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ABSTRACT

One of the goals of federal housing policy is to improve the prospects of children in poor families. But little research has been conducted into the effects of participation in housing programs on children, perhaps because it is difficult to find data sets with information about both participation and interesting outcome measures. This paper combines data from several sources in order to provide a first look at the effect of participation in public housing projects on housing quality and on the educational attainment of children.

We first use administrative data from the Department of Housing and Urban Development to impute the probability that a Census household lives in a public housing project. We find that a higher probability of living in a project is associated with poorer outcomes. We then use two-sample instrumental variables (TSIV) techniques to combine information on the probability of living in a project obtained from the 1990 to 1995 Current Population Surveys, with information on outcomes obtained from the 1990 Census. The instrument common to both samples is an indicator equal to one if the household is entitled to a larger housing project unit because of the sex composition of the children in the household. Families entitled to a larger unit because of sex composition are 24 percent more likely to live in projects. When we control for omitted variables bias using TSIV, we find that project households are less likely to suffer from overcrowding and less likely to live in high-density complexes. Project children are also 12 to 17 percentage points less likely to have been held back in school one or more grades, although this effect is confined to boys. Thus, most families do not face a tradeoff between housing quality and child outcomes -- the average project improves both.

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Since 1937, the federal government has subsidized the housing costs of some low-income families, with the stated goals of improving the quality of housing inhabited by the poor. Given that poor families with children make up 60 percent of the public housing caseload (most of the rest are households headed by the elderly and/or disabled), it is clear that a second important goal is to improve the life-chances of recipient children.

The real costs of this assistance (in 1996 dollars) have grown steadily over time, from $7.3 billion in 1977 to $26 billion in 1996. The number of households assisted has also risen from approximately 3.2 million in 1977 to 5.7 million in 1996, and outlays per unit have approximately doubled over the same period to $5,480 (Committee on Ways and Means, 1996). However, public dissatisfaction with large public housing projects has remained high. Twenty-five years ago, Henry Aaron wrote that "Over the years public housing has acquired a vile image -- highrise concrete monoliths in great impersonal cities, cut off from surrounding neighborhoods by grass or cement deserts best avoided after dark . . . This image suggests that any benefits inhabitants derive from physical housing amenities are offset by the squalid surroundings" (Aaron, 1972 p. 108). Many would argue that if anything, the situation has worsened, as horrifying stories about large projects such as the Robert Taylor Homes or Cabrini Green in Chicago routinely appear in the national news.

As a result, the character of low-income housing aid has changed dramatically over time[1], as money has been diverted away from "project-based" aid towards "household-based" aid given in the form

[1] There are other reasons for the shift in the composition of public housing from projects to vouchers. Apgar (1990) and Olsen (1983) point out that it is typically cheaper to house a family in existing housing than to construct new housing, so that more families can be served for the same budget outlay. Olsen (1983) and Olsen and Barton (1983) also argue that in addition to being more efficient, an entitlement program of housing allowances would be more equitable than the current system in which some households receive benefits and other similar households do not. Finally, programs using existing housing do not crowd out private construction of low-rent housing as public construction projects might (Murray, 1983).

of certificates and vouchers that can be applied towards rents in the existing private housing market.[2] Moreover, since 1982, appropriations for new construction of public housing projects have fallen sharply (Committee on Ways and Means, 1996).[3] And in 1995, the Department of Housing and Urban Development (HUD) put forth a plan that would have eventually replaced all "project-based" assistance with housing certificates provided directly to individual households (Government Accounting Office, 1995).[4]

The aim of voucher/certificate programs is to assist families without consigning them to the projects. But newspaper accounts not withstanding, there is little evidence that projects actually harm children. Basic economics suggests that families would not move into public housing unless it was better in at least some respects than the alternatives they faced. Aaron's intriguing hypothesis is that families in projects tradeoff physical housing amenities and reductions in rental payments against neighborhood characteristics that are bad for their children. But many projects and project neighborhoods may actually be superior to the housing and neighborhoods that families would have occupied in the absence of assistance. And reductions in rental payments may or may not be spent on goods and services beneficial to children. Thus, it is important to look directly at the effects of housing assistance on housing quality and on child well-being.

This paper combines HUD administrative data about the demographic characteristics of households in projects with information about participation in projects from the 1990 to 1995 March Current

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[2] In 1977, only 8 percent of assisted renters received vouchers or certificates compared to 28 percent in 1996.

[3] Note that even though Congress essentially stopped funding the new construction of large public housing projects in the early 1980s, many families continue to live in existing projects. Thus, there can be long lags between changes in public housing policy and actual changes in the composition of the caseload.

[4] Specifically, instead of giving money to local housing authorities, HUD would issue certificates to all current public housing project residents. These residents would then be able to choose to stay in their current units or move elsewhere.

Population Surveys (CPS), and data about outcomes from the 1990 U.S. Census in order to examine the effects of project participation on housing quality and on the educational attainment of children.

We first use the HUD data to calculate the probability that each Census household lives in a public housing project. We find that a higher probability of living in a project is associated with poorer outcomes, a finding which provides a baseline for our subsequent analyses. We then use the two-sample instrumental variable (TSIV) technique developed by Angrist and Krueger (1992, 1995) to combine information on the probability of living in a project obtained from the CPS, with information on outcomes obtained from the Census. The instrument common to both samples is an indicator equal to one if the household is entitled to a larger housing unit in a project because of the sex composition of the children in the household. Families entitled to a larger unit based on the sex composition are 24 percent more likely to live in projects. Using TSIV to control for unobserved characteristics of project residents, we find that project families are less likely to suffer from overcrowding and more likely to live in buildings with fewer than 50 units. And children in these families are 12 to 17 percentage points less likely to have been held back in school one or more grades. Thus, families do not appear to face a tradeoff between housing quality and child outcomes -- projects improve both.

The rest of the paper is laid out as follows: Part I gives additional background information about the public housing programs. Part II discusses methods, while Part III describes the data. Results appear in Part IV, and a discussion and conclusion follow.

Part I: Background

As noted above, public housing "projects" tend to have very bad reputations. Yet, the publicity generated by the worst projects tends to obscure great heterogeneity between projects. Approximately 3,300 public housing authorities own and operate about 13,200 developments with a total of about 1.4 million units. Seventy percent of these authorities operate fewer than 300 units, while the 40 largest

agencies operate 1,786 or more units and account for 36 percent of all public housing project units. HUD considers most of the authorities to be well run -- only 3 percent are classified as "troubled" (General Accounting Office, 1995), but the 8 worst large agencies account for 12 percent of all project units.

Thus it is not at all clear *a priori* that participation in the average project entails sacrificing either housing or neighborhood quality.[5] It is possible that most projects are significantly better than some of the low-rent housing that is available on the private market -- in New York City alone, 60,000 people live in private housing so unsafe that it is judged to endanger lives (Sontag, 1996). For many families in projects, the alternative may be moving from place to place as they seek accommodations they can afford, interspersed with spells of homelessness. Children in these situations are often forced to change schools frequently which puts them at risk of grade repetition and poor academic achievement (General Accounting Office, 1994; Rubin *et al.*, 1996). The fact that several large cities have lengthy waiting lists for public housing projects also lends credence to the idea that projects may be viewed as better than what is available and affordable privately.[6]

Families are eligible for assistance if they have incomes at or below 50 percent of the area median. Housing authorities may also choose to allocate as many as 25 percent of their units to families with incomes between 50 and 80 percent of the area median. Thus, families in projects are selected to be disadvantaged, something that must be kept in mind when housing quality and child outcomes are

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[5] The effects of neighborhoods remain controversial though many studies have found that they are important. Wilson (1987) and Jencks and Mayer (1990) emphasize that bad neighborhoods may lack role models and desirable peers, as well as opportunities for education, recreation, and employment. Case and Katz (1991) provide some evidence that children in neighborhoods in which a large proportion of other children are involved in crime are more likely to be involved in crime themselves. Similar effects are found for drug and alcohol use and for idleness (i.e. being out of school and out of work). In another study of inner-city Chicago project residents who were allowed to apply for Section 8 housing certificates, Rosenbaum (1992) found that in families that were able to move to the suburbs, children were less likely to drop out of school and both mothers and children were more likely to be employed.

[6] New York City currently has approximately 340,000 families on waiting lists for housing assistance (Sontag, 1996).

examined.

Families in projects have their rents capped at 30 percent of their income (after certain deductions are made), a regulation that may complicate the interpretation of "rent" since families with more earnings will pay more. In fact, since the Census rent question is somewhat ambiguous, it is likely that some project families give the amount that they actually pay, while others attempt to estimate the rental value of their units.[7] In any case, it is not uncommon for researchers using survey data to find that participation in housing programs increases rental payments.[8] Hence, rather than focusing exclusively on rent, and assuming that reported rent is a good summary measure of housing quality, we examine two direct measures of housing quality (overcrowding and density), as well as grade repetition, a measure of children's educational attainment.

There is a good deal of evidence relating overcrowded conditions to ill health in children. Overcrowding leads to a higher incidence of respiratory illness (Mann *et al.*, 1992), and of stomach infections (Galpin *et al.*, 1992), and Coggon *et al.* (1993) report that overcrowding was related to a higher probability of death from all causes in a sample of English children.

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[7] On the 1990 Census form, respondents are instructed to classify their dwelling as "Rented for cash rent" if any money is paid, even if the rent is paid by persons who are not members of the household, or by a federal, state, or local government agency. Most project residents should be in this category. Other categories include: owned by respondent or by someone in the household with a mortgage or loan; owned by respondent or someone in the household free and clear (without a mortgage); and occupied without cash rent (e.g. tenant sharecroppers or military personnel). Renter respondents are given the following instructions. "Answer only if you pay rent for this house or apartment -- what is the monthly rent?" The answer categories are: 0-$80,$80-$99, $100-$124, $125-$149, ... , $525-$549, $550-$599, ..., $700-$749, $750-$999, and $1000 or more. The supporting documentation (which is not on the questionnaire itself) explains, "Report the rent agreed to or contracted for, even if the rent for your house, apartment, or mobile home is unpaid or paid by someone else." It is not clear how a project resident would interpret this question. In 1990 the American Housing Survey changed from asking a similar question about the monthly rent to asking about both the monthly contract rent and the rent actually paid by subsidized families. We find (using the MSA sample) that among project residents in the 1990 to 1994 AHS the mean contract rent was $254 compared to a mean amount actually paid of $155 (nominal dollars).

[8] See for example, Crews (1996) who uses data from the 1987 American Housing Survey, groups project and voucher recipients together, and finds an increase in rental payments of about 4 percent.

High density residential complexes contribute to social malaise among their residents. Fischer and Baldassare (1975) state that density is disliked, makes most people uncomfortable, and reduces local social interaction. This malaise may be linked to higher crime rates. For example, Condon (1991) finds that crime rates were lower in low-rise buildings than in high-rise buildings in the same Chicago projects. Atlas and Dreier (1993) cite similar evidence for New York showing that crime rates are lower in low-rise projects. In any case, HUD is actively engaged in replacing the most notorious large high-rise public housing complexes with low-rise "garden" apartments. For example, two high-rises in the Henry Horner Homes in Chicago, the setting for Alex Kotlowitz's shocking book "There Are No Children Here" (1996) are being demolished to make way for 700 townhouses to be located throughout Chicago's west side (HUD, 1996).

The measure of schooling attainment we use is whether a child has been held back one or more grades. Academic performance in early grades has been shown to be a significant predictor of eventual high-school completion (c.f. Barrington and Hendricks, 1989; Cairns *et al.*, 1989; Grissom and Shepard, 1989; and Ensminger and Slusarcick, 1992), which in turn is linked to future employment probabilities and earnings. Thus, our three outcome measures are intended to capture important dimensions of the child well-being that may be affected by public housing including health, exposure to crime, and academic achievement.

Part II: Methods

There are two important empirical problems facing us. The first is that the outcomes we examine are recorded in the Census data, but the Census does not have information about whether or not the family lives in a public housing project, the key right-hand-side variable of interest. One approach to this problem is to use data from a second source to impute a probability of living in public housing to each family. We use data from HUD's "A Picture of Subsidized Housing" (HUD, 1997) for this purpose.

This data set provides cross-sectional information at the individual project level about the fraction of project residents who fall into various race, income, age, and marital status categories, and it also gives the number of units in the project. All the information pertains to 1995/96. We use this information to form a rough estimate of the number of project units in each MSA that are allocated to families in each of a number of income/race/age/marital status/size-of-building categories, as described in the appendix. We then use the Census data to calculate the number of families living in apartments in each MSA who fall into each category. Dividing the first number by the second gives us an estimate of the fraction of households of a particular type who live in projects in each MSA.

Table 1 illustrates the variation in this measure for two MSAs, Boston and Chicago. Table 1 shows that as one might expect, the probability of living in a project varies considerably with income and with demographic characteristics. For example, in Boston, an unmarried parent with an income between $5,000 and $20,000 who is living in a complex with over 50 units is very likely to be living in a project. The table also illustrates that much of the variation in this constructed measure occurs across MSAs. In Chicago, the probability that the household described above lives in a project ranges from 24 to 39 percent depending on race and income.

We include this noisy measure of the probability of living in a project (PROJ%) in an Ordinary Least Squares (OLS) regression of the form:

(1) $OUTCOME = \alpha_0 + \alpha_1 PROJ\% + \alpha_2 X + u,$

where the OUTCOME variables include measures of housing overcrowding, density, and grade repetition which are discussed in greater detail below, and X is a vector of additional exogenous explanatory variables including controls for the household head's gender, age, race, education, and marital status. When OUTCOME refers to child educational attainment, dummy variables for the child's age and sex are also included in X. This procedure gives a baseline "OLS" estimate of the effect of projects on outcomes. Note that it is likely to be biased towards zero by random measurement error in our imputation procedure.

The second empirical problem facing us is that whether or not a family lives in a project reflects choices made by both households and program administrators. Many unobserved factors such as whether the family can double-up with friends and relatives or has recently been homeless are likely to affect both participation and outcomes. Thus, no matter how accurately we imputed whether or not a family lived in a project, OLS estimates obtained using these imputations would be subject to omitted variables bias. Our expectation is that omitted variables will bias the estimated effects of living in projects downwards since families in projects may be more likely to live in substandard housing in any case, and their children may be more likely to experience negative outcomes. Other factors that may affect participation and outcomes are observed, but either poorly measured or also endogenous (e.g. income from other welfare programs).

We attempt to circumvent this selection problem by using an instrumental variables strategy. Under HUD rules, the sex composition of children in the household affects the number of bedrooms in the subsidized unit, and therefore affects the size of the subsidy the family is eligible for. Except in the case of very young children, boys and girls cannot be required to share bedrooms, and there can be no more than two children per bedroom.[9] Thus, a family with two boys would be eligible for a two-bedroom apartment while a family with a boy and a girl would be eligible for a three-bedroom apartment. In what follows, we restrict the analysis to families with exactly two related children under 18 in the household in order to focus on the effects of sex composition and abstract from any effects due to the number of children. Families eligible for larger apartments (i.e. higher subsidies) should be more likely to live in public housing projects other things being equal.

In order for sex composition to be a valid instrument, it must also be the case that it has no

[9] HUD requires that "The dwelling unit shall contain at least one bedroom or living/sleeping room of appropriate size for each two persons. Persons of opposite sex, other than husband and wife or very young children, shall not be required to occupy the same bedroom or living/sleeping room" (U.S. Department of Housing and Urban Development, 1993 p. 188). This rule appears to have been in effect at least since the early 1980s.

independent effect on our outcome measures, however. There is little reason to expect that sex composition will affect overcrowding (at least as we define it below) or density. But there is controversy in the literature about whether sex composition affects educational attainment. Butcher and Case (1994) argue that for girls, the presence of any sisters reduces educational attainment. They find no effect of sex composition among boys. A closer inspection of their reported findings indicates that in two child families they find significant sex composition effects only in the Panel Study of Income Dynamics, and not in the Current Population Survey or National Longitudinal Survey of Women data sets. Kuo and Hauser (1996) argue that it is difficult to find any consistent effect of sex composition on educational attainment, while Kaestner (1997) is unable to replicate the Butcher and Case findings using the National Longitudinal Survey of Youth (NLSY). It is possible that their result holds for older cohorts, but not for the younger group observed in the NLSY.

All of these studies focus on completed educational attainment. It is possible that sex composition has no effect on the probability of being held back, but does have some small effect on girl's completed years of schooling. In any case, we will keep the Butcher and Case results in mind and report the effects of project participation on the probability that boys are held back below--if sex composition matters only for girls, then sex composition should be a valid instrument in a sample of boys.[10]

Our method of imputing the probability of public housing participation from the HUD data made no use of the sex composition of children in the household, since this is not recorded in "A Picture of Subsidized Housing." Thus, other things being equal a family with a boy and a girl and a family with two boys will have the same imputed probability of living in a project, and our proposed instrument is orthogonal to PROJ%. Hence, we cannot estimate (1) using standard instrumental variables techniques and we turn to the TSIV approach.

As discussed in Angrist and Krueger (1992, 1995), TSIV is appropriate in situations in which the

[10] See Angrist and Evans (1996) for use of this sex composition instrument in another setting.

outcomes are available in one data set, the endogenous regressor is available in a second data set, and both data sets contain the instrumental variable and the other exogenous variables included in the model. We use the March CPS as the second data set. It contains information about whether or not the family lives in a public housing project, about the sex composition of the children in the household, and about a wealth of other potential control variables, such as parental education, which are expected to influence outcomes.

In our application, the TSIV method involves estimating the first stage equation predicting project residence using the CPS:

$$(2)\ \text{PROJECT} = \beta_0 + \beta_1\text{EXTRA} + \beta_2 X + v,$$

where PROJECT is a dummy variable equal to one if the family lives in a project, and EXTRA is a dummy variable equal to one if the family has a boy and a girl, and equal to zero if they have two boys or two girls.

In the second stage, the estimated coefficients from the first stage are used to predict project residence, PROJECT^* in the Census data, and this predicted probability is included in models of outcomes estimated using Census data:

$$(3)\ \text{OUTCOME} = \gamma_0 + \gamma_1\text{PROJECT}^* + \gamma_2 X + \varepsilon.$$

The standard errors are then corrected to account for the fact that a predicted value of PROJECT is used in the second stage. Angrist and Krueger show that this procedure produces consistent estimates of the effect of the endogenous variable, PROJECT.

Part III: Data

The outcomes we focus on are recorded in the 1990 Census 1% and 5% Public Use Microdata Samples (PUMS). The Census asks about characteristics of the housing occupied by households. We focus on two variables: Whether or not the family lives in high density housing which is defined as a building with over 50 units; and whether or not the family is overcrowded, which we define as having a

greater number of family members than the number of bedrooms/living rooms plus one.[11] Unfortunately, the smallest geographical unit identified in the PUMS is the MSA, so it is not possible to look at the effects of project participation on neighborhood characteristics.

The Census does not ask about grade repetition *per se*, but does ask about children's educational attainment. The answers are grouped as follows: nursery school, kindergarten, grades 1 to 4, grades 5 to 8, grade 9, grade 10, grade 11, and higher grades (which are not relevant for our purposes). We define children as having been "held back" at least one grade if they are 6 years old and have not completed nursery school; if they are 7 years old and have not completed kindergarten; if they are 8 to 11 years old and are not in at least grades 1 to 4; if they are 12 to 15 years old and are not in at least grades 5 to 8; if they are 16 years old and have not completed grade 9; and if they are 17 years old and have not yet completed grade 10.

Because grades are grouped together, the probability of being held back varies with the child's age -- for example, as shown in Appendix Table 3, we classify 4.5 percent of 8-year-olds as being held back, but only less than 1 percent of 11-year-olds because we cannot distinguish in the data between an 11-year-old in grade 4, and an 11-year-old in grade 1 or 2. Only 11-year-olds who are lagging very far behind (they are in less than grade 1) can be classified for certain as "held back." The probability of being classified as held back rises to 6.1 percent for 12-year-olds, and 6.7 percent for 16-year-olds, so our measure does rise with age as it should, among children for whom "held back" is defined in approximately the same way. In order to deal with this measurement problem, we include single year of age dummies in the models of "held back." We also repeat our analyses for the subsample of children for whom "held

[11] We focus on families that are severely overcrowded in order to avoid picking up a relationship between crowding and sex composition of the children that is not due to incentives for participation in public housing. Suppose for example that a family with a married couple and one boy lived in a two bedroom apartment (one bedroom plus one living room). They would not be classified as overcrowded. If the couple had a second boy, they might choose to remain in the same apartment, whereas if they had a girl, they might prefer to have a three bedroom apartment. Our definition would treat the two families in the same way; neither would be classified as overcrowded.

back" is defined most similarly (8, 12, 16, and 17-year-olds), and for a sample that excludes 6- and 7-year-olds, since among these children, low educational achievement may reflect delays in starting school rather than failure to complete a grade. Although the Census data on children's education is imperfect, it is better than that available in either the CPS or the Survey of Income and Program Participation which ask about education only for children 15 and older.

As discussed above, we focus on households with two related children under 18. There are a number of additional screens applied to the Census data. We exclude individuals in households with members over the age of 61, since they may be eligible for public housing on the grounds of age. We also exclude individuals without a uniquely identified MSA, since it is not possible to match them to the HUD data. In fact, since we go on to match Census data with information from the CPS, we focus on the subset of MSAs that are identified in the CPS.[12] This restriction has the effect of eliminating project residents in some smaller towns from our sample. But anecdotal evidence as well as HUD evaluations suggest that it is the largest projects that are most troubled, and these projects are unlikely to be located in small urban areas. Hence, this sample restriction is likely to exaggerate any negative effects of projects.

We also restrict attention to households in which the head and spouse (if present) are over the age of 17. Finally, we restrict attention to household heads in order to arrive at one observation per family for our analysis of housing characteristics. We call the resulting 442,447 households the "housing sample."

The sample we use for examining educational attainment is somewhat different, since the unit of observation is the child, and the children must be between 6 and 17 years old, inclusive. Applying these tests results in a "child sample" of 562,218 children in 341,321 households. Appendix Table 1 shows the number of observations that are lost as each screen is applied.

Table 2 shows the means of the outcome variables in the Census data, by imputed participation

[12] The CPS identifies the 113 largest MSAs, plus 89 selected MSAs, and 66 selected PMSAs.

rates. The first column is primarily composed of people who we know are not living in projects because they own their own home. The second column is composed of renters who we judge to have a very low probability of living in a project given their own demographic characteristics and the composition of the housing projects in their MSA. The third column contains the relatively few people who have a higher probability of living in a project. The table shows that rent falls as the probability of living in a project rises, as does the probability of living in overcrowded or dense conditions and the probability that a child has been held back. Thus, these raw means suggest the possibility that families sacrifice both housing quality and at least some child outcomes in order to take advantage of lower rental payments in projects. Families in projects are also more likely to be headed by single parents, blacks, and persons with less than a high school education.

The CPS sample used to estimate the first stage equations is estimated using the data drawn from the pooled 1990 to 1995 March surveys. Applying essentially the same screens as in the Census data results in a "housing sample" of 32,098 households, and a "child sample" of 39,935 children. The number of observations lost when each screen is applied is shown in Appendix Table 2.

In view of the move towards certificate and voucher programs that was noted in the introduction, it would be of interest to examine the effects of these programs. Our focus on participation in projects is dictated by the limitations of the CPS data on public housing participation. The fundamental problem is that the CPS asks specifically about projects ("Is this house in a public housing project, that is, is it owned by a local housing authority or other public agency?"), but is not very specific when asking about participation in other types of public housing programs ("Are you paying lower rent because the federal, state, or local government is paying part of the cost?"). The second question covers Section 8 Certificate and Voucher Programs, but it also covers Section 8 Moderate Rehabilitation, and Section 8 New, and Substantive Rehabilitation Programs as well as various other subsidy programs. Administrative data from HUD's "Picture of Subsidized Housing" indicates that less than half of the households answering "Yes"

to the second program are likely to be participating in certificate or voucher programs.

It might still be the case however, that the MSA-level variation in the fraction of households answering "Yes" to the rent subsidy question is driven by differences in participation rates in the voucher program across MSAs. However, when we examined this correlation, we found little evidence of a relationship. In contrast, there is a strong cross-MSA correlation between the fraction participating in projects in the CPS data, and the fraction participating in projects in the HUD data. Thus, the CPS questions can be used for looking at project participation but cannot be used to identify the effects of voucher programs.[13]

A second limitation of the CPS participation data is that it refers to whether or not a household was living in public housing in March of the survey year. The effects of public housing on schooling attainment cannot be expected to be instantaneous--thus, our estimates of the effects of participation on the probability of being held back are only meaningful if current residence in a project is a marker for probable longer term residence. The HUD administrative data speak to this issue--the average length of time since the household moved in is 7 years with a standard deviation of about 5 years, and the average total stay of households is 12 years.

The first two columns of Table 3 show means of the CPS data used to estimate the first stage by whether or not the household lives in a project. A comparison of columns 1 and 2 indicates that households who live in projects are more likely to be eligible for an extra bedroom: 54 percent of these households have a boy and a girl compared to 50 percent of households outside of projects. Table 3 also

[13] It is also possible that some households that participate in voucher programs are wrongly classified as participating in projects (though we feel that the CPS question is very clear about what a project is). In this case, what we identify as project effects might in reality be effects of voucher programs. In order to address this problem, we tried limiting the sample to MSAs in which the administrative data indicated that a relatively high proportion of public housing units were located in projects. Unfortunately, the variation in the fraction of units that are located in projects is not high--it varies from about 40 percent to about 60 percent across most MSAs. Thus, this experiment reduced our sample size without eliminating much if any reporting error.

confirms that as discussed above, households in projects are likely to be disadvantaged along a number of observable dimensions.

The next four columns of Table 3 divide the CPS and Census samples by whether or not the family is entitled to an extra bedroom. The families in columns 3 and 5 have a boy and a girl, whereas families in columns 4 and 6 have either two boys or two girls. The raw CPS data in the first row shows that families who are entitled to an extra bedroom are 17 percent more likely to live in a project. However, the remainder of the table shows that these families also differ from other families in some respects -- in particular, they are less likely to be female-headed. Differences in the observable characteristics of families will be controlled for in the model estimated below.

Finally, a comparison between the CPS figures shown in columns 3 and 4 of Table 3 and the Census figures shown in columns 5 and 6 suggests that there are only slight differences between the two samples. One exception is that the Census families are less likely to be female-headed, and less likely to be classified as Hispanic rather than "other origin."[14]

Part IV: Results

a) OLS estimates using imputed project participation

OLS estimates of equation (1) are shown in Table 4 for two outcome variables: Whether or not the family is overcrowded and whether the child has been held back. Due to the fact that we used housing density to impute the probability of project participation, density is mechanically related to PROJ% so this outcome is omitted from this table. Only the coefficients on PROJ% are shown. The first row of this

[14] There is some discrepancy between the CPS and the Census in the number of married/spouse present households who report that the household head is female (94 percent in the Census compared to 89 percent in the pooled CPS sample). Hence, in order to use the same definition of "female headed" in the two samples, we have adopted the conservative strategy of assuming that the household head is male in these cases. Hispanic is derived from the "detailed Hispanic origin code" in the Census, and from the "origin" code in the CPS. We coded any respondent who answered "yes" to Hispanic ethnicity as hispanic regardless of racial origin (white/black/other).

table reports estimates from models without other covariates and confirms that, as one might expect on the basis of Table 2, families with a higher probability of participating in projects are more likely to suffer from overcrowding, and their children are more likely to have been held back in school.

The second row of Table 4 reports the coefficient on PROJ% from models that include dummy variables for all the demographic and income categories used to construct the project participation rate. Hence these models identify the effects of projects by relying on cross-MSA variation in the availability of project units to households of different types. Controlling for demographic differences between project residents and other households in this way dramatically reduces the estimated effects of projects: The estimated effect of project residence on the probability that children are held back is reduced to statistical insignificance, although project residents are still slightly more likely to suffer from overcrowding.

Recall, that as discussed above, we expect measurement error in PROJ% to bias these coefficients towards zero. Thus, the true "OLS" estimate of the effect of housing projects (i.e. what we would find in a data set that had both outcomes and project participation) may be more negative. A second problem is that if the placement and demographic composition of housing projects is endogenous or reflects characteristics of MSAs which are themselves correlated with our outcome measures (such as high poverty rates), then geographic variation in the character and availability of project units is not a legitimate source of identifying variation. It might be the case for example, that MSA-level variation in PROJ% was correlated with variation in school quality or the extent of racial segregation in the housing market. Hence, we turn to TSIV to try to identify the "true" causal effect of project residence on outcomes.

b) TSIV estimates

The first stage estimates of equation (2) are shown in Table 5 separately for renters only and for the full sample. Within each group, we also show estimates for the child sample, and for the housing sample. In all four samples, the extra bedroom/sex composition variable is a highly significant

determinant of project participation with t-values ranging between 3 and 4. To understand the magnitude of this effect, consider the coefficient estimate in the third column (the housing sample, including both homeowners and renters). The baseline participation rate in projects is 3.35 percent, while the marginal effect of adding an extra bedroom is 0.80 percentage points. Thus, adding an extra bedroom increases the likelihood of project participation by 24 percent. The other controls included in the model indicate that participation declines with the age of the head, is much lower for married heads, and is highest among blacks and those with less than a high school education. The dummy variables for child age are not individually or jointly statistically significant, indicating that the probability of living in a project does not vary with child age.

TSIV estimates of equation (3) appear in Table 6 for the subsample of renters. We focus initially on this subsample so that we can follow the existing public housing literature and look at the estimated effect of project participation on reported rent. Column 1 of Table 6 shows that the effect is positive and statistically significant, a finding that suggests that many households are reporting the rental value of their accommodations rather than what they actually pay. If this is the case, then the estimates in column 1 suggest that families in projects live in housing of better quality than the housing they would otherwise have inhabited.

This interpretation is supported by the point estimates in columns 2 and 3 of Table 6, which show that these households are less likely to be overcrowded, and also less likely to live in large, dense, complexes, although these effects are not statistically significant. Finally, column 4 suggests that families in projects are not trading off physical housing amenities against other factors that harm child outcomes -- children in the projects are 12 percentage points less likely to have been held back than children in other rental accommodation. The other demographic variables included in these models have the expected signs. Families whose heads are older, married, white, and better educated tend to have better outcomes, whether or not they live in projects. The child age dummies are individually statistically significant and pick up

the pattern of classification error discussed above and documented in Appendix Table 3: For example, the estimated probability of being held back rises sharply between the ages of 11 and 12, and then falls again until the child reaches age 16.

Table 7 repeats the TSIV analysis of the overcrowding, density, and grade repetition outcomes for the full sample of children. The estimates are qualitatively similar to those discussed above but the point estimates are larger in absolute value, so that the results are stronger in terms of statistical significance. In our opinion this specification is to be preferred because families choose whether to be renters or homeowners, and this choice may be influenced by public housing programs. These estimates suggest that when unobserved characteristics of families are controlled for, participation in projects has significantly positive effects on both housing quality and child outcomes.

As discussed above, there is some controversy in the literature about whether sex composition is a valid instrument for educational attainment, at least for girls. When we restrict the sample to boys only, the estimated reduction in the probability of being held back is -.25 with a standard error of .10. For girls, the corresponding coefficient and standard error is -.09 and .09. Thus, it appears that the beneficial effects of projects on schooling attainment are confined to boys.

We also repeat our analyses for the subsample of children for whom "held back" is defined most similarly (8, 12, 16, and 17-year-olds). The estimated effects of projects on the probability of being held back are stronger, which is what one might expect given that in this subsample, the probability of being correctly classified as being held back is much higher. The coefficient increases to -.76 with a standard error of .41. In addition we reestimate the model excluding 6- and 7-year-olds, because for these children, low educational achievement may reflect delays in starting school rather than failure to complete a grade. Restricting the sample in this way results in a coefficient estimate of -.17 with a standard error of .08, which is nearly identical to that obtained using the full sample.

Finally, we explore the robustness of our estimates to some additional changes in specification in

Appendix Table 4. In particular, we show that our results are not sensitive to the inclusion of family income, or to the exclusion of variables measuring family structure and marital status. The point estimates and standard errors are very similar to those reported in the main tables. We also show that the effects of public housing are largest when the head has low educational attainment, as one might expect if our estimates are really picking up the effects of housing programs.

Part V: Discussion and Conclusions

Although it is widely assumed that public housing projects are bad for children, there is little empirical research on this question. A likely reason is that there are few large data sets that combine information about project participation, housing quality, and child outcomes. In this paper, we combine information from several sources in order to take a first look at the effects of project participation on housing quality and on educational attainment, a very important child outcome.

In view of the negative public image of public housing projects, our results are surprising. While the correlation between project participation and the outcomes we examine is negative, we conclude that this is due to unmeasured characteristics of project participants. When these characteristics are controlled for using TSIV techniques, we find that projects actually have positive effects on both housing quality and children's academic achievement suggesting that project families are not in fact forced to choose between the two. These results do not imply that the recent shift away from projects is misguided. It is possible for example, that these same children would be better served by a voucher program.[15] But they do suggest that projects as a group have been wrongly vilified. Atlas and Dreier (1993) point out that "Public housing seems to many Americans a metaphor for the failures of activist government...", but perhaps they are correct that in reality "the best kept secret about public housing is that most of it actually provides decent affordable housing to many people".

[15] This question is the subject of ongoing research (c.f. Katz, Kling, and Leibman, 1997).

One important limitation of our work is that we are unable to assess the effects of participation in projects on neighborhood quality because the Census Public Use Samples do not contain Census tract or county identifiers. Linking geographic information of this kind to our data would allow a more direct test of hypotheses about the relationship between housing projects and neighborhoods.

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Table 1: Imputation of Public Housing Participation Rates for Renters, Where the Head is Aged 25 to 44.

	Boston MSA							
	Head is minority				Head is not minority			
	$0≤ Income <$5000	$5000≤ Income <$10,000	$10,000≤ Income <$20,000	Income ≥$20,000	$0≤ Income <$5000	$5000≤ Income <$10,000	$10,000≤ Income <$20,000	Income ≥$20,000
Unmarried, <50 units	.0005	.0114	.0070	.0027	.0000	.0063	.0066	.0010
Unmarried, 50+ units	.3606	1.0000	1.0000	.1383	.2820	1.0000	.7927	.2237
Married, <50 units	.0000	.0082	.0045	.0007	.0000	.0098	.0036	.0001
Married, 50+ units	.0283	1.0000	.2153	.0147	.0454	.0000	.7419	.0099
	Chicago MSA							
Unmarried, <50 units	.0016	.0018	.0017	.0004	.0006	.0013	.0011	.0001
Unmarried, 50+ units	.9880	.3685	.3937	.0452	.6666	.3066	.2444	.0027
Married, <50 units	.0003	.0007	.0002	.0001	.0000	.0022	.0006	.0001
Married, 50+ units	.2847	.1414	.0284	.0013	.0000	.0555	.0119	.0000

Notes: Those in the Census who report being a homeowner receive a probability of zero. When an imputed probability was greater than 1, it was rounded down to 1.0000.

Table 2: Variable Means Based on Imputed Participation Rates (Standard Errors)

	Project Participation = 0	0<Project Participation<.05	Project Participation≥.05
Imputed participation rate	0 (0)	.004 (.000)	.325 (.006)
Child held back	.031 (.000)	.042 (.000)	.048 (.003)
Monthly rental payment/1000	.604 (.001)	.521 (.001)	.379 (.003)
Family is overcrowded	.030 (.000)	.089 (.001)	.119 (.005)
Dense building	.005 (.000)	.050 (.000)	.673 (.007)
Head's age	37.801 (.012)	34.133 (.030)	35.205 (.169)
Head married	.869 (.000)	.419 (.002)	.219 (.007)
Head female	.106 (.000)	.511 (.002)	.724 (.007)
Head black	.084 (.000)	.323 (.001)	.462 (.008)
Head other	.082 (.000)	.185 (.001)	.244 (.007)
Head hispanic origin	.088 (.000)	.242 (.001)	.305 (.007)
9 ≤ Head's education ≤ 11	.091 (.000)	.218 (.001)	.306 (.007)
Head's education = 12	.253 (.000)	.308 (.001)	.295 (.007)
13 ≤ Head's education ≤ 15	.304 (.000)	.274 (.001)	.217 (.007)
Head's education ≥ 16	.313 (.000)	.106 (.001)	.058 (.003)
Number of family members	4.122 (.001)	3.823 (.003)	3.640 (.014)
Number of observations	379,765	59,232	3,450

Notes: For variables dealing with children (held back), means and standard errors drawn from the "child sample"; otherwise, means and standard errors from "housing sample."

Table 3: Variable Means (Standard Errors)

	CPS		CPS		Census	
	Projects=1	Projects=0	Extra Bedroom=1	Extra Bedroom=0	Extra Bedroom=1	Extra Bedroom=0
Participation in public housing	1 (0)	0 (0)	.036 (.001)	.030 (.001)	---	---
Extra bedroom	.543 (.015)	.495 (.002)	1 (0)	0 (0)	1 (0)	0 (0)
Child held back	---	---	---	---	.031 (.000)	.033 (.000)
Monthly rental payment/1000	---	---	---	---	.568 (.001)	.558 (.001)
Family is overcrowded	---	---	---	---	.038 (.000)	.040 (.000)
Dense building	---	---	---	---	.016 (.000)	.017 (.000)
Child's age	10.723 (.096)	11.062 (.017)	11.021 (.023)	11.085 (.024)	11.046 (.006)	11.077 (.006)
Child is girl	.464 (.014)	.484 (.002)	.495 (.003)	.472 (.003)	.499 (.000)	.472 (.000)
Head's age	32.867 (.256)	37.496 (.042)	37.084 (.057)	37.595 (.062)	37.291 (.015)	37.288 (.016)
Head married	.256 (.013)	.796 (.002)	.789 (.003)	.766 (.003)	.810 (.000)	.797 (.000)
Head female	.729 (.013)	.180 (.002)	.191 (.003)	.206 (.003)	.161 (.000)	.170 (.000)
Head black	.479 (.015)	.107 (.001)	.115 (.002)	.123 (.002)	.116 (.000)	.122 (.000)
Head other	.062 (.007)	.054 (.001)	.055 (.001)	.054 (.001)	.097 (.000)	.097 (.000)
Head hispanic origin	.235 (.012)	.169 (.002)	.169 (.002)	.174 (.002)	.110 (.000)	.111 (.000)
$9 \leq$ Head's education ≤ 11	.251 (.013)	.088 (.001)	.092 (.002)	.096 (.002)	.108 (.000)	.111 (.000)
Head's education = 12	.416 (.015)	.319 (.002)	.317 (.003)	.328 (.003)	.261 (.000)	.261 (.000)
$13 \leq$ Head's education ≤ 15	.193 (.012)	.252 (.002)	.255 (.003)	.245 (.003)	.299 (.000)	.299 (.000)
Head's education $\geq$ 16	.041 (.006)	.284 (.002)	.280 (.003)	.272 (.003)	.285 (.000)	.281 (.000)
Number of family members	3.409 (.019)	3.991 (.003)	3.946 (.004)	3.997 (.005)	4.077 (.001)	4.080 (.001)
Number of observations	1,074	31,024	15,947	16,151	227,484	214,963

Notes: For variables dealing with children (held back, child's age, and child's gender), means and standard errors drawn from the "child sample"; otherwise, means and standard errors from "housing sample."

Table 4: OLS Results using Imputed Project Participation Rates from HUD Data Linked To the Census PUMS Data

	Family is overcrowded	Child was held back
Without Covariates:		
Imputed Participation Rate	.1336 (.0074)	.0284 (.0077)
Controlling for Demographic Categories:		
Imputed Participation Rate	.0267 (.0067)	-.0094 (.0076)
Sample	Housing Sample	Child Sample
Number of observations	442,447	562,218

Notes: Standard errors in second column are corrected for multiple children in same household.

Table 5: Results from CPS First Stage Regression on Public Housing Participation

	Renters Only		Renters and Homeowners	
Extra bedroom	.0200 (.0051)	.0205 (.0063)	.0080 (.0019)	.0068 (.0020)
Child's age 7	---	.0070 (.0099)	---	.0021 (.0037)
Child's age 8	---	.0015 (.0104)	---	.0001 (.0037)
Child's age 9	---	.0153 (.0108)	---	.0042 (.0039)
Child's age 10	---	.0127 (.0111)	---	.0033 (.0038)
Child's age 11	---	.0097 (.0109)	---	.0029 (.0038)
Child's age 12	---	-.0001 (.0112)	---	-.0005 (.0038)
Child's age 13	---	.0106 (.0117)	---	-.0005 (.0038)
Child's age 14	---	.0146 (.0118)	---	.0044 (.0039)
Child's age 15	---	.0069 (.0127)	---	.0023 (.0041)
Child's age 16	---	-.0017 (.0125)	---	-.0004 (.0041)
Child's age 17	---	-.0220 (.0120)	---	-.0049 (.0040)
Child is girl	---	-.0118 (.0047)	---	-.0035 (.0015)
Head's age	-.0108 (.0023)	-.0087 (.0036)	-.0100 (.0009)	-.0088 (.0016)
Head's age^2/100	.0133 (.0031)	.0100 (.0047)	.0112 (.0012)	.0094 (.0019)
Head married	-.0095 (.0112)	-.0127 (.0137)	-.0061 (.0051)	-.0058 (.0067)
Head female	.0834 (.0110)	.0800 (.0136)	.0659 (.0052)	.0618 (.0072)
Head black	.1131 (.0069)	.1037 (.0104)	.0820 (.0031)	.0696 (.0056)
Head other	.0332 (.0102)	.0401 (.0122)	.0212 (.0042)	.0226 (.0052)
Head hispanic origin	-.0051 (.0064)	-.0026 (.0077)	.0042 (.0028)	.0064 (.0036)
9 ≤ Head's education ≤ 11 years	.0046 (.0106)	-.0174 (.0147)	.0052 (.0052)	-.0070 (.0088)
Head's education = 12 years	-.0218 (.0098)	-.0357 (.0132)	-.0217 (.0046)	-.0294 (.0074)
13 ≤ Head's education ≤ 15 years	-.0419 (.0105)	-.0357 (.0132)	-.0316 (.0048)	-.0396 (.0074)
Head's education ≥ 16 years	-.0477 (.0118)	-.0671 (.0136)	-.0302 (.0048)	-.0388 (.0072)
Number of family members	-.0160 (.0048)	-.0671 (.0136)	-.0120 (.0018)	-.0074 (.0019)
Constant term	.3203 (.0485)	-.0671 (.0136)	.2916 (.0208)	-.0074 (.0019)
Sample	Housing Sample	Child Sample	Housing Sample	Children's Sample
Number of observations	11,554	12,713	32,098	39,935
R^2	.0856	.0766	.0972	.0844

Notes: Standard errors in the second and fourth columns are corrected for multiple children in same household.

Table 6: Results from Census using Two Sample IV, Renters Only

	Monthly Rental Payment/1000	Family is overcrowded	Dense Building	Child was held back
Participation in public housing	.4140 (.0658)	-.0691 (.0689)	-.0930 (.0588)	-.1237 (.0501)
Child's age 7	---	---	---	-.0597 (.0024)
Child's age 8	---	---	---	-.0391 (.0026)
Child's age 9	---	---	---	-.0613 (.0025)
Child's age 10	---	---	---	-.0745 (.0022)
Child's age 11	---	---	---	-.0745 (.0022)
Child's age 12	---	---	---	-.0109 (.0031)
Child's age 13	---	---	---	-.0525 (.0026)
Child's age 14	---	---	---	-.0642 (.0025)
Child's age 15	---	---	---	-.0711 (.0023)
Child's age 16	---	---	---	.0325 (.0039)
Child's age 17	---	---	---	.0712 (.0044)
Child is girl	---	---	---	-.0108 (.0011)
Head's age	.0239 (.0009)	-.0043 (.0009)	-.0019 (.0008)	-.0069 (.0007)
Head's age^2/100	-.0262 (.0011)	.0029 (.0012)	.0037 (.0010)	.0075 (.0009)
Head married	.0121 (.0030)	-.0488 (.0032)	.0010 (.0027)	-.0131 (.0026)
Head female	-.0890 (.0063)	-.0008 (.0066)	.0150 (.0056)	.0015 (.0048)
Head black	-.1436 (.0076)	.0360 (.0080)	.0560 (.0068)	.0077 (.0053)
Head other	-.0258 (.0030)	.1166 (.0032)	.0271 (.0027)	.0027 (.0026)
Head hispanic origin	-.0235 (.0020)	.0973 (.0021)	.0445 (.0018)	-.0036 (.0016)
9 ≤ Head's education ≤ 11 years	.0532 (.0028)	-.1011 (.0029)	.0164 (.0025)	-.0235 (.0027)
Head's education = 12 years	.1029 (.0031)	-.1170 (.0032)	.0147 (.0027)	-.0314 (.0031)
13 ≤ Head's education ≤ 15 years	.1753 (.0039)	-.1189 (.0041)	.0167 (.0035)	-.0407 (.0039)
Head's education ≥ 16 years	.3012 (.0044)	-.1099 (.0046)	.0353 (.0039)	-.0454 (.0043)
Number of family members	.0563 (.0013)	.1231 (.0014)	-.0061 (.0012)	.0051 (.0010)
Constant term	-.2583 (.0248)	-.1877 (.0260)	.0548 (.0222)	.2635 (.0204)
Sample	Housing Sample	Housing Sample	Housing Sample	Child Sample
Number of observations	134,052	134,052	134,052	160,174
R^2	.2147	.2439	.0155	.0481

Notes: Standard errors in fourth column are corrected for multiple children in same household.

Table 7: Results from Census using Two Sample IV, Renters and Homeowners

	Family is overcrowded	Dense Building	Child was held back
Participation in public housing	-.1030 (.0642)	-.1318 (.0476)	-.1717 (.0719)
Child's age 7	---	---	-.0512 (.0012)
Child's age 8	---	---	-.0229 (.0014)
Child's age 9	---	---	-.0457 (.0012)
Child's age 10	---	---	-.0623 (.0011)
Child's age 11	---	---	-.0621 (.0011)
Child's age 12	---	---	-.0041 (.0015)
Child's age 13	---	---	-.0418 (.0013)
Child's age 14	---	---	-.0537 (.0012)
Child's age 15	---	---	-.0595 (.0012)
Child's age 16	---	---	.0018 (.0017)
Child's age 17	---	---	.0188 (.0018)
Child is girl	---	---	-.0079 (.0005)
Head's age	-.0045 (.0006)	-.0031 (.0005)	-.0063 (.0007)
Head's age^2/100	.0025 (.0007)	.0035 (.0005)	.0066 (.0008)
Head married	-.0585 (.0015)	-.0073 (.0011)	-.0133 (.0017)
Head female	-.0024 (.0045)	.0180 (.0033)	.0049 (.0047)
Head black	.0250 (.0053)	.0416 (.0039)	.0115 (.0050)
Head other	.0852 (.0016)	.0211 (.0012)	.0028 (.0018)
Head hispanic origin	.0818 (.0010)	.0281 (.0007)	-.0008 (.0011)
9 ≤ Head's education ≤ 11 years	-.0970 (.0015)	.0056 (.0011)	-.0175 (.0018)
Head's education = 12 years	-.1191 (.0019)	-.0020 (.0014)	-.0307 (.0026)
13 ≤ Head's education ≤ 15 years	-.1213 (.0024)	-.0037 (.0018)	-.0367 (.0032)
Head's education ≥ 16 years	-.1179 (.0024)	-.0007 (.0017)	-.0381 (.0032)
Number of family members	.0867 (.0008)	-.0048 (.0006)	.0040 (.0007)
Constant term	-.0384 (.0198)	.1008 (.0146)	.2416 (.0207)
Sample	Housing Sample	Housing Sample	Child Sample
Number of observations	442,447	442,447	562,218
R^2	.2146	.0197	.0284

Notes: Standard errors in third column are corrected for multiple children in same household.

Appendix Table 1: Sample Screens from the Census, 1990		
	Census 1% Public Use Microdata Sample	Census 5% Public Use Microdata Sample
1. Initial number of person records	2,500,052	12,501,046
2. Household has 2 related children under age 18	520,418	2,598,587
3. Uniquely identified state	511,364	2,598,587
4. Uniquely identified MSA	352,619	1,654,325
5. One of the MSAs identified in CPS data	339,121	1,597,877
6. No household member is over age 61	318,804	1,501,426
7. Household spouse is over the age of 17 (if present)	318,738	1,500,979
8. Observation is household head	78,240	368,124
9. Head is over the age of 17	78,222	368,034
10. Valid age given for spouse, if head is married	77,523	364,924
Line 10 gives a total of 442,447 households who are used in the "housing sample."		
11. Number of related children, ages 6 to 17	98,607	463,611
Line 11 gives a total of 562,218 children (341,321 households) who are used in the "child sample." Note: When both a husband and wife were present, we assigned the husband as the "Household head."		

Appendix Table 2: Sample Screens from March Current Population Survey, 1990 to 1995

	March 1990	March 1991	March 1992	March 1993	March 1994	March 1995
1. Initial number of person records	158,079	158,477	155,796	155,197	150,943	149,642
2. Household has 2 related children under age 18	33,324	33,379	32,761	33,327	32,593	32,292
3. Uniquely identified MSA	22,799	22,838	22,190	22,385	22,329	21,850
4. No household member is over age 61	22,064	22,073	21,407	21,677	21,504	21,059
5. Household spouse is over the age of 17 (if present)	22,060	22,069	21,403	21,673	21,494	21,049
6. Observation is household head	5,455	5,451	5,291	5,400	5,298	5,216
7. Head is over the age of 17	5,455	5,447	5,291	5,397	5,295	5,213
Line 7 gives a total of 32,098 households, who are used in the first stage "housing sample."						
8. Number of related children, ages 6 to 17	6,760	6,773	6,563	6,659	6,506	6,674
Line 8 gives a total of 39,935 children (24,357 households) who are used in the "child sample."						

Note: When both a husband and wife were present, we assigned the husband as the "Household head."

Appendix Table 3: Definition of Held Back, and Probability of Being Classified as Held Back by Age.

Age	6	7	8-11	12-15	16	17
Held Back if:	<Nursery School	<Kindergarten	< grades 1-4	< grades 5-8	< grade 9	< grade 10

Age	6	7	8	9	10	11	12	13	14	15	16	17
% Held Back	.0695	.0170	.0449	.0205	.0032	.0027	.0608	.0222	.0101	.0047	.0669	.0847

Appendix Table 4: Robustness Checks (from Census using Two Sample IV, Renters and Homeowners)			
	Family is overcrowded	Dense Building	Child was held back
A. Other covariates include: child's age and sex (in column 3), head's age, sex, and race.			
Participation in public housing	-.1794 (.0656)	-.1273 (.0457)	-.1876 (.0711)
B. Other covariates include: covariates in Table 7, plus household income and its square.			
Participation in public housing	-.1028 (.0646)	-.1330 (.0480)	-.1727 (.0723)
C. Head has high school or less, includes covariates in Table 7, 184,523 in "Housing Sample" and in 232,708 "Children's Sample."			
Participation in public housing	-.1883 (.1010)	-.1633 (.0666)	-.1937 (.1113)
D. Head has at least some college, includes covariates in Table 7, in 257,924 "Housing Sample" and in 329,510 "Children's Sample."			
Participation in public housing	-.0354 (.0790)	-.1029 (.0723)	-.1675 (.0919)
Sample	Housing Sample	Housing Sample	Child Sample

Notes: Standard errors in third column are corrected for multiple children in same household.

Appendix: Imputing Public Housing Participation Rates to Demographic Groups

This appendix reviews the construction of PROJ%, the imputed probability of participating in a project based on demographic category, socioeconomic status, and MSA. PROJ% is defined as $PROJ_{d,m,u}/HH_{d,m,u}$, where PROJ is the number of project units that are allocated to demographic group *d* in MSA *m* in developments that are size *u* (where the size *u* is either greater or less than 50 units), and HH is the total number of renter households in demographic group *d* in MSA *m* who live in apartments units of size *u*. This variable PROJ% is used in Tables 1, 2, and 4. At the project level, HUD's "A Picture of Subsidized Households" gives data on the demographic characteristics of housing recipients, the total number of units in the projects, and the MSA location. This data was collected by HUD between October 1995 and September 1996. The first of 83 developments from the Boston MSA with valid demographic data looks like this:

Sample Line from HUD's "A Picture of Subsidized Households."
Age, race, and marital status refers to household head, while income refers to entire household.

Total units in development	% Head under the age of 25	% Head aged 25 to 44	% Head aged 45 to 61	% Head over the age of 61
162	8	**45**	32	15
% Minority	%White	% Unmarried, with kids	% Married, with kids	% No kids
98	2	**50**	4	46
% HH w/ Inc <$5,000	% HH w/ $5000≤ Inc <$10,000	% HH w/ $10,000≤ Inc <$20,000	% HH w/ Inc ≥$20,000	MSA identifier
6	**59**	22	13	1120

To allocate units from a project to a demographic group (and thus construct $PROJ_{d,m,u}$) our procedure multiplies the number of units by the fraction of that age group, race group, marital status group, and income group in a project. Thus, for minority, single-parent households, with heads between the ages of 25 and 44, and household incomes between $5 and $10 thousand, our procedure allocates 21.07 units (162*.45*.98*.50*.59) to them. We carry out a similar computation for the other demographic groups used in our analysis, and for the remaining developments within the MSA. By adding up across all developments with total units greater than 50, we obtain $PROJ_{d,m,u}$ for this specific group. In the entire sample, 9,729 of the 13,537 developments had valid data on demographic characteristics, representing 998,032 project units (out of a national total of 1,326,224 units). Of the 9,729 developments, 5,721 were large (containing more than 50 total apartment units); these large developments included 88 percent of the total apartment units.

To compute the denominator, $HH_{d,m,u}$, we use the 1990 Census Public Use Microdata Set 5% sample. For each household in the Census, we take the following variables: household weight, tenure status (homeowner versus renter), head's age, race, marital status, and number of children, household income (inflated to 1996 dollars), MSA, and number of units in apartment complex. We then exclude households who are homeowners, households without children, and households where the head is under

age 18 or over age 61. Using the remaining variables for renter households, we create 3 groupings for age (18-24, 25-44, and 45-61), 2 for race (minority or nonminority), 2 for family structure (married with children or unmarried with children), 4 for income levels (given above), and 2 for unit size (50 or more units and less than 50 units). From these 96 demographic groupings in each MSA, we add up the household weights to construct $HH_{d,m,u}$.

Using the numerator from HUD data and the denominator from Census data, we compute PROJ%. In cases where $PROJ_{d,m,u}$ was greater than $HH_{d,m,u}$, we impute PROJ% to be 100 percent. Finally, for each observation in the microdata sample (see Appendix Table 2), we merge PROJ% based on the appropriate demographic and socioeconomic variables and MSA. For households who report being homeowners, PROJ% is imputed as 0 percent.