

Do Housing Vouchers Improve Academic Performance? Evidence from New York City

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Introduction

Historically, housing and education have been inextricably linked in the United States, with access to high quality schools often limited to middle and upper income families while poor children and households are “stuck” living in poor neighborhoods with low quality schools. Housing subsidies potentially play an important role in addressing this inequality. Specifically, at a cost of 19.3 billion dollars, the federal Housing Choice Voucher (HCV) program provides housing subsidies to more than 2.5 million children under the age of eighteen, with improving educational outcomes for poor children key among its myriad goals. Despite the intuitive appeal of the program, evidence on its educational impacts to date is limited. In this paper we draw on rich administrative data from the nation’s largest school district to shed light on whether – and to what extent -- this large national program improves educational outcomes for children whose families receive housing vouchers.

There are several reasons to believe that housing vouchers will improve educational outcomes. First, because vouchers are portable housing subsidies, they may provide poor children with access to safer neighborhoods and higher performing schools. Second, they may provide children with access to higher-quality and less crowded homes. Third, because the primary feature of the housing voucher program is that it caps individual rent payments, households receiving these subsidies may pay less in rent and enjoy an effective increase in income. As a result, parents in voucher households may have more income to spend on items such as school supplies and books, thereby improving student performance. Alternatively, parents may work less, increasing time they spend with their children or resulting in lower levels of stress. Finally, housing subsidies might increase housing stability over the longer run, helping

families and children avoid potential disruptive effects of moving to new schools and communities.

Despite the large scope of the program, evidence about the effects of vouchers on educational outcomes remains fairly limited. A recent national analysis finds that families with children just reaching school age use vouchers to move to areas with better schools (Ellen, Horn and Schwartz, 2015). While this finding is encouraging, it is unclear whether children in families with vouchers actually *attend* better schools or whether they perform better following voucher receipt. The evidence from the few studies that do explore student outcomes is inconclusive finding that receipt of a housing voucher has little to no impact on their performance at school (Sanbonmatsu, 2006; Jacob, Kapustin and Ludwig, 2014; Andersson, 2013), but may have significant impacts on long-term outcomes such as college attendance and lifetime earnings (Chetty, Hendren, and Katz, 2015). Further, little is known about the potential explanations for these findings, although recent evidence suggests that factors such as tight housing markets that do not allow families to move or a lack of better schooling options, may limit short-term impacts (Ellen, Schwartz, and Horn, 2015). Therefore, impacts may be concentrated among those students able to move to better neighborhoods and schools.

Using data on the largest school district in the country, New York City, we match over 88,000 voucher families to public school records and follow their schooling and residential experiences. To identify the causal effects of vouchers, we use a difference-in-differences strategy, exploiting the random timing of voucher receipt to compare changes in outcomes of students whose families receive a housing voucher to changes in outcomes of students whose families will receive one in the future. We also compare changes in outcomes among children whose families receive vouchers to changes among children whose families receive other forms

of housing assistance, specifically those who live in public housing, in order to shed light on the effectiveness of vouchers relative to other forms of assistance. Preliminary results suggest that students in voucher households perform slightly better in both ELA and math in the years that they are in the program. We also find that these effects are concentrated among elementary school (grades 3-5) rather than middle school (grades 6-8) aged students, particularly in math. Finally, while the effects of vouchers and public housing are similar in magnitude, vouchers may be more likely to have positive impacts on the ELA performance of older children

Theory/Literature

Housing vouchers might improve educational outcomes through a series of mechanisms. First, because housing vouchers are portable rent subsidies, they may enable households to move to better neighborhoods, particularly those with access to higher performing public schools. Although moves might initially have a negative effect on a child's educational outcomes because of disruptions to social capital and schooling, better resources and higher quality peers available at the new school and neighborhood may well lead to improved academic performance (Schwartz, Stiefel and Cordes, 2015; Cordes, Schwartz and Stiefel, 2015).

Second, the housing subsidy provided by vouchers may allow households to move out of overcrowded, poorly maintained housing into higher quality apartments and homes. This is due both to minimum quality standards of the program, including space requirements, and to greater household resources following the receipt of a subsidy. As a result, voucher holders are more likely to live in sound housing than unsubsidized households with similar incomes. This, in turn, may have important implications for child well-being and academic performance (Mayer, 1997; Klebanov et al, 1997). In particular, Newman and Harkness (2002) posit that children may have

a difficult time focusing on school work when living in overcrowded, poor-quality homes.

Additionally, poor quality housing might directly undermine the health of children (Coggon et al., 1993; Galpin, Walker, and Dubiel, 1992; Mann, Wadsworth, and Colley, 1992). Children in poor health will miss more school and have greater difficulty keeping up with assignments.

Third, a voucher may increase family disposable income if it is used to offset rent burdens. To be clear, the amount of assistance is substantial, increasing a household's effective earnings by an average of 60 percent. Results from the Welfare to Work Voucher program show that housing vouchers reduced the incidence of poverty once the value of the housing voucher was taken into account (Wood et al, 2008). There is good reason to believe that such increases in income could lead to improvements of educational outcomes for children in poor families. Using a kink in the receipt of the Earned Income Tax Credit to identify the impact of additional cash receipts, Dahl and Lochner (2012) find that an additional \$1,000 in income increases children's combined math and reading test scores by 6 percent of a standard deviation.

Fourth, over time housing vouchers might increase housing stability, and help families and children avoid the disruptive effects of moving to new schools and communities (Newman and Harkness, 2002). A large body of work finds that students who move residences experience worse academic outcomes (Haveman, Wolfe and Spaulding 1991; Pribesh and Downey 1999; Swanson and Schneider, 1999; Hanushek, Kain and Rivkin, 2004). A review of the literature between mobility and educational outcomes finds that frequent moves due to factors outside the family's control and moves that do not significantly improve housing conditions are detrimental to children (Crowley, 2003). There is also evidence that moves between neighborhoods and those accompanied by school moves, both of which might be viewed as more disruptive than

short distance moves, are particularly harmful for performance (Cordes, Schwartz and Stiefel, 2015).

Of course, subsidies like vouchers could have negative effects too, if families receiving housing vouchers become more complacent about their child's education or if decreased motivation to find work has negative repercussions for children – perhaps because non-working parents offer less helpful role models. Consistent with this, Jacob and Ludwig (2012) find that housing voucher use reduces quarterly labor force participation by 4 percentage points and quarterly earnings by \$285 among participants randomly selected to receive housing vouchers in Chicago.

Much of the evidence on the educational impacts of housing voucher receipt comes from researchers studying the Moving to Opportunity (MTO) experiment, which provided vouchers to poor households living in high-poverty public housing developments. These studies generally find no significant positive effects of housing vouchers on educational achievement, even for those voucher households who moved to neighborhoods with significantly lower poverty rates (Ladd et al, 2003; Orr et al, 2003; Sanbonmatsu et al, 2006).¹ In a recent study exploring long-term outcomes, however, Chetty, Hendren, and Katz (2015) found that young children (under age 13) who moved to higher quality neighborhoods as part of the experiment experienced significant positive impacts on college attendance and lifetime earnings. On one hand, the MTO studies involved a randomized controlled design and therefore provides credibly causal evidence that housing vouchers were effective in improving long-term, but not short-term outcomes for poor children in public housing. On the other hand, *because* the MTO study involved an

¹ Ladd, Duncan and Ludwig (2003) do find positive impacts on educational outcomes, but only for the Baltimore MTO site. Additionally, the MTO interim evaluation finds positive impacts on educational outcomes in reading in both the Baltimore and the Chicago test sites, though no effects in math (Orr et al, 2003).

experimental design, it was limited in sample and scope. In particular, the MTO households receiving vouchers came from highly distressed public housing developments and thus their experience may not be representative of voucher holders more generally. In addition, treatment, comparison, and control families all received housing subsidies; the study did not aim to test the impact of housing subsidies but rather to compare the effects of different kinds of subsidies, and therefore does not explore differences in outcomes between children with and without housing assistance as we aim to do here.

The few studies examining the broader set of households who receive vouchers find mixed evidence on the impacts of vouchers on children's outcomes. Mills et al (2006) examine results for participants in the Welfare to Work Voucher study. While they find no statistically significant effects on children's behavior problems, they find an increased likelihood that a child will repeat a grade in school, but a decreased likelihood that a child misses school due to health, financial or disciplinary problems. More recently Jacob, Kapustin and Ludwig (2015) explore outcomes for households in Chicago, who were given vouchers through a housing voucher lottery. They find that among this broader population of households, housing vouchers have no impacts on a child's cognitive outcomes, based on reading and math scores, while vouchers have positive impacts on young males (under age 6). They also find no consistent positive impacts of housing vouchers on longer term outcomes including graduation rates and criminal activity (Jacob, Kapustin and Ludwig, 2015). Of course, these results are only for Chicago and for a particular period of time.

Perhaps most relevant to our analysis, Andersson et al (2003) examine earnings outcomes for children raised in various assisted housing settings. OLS estimates suggest a substantial negative impact of housing subsidies on earnings, but in models utilizing differences in access to

housing assistance within families to identify the impact of housing assistance, there is evidence of positive effects for some demographic groups, particularly black women receiving housing-vouchers. This analysis suggests not only that housing assistance may be beneficial, but also that addressing selection is critical to identifying impacts of housing assistance on children's life outcomes.

Together, these mixed results combined with a limited understanding of the mechanisms driving these results suggest a need for additional research in other contexts. We expand on prior work by examining the effects of vouchers on student performance in the largest school district in the country, New York City. Using uniquely rich data on New York City public school students, we begin by describing the characteristics of children whose families will, at some point in their elementary school years, receive housing assistance. Little is known to date about how such students compare to their public school peers, and this provides needed context for interpreting not only our results, but other empirical analyses as well. Next, we turn to estimating the impacts of housing vouchers on student achievement. To do so, we compare outcomes for children whose families receive housing vouchers to similar households who do not yet have a voucher but will receive one in the future. Then we expand on these findings by comparing the change in educational outcomes experienced by children whose families receive housing vouchers to the change in outcomes experienced by children of households who receive other forms of housing assistance. Finally, we provide some preliminary evidence on mechanisms, exploring whether and to what extent HCVs induce residential and/or school mobility in the year immediately following initial voucher receipt.

Data and Sample

Data Sources

To answer these questions, we link data from four main sources: the Department of Housing and Urban Development (HUD), the New York City Department of Education (NYCDOE), the New York City Housing Authority (NYCHA), and the New York City Department of Finance.

From HUD, we use a panel of data on subsidized housing tenants from 2002-2012, which contains information on the residential address, income, and composition of each household in each year. In addition, this dataset also contains individual-level information on the race, gender, and birth month and year of each household resident. Using information on address, gender, race, birth month, and birth year, we link these data to student-level records from the NYCDOE.

From the NYCDOE, we have a complete census of NYC public school students from 1997-2013. These data contain information on student demographics and program characteristics including race, gender, eligibility for free and reduced price lunch, participation in ungraded special education, country of birth, etc. Beginning in 2005, these data also contain student address data, which we use to identify NYC public school students residing in a voucher household. Importantly for our analysis, these data also contain information on student outcomes including attendance and scores on standardized state exams as well as unique student identifiers that allow us to follow students over time. This allows us to control for prior performance when examining the impact of vouchers and, in some models, to include student fixed effects, which allow us to compare how the performance of an individual student changes after voucher receipt.

We use building identifiers from NYCHA to identify the students living in public housing. Such students may serve as a good comparison group for students in voucher

households because they are likely to face similarly high levels of sustained poverty over the course of their childhood. In addition, this allows us to compare the relative effectiveness of vouchers, where families can choose where to live, with public housing, where families are assigned to a unit.

Finally, we supplement this with data from the New York City Department of Finance's Real Property Assessment Database. These data allow us to classify buildings into types (i.e. single family, 2-4 family, 5 or more family, mixed use, etc.) as well as attach building characteristics such as age, number of stories, etc., which we can use to examine changes in housing quality after voucher receipt.

Linking Voucher Records to Student Records

To link voucher records to student records, we attached a BBL (borough block lot) code to each address recorded in the HUD data. This is a unique code that identifies the building where a voucher household lives in a given year. We then identified the set of children in voucher households who were ages 6-14 between 2002 and 2012 to link to student records from the NYCDOE. We then matched voucher records to NYCDOE records in three steps using information on student BBL, month of birth, year of birth, gender, and race/ethnicity (white, black, Hispanic, Asian/other).²

First, we employed a direct match on all variables. For the second and third steps of the matching process, we used a fuzzy match. Step 2 of the match process required a perfect match

² Since we do not have address data for NYCDOE records until 2005, we are only able to use this method to match voucher holders to NYCDOE records from 2005 forward. For those voucher households that enter the program prior to 2005, however, we are able to track the number of years a household has received a voucher going back to 2002 using the data from HUD.

on gender, building of residence, and birth date but allowed for differences in race/ethnicity. All possible fuzzy matches were manually reviewed to ensure that only the most likely matches were kept. Finally, to allow for differences in reporting time between HUD and DOE records, we matched the remaining voucher students on gender, birthdate and NYCDOE BBLs one and two years in the future while allowing for non-matches on race/ethnicity. For example, when trying to match voucher holders from 2008 to students in 2008, a student would be counted as a match if he/she had the same gender and birth date as a voucher holder AND he/she lived in the same building as that voucher holder in either 2009 or 2010. We did this with the reasoning that while HUD address records are likely up to date (because of certification requirements), there may be a lag between when a student moves homes and his/her address information is updated in the NYCDOE system. Again, all possible fuzzy matches were manually reviewed and only the most likely matches were kept. Of the 143,903 unique voucher holders identified from the HUD records, we successfully link 89,169 (62 percent) to DOE records. This match rate reflects, in part, the fact that children in some voucher households do not attend NYC public schools. In particular, we observed a low match rate among voucher holders in areas of the city with large Hassidic Jewish populations, who do not send their children to public schools. In addition to varying across space, the success rate of the match also varies across years from a low of 61 percent in 2005 to a high of 68 percent in 2009, with an average of 38,000 children in a given year.

Sample

We limit our main sample to students in grades 3-8 between academic years (AY) 2005 and 2011, for whom test scores are available. We focus on students who attend NYC public

schools for at least two years so that we can control for prior performance (a proxy for cumulative unobserved inputs into a child's learning process up to time t). Table 1 compares the characteristics of voucher holders, public housing residents, and all other NYCDOE students ages 6-14 in academic year 2008-2009. This table highlights some key differences between these three groups. To begin, students over 95 percent of NYC public school students with vouchers or living in public housing are black or Hispanic, compared to 65 percent of students who do not receive housing assistance. Further, virtually no voucher recipients or public housing residents are foreign born and the vast majority are eligible for free and reduced price lunch, whereas almost 15 percent of students in unsubsidized housing are foreign born and nearly 30 percent do not receive lunch subsidies. Since all else equal, both foreign born students and those who do not receive lunch subsidies tend to perform significantly better on exams, we further limit our sample by excluding foreign-born students and those students who are never eligible for a lunch subsidy.

Given the large differences between students who never receive housing assistance and those who ever receive housing assistance, we focus on two primary samples of students: students who ever live in a household that receives a housing voucher and students who ever live in a household that receives housing assistance of any kind (either a voucher or public housing). As a robustness check, we also estimate a set of results using the full sample of students.

Measures

We explore several potential outcomes related to academic performance including state test scores in English Language Arts (ELA) and math, attendance, and retention in grade. Our current analysis includes only test score results, but we will expand future analysis to include these other outcome measures. Test scores are standardized by grade and year to have a mean of

0 and standard deviation of 1, such that coefficient estimates can be interpreted in standard deviation units.

Our main independent variable of interest, voucher receipt, is measured in several ways. In our baseline model, we use a single indicator, *voucher*, which is equal to one in all years that student receives a voucher. In additional models we also add a control for *post-voucher*, which is equal to one in all years after a student no longer receives a housing voucher. Given prior evidence that the impact of voucher receipt may vary with age, we also estimate models where we interact *voucher* with an indicator for whether a student is of elementary (grades 3-5) or middle school (grades 6-8) age. To compare the effects of vouchers relative to public housing, we construct an analogous set of variables capturing tenure in public housing.

Next, we turn the impacts of vouchers on mobility, where the outcomes of interest are whether a student moved residences, neighborhood only, neighborhood and school, or schools only, where moved residences is an indicator equal to 1 if a student lives in a different building in year t than he did in year $t-1$, moved neighborhoods only is an indicator equal to 1 if a student lives in a different census tract in year t than he did in year $t-1$ but still attends the same school, moved neighborhoods and schools is an indicator equal to one if a student lives in a different census tract and attends a different school in year t than in year $t-1$, and moved schools only is an indicator equal to 1 if a student attends a different school in year t than he did in $t-1$ but did not move to a different census tract.

Methods

One of the primary challenges for identifying the impact of housing vouchers on student performance is selection—namely voucher households are much more disadvantaged than non-

voucher households in ways that are unobserved: they are likely to be poor for longer periods, live in larger households with fewer resources, etc. Therefore, in the absence of voucher receipt, children in voucher households are likely to have worse educational outcomes than other observationally similar children. To address this challenge, we limit our sample to those who ever receive a housing voucher and exploit the random timing of voucher receipt to obtain credibly causal estimates of the impact of vouchers on children’s educational outcomes.

Our main specification is as follows:

$$Y_{ist} = \beta_0 + \beta_1 Voucher_{ist} + \mathbf{X}'_{ist} \boldsymbol{\gamma} + \delta_g + \tau_t + \varphi_s + \varepsilon_{ist} \quad (1)$$

where Y is an outcome of student i , in school s , at time t . $Voucher$ is an indicator equal to one if a student receives a voucher in year t , \mathbf{X} is a vector of student characteristics including gender, race, eligibility for free or reduced price lunch, receipt of special education services, lagged test scores, etc. δ are grade effects, τ are time effects, and φ are school effects. We also re-estimate this model using student fixed effects and excluding lagged test scores and time-invariant characteristics. The primary coefficient of interest is β_1 , which identifies the impact of receiving a housing voucher.

These results can be interpreted as causal if timing of voucher receipt is conditionally random. There is good reason to believe this to be the case—as of March 17, 2014 there were 121,999 families on the waiting list for vouchers and the NYCHA website states “it is virtually impossible to establish an average waiting time for a family to enter Conventional Public Housing. Some applicants can be matched up with an available apartment in months, while

others often have to wait years.”³ It is therefore plausible to assume that a family is unable to anticipate voucher receipt in any given year.⁴

One concern with this specification is that the comparison group consists both of students whose households will receive a voucher in the future and those students whose households received a voucher in the past. Since exit from the voucher program is likely to be endogenous, estimates from the baseline specification may be biased. Of particular concern would be if exit from the voucher program signaled some kind of household disruption that would tend to lead to student performance, in which case estimates from (1) would be upwardly biased. In order to address this, we augment our baseline specification as follows.

$$Y_{ist} = \beta_0 + \beta_1 Voucher_{ist} + \beta_2 PostVoucher_{ist} + \mathbf{X}'_{ist} \boldsymbol{\gamma} + \delta_g + \tau_t + \varphi_s + \varepsilon_{ist} \quad (2)$$

Where *PostVoucher* is an indicator equal to one in all years after a student’s household exits the voucher program and all other variables are as previously defined. Once again the coefficient of interest is β_1 , which is identified relative to the performance of students whose households will receive a voucher in the future. This is our preferred specification.

Next, we expand our sample to include all students who ever received any type of housing assistance (vouchers or public housing). This not only expands the size of our comparison group, but allows us to examine the relative impacts of market-based (vouchers) versus place-based (public housing) assistance. In this sample, we augment equation (2) by including a set of variables capturing public housing tenure.

$$Y_{ist} = \beta_0 + \beta_1 Voucher_{ist} + \beta_2 PostVoucher_{ist} + \beta_3 NYCHA_{ist} + \beta_4 PostNYCHA + \mathbf{X}'_{ist} \boldsymbol{\gamma} + \delta_g + \tau_t + \varphi_s + \varepsilon_{ist} \quad (3)$$

³ See <http://www.nyc.gov/html/nycha/html/about/factsheet.shtml>

⁴ Some families receive vouchers through emergency provisions, which might be indicative of many other negative circumstances occurring in their lives. To the extent that this biases our estimates, it will work against finding any positive impact of vouchers.

where *NYCHA* is an indicator equal to one if a student lives in public housing in year *t*, *PostNYCHA* is an indicator equal to one in all years after a student moves out of public housing, and all other variables are as previously defined. This model allows us to examine whether market-based subsidies such as vouchers have significantly different impacts than place-based policies such as public housing. The coefficients of interest are β_1 and β_3 , which measure the impacts of vouchers and public housing, respectively and are identified relative to the performance of students whose households will receive a housing subsidy in the future.

Finally, to examine whether receipt of a housing voucher induces students to move homes, neighborhoods, or schools, we estimate the following model using a sample of students who ever receive a housing voucher:

$$\begin{aligned}
 Y_{ist} = & \beta_0 + \beta_1 Vouch3yrPre_{ist} + \beta_2 Vouch2yrPre_{ist} + \beta_3 Vouch1yrPre_{ist} + \\
 & \beta_4 VoucherStart_{ist} + \beta_5 Vouch1yrPost_{ist} + \beta_6 Vouch2yrPost_{ist} + \\
 & \beta_7 Vouch3yrPost_{ist} + \mathbf{X}'_{ist} \boldsymbol{\gamma} + \delta_g + \tau_t + \varphi_s + \varepsilon_{ist}
 \end{aligned} \tag{4}$$

Where *Y* is one of several outcomes measuring mobility, *Voucher3yrPre* is an indicator equal to 1 three years before a student's household receives a voucher, *Voucher2yrPre* is an indicator equal to 1 two years before a student's household receives a voucher, etc., *VoucherStart* is an indicator equal to 1 in the year a student's household receives a voucher, *Vouch1yrPost* is an indicator equal to 1 in the first year following initial voucher receipt, etc., and all other variables are as previously described. The primary coefficient of interest in these models is β_4 , which captures the change in probability that a student moves in the year that his/her household first receives a voucher relative to 4 years prior to or after receiving the

voucher. A significant positive coefficient, therefore, would indicate that students are significantly more likely to move in the year that their household first receives a voucher.

Results

Descriptive Statistics

We begin by examining the characteristics of students who receive housing assistance as well as the neighborhoods that these students live in, which provide important context for interpreting our results.

As shown in Table 1, a majority of students within housing assistance receive such assistance for the entire period they are observed. In particular, 60.1 percent students with HCVs and 64.7 percent of students who live in public housing *always* receive HCVs or live in public housing. Importantly, this means that approximately 40 percent of students who are ever observed receiving a voucher are also observed without a voucher so that a non-trivial fraction of students contribute to our fixed effects estimates.

Students who receive housing assistance are also somewhat more likely to move residences and also to move neighborhoods than their peers, which may not be surprising if households are more likely to move once they receive housing vouchers or are assigned to a public housing unit. Students with housing assistance are also more likely to move schools without moving residences than their peers who do not receive housing assistance. Given that school moves are often associated with lower performance (Schwartz, Stiefel, and Cordes, 2015), this provides further reason to believe that students with housing assistance would tend to perform worse.

Finally, we see that students who receive housing assistance tend to live in different parts of the city and in more disadvantaged neighborhoods. For example, the students who receive housing assistance are much less likely to live in Queens or Staten Island than students who receive no housing assistance, while students in public housing are more likely to live in Manhattan than either students with HCVs or those with no housing assistance. Students receiving housing assistance also live in neighborhoods with higher poverty and unemployment rates and lower median incomes than students who do not receive assistance. In general, however, students in public housing tend to live in the most disadvantaged neighborhoods, which is perhaps not surprising given that public housing complexes in NYC are quite large and can comprise the majority and in some cases the entire census tract.

In general, these results suggest that students who receive housing assistance tend to be different from those who do not in ways that would lead to worse performance: they are more likely to be poor for long periods of time, are more mobile, and live in worse neighborhoods. Thus, the full sample of students who do not receive housing assistance may serve as a poor comparison group for the analysis.

In the analysis that follows, we first present results limiting our sample to students who ever receive a housing voucher and then turn to results examining a broader sample of students who ever live in assisted housing. As a robustness check we also estimate results using the full sample of students.

Voucher Only Sample

Table 2 presents findings from our baseline specification. Here, we see robust evidence that receiving a voucher increases student performance. While in value-added models students

appear to perform no differently in the years they receive a voucher, in models including student and school effects, we see that students currently receiving a voucher perform 0.018 sds higher in ELA and 0.015-0.018 sds higher in math than students not currently receiving a voucher. As previously mentioned, these estimates may be biased because the comparison group consists, in part, of students who endogenously exited the voucher program. We address this in our next set of models, adding a control for post-voucher receipt (Table 3).

These models present robust evidence across all specifications that students perform significantly worse in the years after they exit the voucher program. This lower performance could be the result of multiple factors: the loss of a significant subsidy, moving to worse neighborhoods, etc. Alternatively, this lower performance could reflect disruptions in the household that ultimately led to the loss of a voucher such as divorce, job loss, or other factors that might result in the failure to submit paperwork for continued voucher eligibility. We do not take a stance here on whether these reflect causal evidence, although this is certainly an important area for future work.

Due to this generally lower performance of students who exit the voucher program, there does seem to be an indication that estimates without a control for voucher exit are upwardly biased. In value-added models (columns 1 and 4), we see that students who receive a voucher in a given year perform slightly worse than other students who will receive vouchers in the future. When we turn to estimates with student fixed effects, however, we see that while estimates are somewhat smaller than in Table 2, students perform significantly better in the years they receive a voucher – 0.013-0.014 sds in ELA and 0.009-0.012 sds math.

The differences between value-added and student fixed effects estimates may reflect differences in the identification strategies. In value-added models, coefficients are identified by

comparing the performance of students who receive housing vouchers to a different set of students in the same year, namely other students who will receive a housing choice voucher in the future. Student fixed effects models, however, compares the performance of students who receive housing vouchers to themselves in years that they have not yet received a housing voucher. Thus if the comparison group for the value-added models differs systematically from that in the student fixed effects model, this may be driving the differences. To explore this further, we compare the characteristics of students who will receive a voucher in the future to those currently receiving a voucher (Appendix Table A2). The main difference is that students who will receive a voucher in the future are much more likely to be foreign born and less likely to be in special education than students currently receiving a voucher. That is, students who will receive a voucher in the future are a group that we would expect to be slightly higher performing even in the absence of vouchers. These differences likely explain the differences in estimates between value-added and student fixed effects models. Since the timing of voucher receipt is much more likely to be random within students than between students, we prefer the results from our student-fixed effects specifications and focus on results from these models for the remainder of the discussion.

Given prior evidence that neighborhood mobility in general (Chetty and Hendren, 2014), and vouchers in particular (Chetty, Hendren, and Katz, 2015; Jacob, Kapustin and Ludwig, 2015), may be more beneficial for young children, we next estimate the impact of voucher receipt separately for elementary and middle schoolers (Table 4). Consistent with prior evidence, we find that positive impacts are driven by students who receive a voucher in elementary school (grades 3-5), while there is no impact for receiving a voucher in middle school (grades 6-8). Specifically, students who receive a voucher in grades 3-5 perform 0.017-0.019 sds higher in

ELA and 0.013-0.020 sds higher in math. We also find evidence that vouchers have a larger impact in the early (1-3) versus the later (4 or more) years of receipt (Appendix Table A2). These estimates could reflect a selection issue, however, if those households with long-term reliance on housing assistance are more disadvantaged than those households that

Housing Assistance Sample

We next expand our sample to include the set of students who ever live in public housing, who we expect to be similarly disadvantaged to voucher students. Suggestive evidence of this is seen in Table 1, where it is clear that students living in public housing are similar to those receiving vouchers on a multitude of characteristics including race and poverty. If anything, this group might be even *more* disadvantaged as students in public housing tend to live in worse neighborhoods. By including them in our comparison group, we can shed some light on the relative effectiveness of these two different forms of housing subsidies.

Both vouchers and public housing appear to improve student performance (Table 5). Compared to students who will receive some form of housing subsidy in the future, students with vouchers perform 0.016-0.018 sds higher in ELA and 0.010-0.013 sds higher in math. Similarly, students in public housing perform 0.013-0.015 sds higher in ELA and 0.010-0.018 sds higher in math. Interestingly in math, the inclusion of school fixed effects significantly increases the estimated impact of public housing, which may indicate that students in public housing attend a lower quality set of schools.

Some differences do emerge, however, when we examine the effects of vouchers and public housing by grade (Table 6). Now there is evidence that receipt of a voucher during both elementary and middle school increases ELA performance, while impacts for math are still only

experienced for those who receive a voucher in elementary school. On the other hand, the impact of public housing is driven entirely by students who reside in public housing during elementary school, where point estimates are nearly double those of the estimates where we do not disaggregate by grade. Similar to the results from the voucher only sample, we also see evidence that impacts occur primarily in the early years of voucher receipt, although no such pattern is observed in public housing (Appendix Table A3).

Finally, as a robustness test, we also estimate results using the full sample of students in grades 3-8. These results are consistent with what we find using the more limited sample of students (Appendix Table A4).

Taken together, these results show consistent evidence that vouchers improve performance among students who at some point receive housing subsidies. Furthermore, the program may have the largest impacts on younger students and during the early years of voucher receipt. Finally, the effects of vouchers and public housing are similar in magnitude, although vouchers may be more likely to have positive impacts on the ELA performance of older children.

Vouchers and Mobility

While statistically significant, these results are of relatively modest magnitude when compared with other interventions such as class size reductions (around 0.2 sds) or the size of the black-white achievement gap (0.7 sds in NYC). One potential reason for this modest result is that the impacts of vouchers are concentrated among those students who move to better neighborhoods and schools after receiving a voucher. As a preliminary examination of this, we estimate the impact of receiving a voucher on the probability that a student moves residences, neighborhoods, and schools. We are specifically interested in mobility during the year that a

student first receives a voucher as an indication that voucher receipt may induce household mobility.

We do find evidence that receipt of a voucher significantly impacts not only a student's probability of moving residences, but the probability of moving neighborhoods (either alone or in conjunction with a school move). Perhaps consistent with what we might expect, students who receive vouchers are 7.0 percentage points more likely to move residences in the year they first receive a voucher (Table 7). In addition, they are 3.7 percentage points more likely to move neighborhoods alone and 2.9 percentage points more likely to move both neighborhoods and schools in the year they first receive a voucher. Turning back to Table 1, we see that these translate into very meaningful increases. Given that baseline mobility of voucher holders is 3.1 percent for neighborhood only moves and 3.3 percent for neighborhood and school moves, this means that students are more than twice as likely to move neighborhoods alone and more than 1.5 times as likely to move both neighborhoods and schools in the year they first receive a voucher.

In future work, we plan to examine whether the impacts of vouchers on educational outcomes are concentrated among those students who move, and in particular, whether effects are larger among those students who move to higher quality neighborhoods and/or schools.

Next Steps

Preliminary results from this analysis suggest that vouchers do improve educational outcomes for children whose families receive this type of assistance. We still have more work to conduct to try and understand the mechanisms behind these results and examine why these results may be different from those in the existing literature.

In future drafts of this paper we intend to explore several potential mechanisms through which voucher receipt might affect student performance. As previously mentioned, we will examine whether and to what extent the impacts of vouchers are driven by students who move. In addition, we plan to explore the relative quality of neighborhood and school environments of mobile students. We plan to measure school quality using a variety of measures: pre-treatment school value-added, school-level proficiency rates, and parental perceptions of the school obtained from the New York City Learning Environment Survey. Similarly, we will examine a number of neighborhood quality measures including poverty and a neighborhood disadvantage index that includes measures of family structure, minority concentration, poverty, unemployment, and incidence of public assistance. Following prior work, this disadvantage index is created by transforming individual items into z-cores, adding them, and dividing by the number of indicators (Benson, et al 2003; Sampson, et al 1999).

We will explore the possibility that our findings are driven by the income effect by examining the amount of housing subsidy a family receives and changes in the income a family receives through working. We do so in multiple ways. First, we have access to data on daily free meal participation among students. One sign of an income effect may be decreased meal participation after a student receives a voucher and his/her family is more able to purchase lunch for the child outside of school. Second, we have access to these data for the years a household receives a housing voucher. Unfortunately we do not have access to these indicators in the years before and after a household receives a housing voucher, but we can look at changes in these indicators for the years a household does receive a housing voucher.

We will also explore the impact on residential stability by examining whether households move more before or after they receive a housing voucher. We will also study whether mobility

patterns change throughout a household's tenure in the program, specifically whether voucher households move more at the start of their participation, and then experience declining mobility as they have a voucher for more years. Finally, we can also examine mobility patterns after a household no longer receives a housing voucher.

We also plan to examine differential impacts by gender, school mobility, residential mobility, etc. We hope this research will shed light on the ways in which housing vouchers affect school children, and lead to policy recommendations that can increase the utility of housing vouchers for low income children.

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Tables

Table 1. Baseline Descriptive Statistics by Type of Housing Assistance, All Students, Grades 3-8

	Ever voucher	Ever public housing	Never housing assistance
Individual Characteristics			
White	1.5%	1.8%	17.5%
Black	46.9%	50.3%	27.3%
Hispanic	49.8%	44.2%	37.4%
Asian	1.8%	3.7%	17.8%
Foreign born	3.6%	5.3%	19.0%
Born in NYC	82.5%	82.3%	66.5%
Special ed.	13.2%	14.7%	9.5%
Poor	93.6%	88.7%	71.1%
Non-English at home	30.5%	26.5%	45.2%
LEP	9.1%	8.1%	14.1%
Housing assistance			
Ever voucher	100.0%	4.4%	0.0%
Ever public housing	0.0%	100.0%	0.0%
Always voucher	60.1%	1.9%	0.0%
Always public housing	0.0%	64.7%	0.0%
Mobility			
Moved homes	7.9%	9.8%	6.7%
Moved school only	13.5%	12.8%	10.8%
Moved neighborhood only	3.1%	3.7%	2.5%
Moved school & neighborhood	3.3%	4.1%	2.6%
Residence Borough			
Manhattan	11.7%	23.8%	10.5%
Bronx	47.3%	28.5%	18.6%
Brooklyn	29.6%	34.5%	31.0%
Queens	7.9%	9.2%	31.2%
Staten Island	2.1%	2.5%	6.5%
Census tract characteristics			
Private School, Ages 5-14	9.5%	8.1%	14.4%
Poverty Rate	30.6%	37.2%	20.6%
Unemployment Rate	14.4%	17.4%	10.9%
Severely Crowded	4.7%	3.1%	4.7%
Severe rent burden	35.5%	24.8%	32.0%
Moderate rent burden	24.7%	24.6%	24.4%
Gross Rent	\$1,040	\$697	\$1,197
Median HH Income	\$30,614	\$24,446	\$41,102
N	59,173	83,495	598,412

Notes: Baseline is defined as the earliest year that a student is observed in the data, whether or not they receive housing assistance in that year. Census tract characteristics are from the 2012 5-year ACS estimates.

Table 2. Vouchers and Student Performance, Voucher Only Sample, Grades 3-8, AY 2005-2011

VARIABLES	ELA			Math		
	(1)	(2)	(3)	(4)	(5)	(6)
Voucher						
Voucher in t	0.003 (0.003)	0.018*** (0.003)	0.018*** (0.003)	-0.001 (0.003)	0.018*** (0.003)	0.015*** (0.003)
Observations	234,107	234,107	234,107	237,455	237,455	237,455
R-squared	0.382	0.733	0.741	0.445	0.753	0.769
School FX	X		X	X		X
Student FX		X	X		X	X

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Notes: Voucher in t is an indicator equal to one in all years the student's family receives a voucher. All models include controls for free lunch eligibility, LEP, SPED, recent immigrant, not speaking English at home, grade, and year effects. Models in columns 1 and 4 also control for lagged test scores, gender and race. The comparison group is students who are not currently receiving a voucher, but have received one in the past or will receive one in the future.

Table 3. Vouchers and Student Performance, Grades 3-8, AY 2005-2011, Voucher Only Sample

	ELA			Math		
	(1)	(2)	(3)	(4)	(5)	(6)
Voucher						
Voucher in t	-0.008** (0.003)	0.014*** (0.003)	0.013*** (0.003)	-0.011*** (0.003)	0.012*** (0.003)	0.009*** (0.003)
Post voucher	-0.040*** (0.006)	-0.018*** (0.006)	-0.018*** (0.006)	-0.035*** (0.006)	-0.025*** (0.006)	-0.025*** (0.006)
Observations	234,107	234,107	234,107	237,455	237,455	237,455
R-squared	0.382	0.733	0.741	0.445	0.753	0.769
School FX	X	X	X	X	X	X
Student FX			X			X

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Notes: Voucher in t is an indicator equal to one in all years the student's family receives a voucher, and post voucher is an indicator equal to one in all years after a student's family exits the voucher program. All models include controls for free lunch eligibility, LEP, SPED, recent immigrant, not speaking English at home, grade, and year effects. Models in columns 1 and 4 also control for lagged test scores, gender and race. The comparison group is students whose households will receive a voucher in future.

Table 4. Vouchers and Student Performance by Grade Level, Grades 3-8, AY 2005-2011, Voucher Sample

	ELA		Math	
	(1)	(2)	(3)	(4)
Voucher				
Voucher in t, elem	0.019*** (0.004)	0.017*** (0.004)	0.020*** (0.004)	0.013*** (0.004)
Voucher in t, middle	0.005 (0.005)	0.007 (0.005)	-0.002 (0.005)	0.002 (0.005)
Observations	234,107	234,107	237,455	237,455
R-squared	0.733	0.741	0.753	0.769
School FX		X		X
Student FX	X	X	X	X

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Notes: Voucher in t, elem is an indicator equal to one in all years that a student receives a voucher while in grades 3-5 and voucher in t, middle is an indicator equal to one in all years that a student receives a voucher while in grades 6-8. All models include a control for post voucher equal to one in all years after a student's family exits the voucher program. All models also include controls for free lunch eligibility, LEP, SPED, recent immigrant, not speaking English at home, grade, and year effects. The comparison group is students whose household will receive a voucher in the future.

Table 5. Vouchers & Student Performance, Grades 3-8, AY 2005-2011, Housing Assistance Sample

VARIABLES	ELA			Math		
	(1)	(2)	(3)	(4)	(5)	(6)
Voucher						
Voucher in t	0.003 (0.003)	0.019*** (0.003)	0.018*** (0.003)	-0.002 (0.003)	0.018*** (0.003)	0.016*** (0.003)
Ever voucher	0.003 (0.003)			-0.003 (0.003)		
Public Housing						
Public housing in t	-0.007** (0.003)	0.014*** (0.003)	0.014*** (0.003)	-0.009*** (0.003)	0.004 (0.003)	0.008*** (0.003)
Observations	526,467	526,467	526,467	534,218	534,218	534,218
R-squared	0.389	0.740	0.747	0.454	0.760	0.774
School FX	X		X	X		X
Student FX		X	X		X	X

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Notes: Voucher in t is an indicator equal to one in all years the student's family receives a voucher and ever voucher is equal to 1 for all students ever observed receiving a voucher between 2002 and 2012. Public housing in t is equal to 1 in all years that at student lives in public housing. All models include controls for free lunch eligibility, LEP, SPED, recent immigrant, not speaking English at home, grade, and year effects. Models in columns 1 and 4 also control for lagged test scores, gender and race.

Table 6. Vouchers & Student Performance, Grades 3-8, AY 2005-2011, Housing Assistance Sample

	ELA		Math	
	(1)	(2)	(3)	(4)
Voucher				
Voucher in t	0.018*** (0.003)	0.016*** (0.003)	0.013*** (0.003)	0.010*** (0.003)
Post voucher	-0.006 (0.006)	-0.010 (0.006)	-0.022*** (0.006)	-0.024*** (0.006)
Public housing				
Pub. housing in t	0.013*** (0.004)	0.015*** (0.004)	0.010*** (0.004)	0.018*** (0.004)
Post pub. housing	-0.002 (0.006)	0.003 (0.006)	0.014** (0.006)	0.024*** (0.006)
Observations	526,467	526,467	534,218	534,218
R-squared	0.740	0.747	0.760	0.774
School FX		X	X	X
Student FX	X	X		X

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Notes: Voucher in t is an indicator equal to one in all years the student's family receives a voucher, and post voucher is an indicator equal to one in all years after a student's family exits the voucher program. All models include controls for free lunch eligibility, LEP, SPED, recent immigrant, not speaking English at home, grade, and year effects. Models in columns 1 and 4 also control for lagged test scores, gender and race. The comparison group is students whose households will receive some form of housing assistance in the future.

Table 7. Vouchers & Student Performance by Grade Level, Grades 3-8, AY 2005-2011, Housing assistance Sample

	ELA		Math	
	(1)	(2)	(3)	(4)
Voucher				
Voucher in t, elem	0.018*** (0.004)	0.016*** (0.004)	0.020*** (0.004)	0.014*** (0.004)
Voucher in t, middle	0.012*** (0.004)	0.011*** (0.004)	-0.001 (0.004)	0.001 (0.004)
Public housing				
Pub. housing in t, elem	0.022*** (0.004)	0.025*** (0.005)	0.020*** (0.004)	0.029*** (0.004)
Pub. housing in t, middle	-0.000 (0.005)	0.004 (0.005)	-0.008 (0.005)	0.004 (0.005)
Observations	526,467	526,467	534,218	534,218
R-squared	0.741	0.747	0.760	0.774
School FX		X		X
Student FX	X	X	X	X

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Notes: Voucher in t, elem is an indicator equal to one in all years that a student receives a voucher while in grades 3-5 and voucher in t, middle is an indicator equal to one in all years that a student receives a voucher while in grades 6-8. Public housing variables measured analogously. All models include a control for post voucher equal to one in all years after a student's family exits the voucher program and a control for post public housing equal to one in all years after a student's family moves out of public housing. All models also include controls for free lunch eligibility, LEP, SPED, recent immigrant, not speaking English at home, grade, and year effects. The comparison group is students whose households will receive housing assistance in the future.

Table 8. Vouchers and Probability of Moving, Grades 3-8, AY 2005-2011, Ever Voucher Sample

	Residence (1)	Neighborhood only (2)	Neighborhood & School (3)	School only (4)
3 years pre voucher	-0.030*** (0.006)	-0.019*** (0.004)	-0.008* (0.004)	-0.012** (0.006)
2 years pre voucher	-0.024*** (0.005)	-0.020*** (0.003)	-0.006* (0.003)	0.002 (0.004)
1 year pre voucher	0.007* (0.004)	0.001 (0.003)	0.005* (0.003)	0.005 (0.004)
Voucher start	0.070*** (0.003)	0.037*** (0.002)	0.029*** (0.002)	-0.020*** (0.003)
1 year post voucher	0.016*** (0.002)	0.011*** (0.002)	0.006*** (0.002)	-0.004** (0.002)
2 years post voucher	0.031*** (0.004)	0.018*** (0.002)	0.015*** (0.003)	-0.009*** (0.004)
3 years post voucher	0.042*** (0.005)	0.020*** (0.003)	0.019*** (0.004)	-0.018*** (0.005)
Observations	242,313	242,313	242,313	242,313
R-squared	0.342	0.293	0.320	0.584
School FX	X	X	X	X
Student FX	X	X	X	X

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Notes: 3 years pre voucher is an indicator equal to one three years before a student's family first receives a voucher and 0 in all other years, 2 years pre voucher is an indicator equal to one two years before a student's family first receives a voucher and 0 in all other years, voucher start is an indicator equal to 1 in the first year that a student's household receives a voucher. One year post voucher is an indicator equal 1 for students who have been living in a voucher household for 1 year, two years post voucher is an indicator equal 1 for students who have been living in a voucher household for 2 years, etc. All models include controls for free lunch eligibility, LEP, SPED, recent immigrant, not speaking English at home, grade, and year effects.

Appendix

Table A1. Characteristics of Students Pre, During, and Post Housing Assistance, All Students, AY 2009

	Voucher			Public housing		
	Pre	During	Post	Pre	During	Post
Individual Characteristics						
Female	51.7%	52.6%	52.3%	52.1%	52.2%	52.4%
Black	38.1%	49.3%	53.2%	40.4%	50.7%	53.0%
Hispanic	55.7%	47.7%	45.0%	49.0%	44.3%	42.4%
Asian	3.9%	1.7%	1.1%	8.6%	3.5%	2.5%
Foreign born	8.5%	2.9%	2.7%	13.7%	3.8%	6.3%
Born in NYC	84.3%	91.1%	91.3%	81.1%	91.5%	87.1%
Special ed.	12.3%	15.0%	16.8%	12.6%	17.1%	14.7%
Poor	92.6%	92.0%	87.6%	87.5%	86.1%	83.5%
Non-English at home	39.8%	27.3%	23.7%	41.4%	24.2%	22.0%
LEP	16.5%	8.4%	6.1%	18.1%	7.1%	7.3%
Mobility						
Moved homes	15.8%	15.5%	22.3%	10.7%	9.0%	44.5%
Moved school only	20.9%	18.0%	18.7%	23.6%	18.3%	16.1%
Moved neighborhood only	6.8%	7.0%	10.0%	4.1%	4.0%	22.1%
Moved school & neighborhood	7.8%	7.6%	11.2%	5.4%	4.4%	20.2%
Residence Borough						
Manhattan	15.2%	10.1%	12.2%	15.5%	25.9%	10.2%
Bronx	44.8%	48.2%	44.9%	34.4%	27.5%	39.0%
Brooklyn	30.7%	30.6%	30.5%	37.2%	35.0%	30.5%
Queens	7.0%	8.5%	9.8%	10.3%	9.0%	16.0%
Census tract characteristics						
Private School, Ages 5-14	9.4%	9.5%	9.5%	9.9%	7.8%	10.8%
Poverty Rate	31.3%	30.4%	31.0%	28.7%	38.7%	27.5%
Unemployment Rate	14.5%	14.4%	14.5%	13.2%	18.1%	13.4%
Severely Crowded	4.8%	4.6%	4.4%	5.2%	2.8%	4.4%
Severe rent burden	33.9%	35.3%	34.1%	34.6%	23.1%	34.0%
Moderate rent burden	24.5%	24.6%	24.7%	24.5%	24.6%	24.4%
Gross Rent	1,001	1,038	1,010	1,065	630	1,066
Median HH Income	30,442	30,494	30,469	32,492	22,953	33,137
N	4,245	28,631	3,994	4,497	37,261	4,647

Notes: Pre voucher are students whose household will receive a voucher in the future, but do not have one in 2009, voucher students are students in households with a voucher during the 2009 school year, post voucher are those students whose household previously had a voucher, but no longer have one in 2009. Public housing categories are defined analogously.

Table A2. Vouchers and student performance by number of years with voucher, Grades 3-8, AY 2005-2011, Voucher Sample

	ELA		Math	
	(1)	(2)	(3)	(4)
# yrs w/ Voucher				
1	0.011*** (0.004)	0.011*** (0.004)	0.010** (0.004)	0.007* (0.004)
2	0.012*** (0.004)	0.011*** (0.004)	0.009** (0.004)	0.007* (0.004)
3	0.015*** (0.004)	0.014*** (0.004)	0.007 (0.004)	0.006 (0.004)
4	-0.001 (0.005)	-0.001 (0.005)	-0.003 (0.006)	-0.003 (0.005)
5+	-0.012* (0.007)	-0.010 (0.007)	-0.025*** (0.007)	-0.019*** (0.007)
Observations	234,107	234,107	237,455	237,455
R-squared	0.733	0.741	0.753	0.769
School FX		X		X
Student FX	X	X	X	X

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Notes: Voucher for 1 year is an indicator equal to 1 in the first year that a student has a voucher and 0 in all other years, voucher for 2 years is an indicator equal to 1 in the second year that a student has a voucher and 0 in all other years, etc. All models include a control for post voucher equal to one in all years after a student's family exits the voucher program. All models also include controls for free lunch eligibility, LEP, SPED, recent immigrant, not speaking English at home, grade, and year effects. The comparison group is students whose households will receive a voucher in the future.

Table A3. Vouchers and Student Performance by number of years with voucher, Grades 3-8, AY 2005-2011, Housing Assistance Sample

	ELA		Math	
	(3)	(4)	(7)	(8)
# yrs w/ Voucher				
1	0.012*** (0.004)	0.011*** (0.004)	0.010*** (0.004)	0.007* (0.004)
2	0.015*** (0.004)	0.014*** (0.004)	0.009** (0.004)	0.007** (0.004)
3	0.026*** (0.004)	0.023*** (0.004)	0.007* (0.004)	0.007 (0.004)
4	0.011** (0.005)	0.008 (0.005)	-0.005 (0.005)	-0.003 (0.005)
5+	0.003 (0.006)	0.000 (0.006)	-0.028*** (0.006)	-0.021*** (0.006)
# yrs in pub housing				
1	0.011** (0.004)	0.013*** (0.004)	0.001 (0.004)	0.010** (0.004)
2	0.006 (0.005)	0.009* (0.005)	0.010** (0.005)	0.021*** (0.005)
3	0.015*** (0.005)	0.019*** (0.005)	0.000 (0.005)	0.015*** (0.005)
4	0.014** (0.006)	0.018*** (0.006)	-0.011* (0.006)	0.005 (0.006)
5+	-0.009 (0.007)	-0.004 (0.007)	-0.038*** (0.007)	-0.018*** (0.007)
Observations	526,467	526,467	534,218	534,218
R-squared	0.741	0.747	0.761	0.774
School FX		X		X
Student FX	X	X	X	X

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Notes: Voucher for 1 year is an indicator equal to 1 in the first year that a student has a voucher and 0 in all other years, voucher for 2 years is an indicator equal to 1 in the second year that a student has a voucher and 0 in all other years, etc. Number of years with public housing are defined analogously. All models also include a control for post voucher equal to one in all years after a student's family exits the voucher program and a control for post public housing equal to one in all years after as student moves out of public housing. All models also include controls for free lunch eligibility, LEP, SPED, recent immigrant, not speaking English at home, grade, and year effects. The comparison group is students who will receive housing assistance in the future.

Table A4. Vouchers & Student Performance, Grades 3-8, AY 2005-2011, Full Sample

VARIABLES	ELA		Math	
	(1)	(2)	(3)	(4)
Voucher				
Voucher in t	0.004 (0.003)	0.013*** (0.003)	0.000 (0.003)	0.006** (0.003)
Ever voucher	-0.057*** (0.003)		-0.065*** (0.003)	
Public Housing				
Public housing in t	-0.015*** (0.003)	0.013*** (0.004)	-0.017*** (0.003)	0.000 (0.003)
Ever pub. housing	-0.066*** (0.003)		-0.066*** (0.003)	
Observations	2,564,768	2,564,768	2,648,232	2,648,232
R-squared	0.457	0.772	0.532	0.806
School FX	X		X	
Student FX		X		X

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Notes: Voucher in t is an indicator equal to one in all years the student's family receives a voucher and ever voucher is equal to 1 for all students ever observed receiving a voucher between 2002 and 2012. Public housing variables are measure analogously. All models include controls for free lunch eligibility, LEP, SPED, recent immigrant, not speaking English at home, grade, and year effects. Models in columns 1 and 3 also control for lagged test scores, gender and race.