All	879,515	10	26	33.704	53	18.159

Variable: adjusted school performance index

Sample	Program	Households	25th percentile	Median	Mean	75th percentile	Std Dev
All households	PH	527,254	11	35	43.440	75	17.709
	PBS8	681,358	14	39	42.542	68	15.980
	PBV	39,969	12	34	40.070	65	14.194
	TBV	1,108,682	15	39	43.261	69	19.078
	All	2,357,263	14	38	43.039	70	17.621
Households with children ages 6-12	PH	115,283	9	30	39.772	68	18.185
	PBS8	94,537	11	32	38.206	62	15.054
	PBV	7,921	12	29	37.463	62	15.595
	TBV	318,309	13	35	40.181	64	18.584
	All	536,050	12	33	39.705	64	17.679

PH = Public Housing. PBS8 = Project Based Section 8. PBV = Project Based Voucher. Std Dev = standard deviation. TBV = Tenant Based Voucher.
Sources: IMS/PIC 2012, 2013; TRACS 2012, 2013; GreatSchools 2012–2013, 2013–2014; Maponics 2016

In each program category, average school performance is lower when the analysis is limited to households with elementary age children. For PBS8 households with children ages 6-12, the mean school performance index is 32.1.

Note that although Ellen and Horn (2012) reported that school performance was greater on average for schools nearest PBS8 households with children compared with those nearest HCV households with children, they did not differentiate between HCV households in the TBV and PBV programs.

School performance of HUD-assisted households is notably better controlling for the proportion of students that are economically disadvantaged, although means are still below national averages for each program. The mean adjusted school performance index is 43.0 for all assisted households, 43.4 for PH households, 42.5 for PBS8 households, 40.1 for PBV households, and 43.3 for TBV households. For each program category, the mean adjusted index is lower when the sample is limited to households with children ages 6-12.

Exhibit 3 reports quartiles of the school performance index and adjusted school performance index by HUD program. Schools assigned to HUD assisted households are overrepresented in

the lower quartiles of school performance. About 45 percent of schools assigned to assisted households are in the lowest quartile of the school performance index, while only 14.1 percent are in the upper quartile.

Exhibit 3

School Performance Index Quartiles

Quartile of School Performance Index					
Sample	**Program**	**1st**	**2nd**	**3rd**	**4th**
All households	PH	49.5%	21.7%	12.4%	16.4%
	PBS8	44.3%	25.4%	16.6%	13.7%
	PBV	47.8%	22.9%	15.4%	13.9%
	TBV	43.4%	25.7%	17.6%	13.3%
	All	45.1%	24.6%	16.1%	14.1%
Households with children ages 6-12	PH	54.5%	20.6%	11.2%	13.7%
	PBS8	51.1%	24.6%	14.3%	10.0%
	PBV	51.0%	19.9%	16.5%	12.5%
	TBV	47.1%	25.3%	16.3%	11.3%
	All	49.5%	24.1%	14.8%	11.6%
Quartile of Adjusted School Performance Index					
Sample	**Program**	**1st**	**2nd**	**3rd**	**4th**
All households	PH	41.1%	19.8%	14.1%	24.9%
	PBS8	37.3%	23.3%	19.6%	19.8%
	PBV	42.1%	20.8%	19.6%	17.4%
	TBV	36.7%	23.5%	20.0%	19.8%
	All	38.0%	22.6%	18.6%	20.9%
Households with children ages 6-12	PH	45.7%	20.1%	13.0%	21.3%
	PBS8	42.8%	23.7%	17.2%	16.2%
	PBV	46.9%	19.4%	17.3%	16.4%
	TBV	40.6%	23.9%	18.6%	17.0%
	All	42.1%	23.0%	17.1%	17.8%

PH = Public Housing. PBS8 = Project Based Section 8. PBV = Project Based Voucher. TBV = Tenant Based Voucher.
Sources: IMS/PIC 2012, 2013; TRACS 2012, 2013; GreatSchools 2012-13, 2013-14; Maponics 2016.

It may be noteworthy that the share of schools assigned to PH households in the upper quartile of the school performance index (16.4 percent) is greater than the corresponding share for TBV households (13.3 percent).

School performance tends to be greater when adjusting for the proportion of students that are economically disadvantaged. For PBS8 households, 13.7 percent of schools are in the upper quartile of the school performance index, compared to 19.8 percent for the adjusted school performance index.

For each program category and both school performance indices, the school performance is lower when focusing on households with elementary age children. For all PBV households, 13.9 percent of schools are in the upper quartile of the school performance index; for PBV households with children ages 6-12, the corresponding percentage is 12.5 percent.

Statistical Analysis

Readers should view national statistics with caution because proficiency standards vary by state. In Appendix A, state means are reported in linked micromaps.

To estimate school performance by program controlling for state differences, I employ regression analysis with state fixed effects. I estimate mean effects with least squares regression and performance quartiles with generalized logistic regression.

Linear Regressions

Exhibit 4 reports estimates for four least squares regressions. All regressions contain binary indicators for PH, PBS8, and PBV, with TBV households relegated to the intercept. The models also contain dummies for school year 2012–2013 and states (state coefficients not reported).

Exhibit 4

Linear Regression Estimates

Dependent variable=school performance index

Sample: all households

Variable	Coefficient	Std Error	t-value	P-value
Intercept	45.036	0.258	174.489	<.0001
PH	-3.024	0.024	-125.166	<.0001
PBS8	0.902	0.022	41.395	<.0001
PBV	-2.552	0.071	-35.822	<.0001
School year 2012-13	4.028	0.085	47.171	<.0001
N=9,632,219 R-squared=.078				

Dependent variable=school performance index

Sample: households w/children ages 6-12

Variable	Coefficient	Std Error	t-value	P-value
Intercept	43.102	0.581	74.203	<.0001
PH	-4.109	0.048	-86.140	<.0001
PBS8	-1.508	0.050	-30.219	<.0001
PBV	-2.294	0.164	-13.960	<.0001
School year 2012-13	5.461	0.178	30.621	<.0001
N=2,155,276 R-squared=.086				

Dependent variable=adjusted school performance index

Sample: all households

Variable	Coefficient	Std Error	t-value	P-value
Intercept	43.945	0.255	172.599	<.0001
PH	-2.557	0.029	-87.003	<.0001
PBS8	0.313	0.027	11.794	<.0001
PBV	-4.202	0.087	-48.373	<.0001
School year 2012-13	1.501	0.106	14.205	<.0001
N=7,674,015 R-squared=.077				

Exhibit 4

Linear Regression Estimates

Dependent variable=adjusted school performance index

Sample: households w/children ages 6-12

Variable	Coefficient	Std Error	t-value	P-value
Intercept	41.918	0.576	72.785	<.0001
PH	-3.062	0.060	-51.216	<.0001
PBS8	-1.126	0.064	-17.725	<.0001
PBV	-4.317	0.195	-22.129	<.0001
School year 2012-13	2.069	0.223	9.262	<.0001
N=1,657,608 R-squared=.082				

PH = Public Housing. PBS8 = Project Based Section 8. PBV = Project Based Voucher. Std Error=standard error. TBV = Tenant Based Voucher.
Note: The regressions also include state fixed effects.
Sources: IMS/PIC 2012, 2013; TRACS 2012, 2013; GreatSchools 2012–13, 2013–14; Maponics 2016.

The first estimates reported in exhibit 4 model the school performance index for all households. The difference between each pair of program coefficients is statistically significant at the .0001 level, which is perhaps not surprising given the large sample size. Mean predictions by program evaluated at the means of the school year and state dummies are reported in exhibit 5. The most noteworthy result is that the mean prediction for PBS8 households is greater than the mean prediction for TBV households, which is contrary to national means reported in the previous section in exhibit 2.

Exhibit 5

Mean Regression Predictions by Program

Predicted variable: school performance index

Sample	Program	Mean Prediction
All households	PH	34.134
	PBS8	38.060
	PBV	34.606
	TBV	37.158
	All	36.702
Households with children ages 6-12	PH	30.783
	PBS8	33.384
	PBV	32.598
	TBV	34.892
	All	33.704

Predicted variable: adjusted school performance index

Sample	Program	Mean Prediction
All households	PH	41.993
	PBS8	44.863
	PBV	40.348
	TBV	44.550
	All	43.994
Households with children ages 6-12	PH	38.766
	PBS8	40.702
	PBV	37.511
	TBV	41.828
	All	40.908

PH = Public Housing. PBS8 = Project Based Section 8. PBV = Project Based Voucher. TBV = Tenant Based Voucher.
Sources: IMS/PIC 2012, 2013; TRACS 2012, 2013; GreatSchools 2012–2013, 2013–2014; Maponics 2016.

As shown in exhibit 5—

- The mean predicted school performance index for PH is 34.1.
- The mean predicted school performance index for PBS8 is 38.1.
- The mean predicted school performance index for PBV is 34.6.
- The mean predicted school performance index for TBV is 37.2.

The second regression estimates reported in exhibit 4 model the school performance index for households with children ages 6-12. The difference between each pair of program coefficients is statistically significant at the .0001 level. Mean predictions by program, reported in exhibit 5, are as follows:

- The mean predicted school performance index for PH households with children ages 6-12 is 30.8.
- The mean predicted school performance index for PBS8 households with children ages 6-12 is 33.4.
- The mean predicted school performance index for PBV households with children ages 6-12 is 32.6.
- The mean predicted school performance index for TBV households with children ages 6-12 is 34.9.

For each program, the mean prediction for households with elementary age children is lower than the corresponding prediction for all households in the program. The mean prediction for TBV households with children ages 6-12 is greater than the predictions for households with children ages 6-12 receiving project-based assistance. This is contrary to findings from Ellen and Horn (2012) that school performance was greater on average for schools nearest PBS8 households with children compared to those nearest HCV households with children.

The third set of regressions estimates in exhibit 4 model the adjusted school performance index for all households. The difference between each pair of program coefficients is statistically significant at the .0001 level. Mean predictions by program are reported in exhibit 5. For each program, the mean prediction for the adjusted school performance index is greater than the corresponding prediction for the unadjusted school performance index:

- The mean predicted adjusted school performance index for PH is 42.0.
- The mean predicted adjusted school performance index for PBS8 is 44.9.
- The mean predicted adjusted school performance index for PBV is 40.3.
- The mean predicted adjusted school performance index for TBV is 44.6.

The final set of regressions estimates in exhibit 4 model the adjusted school performance index for households with children ages 6-12. The difference between each pair of program coefficients is statistically significant at the .0001 level. Mean predictions by program are reported in exhibit 5. For each HUD program, the mean predicted adjusted school performance index for households with elementary age children is lower than the corresponding prediction for all households in the program.

As shown in exhibit 5—

- The mean predicted adjusted school performance index for PH households with children ages 6-12 is 38.8.
- The mean predicted adjusted school performance index for PBS8 households with children ages 6-12 is 40.7.
- The mean predicted adjusted school performance index for PBV households with children ages 6-12 is 37.5.
- The mean predicted adjusted school performance index for TBV households with children ages 6-12 is 41.8.

To test sensitivity of my linear regression estimates to inclusion of households assigned to multiple schools, I report linear regression estimates and mean predictions excluding these households in Appendix B. Estimates indicate that for all programs, predicted school performance is slightly lower, excluding households assigned to multiple schools. The relationship between program estimates changed little, however. Predicted mean performance of schools assigned to TBV and PBS8 households is greater than the corresponding predictions for PH and PBV households in all regressions.

Logistic Regressions

To analyze differences in quartiles of school performance by program, I estimate four generalized logistic regressions. The models contain binary indicators for PH, PBS8, and PBV, with TBV households relegated to the three intercepts (there are three coefficients for each independent variable, corresponding to the second, third, and fourth quartiles of performance, with the first quartile as the reference category). The models also contain dummies for school year 2012–2013 and states. Estimated odds ratios, p-values, and 95 percent confidence levels for each pair of programs are reported in exhibit 6.

Exhibit 6

Estimated Odds Ratios

Predicted variable=quartile of school performance index

Sample: all households

Programs	Quartile	Odds Ratio Estimate	P-value	Lower 95% Confidence Limit	Upper 95% Confidence Limit
PH vs PBS8	2nd	0.797***	<.0001	0.791	0.803
PH vs PBS8	3rd	0.678***	<.0001	0.673	0.685
PH vs PBS8	4th	0.760***	<.0001	0.753	0.767
PH vs PBV	2nd	0.992	0.444	0.972	1.013
PH vs PBV	3rd	0.840***	<.0001	0.820	0.861
PH vs PBV	4th	0.953***	0.0002	0.928	0.977
PH vs TBV	2nd	0.807***	<.0001	0.801	0.812
PH vs TBV	3rd	0.676***	<.0001	0.671	0.682
PH vs TBV	4th	0.885***	<.0001	0.877	0.892
PBS8 vs PBV	2nd	1.245***	<.0001	1.220	1.271
PBS8 vs PBV	3rd	1.238***	<.0001	1.209	1.268
PBS8 vs PBV	4th	1.253***	<.0001	1.222	1.286
PBS8 vs TBV	2nd	1.012***	<.0001	1.006	1.018
PBS8 vs TBV	3rd	0.997	0.380	0.990	1.004
PBS8 vs TBV	4th	1.164***	<.0001	1.155	1.173
PBV vs TBV	2nd	0.813***	<.0001	0.797	0.830
PBV vs TBV	3rd	0.805***	<.0001	0.786	0.824
PBV vs TBV	4th	0.929***	<.0001	0.905	0.952

N=9,632,219, -2 log likelihood=9,071,182.6

Predicted variable=quartile of school performance index

Sample: households w/children ages 6-12

Programs	Quartile	Odds Ratio Estimate	P-value	Lower 95% Confidence Limit	Upper 95% Confidence Limit
PH vs PBS8	2nd	0.800***	<.0001	0.786	0.813
PH vs PBS8	3rd	0.732***	<.0001	0.717	0.748
PH vs PBS8	4th	0.886***	<.0001	0.866	0.907
PH vs PBV	2nd	1.047*	0.077	0.995	1.101
PH vs PBV	3rd	0.700***	<.0001	0.662	0.739
PH vs PBV	4th	0.896***	0.001	0.841	0.954
PH vs TBV	2nd	0.745***	<.0001	0.735	0.756
PH vs TBV	3rd	0.624***	<.0001	0.613	0.635
PH vs TBV	4th	0.816***	<.0001	0.801	0.830
PBS8 vs PBV	2nd	1.309***	<.0001	1.244	1.376
PBS8 vs PBV	3rd	0.956	0.107	0.905	1.010
PBS8 vs PBV	4th	1.011	0.741	0.949	1.077
PBS8 vs TBV	2nd	0.932***	<.0001	0.919	0.945
PBS8 vs TBV	3rd	0.852***	<.0001	0.838	0.866
PBS8 vs TBV	4th	0.920***	<.0001	0.902	0.939
PBV vs TBV	2nd	0.712***	<.0001	0.678	0.748
PBV vs TBV	3rd	0.891***	<.0001	0.845	0.940
PBV vs TBV	4th	0.910***	0.003	0.856	0.968

N=2,155,276, -2 log likelihood=2,051,739.5

Exhibit 6

Estimated Odds Ratios

Predicted variable=quartile of adjusted school performance index

Sample: all households

Programs	Quartile	Odds Ratio Estimate	P-value	Lower 95% Confidence Limit	Upper 95% Confidence Limit
PH vs PBS8	2nd	0.826***	<.0001	0.818	0.834
PH vs PBS8	3rd	0.696***	<.0001	0.689	0.704
PH vs PBS8	4th	0.827***	<.0001	0.818	0.835
PH vs PBV	2nd	1.085***	<.0001	1.056	1.116
PH vs PBV	3rd	0.862***	<.0001	0.838	0.887
PH vs PBV	4th	1.256***	<.0001	1.219	1.294
PH vs TBV	2nd	0.827***	<.0001	0.819	0.834
PH vs TBV	3rd	0.688***	<.0001	0.681	0.695
PH vs TBV	4th	0.886***	<.0001	0.878	0.895
PBS8 vs PBV	2nd	1.314***	<.0001	1.278	1.350
PBS8 vs PBV	3rd	1.238***	<.0001	1.204	1.273
PBS8 vs PBV	4th	1.519***	<.0001	1.475	1.565
PBS8 vs TBV	2nd	1.001	0.860	0.993	1.009
PBS8 vs TBV	3rd	0.988***	0.007	0.980	0.997
PBS8 vs TBV	4th	1.072***	<.0001	1.063	1.082
PBV vs TBV	2nd	0.762***	<.0001	0.741	0.783
PBV vs TBV	3rd	0.798***	<.0001	0.776	0.820
PBV vs TBV	4th	0.706***	<.0001	0.685	0.727

N=7,674,015, -2 log likelihood=6,081,156.6

Predicted variable=quartile of adjusted school performance index

Sample: households w/children ages 6-12

Programs	Quartile	Odds Ratio Estimate	P-value	Lower 95% Confidence Limit	Upper 95% Confidence Limit
PH vs PBS8	2nd	0.833***	<.0001	0.814	0.852
PH vs PBS8	3rd	0.754***	<.0001	0.735	0.774
PH vs PBS8	4th	0.869***	<.0001	0.847	0.892
PH vs PBV	2nd	1.185***	<.0001	1.113	1.261
PH vs PBV	3rd	0.937*	0.055	0.877	1.001
PH vs PBV	4th	1.168***	<.0001	1.091	1.251
PH vs TBV	2nd	0.802***	<.0001	0.788	0.817
PH vs TBV	3rd	0.669***	<.0001	0.655	0.683
PH vs TBV	4th	0.854***	<.0001	0.837	0.871
PBS8 vs PBV	2nd	1.422***	<.0001	1.336	1.515
PBS8 vs PBV	3rd	1.242***	<.0001	1.163	1.327
PBS8 vs PBV	4th	1.344***	<.0001	1.254	1.440
PBS8 vs TBV	2nd	0.963***	0.0001	0.945	0.982
PBS8 vs TBV	3rd	0.887***	<.0001	0.868	0.906
PBS8 vs TBV	4th	0.983	0.121	0.961	1.005
PBV vs TBV	2nd	0.677***	<.0001	0.637	0.720
PBV vs TBV	3rd	0.714***	<.0001	0.670	0.761
PBV vs TBV	4th	0.731***	<.0001	0.684	0.782

N=1,657,608, -2 log likelihood=1,343,212.7

N=1,657,608, -2 log likelihood=1,343,212.7

** statistically significant at the .10 level; ** significant at the .05 level; ***significant at the .01 level*

PH = Public Housing. PBS8 = Project Based Section 8. PBV = Project Based Voucher. TBV = Tenant Based Voucher.

Sources: IMS/PIC 2012, 2013; TRACS 2012, 2013; GreatSchools 2012–2013, 2013–2014; Maponics 2016.

The first set of odds ratios reported in exhibit 6 is from a logistic regression estimating quartiles of the school performance index for all households. As seen in exhibit 6—

- The estimated odds of a TBV household being assigned to a school in the second, third, and fourth quartiles of school performance are significantly greater than the corresponding odds for PH and PBV households (all p-values <.0001).
- Results indicate that the odds of a PBS8 household being assigned to a school in the three upper quartiles of school performance are significantly greater than the corresponding odds for PH and PBV households (all p-values <.0001).
- The estimated odds of a PBS8 households being assigned to a school in the fourth quartile of school performance is significantly greater than the corresponding odds for a TBV household; the odds of being assigned to a school in the second or third quartile are very similar for both programs.

The second set of odds ratio estimates reported in exhibit 6 are from modeling quartiles of the school performance index for households with children ages 6-12. The data show—

- The estimated odds of a TBV household with elementary school age children being assigned a school in the upper three quartiles of school performance are significantly greater than the corresponding odds for households with elementary school age children in all other programs (all p-values <.0001).
- For PBS8 household with elementary school age children, the estimated odds of being assigned a school in the upper three quartiles of school performance are significantly greater than the corresponding odds for PH households (all p-values <.0001).

The next set of odds ratios reported in exhibit 6 is from modeling quartiles of the adjusted school performance index for all households, which indicates that—

- The estimated odds of a TBV household being assigned to a school in the second, third, and fourth quartiles of adjusted school performance are significantly greater than the corresponding odds for PH and PBV households (all p-values <.0001).
- Estimated odds of a PBS8 household being assigned to a school in the three upper quartiles of adjusted school performance are significantly greater than the corresponding odds for PH and PBV households (all p-values <.0001).
- The estimated odds of a PBS8 household being assigned to a school in the fourth quartile of adjusted school performance is significantly greater than the corresponding odds for a TBV household; the estimated odds of being assigned to a school in the second or third quartile are very similar for the two programs.

The final set of odds ratios reported in exhibit 6 is from modeling quartiles of the adjusted school performance index for households with children ages 6-12, which shows—

- The estimated odds of a TBV household with elementary age children being assigned to a school in the three upper quartiles of adjusted school performance are significantly greater than the corresponding odds for PH and PBV households (all p-values <.0001).
- For PBS8 household with elementary age children, the estimated odds of a being assigned to a school in the three upper quartiles of adjusted school performance are significantly greater than the corresponding odds for PH and PBV households (all p-values <.0001).
- The odds of a TBV household with elementary age children being assigned to a school in the second or third quartile of adjusted school performance is significantly greater than the corresponding odds for a PBS8 household; the estimated odds of being assigned to a school in the fourth quartile of adjusted school performance are very similar for both programs.

Summary

To summarize, key findings of the statistical analysis include the following:

- Average school performance of schools assigned to HUD-assisted households is well below national averages for all HUD programs.
- School performance rates are higher controlling for the proportion of students that are economically disadvantaged, although means remain below national averages.
- School performance rates tend to be lower when the analysis is limited to HUD-assisted households with elementary age children.
- TBV households tend to be assigned to higher performing schools than PH and PBV households.
- PBS8 households tend to be assigned to higher performing schools than PH and PBV households.
- When all households are included in the analysis, school performance of schools assigned to PBS8 households tends to be greater compared to those assigned to TBV households.
- When the analysis is limited to households with elementary age children, average performance of schools assigned to TBV households is greater compared to that of schools assigned to PBS8 households.

Discussion of Regression Estimates

The result that school performance for schools assigned to TBV households is greater on average than for schools assigned to PH households is not surprising given that almost 40 percent of PH households reside in census tracts with poverty rates of at least 40 percent, compared to 15.6 percent of TBV households. Ellen and Horn (2012) also report that average school performance is much greater for schools nearest TBV households with children compared to schools nearest PH households with children.

My finding that average school performance is greater for schools assigned to TBV households compared to schools assigned to PBV households contradicts results from Mast and Hardiman

(2017). Mast and Hardiman, however, compared PBV households to a matched sample of TBV households; households were matched on household characteristics with propensity score weighting. My regression models did not control for differences in household characteristics.

Ellen and Horn (2012) report that average school performance is greater for schools near PBS8 households with children, compared to schools near HCV households with children. My regression analysis indicates that average school performance is very similar for schools assigned to both TBV households and PBS8 households with elementary age children. Numerous reasons may explain why the results of our studies differ. First, I analyze assigned schools, while Ellen and Horn (2012) analyze nearest schools. Second, we use data for different school years; Ellen and Horn use data for school year 2008–2009, while I use data for school years 2012–2013 and 2013–2014. Third, Ellen and Horn analyze data for households with any children, while I analyze data for households with elementary age children. Fourth, my regression estimates adjust for differences in state proficiency standards with state fixed effects. Ellen and Horn (2012) did not adjust for state differences (they did report statistics by state and metro area). Fifth, Ellen and Horn analyzed data for all HCV households with children, while I report separate estimates for TBV and PBV households.

My finding that, for all HUD programs, average school performance is greater for schools assigned to all households compared with schools assigned to households with elementary age children could be driven in part by less resistance in higher opportunity neighborhoods to assisted households without children. About 77 percent of households without elementary age children have no children; 39 percent are elderly households without children; and 23.2 percent are households with disabilities[4] and no children. Landlords in higher opportunity neighborhoods may have preferences for TBV households without children, and there could be a lack of affordable rental units with enough bedrooms for larger families in neighborhoods with better schools. Local governments may also be less resistant to assisted housing developments in higher opportunity areas targeted to the elderly and disabled without children.

Limitations and Areas for Further Research

As did prior studies, I measure school performance based on standardized math and reading exam data. Yet schools can improve students' lives in many ways other than academic achievement. Chetty et al. (2016) found that children moving to lower poverty neighborhoods (with better chances of attending higher performing schools) experienced higher earnings and college matriculation, more marriages, and fewer out of wedlock births. School metrics for such longer-term outcomes are not nationally available, however.

I examine school performance of schools assigned to HUD-assisted households. Some assisted households will not attend their assigned schools due to school choice, magnet or charter school attendance, or private school attendance. In 2007 (the most recent year for which data are available), almost three-fourths of students in the United States attended their assigned public school (National Center for Education Statistics, 2015). The fraction of lower income students

[4] I define households with disabilities as households where the household head or spouse/co-head has a disability.

attending their assigned school is likely higher because higher income students are much more likely to attend private school (Kolko, 2014).

I matched school performance data for school years 2012–2012 and 2013–2014 to Maponics attendance zone data for 2016. Some school zones will have changed between the time test score data were collected and the time the attendance zone data were collected. Maponics does not archive its attendance zone data, so I did not have access to attendance zone data for earlier years.

About 18 percent of households in my analysis were assigned to multiple schools, providing them a choice of public schools to attend. In such cases, I gave each household-school match equal weight in statistical computations. Sensitivity analysis indicated that my regression results were not changed substantially by including these households. Future research could analyze such matches with different weighting schemes, such as inverse-distance weighting or only using the closest school.

Ellen and Horn (2012) included LIHTC units in their analysis, using units with two or more bedrooms as a proxy for households with children. I excluded LIHTC from my analysis because it is not possible to identify units with elementary age children. Further research could include LIHTC units in the analysis and explore better identifying units with children.

I analyze performance data for fourth grade students. Evidence from Chetty et al. (2016) suggests that peer and/or neighborhood effects may be most efficacious in students ages 12 and under. As such, school performance of elementary and middle schools may be most policy relevant. However, future research could also examine school performance of high schools assigned to assisted households.

The regression models included state fixed effects to control for differences in proficiency standards across states. Policy makers may also be interested in how school performance varies by program in the same Public Housing Agencies (PHAs), which could be accomplished with models with PHA fixed or random effects.

My regression models did not control for differences is household characteristics such as those controlled for by Horn et al. (2014) and Mast and Hardiman (2017). Future research could estimate how much variation across programs can be explained by household demographics.

My analysis is cross-sectional. Building on research by Ellen et al. (2016), future research could examine if TBV households that move, particularly those with children, choose neighborhoods with higher performing schools. Researchers could also examine assisted households moving out of project-based assistance with TBVs (due to Rental Assistance Demonstration conversions, for instance).

Conclusion

This study examines school performance of schools assigned to households in four of HUD's largest rental assistance programs: TBV, PH, PBV, and PBS8. Past studies examined school performance of schools near, but not assigned to, HUD-assisted households. School performance is measured by fourth grade reading and math results on state standardized tests.

The main hypothesis tested is whether, given their choice of neighborhoods, TBV households are assigned to more proficient schools than households in the PBV, PH, and PBS8 programs. Results from regression analysis indicate that schools assigned to TBV households are significantly more proficient in reading and math compared to schools assigned to PBV and PH households.

Comparisons of schools assigned to TBV and PBS8 households depend on the sample of households analyzed. When all households are included in the statistical analysis, schools assigned to PBS8 are significantly more proficient compared to schools assigned to TBV households. When the sample is constrained to households with elementary age children, differences in performance between schools assigned to households in the two programs are much smaller.

Results also indicate that for households in all programs, school performance is well below national averages. Adjusting for differences in school demographics and differences in proficiency standards across states, school performance of schools assigned to assisted households is greater but still well below national averages.

For households in each HUD program, average school performance is lower when the analysis is limited to households with elementary age children. This raises questions regarding the success of HUD programs in locating households with children in opportunity neighborhoods.

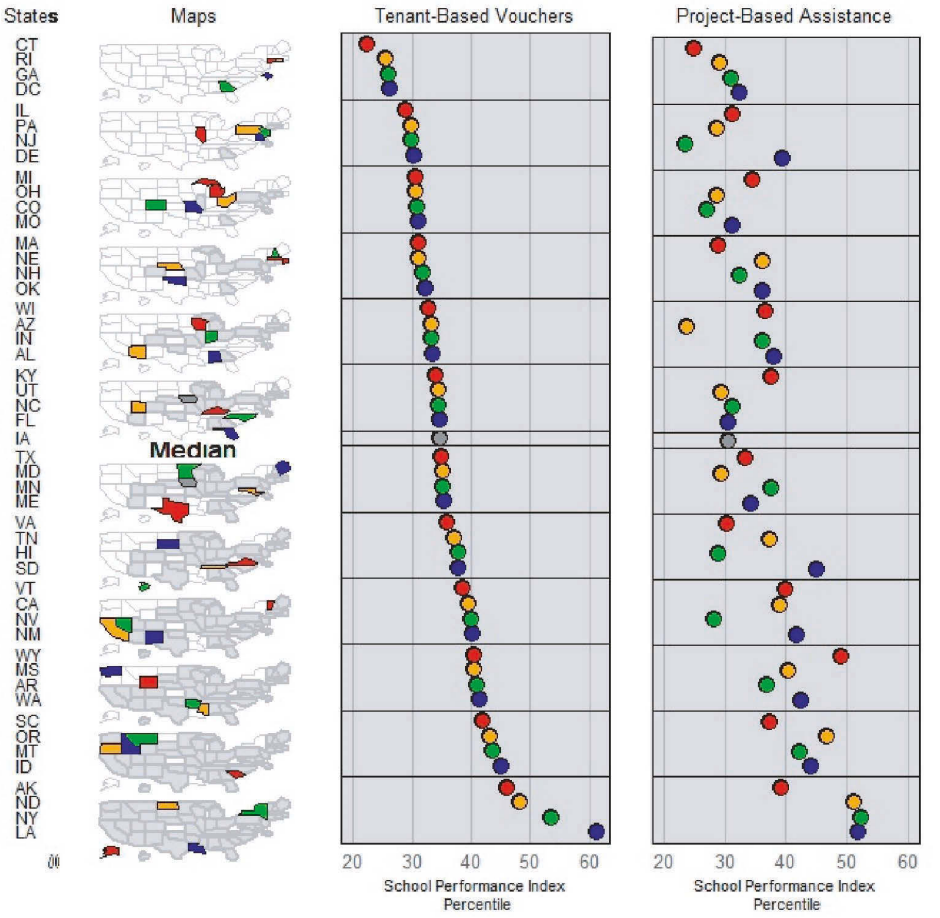
Appendix A

Exhibit A.1 reports a linked micromap with two program categories: TBV households and households receiving project-based assistance (including PH, PBS8, and PBV households). The data are sorting by the mean school performance index for TBV households. Exhibit A.1 shows that—

- Mean school performance is greater for TBV households compared to households receiving project-based assistance in 25 of 49 states.
- For TBV households, mean school performance indices range from 22.4 in Connecticut to 61.3 in Louisiana; the median is 34.7 in Iowa.
- For households receiving project-based assistance, means range from 23.6 in New Jersey to 52.4 in New York, with a median of 36.1 in Indiana.

Exhibit A.1

Linked Micromap of State Mean School Performance Indices



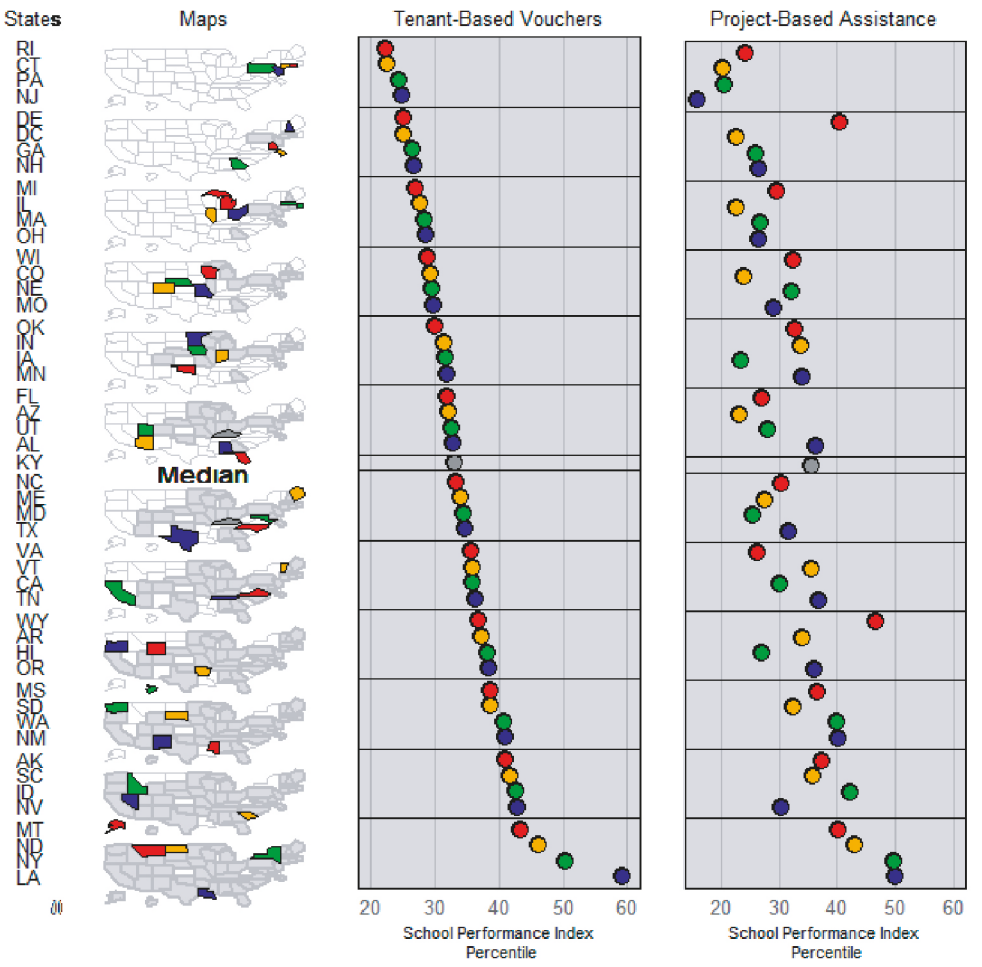
Sources: IMS/PIC 2012, 2013; TRACS 2012, 2013; GreatSchools 2012–2013, 2013–2014; Maponics 2016.

Exhibit A.2 reports a linked micromap with state mean school performance indices for households with children ages 6-12 in two program categories. The data are sorting by the school performance index for TBV households with children ages 6-12. Exhibit A.2 shows that—

- Mean school performance is greater for TBV households with elementary age children compared to households with elementary age children receiving project-based assistance in 37 of 49 states.
- For TBV households with elementary age children, mean school performance indices range from 22.2 in Rhode Island to 59.2 in Louisiana, with a median of 33.0 in Kentucky.
- For households receiving project-based assistance with elementary age children, means range from 15.7 in New Jersey to 49.9 in Louisiana, with a median of 31.6 in Texas.

Exhibit A.2

Linked Micromap of State Mean School Performance Indices, Households with Children Ages 6-12



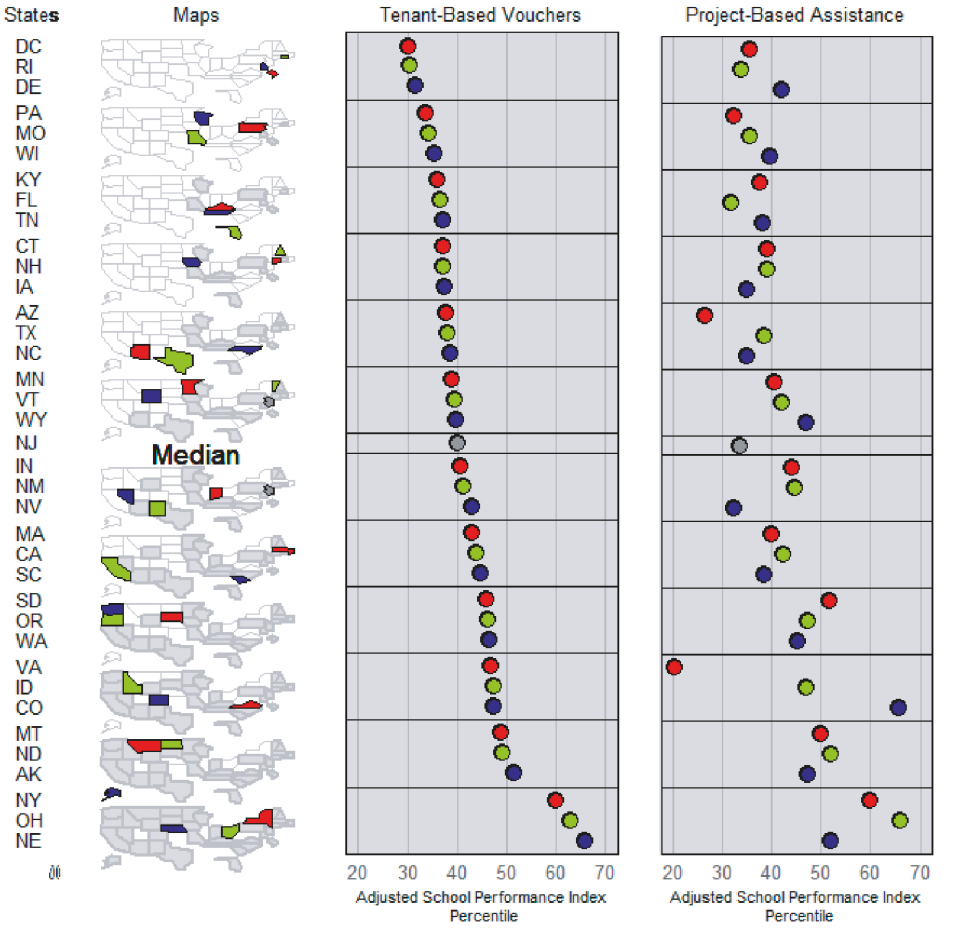
Sources: IMS/PIC 2012, 2013; TRACS 2012, 2013; GreatSchools 2012–2013, 2013–2014; Maponics 2016.

Exhibit A.3 reports a linked micromap with state mean adjusted school performance indices in two program categories. The data are sorting by the adjusted school performance index for TBV households. Exhibit A.3 shows that—

- Mean adjusted school performance is greater for households with receiving project-based assistance in 22 of 37 states compared to TBV households.
- For TBV households, mean adjusted school performance indices range from 30.2 in Washington, D.C. to 65.8 in Nebraska, with a median of 40.0 in New Jersey.
- For households receiving project-based assistance, means range from 20.3 in Virginia to 66.1 in Ohio, with a median of 40.1 in Massachusetts.

Exhibit A.3

Linked Micromap of State Mean Adjusted School Performance Indices



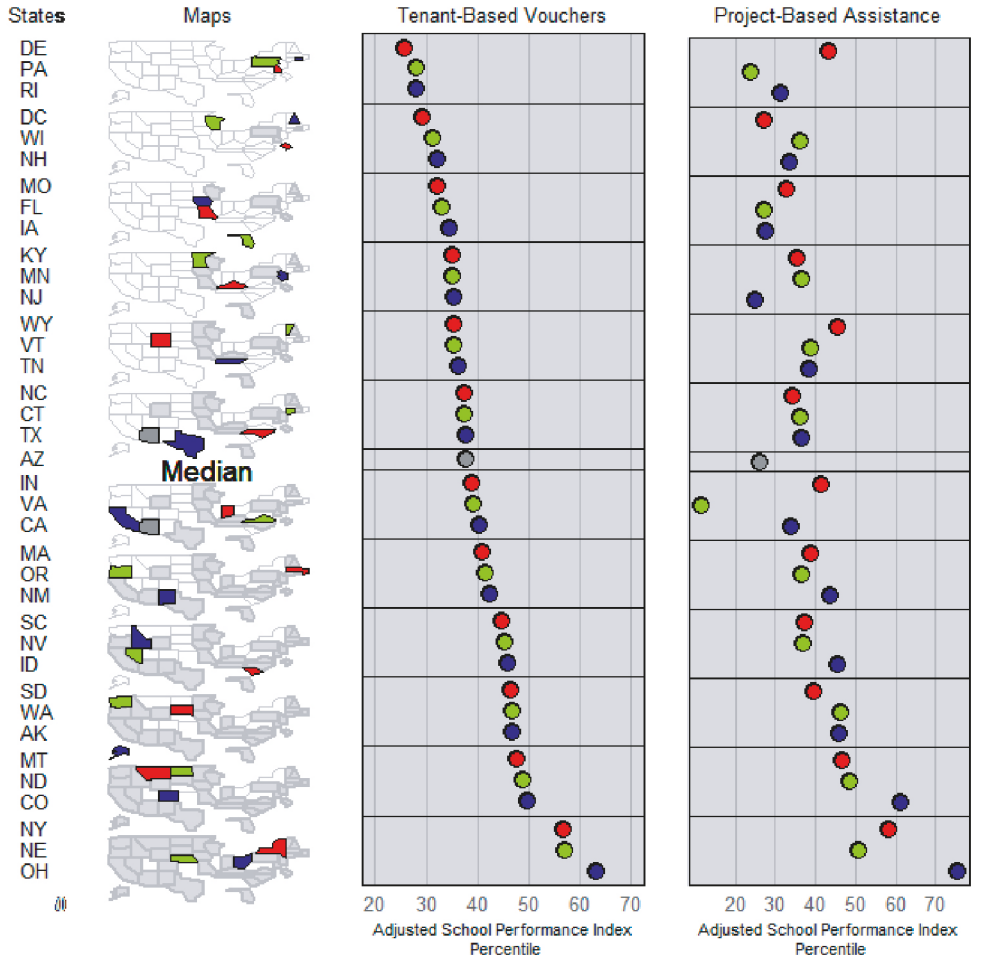
Sources: IMS/PIC 2012, 2013; TRACS 2012, 2013; GreatSchools 2012–2013, 2013–2014; Maponics 2016.

Exhibit A.4 reports a linked micromap with state mean adjusted school performance indices for households with children ages 6-12 in two program categories. The data are sorting by the adjusted school performance index for TBV households with children ages 6-12. Exhibit A.4 shows that—

- Mean adjusted school performance is greater for TBV households with elementary age children in 22 of 37 states compared to households with elementary age children receiving project-based assistance.
- For TBV households with elementary age children, mean adjusted school performance indices range from 25.8 in Delaware to 63.3 in Ohio, with a median of 37.7 in Arizona.
- For households receiving project-based assistance with elementary age children, means range from 11.5 in Virginia to 75.3 in Ohio, with a median of 37.0 in Nevada.

Exhibit A.4

Linked Micromap of State Mean Adjusted School Performance Indices, Households with Children Ages 6-12



Sources: IMS/PIC 2012, 2013; TRACS 2012, 2013; GreatSchools 2012–2013, 2013–2014; Maponics 2016.

Appendix B: Regression Estimates and Mean Predictions Excluding Households Assigned to Multiple Schools

Exhibit B1

Regression Estimates

Dependent variable=school performance index

Sample: all households

Variable	Coefficient	Std Error	t-value	P-value
Intercept	47.177	0.463	101.794	<.0001
PH	-3.035	0.042	-72.996	<.0001
PBS8	1.246	0.036	34.922	<.0001
PBV	-3.221	0.119	-27.147	<.0001
School year 2012-13	4.417	0.143	30.888	<.0001
N=3,027,188 R-squared=.037				

Dependent variable=school performance index

Sample: households w/children ages 6-12

Variable	Coefficient	Std Error	t-value	P-value
Intercept	44.234	0.977	45.259	<.0001
PH	-4.526	0.078	-58.032	<.0001
PBS8	-1.351	0.078	-17.230	<.0001
PBV	-3.674	0.265	-13.846	<.0001
School year 2012-13	5.878	0.291	20.232	<.0001
N=728,176 R-squared=.041				

Dependent variable=adjusted school performance index

Sample: all households

Variable	Coefficient	Std Error	t-value	P-value
Intercept	44.591	0.522	85.493	<.0001
PH	-3.607	0.060	-59.974	<.0001
PBS8	0.626	0.050	12.447	<.0001
PBV	-4.175	0.167	-25.001	<.0001
School year 2012-13	2.154	0.192	11.194	<.0001
N=3,027,188 R-squared=.029				

Dependent variable=adjusted school performance index

Sample: households w/children ages 6-12

Variable	Coefficient	Std Error	t-value	P-value
Intercept	42.062	1.100	38.245	<.0001
PH	-4.531	0.116	-39.168	<.0001
PBS8	-1.071	0.116	-9.212	<.0001
PBV	-4.724	0.357	-13.214	<.0001
School year 2012–13	2.359	0.394	5.986	<.0001
N=728,176 R-squared=.036				

PH = Public Housing. PBS8 = Project Based Section 8. PBV = Project Based Voucher. Std Error=standard error. TBV = Tenant Based Voucher.
Sources: IMS/PIC 2012, 2013; TRACS 2012, 2013; GreatSchools 2012–2013, 2013–2014; Maponics 2016.

Exhibit B2

Mean Regression Predictions

Predicted variable: school Performance index		
Sample	**Program**	**Mean Prediction**
All households	PH	31.566
	PBS8	35.847
	PBV	31.380
	TBV	34.601
	All	34.333
Households with children ages 6-12	PH	27.884
	PBS8	31.058
	PBV	28.735
	TBV	32.410
	All	31.233
Predicted variable: adjusted school Performance index		
Sample	**Program**	**Mean Prediction**
All households	PH	38.954
	PBS8	43.187
	PBV	38.386
	TBV	42.561
	All	41.968
Households with children ages 6-12	PH	35.461
	PBS8	38.922
	PBV	35.269
	TBV	39.993
	All	38.855

PH = Public Housing. PBS8 = Project Based Section 8. PBV = Project Based Voucher. TBV = Tenant Based Voucher.
Sources: IMS/PIC 2012, 2013; TRACS 2012, 2013; GreatSchools 2012–2013, 2013–2014; Maponics 2016.

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