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Housing Voucher Receipt and the Quality of Schools Available to Recipient Children

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Abstract

Using data on housing voucher recipients with school-aged children residing across the state of Wisconsin, we perform a three-stage analysis of the relationship between voucher receipt and the educational opportunities of children in recipient households. First, we examine the extent to which voucher receipt results in households relocating to a different school district. Second, we estimate the effect of voucher receipt on the quality of the school district—as measured by average standardized test scores in the district—in which recipient households reside. Finally, for the subset of recipient households residing in the Madison Metropolitan School District, we estimate the effect of voucher receipt on the quality of the specific school attendance zone—again measured by average standardized test scores—in which recipient households live. Our results indicate that voucher receipt initially induces cross-boundary relocation for households with children, but provides greater stability in subsequent years; there is some evidence that these moves result in voucher recipients residing in areas with access to higher quality public schools, particularly in urban areas. We discuss the implications of these findings for research and policy.

Keywords: Section 8; Housing Choice Voucher Program; school district quality

Housing Voucher Receipt and the Quality of Schools Available to Recipient Children

I. INTRODUCTION

Since its inception in the mid-1970s, the Section 8 housing voucher program has grown from a small pilot project to become one of the primary programs for providing housing assistance to low-income households in the United States—2.2 million households received vouchers through the Section 8 program in 2012 (HUD, 2013). This growth in the Section 8 program has been accompanied by recognition of the wide range of outcomes that participation in the program may influence. Originally intended to improve the housing stability and quality of voucher recipients, recent research on the Section 8 program has focused not only on its success in achieving that goal, but also on its effects on a variety of other individual-level outcomes, including earnings and employment (Carlson et al., 2012a; Mills et al., 2006; Jacob and Ludwig, 2012); neighborhood quality (Carlson et al., 2012b; Mills et al. 2006); household composition (Carlson, 2012b; Mills et al., 2006); and receipt of public assistance (Carlson et al., 2013; Mills et al., 2006; Jacob and Ludwig, 2012).

This paper further expands the scope of outcomes recognized as potentially affected by Section 8 participation through its explicit focus on the children of recipient households. Specifically, in this paper we use data on a sample of housing voucher recipients with school-aged children residing across the state of Wisconsin to analyze the effects of voucher receipt on the educational opportunities of children in recipient households. We perform this analysis in three stages. First, we examine the extent to which voucher receipt results in households relocating to a different school district. Second, we estimate the effect of voucher receipt on the quality of the school district—as measured by average standardized test scores in the district—in which recipient households reside. Finally, for the subset of recipient households residing in the Madison Metropolitan School District, we estimate the effect of voucher receipt on the quality of the specific school attendance zone—again measured by average standardized test scores—in which recipient households live. Taken together, these analyses will provide insight into the extent to which housing vouchers shape the educational opportunities of the children of voucher recipients.

We perform these analyses using a data set containing detailed information on a sample of Wisconsin households with school-aged children that first received a housing voucher in 2003. Our data set contains a wide range of information on these households starting in 2000—three years prior to voucher receipt—and extending through 2006. The households in our sample reside in all parts of the state and exhibit substantial demographic diversity. These features distinguish our sample from those used in most prior studies of voucher receipt, which have typically been conducted in the context of large urban areas. We specify the counterfactual in our analyses as no voucher receipt. As we note below, the vast majority of households received no housing assistance prior to voucher receipt; only a small number resided in public housing—the counterfactual used in much previous work on Section 8 vouchers—before transitioning to voucher receipt.

We proceed by first providing a description of the Section 8 program, discussing conceptual issues relevant to our analysis, and reviewing prior research on the topic. We then move on to present our research approach; we describe the data we use to address our questions and the techniques we employ to analyze the data. We close by presenting the results of our analysis and discussing their implications for research and policy.

II. HOUSING VOUCHER RECEIPT AND SCHOOL QUALITY

A. The Process of Voucher Assignment

Operated by the Department of Housing and Urban Development (HUD) and administered by over 3,000 local public housing authorities (PHAs), the Section 8 voucher program (officially known as the Housing Choice Voucher Program) is the primary tenant-based approach for providing housing assistance to low-income households in the United States.[1] The most recent HUD data indicate that 2.2

[1]The Section 8 program has officially been titled the Housing Choice Voucher Program since 1999, but most researchers and administrators still refer to it as the "Section 8 voucher" program. The "Section 8" designation refers to the program's statutory authorization under Section 8 of the United States Housing Act of 1937, as

million households—including more than one million households with minor children—are served by the program annually. The stated objectives of the program are to enable "very low-income families, the elderly, and the disabled to afford decent, safe, and sanitary housing in the private market," and to facilitate the relocation of recipients into better neighborhoods.[2]

The process of securing a Section 8 voucher begins with the submission of an application to a PHA and the subsequent placement on a waiting list.[3] Each PHA has the autonomy to establish waiting list preferences for applicants with particular characteristics.[4] When the applicant's name rises to the top of the waiting list, a voucher is awarded; recipients are then responsible for locating housing in the private market that meets a minimum standard of health and safety and is owned by a landlord willing to rent under the terms of the program. If a voucher recipient—whose income must, in general, be below 50 percent of the median income of the county or metropolitan area of residence—is able to locate suitable housing, the recipient unit generally contributes 30 percent of its income toward rent.[5] The Section 8 program then subsidizes the difference between the tenant contribution and actual rent, up to a locally defined "fair market rent" payment standard.[6] A main motivation undergirding the Section 8 program is

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amended by the Housing and Community Development Act of 1974; we use the "Section 8" designation in this paper.

[2]See http://www.hud.gov/offices/pih/programs/hcv/about/fact_sheet.cfm#10. As the program has expanded over time, a number of constraints have partially interfered with the goal of geographic mobility for voucher recipients. One constraint has been the limited geographic span of many local PHAs that serve only parts of metropolitan areas. While some PHAs allow recipients to find housing in other jurisdictions, administrative burdens and the need to transfer supporting funds constrain this practice. Such transfers also impose additional costs on recipients in the form of duplicate application, orientation, and program criteria (Katz and Turner, 2000).

[3]Applicants who received a voucher in Wisconsin in 2009 spent an average of 14 months on the waiting list.

[4]For a comprehensive description of waiting list policies—including common examples of preferences instituted by PHAs—see http://www.hud.gov/offices/adm/hudclips/guidebooks/7420.10G/7420g04GUID.pdf.

[5]See http://www.hud.gov/offices/pih/programs/hcv/about/fact_sheet.cfm. Each PHA must provide 75 percent of its vouchers to applicants whose incomes do not exceed 30 percent of the area median income.

[6]This standard is set by the Department of Housing and Urban Development (HUD) at the 40th percentile of the local rental market, as calculated by the monetary value of leases commenced in the previous year. The payment standard is typically between 90 percent and 110 percent of area "fair market rent."

to "deconcentrate" the poor by making it possible for voucher recipients to move to better neighborhoods (U.S. Department of Housing and Urban Development, 2000).

B. Conceptual Considerations

With few exceptions, children have traditionally been required to enroll in the school district that encompasses their residence. Within each district, students typically attend the school in whose attendance zone—a defined geographic area—they reside. Although the expansion of school choice policies in recent years has served to delink residential location from school of attendance for some children, residence-based assignment remains the predominant method for determining the school that a child will attend, particularly in non-urban areas. Even in urban areas with well-developed school choice policies—such as Milwaukee—students are not guaranteed to attend their preferred school. Indeed, students who reside within a school's attendance zone are often given priority for enrollment, and research indicates that a significant number of students in high-choice environments attend the school in whose attendance zone they reside (Witte et al., 2008).

Given these realities of the school assignment process, the best way for a family to ensure that their child will attend a particular district—or a specific school within a district—is to reside within the geographic boundaries of the desired school or district. The design of the Section 8 program has the potential to influence residential location decisions, and thus the quality of the schools available to the children of voucher recipients. For most Section 8 recipients, decisions regarding residential location will be influenced by the incentives implicit in the program. Because the vast majority of Section 8 recipients received no housing subsidy before participating in the Section 8 program, voucher receipt alters the budget constraint for housing.[7] As described earlier, the design of the program requires voucher recipients

[7] Like Section 8 voucher holders, recipients of public housing assistance are required to contribute 30 percent of their income toward rent and all remaining housing costs are subsidized by the government. As a result, voucher receipt does not change the budget constraint for housing for these recipients, a fact that has consequences

to contribute 30 percent of their income toward rent and the voucher then subsidizes the difference between the tenant contribution and the market rent, up to a locally defined fair market rent. This program design results in voucher recipients facing a zero marginal price of housing up to the fair market rent.[8]

Shroder (2002) defines housing in terms of two primary dimensions—unit characteristics and site factors. Unit characteristics are features of the physical dwelling, such as the number of square feet, the number of bedrooms and bathrooms, the quality of construction and craftsmanship, and other similar features. Site factors, on the other hand, are characteristics of the area surrounding the physical dwelling and include such attributes as population density, transportation infrastructure, noise and pollution exposure, neighbors' behavior, and—most relevant to the analyses in this paper—school quality. If school quality is a highly valued site factor by Section 8 recipients searching for housing, then standard economic theory predicts that voucher receipt would result in improved quality of schooling options. However, if recipient households place the great majority of weight on unit characteristics or non-school quality site factors in selecting housing, then voucher receipt may not produce improvements—and could even result in declines—in the quality of available schooling options. Given the ambiguous theoretical predictions, only empirical evidence can shed light on this question.

C. Previous Empirical Research

The first major attempt to assess the educational effects of voucher receipt occurred through the Gautreaux study in Chicago. This study was made possible by a 1976 federal court order that resulted in the provision of housing vouchers to some 7,000 families residing in public housing projects. Households were to be randomly assigned to either a neighborhood in the city or one in the suburbs that were no more

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for the interpretation of studies where the counterfactual is specified as receipt of public housing assistance, as opposed to no housing assistance.

[8]Technically, recipients face a zero marginal price of housing for units between the minimum acceptable standards of health and safety and fair market rent. Beyond the level of fair market rent, voucher recipients are able to purchase additional housing (up to 40 percent of their income) by paying the incremental market rent, without loss of the voucher.

than 30 percent African American. Because the Gautreaux program lacked a control group that received no housing voucher, the study estimates the effect of relocation rather more than it does voucher receipt. With this in mind, the study found that children who moved to the suburbs had better educational opportunities; these students were judged to have received superior educations in schools generally considered to be above national averages. In addition, the mothers of the children who had moved to the suburbs were generally pleased with their education (Kaufman and Rosenbaum, 1992; Rubinowitz and Rosenbaum, 2000).

Gautreaux's lack of a control group receiving no voucher, coupled with questions about whether the housing counselors who helped program participants use their vouchers followed all random assignment protocols (Durlauf, 2002), led the U.S. Department of Housing and Urban Development to fund two additional experimental analyses designed to provide insight into the effects of voucher receipt. The Welfare to Work (WtW) experiment randomly assigned welfare recipients in five large and midsize cities to either receive a voucher or not. Although the WtW evaluation examined many outcomes, the educational experiences and outcomes of recipient children are not among them (see Mills et al., 2006). The Moving to Opportunity (MTO) experiment, on the other hand, devoted substantial attention to assessing the educational experiences and outcomes of recipient children. This study randomly assigned public housing residents in five large cities to one of three groups: 1) a control group that remained in public housing, 2) a Section 8 group that could use their voucher anywhere, and 3) an experimental group that could use its voucher only in low-poverty neighborhoods. Participating households were tracked for 10 to 15 years after random assignment and the results indicate that, relative to the control group, youth in the Section 8 and experimental groups attended schools with lower proportions of low-income and minority students and slightly higher average test scores (Sanbonmatsu et al., 2011). Despite these differences in school context, there were no significant differences in the average achievement test scores across the three groups.

A third source of experimental evidence on the relationship between voucher receipt and children's educational experiences and outcomes comes from Jacob's (2003) study, which used the Chicago Housing Authority's scheduled demolition of over 6,400 units of public housing during the 1990s as a source of plausibly exogenous variation in voucher receipt. Residents whose units were demolished were offered Section 8 vouchers that could be used in the metropolitan area. The results of the analysis indicate that the achievement scores of students in families whose units were demolished—and thus offered vouchers—was not significantly different from the achievement of students who remained in their public housing units.

In addition to these three experimental studies, nonexperimental research has also provided insights into the relationship between voucher receipt and students' educational experiences and outcomes. Studies have reported that voucher recipients—and low-income households more generally—may lack the self-confidence, resources, or relationships to make fully informed judgments about school quality (Lareau, 2003; Teske and Schneider, 2001; DeLuca and Rosenblatt, 2010). For example, DeLuca and Rosenblatt (2010) judge that about 38 percent of the experimental mothers and 49 percent of the control mothers lacked information that was critical for making quality school choice decisions. Relying on friends who had little knowledge of Baltimore area schools, parents frequently enrolled their children in schools that were safer but not more academically rigorous than their previous school. Moreover, DeLuca and Rosenblatt (2010) report that many parents did not believe that the quality of a school would affect their children's education, believing instead that their child's intrinsic motivation was the key to learning. Finally, school quality was often at best a secondary concern in residential location considerations. For many parents, proximity to public transportation, family members, and jobs were far more important.

Taken together, previous analyses of the relationship between voucher receipt and children's educational experiences and outcomes suggests that voucher receipt can lead to improvements in the quality of the schools that recipient children attend, but there is little evidence that these contextual

differences lead to changes in student performance. However, it is important to note that the major studies—Gautreaux, MTO, and Jacob's (2003) study—were all conducted under a counterfactual of receipt of some form of housing assistance and in the context of large urban areas. Because housing voucher receipt in these studies is limited to families already receiving public housing assistance, voucher receipt does not alter their budget constraint for housing. In contrast, this study is conducted under the counterfactual of no voucher receipt, which for over 90 percent of recipients means no housing assistance.[9] This, and the fact that households in our sample reside across all parts of Wisconsin—as opposed to a single large urban area—suggests that our results may differ from those of the studies reviewed above.

III. DATA AND ESTIMATION SAMPLE

In this paper we draw on several data sources to construct a unique data set containing a wide range of information on a sample of housing voucher recipients from across the state of Wisconsin. We use this data set as the basis of a three-stage analysis of the effects of voucher receipt on the educational opportunities of children in recipient households. In the first stage of the analysis we examine the extent to which voucher receipt results in households relocating to a different school district. Second, we estimate the effect of voucher receipt on the quality of the school district—as measured by average standardized test scores in the district—in which recipient households reside. Finally, for the subset of recipient households residing in the Madison Metropolitan School District, we estimate the effect of voucher receipt on the quality of the specific school attendance zone—again measured by average standardized test scores—in which recipient households live. Together, these analyses will improve our understanding of the extent to which voucher receipt leads to changes in the educational opportunities of children.

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[9]Less than 10 percent of new voucher recipients in our sample transitioned from public housing assistance.

The first step in creating the data set that underlies all analyses to follow involved extracting records from the Client Assistance for Re-employment and Economic Support (CARES) database. The CARES database is maintained by the State of Wisconsin and contains a wide variety of detailed information—including household composition, demographics, address history, and public program participation—on all cases that apply for or receive any form of public assistance from the state.[10] From this database we identified all cases that first received a housing voucher in 2003 and then extracted information on these cases.[11] Specifically, we extracted annual information on household composition, demographic characteristics, address history, and public program participation beginning as early as 2000 and extending through 2006, or up to three years after initial voucher receipt.

After extracting this information from CARES, we commissioned the Applied Population Laboratory (APL) at the University of Wisconsin–Madison to geocode each address in each case's address history to the school district in which it was located. Furthermore, for addresses located within the geographic boundaries of the Madison Metropolitan School District (MMSD), the APL geocoded each address to the specific school attendance zone in which it is located.[12] We then added the school district of

[10]The definition of a "case" depends on the type of assistance sought or being received. A TANF case generally consists of a parental casehead and the casehead's minor children. Supplemental Nutrition Assistance Program (SNAP, formerly Food Stamps) cases consist of an identified casehead, generally the adult who applies for assistance, and all members of the household who buy and prepare food with the casehead. A household receiving both TANF and SNAP would have the same case identification number in the two programs. Case identification numbers remain the same if the casehead leaves the case and another adult becomes the casehead.

[11]The data on receipt of a housing voucher is derived from questions asked of households applying for, or seeking continuation of, TANF or SNAP. The CARES database indicates whether households receive voucher-based housing subsidies, reside in public housing, or receive no housing assistance. A family unit is defined as being in the voucher group if the CARES case file indicates that it first received a rental subsidy in a particular calendar year or if the case file indicates that the case received a rental subsidy after a minimum of two consecutive months of nonreceipt.

[12]A small number of districts, including the Madison Metropolitan School District, make Shapefiles containing school attendance zone boundaries publicly available. The APL utilized these publicly available Shapefiles in geocoding addresses to school attendance boundaries.

residence and, for cases with addresses within the MMSD, the school attendance zone of residence to the records extracted from CARES.[13]

As the final step in the process of creating our data set, we collected annual district-level performance data for all school districts in Wisconsin beginning in 2000 and extending through 2006. Specifically, for each year, we collected the average scale score for each tested grade, standardized the scale score by the statewide district-level mean and standard deviation for the proper year, subject, and grade, and then took the average of the standardized scores—weighted by grade enrollments—to create an annual measure of average district performance. We performed this procedure for both reading and math; all analyses to follow consider each subject separately.

The data set resulting from this process contains up to seven years of observations—spanning calendar years 2000 to 2006—on over 5,000 cases that first received housing vouchers in 2003. The data set contains extensive demographic, geographic, and school quality information on a sample that includes both urban and rural residents, households with a wide variety of racial and ethnic backgrounds, and cases with a variety of family compositions, from single-parent families to married couples with multiple children. Table 1 summarizes the demographic characteristics of the cases in our dataset at the time of voucher receipt in 2003.

IV. EMPIRICAL APPROACH AND ESTIMATION RESULTS

A. Voucher Receipt and Movement Across School District Boundaries

Drawing on this rich and large data set, our first set of analyses examines the relationship between voucher receipt and movement across school district boundaries for households with school-aged children. As the first step in this analysis, we simply calculate—separately for each year from 2001 to 2006—the proportion of cases that live in the same school district as they did one year earlier. These

[13]For each year, we based each case's school district of residence and school attendance zone of residence, when applicable, on their address as of September 1 of the calendar year. We chose this date because it is very close to the beginning of the school year.

Table 1. Demographic Characteristics of Sample Cases at Time of Voucher Receipt in 2003

Characteristic	Percentage of Cases
Total Number of Cases	3,418
Sex	
Male	4.6
Female	95.4
Age	
18–30	62.8
31–45	31.1
46–59	5.1
60+	0.0
Race	
White	54.8
Black	30.6
Hispanic	3.9
Other race	10.7
Education Level	
No high school diploma	33.1
High school diploma	66.9
Marital Status	
Single, never married	56.3
Divorced or annulled	17.3
Separated	12.6
Married	12.9
Widowed	1.0
County Urbanicity	
Rural	27.4
Urban	54.4
Milwaukee	18.2
Number of Children	
1	42.4
2	31.3
3	16.1
4+	10.2

results, which are presented in Table 2, indicate that in the two years prior to voucher receipt—2001 and 2002—approximately 14 and 18 percent of cases, respectively, lived in a different school district than they did on September 1 of the prior year. This percentage rose to over 21 percent in 2003—the year of voucher receipt—before noticeably declining in the years after receipt; the rate of interdistrict mobility ranged from 12 to15 percent in the years after voucher receipt. These results suggest fairly high rates of cross-district mobility in the years preceding voucher receipt with a spike in such movements in the year of receipt. This spike is then followed by a period of relative stability in residential location.[14]

We explore these patterns further in a multivariate setting. Specifically, we estimate a model predicting movement across school district boundaries as a function of rental subsidy receipt and a case fixed effect. This model can be written as:

$$M_{it} = R_{it} + \gamma_i + \varepsilon_{it} \quad (1)$$

where *M* represents cross-district movement for case *i* at time *t*, *R* represents rental subsidy receipt, γ is the case fixed effect, and ε is a stochastic error term. The pattern of results presented in Table 2 led us to estimate this model separately over three time periods: 1) all years from 2001 to 2006, 2) the two years preceding voucher receipt and the first year of voucher receipt (i.e., 2001 to 2003), and 3) all years from 2001 to 2006, excluding 2003. Estimation of the model over the first time period indicates the average effect of voucher receipt on interdistrict mobility across the first four years of voucher receipt, whereas its estimation over the second time period reveals the effects of voucher receipt on cross-district relocation solely within the first year after receipt. Finally, estimation of equation one over the third time period generates evidence exclusively about the longer-term effects of voucher receipt on interdistrict movement—it provides insight into the non-first year relocation effects.

[14]This pattern is consistent with results in Carlson et al. (2012b), which studied the mobility-related effects of voucher receipt more generally.

Table 2. Percentage of Cases with School-Aged Children Living in Different School District from Previous Year: By Year

Year	Percent
2001	13.9
2002	18.1
2003	**21.1**
2004	14.9
2005	12.5
2006	11.9

Note: Year of voucher receipt in bold.

The results from these estimates are presented in Table 3. The first column, which contains the "all year" results, demonstrates that, relative to pre-receipt years, voucher recipients are slightly less likely to relocate across school district boundaries in the first four years after voucher receipt. However, the results presented in columns 2 and 3 demonstrate that these "all year" results mask important heterogeneity. The results in the second column show that, relative to pre-receipt years, voucher recipients are significantly more likely to move across school district boundaries in the first year of voucher receipt. In contrast, the column 3 results indicate that in subsequent years after voucher receipt households are significantly less likely to move to a new school district than they were in the years leading up to voucher receipt.

Table 3. Coefficients and Standard Errors from OLS Regression Containing Case Fixed Effects of Moving School Districts on Rental Subsidy Receipt: Cases With School-Aged Children

Variable	All Years	2001–2003 Only	All Years Except 2003
Rentsub	-0.0271***	0.0194*	-0.047***
	(0.0075)	(0.0101)	(0.0080)
N	13,967	6,168	11,171
N Cases	3,470	2,894	3,381

Note: * $p<0.10$; ** $p<0.05$; *** $p<0.01$.

The results presented in Table 3 are consistent with the comparisons in Table 2—in the time period prior to voucher receipt households make cross-district moves rather frequently. Initial voucher receipt produces a further spike in interdistrict movements as households are likely attempting to settle on what they hope to be a relatively long-term residence. This spike is followed by a period of relative residential stability.

B. Voucher Receipt and School District Quality

Given this pattern of interdistrict relocation, we now study the effect of voucher receipt on the quality of the schools available to recipient children. In our initial assessment of the relationship between voucher receipt and the quality of the schools available to recipient children, we calculate the average standardized test score—using the process described above—for the school districts in which sample members reside. These scores are presented separately for reading and math in the top panel of Table 4. The results demonstrate that the sample members resided in school districts with substantially below-average test scores across the full period of observation. They also indicate, however, some improvement in school district quality over time. In the two years prior to voucher receipt, households resided in districts with standardized test scores that ranged from about 0.75 to 0.95 standard deviations below average. In the years following voucher receipt, however, cases resided in districts of somewhat higher quality—depending on the year, the average case resided in a district ranging from 0.55 to 0.70 standard deviations below average.

This pattern of over-time improvement is amplified when the analytic sample is restricted to cases that relocated across school district boundaries in 2003—the year they first received their voucher. The bottom panel of Table 4 demonstrates that in the two years prior to voucher receipt these cases resided in districts with test scores that ranged from one-third to one-half of a standard deviation below average. In the years following voucher receipt, however, these cases lived in districts with approximately average levels of student achievement; depending upon the specific year and subject, the achievement level of the

Table 4. Mean Reading and Math Achievement of Districts in which Cases with School-Aged Children Reside: By Year

Year	Math	Reading
	All Cases	
2001	-0.923	-0.930
2002	-0.774	-0.740
2003	**-0.658**	**-0.658**
2004	-0.664	-0.681
2005	-0.573	-0.730
2006	-0.654	-0.785
	Cases that Relocated in 2003	
2001	-0.513	-0.502
2002	-0.344	-0.331
2003	**-0.037**	**-0.019**
2004	-0.053	-0.103
2005	-0.035	-0.142
2006	-0.086	-0.173

Note: Cell entries are standardized scores. Year of voucher receipt in bold.

district where the average case resided ranged from 0.02 to 0.17 standard deviations below the statewide mean. The subset of recipient households that relocate across school districts appear to use their voucher to seek better educational opportunities for their children.

Building upon these bivariate analyses, we next estimate the following multivariate model:

$$A_{it} = R_{it} + X_{it} + \gamma_i + \varepsilon_{it} \quad (2)$$

where the achievement, A, of the district in which case i resides at time t is a function of voucher receipt, R, a vector of time-varying characteristics, X, and a case fixed effect, γ. Included in the vector of time-varying characteristics are measures of the age of the youngest child in the case, the marital status of the casehead, and the recorded earnings of the casehead. Results from the estimation of this model are

presented in Table 5. In somewhat of a departure from the results presented in Table 4, the full-sample results based on estimation of equation 2 reveal only a small relationship between voucher receipt and the quality of the school districts in which cases reside. In math, voucher receipt leads to a statistically significant increase in the quality of a case's district of residence, but the magnitude of the estimated effect is small—less than 0.05 standard deviations. There is no statistically significant relationship between voucher receipt and the reading scores of the district in which voucher recipients live.

Table 5. Coefficients and Standard Errors from OLS Regression Containing Case Fixed Effects of Achievement Levels of School Districts in which Cases Reside on Rental Subsidy Receipt

	Full Sample		Cases that Changed School Districts in 2003	
Variable	Math	Reading	Math	Reading
Rentsub	0.044***	-0.009	0.386***	0.342***
	(0.015)	(0.015)	(0.066)	(0.065)
N	12,699	12,699	2,281	2,281
N Cases	3,571	3,571	627	627

Note: * $p<0.10$; ** $p<0.05$; *** $p<0.01$. Along with the case fixed effect, all models contain variables measuring the age of the youngest child, casehead marital status, and casehead earnings.

A much stronger relationship between voucher receipt and the quality of schools in recipients' district of residence emerges when the analytic sample is restricted to the subset of cases that relocated across district lines in 2003—the year they received their voucher. In both math and reading, voucher receipt results in a significant increase in the quality of the schools in the district in which these cases reside; in each subject the point estimate is statistically significant and in excess of one-third of a standard deviation. These results provide further evidence that recipients who use voucher receipt to move across school districts do improve the educational options available to their children.

C. School Attendance Zone Analysis

The preceding analyses provide important information about the relationship between voucher receipt and the quality of educational options available to recipient children. However, for two related, yet distinct, reasons the results presented above do not paint a complete picture of the relationship. First, in many districts there is significant heterogeneity in the quality of schools within the district; there is often as much variability in school quality within a district as there is across districts. Second, students do not attend a district, but rather a specific school within a district. Consequently, relocating to a higher-quality district may increase the likelihood that a student will attend a better school, but it does not guarantee that outcome.

To assess how voucher receipt shapes the specific schooling options available to recipient children we take advantage of the fact that the Madison Metropolitan School District makes their attendance zone boundaries publicly available. In the 2006 to 2007 school year—the last year in our data set—more than 24,000 students were zoned to attend 27 different elementary schools, 9 separate middle schools, and 4 primary high schools. As described previously, for the subset of recipient households that resided within the MMSD, each address in a case's address history was geocoded to the elementary, middle, and high school attendance zone in which it is located. Using this information, we first examine the extent to which voucher receipt leads households with children to relocate across school attendance zone boundaries, and then analyze the relationship between voucher receipt and the quality of the attendance zone in which cases reside.

Consistent with the district-level analysis above, we first present—separately for each year—the percentage of cases that reside in the same school attendance zone as they did on September 1 of the previous year. Due to the tiered nature of the K–12 educational system, each household resides in three school attendance zones—an elementary school zone, a middle school zone, and a high school zone. Consequently, Table 6 separately presents the percentage of cases that move across each of these three boundaries separately for each year from 2001 through 2006.

Table 6. Percentage of Cases with Children Living in Different School Attendance Zone from Previous Year: By Year, Madison Metropolitan School District

Year	Elementary School	Middle School	High School
2001	46.6	39.3	28.1
2002	40.0	34.2	24.3
2003	**39.1**	**33.3**	**25.5**
2004	21.8	19.3	12.0
2005	25.2	22.2	16.7
2006	31	24.8	23.3

Note: Year of voucher receipt in bold

In line with the district-level results, Table 6 indicates a sharp reduction in the proportion of cases that move across district boundaries in the years after voucher receipt. For each level of education—elementary, middle, and high schools—the rate of cross-district movements in 2004 is less than half of what it was in 2003, which is the initial year of voucher receipt. In contrast to the district-level results, however, relocation rates in the year of receipt are not notably higher than they were in the pre-receipt years. Due to differences in the size of attendance zone boundaries across elementary, middle, and high schools, cross-boundary relocation is highest for elementary schools and lowest for high schools—middle schools fall in between.

As in the district-level analysis, we further explore these relocation patterns by estimating equation (1) over the MMSD cases, which were geocoded to school attendance zones as described above. The results of this estimation are presented in Table 7. Also like the district-level analysis, we estimate equation (1) over three time periods: 1) all years from 2001 to 2006, 2) 2001 to 2003, and 3) all years from 2001 to 2006, excluding 2003. We again present separate results for movement across elementary, middle, and high school boundaries.

At both the elementary and middle school levels, the "all year" results demonstrate that, relative to pre-receipt years, voucher recipients are less likely to relocate across school attendance zones in the first four years after voucher receipt; there is no relationship at the high school level. Together, the "2001

Table 7. Coefficients and Standard Errors from OLS Regression Containing Case Fixed Effects of Moving School Attendance Zone on Rental Subsidy Receipt, Madison Metropolitan School District

	Elementary School Zone		
Variable	**All Years**	**2001–2003 Only**	**All Years Except 2003**
		Elementary School Zone	
Rentsub	-0.103**	-0.077	-0.131**
	(0.0490)	(0.0580)	(0.0580)
N	720	336	582
N Cases	221	172	215
		Middle School Zone	
Rentsub	-0.090**	-0.070	-0.117**
	(0.0450)	(0.0530)	(0.0520)
N	734	341	593
N Cases	223	175	217
		High School Zone	
Rentsub	-0.031	-0.0286	-0.052
	(0.0440)	(0.0490)	(0.0530)
N	734	341	593
N Cases	223	175	217

Note: * $p<0.10$; ** $p<0.05$; *** $p<0.01$

to 2003 only" and the "All years except 2003" results demonstrate that this increased residential stability comes in the post-2003 years. There is no statistically significant difference in the likelihood of cross-boundary relocation between 2003 and the two pre-receipt years. In contrast, relative to the pre-voucher years of 2001 and 2002, cases are significantly less likely to relocate across attendance zones in 2004 to 2006, at least at the elementary and middle school levels. The relatively large size of high school attendance zones is likely responsible for the lack of any observed statistically significant relationships at that level.

Further mirroring the structure of our district-level analysis, we next assess the relationship between voucher receipt and the quality of the schools that recipient children are zoned to attend. As the first step in this analysis, we calculate the average standardized test score—using the process described in Section III—for the schools in whose attendance zones the sample members reside.[15] These results are presented in Table 8 separately by subject and level of school. Although there are differences between the average achievement levels of Madison's elementary, middle, and high schools, the over-time trends are similar at these levels. Specifically, the results in Table 8 suggest a slight improvement in the quality of the schools in whose boundaries sample members reside in the years following voucher receipt. These improvements are not large—in the range of 0.05 standard deviations—but they are discernible and fairly consistent. Table 8 also provides further indication of school quality increases in the post-receipt years when the sample is restricted to cases that relocated across elementary school attendance boundaries in 2003. Interestingly, the quality increases are most consistent at the middle and high school levels and less evident at the elementary level, particularly in reading.

We gain additional insight into the relationship between voucher receipt and the quality of the school in whose attendance zone voucher recipients reside through estimation of equation (2) over the MMSD sample, but with the measure of attendance zone school quality substituted for the analogous measure of district school quality. We estimate the model separately for elementary, middle, and high school attendance zones and separately by reading and math. The results of these estimations are presented in Table 9.

The results presented in Table 9 reveal no statistically significant relationship—at any schooling level—between voucher receipt and the quality of the school in whose attendance zone the household resides. In most cases, the point estimates of the relationship are positive—and up to one-tenth of a

[15]In this analysis schools are assumed to have a fixed level of quality. To obtain our measure of fixed quality, we averaged each school's standardized scores over the period of observation.

Table 8. Mean Reading and Math Achievement of Schools in Whose Attendance Zones Voucher Cases with school-Aged Children Reside: By Year, Madison Metropolitan School District

	Elementary School Zone		Middle School Zone		High School Zone	
Year	Math	Reading	Math	Reading	Math	Reading
			All Cases			
2001	-0.130	-0.135	0.236	0.260	0.461	0.381
2002	-0.155	-0.142	0.211	0.239	0.440	0.362
2003	**-0.117**	**-0.111**	**0.264**	**0.285**	**0.472**	**0.402**
2004	-0.109	-0.109	0.271	0.286	0.483	0.411
2005	-0.130	-0.142	0.209	0.233	0.487	0.409
2006	-0.092	-0.089	0.240	0.265	0.489	0.413
			Changed Attendance Zones in 2003			
2001	-0.222	-0.203	0.142	0.181	0.339	0.227
2002	-0.218	-0.196	0.033	0.092	0.278	0.168
2003	**-0.163**	**-0.185**	**0.198**	**0.214**	**0.389**	**0.311**
2004	-0.178	-0.233	0.168	0.177	0.391	0.308
2005	-0.204	-0.251	0.208	0.214	0.438	0.360
2006	-0.007	-0.003	0.227	0.262	0.479	0.403

Note: Cell entries are standardized scores. Year of voucher receipt in bold.

Table 9. Coefficients and Standard Errors from OLS Regression Containing Case Fixed Effects of on Achievement Levels of School Attendance Zones in which Cases with School-Aged Children Reside on Rental Subsidy Receipt, Madison Metropolitan School District

	Elementary School Zone			
	Full Sample		Cases That Changed School Zones in 2003	
Variable	Math	Reading	Math	Reading
		Elementary School Zone		
Rentsub	0.011	0.016	0.002	-0.062
	(0.042)	(0.050)	(0.110)	(0.130)
N	735	735	204	204
N Cases	241	241	58	58
		Middle School Zone		
Rentsub	0.039	0.034	0.107	0.060
	(0.046)	(0.042)	(0.125)	(0.113)
N	746	746	205	205
N Cases	243	243	58	58
		High School Zone		
Rentsub	0.0110	0.019	0.0860	0.118
	(0.038)	(0.043)	(0.101)	(0.114)
N	746	746	205	205
N Cases	243	243	58	58

Note: * $p<0.10$; ** $p<0.05$; *** $p<0.01$. Along with the case fixed effect, all models contain variables measuring the age of the youngest child, casehead marital status, and casehead earnings.

standard deviation in magnitude—but none of them reaches conventional levels of statistical significance, a fact that is at least partially attributable to the relatively small number of households in our sample. These sample size limitations are further amplified when the analytic sample is restricted to cases that relocated across MMSD attendance zone boundaries in the year of voucher receipt—less than 60 did so.

Considered as a whole, these attendance zone results demonstrate that a significant proportion of voucher recipients relocate across zone boundaries in the year they receive their voucher, and subsequently exhibit greater stability in their residential locations. There is some evidence that these

initial moves lead to some improvement in the quality of the schools available to recipient children, but these improvements do not reach conventional significance levels.

D. Analysis by County Urbanicity

A distinguishing feature of the data set we draw upon in this study is the fact that it contains information on voucher recipients residing in a variety of geographic contexts across Wisconsin—rural areas, midsize cities, and Milwaukee; previous studies have been conducted in the context of large urban areas. As detailed in Carlson et al. (2012a, 2012b), there are several factors that could produce heterogeneity in the effects of voucher receipt across geographic contexts. Consequently, we assess whether the effects of voucher receipt on the educational opportunities of children in recipient households vary across urban and rural areas. Mirroring the approach taken above, we first examine whether the relationship between voucher receipt and cross-district movement differs across cases residing in urban and rural areas before assessing potential geographic heterogeneity in the effect of voucher receipt on the quality of the school district in which recipient households reside.

We explore the potential for geographic heterogeneity in the relationship between voucher receipt and inter-district relocation by estimating equation one separately for cases that resided in urban counties and rural counties at the time of voucher receipt in 2003.[16] The results from estimation of this model are presented in Table 10; the full sample results presented in Table 3 are also provided for purposes of comparison. The results in Table 10 provide some evidence of geographic heterogeneity in the relationship between voucher receipt and movement across school district boundaries. For example, the results indicate that recipients in urban areas are slightly more likely than rural recipients to move across district boundaries in the initial year of receipt. On the other hand, recipients in rural areas exhibit greater

[16]The State of Wisconsin classifies each county as either urban or rural for purposes of state business. There are 24 urban counties and 49 rural counties under this classification scheme, which we use as the basis for classifying cases as residing in a rural or urban county.

Table 10. Coefficients and Standard Errors from OLS Regression Containing Case Fixed Effects of Moving School Districts on Rental Subsidy Receipt: Cases with School-Aged Children, by Urbanicity

Variable	All Years	2001–2003 Only	All Years Except 2003
		All Cases	
Rentsub	-0.0271***	0.0194*	-0.047***
	(0.0075)	(0.0101)	(0.0080)
N	13,967	6,168	11,171
N Cases	3,470	2,894	3,381
		Urban	
	-0.0226***	0.0214**	-0.0413***
Rentsub	(0.0076)	(0.0106)	(0.0080)
N	10,576	4,741	8,496
N Cases	2,541	2,154	2,486
		Rural	
Rentsub	-0.0445**	0.0124	-0.069***
	(0.0267)	(0.0267)	(0.0230)
N	3,391	1,427	2,678
N Cases	929	740	895

Note: * $p<0.10$; ** $p<0.05$; *** $p<0.01$

stability—they are less likely to move across district boundaries—than urban recipients in the years after voucher receipt.

To assess whether these differential relocation patterns are accompanied by heterogeneity in the relationship between voucher receipt and school district quality, we estimate equation 2 separately for urban and rural recipients. We estimate this model for all cases in each geographic category as well as for the subset of cases that relocated across school district boundaries in 2003. Results from these estimations are presented in Table 11. These results are presented alongside the results for all cases, which are again provided for comparison purposes. The results for cases residing in urban areas demonstrate that these

Table 11. Coefficients and Standard Errors from OLS Regression Containing Case Fixed Effects of Achievement Levels of School Districts in Which Cases Reside on Rental Subsidy Receipt, by Urbanicity

	Full Sample		Cases That Changed School Districts in 2003	
Variable	Math	Reading	Math	Reading
		All Cases		
Rentsub	0.044***	-0.009	0.386***	0.342***
	(0.015)	(0.015)	(0.066)	(0.065)
N	12,699	12,699	2,281	2,281
N Cases	3,571	3,571	627	627
		Urban		
Rentsub	0.052***	-0.006	0.587***	0.539***
	(0.018)	(0.018)	(0.090)	(0.089)
N	9,634	9,634	1,485	1,485
N Cases	2,609	2,609	388	388
		Rural		
Rentsub	0.010	-0.023	-0.024	-0.061
	(0.026)	(0.025)	(0.069)	(0.065)
N	3,065	3,065	796	796
N Cases	962	962	239	239

Note: * $p<0.10$; ** $p<0.05$; *** $p<0.01$. Along with the case fixed effect, all models contain variables measuring the age of the youngest child, casehead marital status, and casehead earnings.

cases reside in districts with slightly higher average math scores in the years after receipt—relative to pre-receipt years—but there is no significant difference in the average reading scores of the district in which they reside in the years before and after voucher receipt. There is no relationship between voucher receipt and school district quality for cases in rural areas.

Heterogeneity in the relationship between voucher receipt and school district quality is much more apparent when the analytic sample is restricted to cases that relocated across school district boundaries in 2003—the year of voucher receipt. Cases in urban areas that relocated upon voucher receipt resided in a school district with average math and reading scores that were over 0.50 standard deviations greater than the average scores of the districts where they lived prior to voucher receipt and the accompanying relocation. In contrast, cases living in rural areas experienced no detectable change in school district quality after relocating across district boundaries when they received their voucher. Interestingly, most of the quality gains for urban recipients who relocated in 2003 were realized by cases residing not in Milwaukee, but in smaller cities such as Green Bay, La Crosse, or Eau Claire; fewer than 25 of the nearly 400 urban cases that relocated across district boundaries in 2003 lived in Milwaukee at the time of receipt.[17] This finding illustrates the value of examining the operations and effects of the Section 8 program outside of large urban contexts.

V. CONCLUSION

This study analyzes the effect of voucher receipt on the quality of the public schools available to the children of recipient households. Four main findings emerged throughout the course of the study. First, our analysis of the 2003 cohort of statewide voucher recipients revealed that, even with relatively high levels of relocation across school district boundaries in the two immediate pre-voucher years, there is a spike in cross-district relocation in the year of voucher receipt. Second, our results indicate that this spike in cross-district relocation is followed by a period of relative stability with respect to residential location. Together, these findings suggest that voucher receipt provides an opportunity for many households to identify and relocate to a desirable residential location where they are able to reside with a relative degree of stability over the following few years. Third, our analysis provides some evidence that

[17]For the small number of Milwaukee recipients that relocated across district boundaries upon voucher receipt in 2003, the average increase in school district quality was substantial—nearly 2 standard deviations. Further details are available from the authors upon request.

voucher receipt—through the cross-district moves referenced above—results in small increases in the quality of the school districts in which recipient households reside. These quality gains are more apparent when the analytic sample is restricted to those cases that relocated across school district boundaries in the year of voucher receipt—these cases saw an average increase in quality of over one-third of a standard deviation. Finally, our school attendance zone analysis demonstrates that—relative to the two immediate pre-receipt years—voucher receipt does not lead to a spike in cross-boundary relocation, but it does produce greater residential stability in the years following voucher receipt. Additionally, like the district-level analysis, there is some evidence that cross-boundary relocations in the year of voucher receipt result in households living in school attendance zones of slightly higher quality than they were previously.

The results of our analysis indicate that voucher receipt can lead to improved educational opportunities, but they are silent on the subsequent question—arguably the more important one—of whether these improved opportunities translate into better educational outcomes for the children of recipient households. Previous research provides a basis for pessimism on this account as both MTO (Sanbonmatsu et al., 2011) and Jacob's (2003) study from Chicago found voucher receipt to have little effect on children's educational outcomes. As noted above, these prior studies draw entirely on samples residing in large urban areas; our study analyzes a sample of voucher recipients that reside all across the state of Wisconsin. The majority of cases in our sample reside in suburban and rural areas.[18] Moreover, the counterfactual we employ in our analysis differs from that underlying previous studies. While prior research analyzed the effect of voucher receipt on educational outcomes on families that had some form of prior housing assistance, typically public housing, our analysis is conducted under a counterfactual of "no voucher receipt" (see note 9). For over 90 percent of cases in our sample, this counterfactual is equivalent to one of no housing assistance. The issue of differing counterfactuals could cut two ways

[18]There are a variety of reasons to expect that the effects of voucher receipt may vary across these contexts (see Carlson et al., 2012a, 2012b).

with respect to an analysis of the relationship between voucher receipt and educational outcomes. On the one hand, it can reasonably be argued that a counterfactual of prior public housing receipt would serve as a "most likely" test case for detecting a positive relationship between voucher receipt and educational outcomes—schools attended by public housing residents are often low-quality in nature, particularly in Chicago and the other cities that serve as the settings for previous work. On the other hand, a counterfactual of public housing does not accurately reflect the most realistic alternative—no housing assistance—for most voucher recipients. In addition, such a counterfactual ignores many of the benefits of the Section 8 program experienced by new voucher recipients, such as increased income and greater residential stability. Each of these factors, as well as others, could contribute to improved educational outcomes. Consequently, whether the cross-boundary relocations that we detect in our analytical context translate into improved educational outcomes boils down to an empirical question, one that we plan to pursue in future research.

Regardless of the ultimate relationship between voucher receipt and children's educational outcomes, the results presented above provide important insight into one potential mechanism linking these two factors—the movement of families across school districts or attendance zones. Notably, most prior studies estimate the direct causal relationship between an intervention such as voucher receipt and children's educational performance, but provide little evidence on the mechanisms that might be producing any observed results. Making informed policy decisions requires information on both the magnitude of any causal relationship as well as the possible mechanisms that underlie the relationship.

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