The Effects of U.S. Low-Income Housing Programs on Recipient Consumption and Wellbeing

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Abstract

This paper is the first to provide evidence on key aspects of the performance of each of the major types of housing assistance in the U.S. – HUD's public housing and housing voucher programs, its largest programs that subsidize the operation of privately owned housing projects, and a conglomerate of all other programs dominated by low-income tax credit projects. The aspects studied are the effects of the programs on the overall desirability of the housing and neighborhoods occupied by their participants and their aggregate consumption of non-housing goods and services, their net benefit to tenants, the taxpayer cost incurred to provide these benefits, and the difference in mean benefits across recipients and eligible households with different demographic characteristics. The primary data is from the 2013 American Housing Survey (AHS) national sample that identifies the type of housing assistance received by most households based on HUD's administrative records. The results indicate that HUD's largest programs lead to a much greater percentage increase in recipient consumption of non-housing goods than in their consumption of housing services. For HUD's project-based assistance, the improvement in housing conditions is negligible. For the conglomerate of other programs, the percentage increase is greater for housing consumption than for other goods, but both percentages are quite small. Another important result is that tenant benefit per dollar of taxpayer cost is much larger for the housing voucher program than for HUD's public housing program or its largest programs that subsidize the operation of privately owned projects. It is even smaller for the programs that subsidize the construction of tax credit projects.

Keywords: Low-income housing programs, housing vouchers, public housing, project-based housing assistance, tenant-based housing assistance, housing subsidies

JEL Codes: H53, I38, R28

1. Introduction

Low-income housing assistance is a major part of the U.S. welfare system. The programs involved served more than 16 million people and cost more than $63 billion in FY 2020. The U.S. Department of Housing and Urban Development (HUD) spent about $54 billion, federal tax expenditures on low-income housing tax credits, mortgage revenue bonds, and multi-family revenue bonds added more than $8 billion, the U.S. Department of Agriculture (USDA)'s housing programs cost more than $1 billion, and many state and local governments provide low-income housing assistance.

Among the poorest families in the U.S. of the same size and composition and with the same income from private sources, the greatest difference in consumption levels is between families with and without low-income housing assistance. Medicaid, SNAP, and the EITC assist all eligible families who ask for help, and participation rates in these programs are extremely high among the poorest families. Housing assistance is an anomaly among the largest parts of the welfare system. Unlike other major means-tested transfer programs, low-income housing programs do not offer assistance to all the families that are eligible for them. Eligible families that want assistance must get on a waiting list, and most waiting lists are long and closed to new applicants for extended periods. Only about a third of poor households receive housing assistance, but the subsidies to the poorest recipients are large. The national average subsidy to housing voucher recipients in the poorest households with a size and composition appropriate for a two-bedroom unit was about $1,200 a month in 2020.[1] In the most expensive places to live, it was much greater – $1,951 in New York City, $1,956 in Los Angeles, $2,311 in Boston, and $3,339 in San Francisco.

Despite the importance of low-income housing assistance in the U.S., there are no recent estimates of the overall effect of the entire system on recipient consumption patterns, the magnitude of recipient benefits relative to taxpayer costs, or how program benefits vary with household characteristics. More importantly, there are no estimates of the differences in these magnitudes across different housing programs.[2] Each year, Congress decides how much to spend

[1] The poorest households have no countable income. To a first approximation, the voucher subsidy to these households is equal to a program parameter called the Fair Market Rent. The history of this parameter since 1983 across all locations can be found at https://www.huduser.gov/portal/datasets/fmr.html#history.

[2] Olsen and Zabel (2015) and Collinson, Ellen, and Ludwig (2016) summarize the evidence on the performance of low-income housing programs.

on each program. Evidence on their comparative performance is important for making well-informed decisions. The primary purpose of this paper is to provide such evidence.

The results indicate that HUD's largest programs lead to a much greater percentage increase in recipient consumption of non-housing goods than in their consumption of housing services. The housing voucher program produces the greatest percentage increase in aggregate housing consumption. For HUD's project-based assistance and for the conglomeration of other programs, the improvement in housing conditions is negligible. We also find that tenant benefit per dollar of taxpayer cost is much larger for the housing voucher program than for HUD's public housing program or its largest programs that subsidize the operation of privately owned projects.

A secondary purpose of the paper is to determine the importance of accounting for taxes, tax credits, and underreported resources in estimating these effects. Most previous studies based on survey data have taken self-reported resources at face value, and they have ignored the effect of the tax system on a household's resources available for consumption of private goods. Recent research has revealed substantial underreporting of the resources of the poorest families in major household surveys (Corinth et al., 2021; Meyer et al., 2019, 2015; Meyer and Mittag, 2019). This underreporting has led to a substantial misperception of the consumption levels of these households. Whether it would have a large impact on the estimated effect of low-income housing assistance is an open question. We make a concerted effort to account for the underreporting of resources and the tax system. Our results suggest doing so leads to significantly larger estimates of the increase in housing consumption of recipients of housing assistance.

2. Current System of Low-Income Housing Assistance in the United States

Most low-income housing assistance in the U.S. is for renting a unit, and the most important distinction between rental housing programs is whether the subsidy is attached to a housing project (project-based assistance) or the assisted household (tenant-based assistance). If the subsidy is attached to a housing project, each family must accept the specific unit offered in order to receive assistance and loses its subsidy if it moves to a unit outside the project unless it is able to obtain alternative housing assistance before moving. Each family offered tenant-based assistance is free to occupy any unit that meets the program's minimum housing standards, rents for less than the program's ceiling applicable to the family, is affordable with the help of the

subsidy, and whose owner is willing to participate in the program. The family retains its subsidy if it moves to another unit meeting these conditions.

There are two broad types of project-based rental assistance, namely, public housing and privately owned subsidized projects. Both types have usually involved the construction of new projects. In almost all other cases, they have involved substantial rehabilitation of existing buildings. Many of these programs no longer subsidize the construction of projects, but most projects built under them still house low-income households with the help of subsidies for their operation and renovation. Overall, project-based assistance accounts for about two thirds of all households that receive low-income rental assistance in the U.S.

Governments provide most project-based assistance to private parties that develop and operate housing projects. Most of these private parties are for-profit firms, but not-for-profits have a significant presence. The largest programs of this type are the IRS's Low-Income Housing Tax Credit (LIHTC), HUD's project-based Section 8 program, and USDA's Section 515/521 program. Under these programs, in exchange for certain subsidies, private parties agree to provide rental housing meeting certain standards at restricted rents to eligible households for a specified number of years. Most privately-owned subsidized projects receive subsidies from multiple sources, and few sources provide a subsidy to all suppliers who would like to participate. About 4 million households in the U.S. live in projects of this type.

Subsidized housing projects are also developed and operated by local public housing authorities established by local governments, albeit with substantial federal subsidies and regulations that restrict their choices. In the public housing program, government employees make most of the decisions made by firms in the private market – what to build, how to maintain it, and when to tear it down. Decisions about where to build projects has been heavily influenced by local political bodies. The public housing stock has declined by more than 400,000 units since its peak in 1991. About 1 million households live in public housing projects.

HUD's Housing Choice Voucher Program (often called Section 8) is the only significant program of tenant-based assistance in the U.S. In terms of expenditure, it is the largest low-income program with an annual taxpayer cost of about $24 billion. It serves more than 2 million households and accounts for about a third of all households that receive low-income rental assistance.

Because the number of units in HUD's largest programs that have subsidized the

construction of housing projects has been declining for several decades, it is often assumed that there has been little construction of subsidized projects over this period. This ignores the role of LIHTC in the current system. Since its inception in 1987, LIHTC has subsidized the construction of projects with more than 1.45 million units. This exceeds the increase in the number of households served by tenant-based Housing Choice Vouchers over this period.[3] Without any change in legislation, LIHTC will lead to a large increase in the number of units in subsidized projects each year. Recent proposed legislation that has substantial support in Congress would massively expand it.

3. Theoretical Framework

The general assumptions that underlie our analysis can be described with the help of Figure 1. We assume that the wellbeing of a household's decisionmaker depends on the household's consumption of housing and neighborhood services Q_H (hereafter housing services) and other goods and services Q_X (hereafter other goods). In the absence of housing assistance, the household's income is Y, the market price of housing services is P_H, the market price of other goods is P_X, and the household's budget frontier is EF. If the decisionmaker's indifference curves were as depicted, he or she would choose the bundle M in the absence of the housing program. Under the program, the household consumes the bundle G, where Q_H^G is the market rent of the unit MR divided by the market price of housing services P_H and Q_X^G is the household's expenditure on other goods under the program divided by the market price of other goods P_X. We assume that the household's expenditure on other goods under the program is its income minus its rent TR. Finally, there is some cash grant B that would be as satisfactory to the decisionmaker as the housing program.

As drawn, the housing program leads to greater consumption of housing services and less consumption of other goods. Nothing in the structure of low-income housing programs ensures this outcome. This is seen most easily for project-based housing assistance that offers the household an all-or-nothing choice of a bundle involving a particular dwelling unit for a specific rent. If the household had a stronger taste for housing services relative to other goods than

[3] LIHTC has also subsidized the substantial rehabilitation of many projects built under older programs that subsidized the construction of privately owned projects, and increasingly it has been used to rehab public housing projects under the Rental Assistance Demonstration.

depicted, its chosen consumption bundle in the absence of housing assistance could be to the southwest or southeast of G, and the program would induce the household to consume more of both goods or less housing services and more other goods.

This simple description of the program's effect reveals some general assumptions that underlie the analysis.

First, we assume that the housing program has no effect on market prices. The same indices of market prices are used to calculate the bundle G consumed under the program and describe the household's budget constraint EF in its absence. The price indices used in the empirical analysis are market prices in the presence of housing programs.

The assumption that the housing programs studied have no effect on market prices is surely close to the truth. Less than 7% of all households receive low-income housing assistance, and due to their very low incomes, they would account for a much smaller fraction of the total demand for housing services and other goods in the absence of housing assistance. Therefore, even a demand-side housing program that greatly increased their demand for housing services or a supply-side program that greatly increased their housing consumption would have a small effect on total housing demand or consumption, and this would be offset to some extent by reduced demand and consumption by taxpayers who pay for these programs.

In their surveys of the literature, DiPasquale (1999) and Blackley (1999) conclude that the weight of the evidence is that long-run supply curves for housing services are quite elastic. The most widely cited recent paper reaches the same conclusion (Saiz, 2010). The modest increase in total housing production that results from low-income housing programs leads to minimal changes in the input prices that underlie the cost of producing a dwelling unit with specified characteristics and hence the long-run equilibrium price in the unsubsidized market.

The evidence indicates that substantial expansions of the housing voucher program have had a small effect on the rents of unsubsidized units. The best evidence is from the Housing Assistance Supply Experiment (HASE) that operated entitlement housing allowance programs in the Green Bay and South Bend metropolitan areas in the 1970s and early 1980s. This study found little effect of housing allowances on the market rents of units of any type (Lowry, 1983; Rydell et al., 1982). For units that were significantly below the program's minimum housing standards prior to the experiment, rents fell slightly. For modest units meeting the standards or falling slightly below them, rents rose slightly. A careful reassessment of the HASE evidence

reached the same conclusion (Mills and Sullivan, 1981). If an entitlement housing allowance program for which 20% of households were eligible had no discernible effect on housing prices, it is reasonable to conclude that smaller existing tenant-based programs have little effect. Eriksen and Ross (2015) find similar results based on more recent expansions of the Housing Choice Voucher Program throughout the country. There are no studies of the effect on long-run equilibrium market prices of programs that subsidize the construction and operation of low-income housing projects.

A second general assumption underlying the analysis is that low-income housing assistance has no effect on a household's cash income. The same income Y that is used to calculate consumption of other goods under the program underlies the assumed budget frontier in the absence of housing assistance EF. The evidence indicates that housing assistance induces recipients to earn less.[4] The best study finds that non-elderly non-disabled adult voucher recipients reduce their earnings by about 10% (Jacob and Ludwig, 2012). Other studies indicate work disincentive effects of similar magnitudes for HUD's largest programs of project-based assistance. The effect of housing assistance on the total cash income of these families is muted by larger payments from cash assistance programs in which they would participate in the absence of housing assistance and their increased participation rates in these programs (Abt Associates Inc. et al., 2006; Jacob and Ludwig, 2012). The effects are much smaller for elderly and disabled (Jacob and Ludwig 2012), and 60% of HUD-assisted households have an elderly or disabled cohead (HUD, 2021).

A third general assumption underlying the analysis is that households spend their entire income each period. Current expenditure on other goods is assumed to be current income minus current housing expenditure. There is no saving or dissaving. This is surely close to the truth for recipients of low-income housing assistance. However, we use data on some unassisted households with higher incomes to estimate a model explaining housing expenditure in the absence of housing assistance. To ameliorate the problem associated with their saving and dissaving, we exclude from the analysis households in the top quintile of real per-capita income.

Fourth, our analysis ignores most in-kind transfer programs that serve recipients of low-income housing assistance. We account for low-income housing programs and SNAP, but we ignore Medicaid, National School Lunch Program, WIC, Pell Grants, Head Start, and many other

[4] Olsen and Zabel (2015, pp. 917-922) summarize the evidence.

smaller in-kind transfers. Our data does not contain information about participation in these programs. Due to the failure to account for them, recipients of housing assistance consume more other goods than indicated by our results, and they would have larger and more complicated budget spaces in the absence of housing assistance. Failure to account for these programs undoubtedly biases our estimates of the effects of low-income housing programs to some extent.

Finally, our analysis excludes the benefits of low-income housing programs to people other than the household's decisionmaker. This study assumes that each household has a single decisionmaker who decides on the household's total consumption of each good and its allocation across household members. (This abstracts from the complexities of households with multiple decisionmakers.) The benefit estimated in this paper refers to the benefit to the household's decisionmaker. This includes the value that the decisionmaker places on outcomes for other members of the household. For example, decisionmakers may reduce their own current consumption in favor of consumption choices that they believe will lead to higher incomes for their children later in life, and the net benefit from the housing program reflects the value that they place on this outcome. These choices might have benefits to the household's children beyond that to their parents captured by our net benefit. Furthermore, low-income housing assistance is supported by nonrecipients. These people value increased consumption of housing and other goods by recipients. A truly comprehensive cost-benefit analysis would account for these benefits. Like previous studies, this paper does not attempt to estimate them.

4. Data

The primary data used in this study is from the 2013 American Housing Survey (AHS) national sample. The AHS collects voluminous data for a large random sample of U.S. households (about 60,000 in 2013). The information includes (1) many characteristics of the household's dwelling unit and its neighborhood, (2) the general location of the unit (metro/nonmetro/Census division categories and the specific metro area for households living in 144 large ones), (3) whether the unit is rented or owner-occupied, (4) the household's expenditure on housing, (5) many of its demographic characteristics including its income, (6) whether the household receives housing assistance, and (7) the type of assistance received.

4.1 Identifying Type of Housing Assistance.

The 2013 AHS is especially suitable for the purposes of this research because it identifies the type of housing assistance received by each household from HUD's largest programs based on HUD's administrative records. These programs account for most low-income housing assistance. Prior to 2011, information about receipt of housing assistance in the AHS was based entirely on self-reporting, and many recipients of these HUD programs failed to report it (about 18% in 2013). We use data for 2013 because later AHS public use files fail to distinguish between public housing and HUD-subsidized privately owned projects. We use the variable HUDADMIN in the 2013 AHS based on HUD's administrative records to identify which households had a HUD housing voucher, which lived in public housing, and which lived in a privately owned project subsidized by one of HUD's largest programs.

According to the AHS variable HUDADMIN, about 5 million households received housing assistance from HUD's largest programs. However, the HUD administrative records underlying HUDADMIN do not capture all households that receive low-income rental assistance. We use self-reported receipt variables (PROJ, VCHER, SUBRT, RENEW) to identify recipients of rental assistance not identified by HUDADMIN and refer to this group as other subsidized households. Respondents representing an additional 2.4 million households fall into this category. The AHS does not contain information about the type of rental assistance received by these households, but it seems likely that at least two thirds live in housing projects whose construction or renovation was funded in part by low-income housing tax credits (LIHTC).[5] Appendix A contains the analysis that leads to this conclusion.[6]

The non-LIHTC households in the other subsidized category are served by a variety of programs. Some live in USDA Section 515/521 projects that were neither built nor renovated with the help of LIHTC. Others received housing assistance from HUD's homeless programs or state and local programs funded by HUD's block grants (HOME, IHBG, CDBG). HUDADMIN does not cover households served by these programs. Still others live in projects subsidized by small USDA, state, or local housing programs. A few are surely households that received

[5] Almost all tax credit projects receive subsidies from multiple sources. NCSHA (2018, Table 8) lists more than 18 federal sources that are used in combination with tax credits, and many tax credit projects receive subsidies from state or local sources.

[6] The appendices and accompanying tables are available online: https://people.southwestern.edu/~earlyd/EffectsLowIncHousingPolicy-ONLINE.pdf

assistance from HUD's largest programs but were not identified by the Census Bureau because HUD's records of assisted households was incomplete, or address matching could not be done perfectly.

Some households not classified as voucher recipients by HUDADMIN reported voucher receipt (about 8% of all voucher recipients). We combine these households with those identified as voucher recipients by HUDADMIN. Past research indicates that most recipients of low-income housing assistance are clear about the distinction between having a tenant-based housing voucher and living in a subsidized housing project. This together with the similarity between the mean values of household characteristics and our outcome measures for the two groups of voucher recipients leads us to believe most households that report voucher receipt have a HUD Housing Choice Voucher or a similar voucher.

We classify all other households that self-report receipt of rental housing assistance but do not receive HUD assistance according to HUDADMIN as other subsidized households. Most surely live in privately owned subsidized projects.

Table 1 presents our estimate of the number of households and people who received assistance from each type of housing program based on AHS data. Without a doubt, this is a lower bound. Some households not captured by HUDADMIN did not report their receipt of housing assistance.

4.2 Taxpayer Cost

The AHS does not report the taxpayer cost of any subsidized unit. We estimate it based on the predicted market rent of the unit, evidence on the ratio of total cost to market rent for each program, and reported tenant rent. This section describes the evidence on the ratio of total cost to market rent for each type of program.

Research indicates that the rents paid to landlords of tenant-based voucher units are very close to the rents of unsubsidized units with identical characteristics (Olsen, 2019). Therefore, we assume that the total cost of these units exceeds market rent by the program's administrative cost. According to Turnham et al. (2015, p. xxxv), the administrative cost of the voucher program between 7/1/13 and 6/30/14 was $1.461 billion. According to McCarty et al. (2019, p. 12), total government payments to landlords were $17.964 billion in FY 2013 and $19.177 in FY2014. This leads to an estimate of $18.874 billion for the period from 7/1/13 to 6/30/14 and

an estimated ratio of administrative cost to government payments to landlords of .084. HUD's Picture of Subsidized Households indicates that the government paid about 67% of the total rent of voucher units in this period. This leads to the conclusion that administrative cost adds about 6% of market rent to the total cost of the voucher program.[7]

The best study of the cost-effectiveness of public housing indicates a ratio of total cost to market rent of 1.79 and 2.20 in its two sites (Mayo et al., 1980, Table 5-1). These numbers include administrative cost. More recent evidence greatly understates the cost of public housing. GAO (2001) estimated that public housing redevelopment under the HOPE VI program cost about 27% more than housing vouchers for units with the same number of bedrooms in the same metro area. However, this estimate ignored the opportunity cost of the land and the large difference between full property taxes and the small payments in lieu of taxes made by public housing authorities to local governments. HUD (1974, p. 123) indicates that the property tax abatement accounts for about 22% of the total cost of providing housing under the public housing program.

The best study of the cost-effectiveness of HUD's privately owned subsidized projects indicates a ratio of total cost to market rent ranging from 1.44 to 1.61 (Wallace et al., 1981, Table 4-22 adjusted for the other subsidies mentioned below). This is a study of the Section 8 New Construction and Substantial Rehabilitation Program, HUD's largest program of this type. It made predictions of the market rents of subsidized units based on two different data sets containing information on the rent and characteristics of unsubsidized units. The study did not collect information on the indirect costs of the Section 8 New Construction Program such as Government National Mortgage Association Tandem Plan interest subsidies for Federal Housing Administration–insured projects and the forgone tax revenue due to the tax-exempt status of interest on the bonds used to finance state housing finance agency projects. Based on previous studies, the authors argue that these indirect costs would add 20 to 30 percent to the total cost of the Section 8 New Construction Program (Wallace et al., 1981, pp. 221, 226). The range of estimates is based on the four combinations of the two predictions of market rent and the lower and upper limits on the indirect costs.

[7] The ratio of administrative cost to government payments to landlords is .084 and the ratio of government payments to landlords to total payments to landlords is .67. We assume that total payments to landlords are equal market rents. Therefore, the ratio of administrative cost to market rent is about .06.

For both public housing and HUD-subsidized privately owned projects, we produce results based on the upper and lower bound estimates of the ratio of total cost to market rent.

Dealing with other subsidized households is more problematic because they are served by a wide variety of programs. Since at least two thirds live in housing projects funded in part with LIHTC, our estimates of the lower bound on the ratio of total cost to market rent of their units is based primarily on GAO (2002) results on differences in the cost per unit for housing vouchers versus tax credit projects for units with the same number of bedrooms and in the same type of area (metro v. nonmetro). Appendix B describes how we used the GAO results to approximate the ratio of total cost to market rent for the units occupied by other subsidized households and the rationale for our procedures.

The GAO results clearly understate the non-administrative cost of LIHTC projects. For example, the GAO calculations assume that tax credit projects pay full property taxes. In fact, many receive abatements or exemptions. The GAO calculations also assume that tax credit projects receive no subsidies for renovations during their initial 30-year use agreement. Based on experience with similar programs, GAO argues that many projects are likely to receive additional tax credits to remedy the effects of under-maintenance during this period. GAO (2002, p. 24) argued that accounting for these two subsidies would increase their estimates of total cost by no more than 15%.

We base our upper bound estimate of the taxpayer cost of the housing assistance to other subsidized households on this result. Other omitted costs such as land sold or leased to developers by local government agencies or public housing authorities for a nominal amount and residual loans from these sources that are not expected to be repaid in their entirety or at all are probably substantial. However, since their magnitude has never been documented, we ignore them.

Table 2 summarizes our estimates of the lower and upper bounds of the ratio of total cost to market rent across the different types of assistance. Multiplying the predicted market rent of the unit occupied by an assisted household by the relevant ratio of total cost to market rent yields the estimated total cost of providing its housing. Subtracting the tenant rent yields the taxpayer cost.

4.3 Voucher Recipient Rents

The taxpayer cost of housing assistance depends on not only the total cost of providing the housing but also the tenant's rent. For households living in subsidized projects, there is no ambiguity concerning what rent to report. This is not true for voucher recipients. They sign an agreement with their landlord and housing authority specifying the rent that will be received by the landlord and the rent that will be paid by the tenant. To ensure that reported contract rent in the AHS is the tenant's rent, the survey asks respondents who reported receipt of a housing voucher a more detailed question about the rent they pay (PRENT). In most cases (75%), these household reported a lower rent in response to this question than their answer to the initial question about their rent. In these cases, the AHS uses PRENT to calculate the household's housing expenditure. The problem is that about a quarter of voucher recipients identified by administrative records were not asked this question because they did not self-report receiving housing assistance. Therefore, it is unclear whether those voucher recipients reported tenant or landlord rent to the AHS.

We use a simple algorithm to (1) predict which voucher recipients who were not asked the detailed rent question underlying the variable PRENT reported landlord rent to the AHS and (2) estimate tenant rent for those households. The general approach is to identify a range of plausible values for tenant rent and range of plausible values for landlord rent for each household. If the reported rent is closer to the midpoint of the tenant range than the landlord range, we accept the reported rent as the tenant's rent. Otherwise, we assume that it is the rent received by the landlord.

Our range of plausible values for tenant rent in the voucher program is 27% to 36% of household income. According to voucher program rules, tenants pay between 30% and 40% of their adjusted income in rent. In the voucher program, adjusted income is about 90% of total income. Our range of plausible values of landlord rent is between 90% of the lowest Fair Market Rent in the household's general area (the AHS variable FMRA) and 110% of the highest Fair Market Rent in the area (the variable FMRB) plus 9% of the household's income. This range accounts for the discretion of public housing authorities to establish payment standards 10% below or above HUD's Fair Market Rents and the discretion of tenants to occupy units renting for more than the local payment standard.

This process suggests that roughly 12% of voucher holders who were not asked the detailed rent question underlying the variable PRENT reported landlord rent instead of tenant rent during the AHS survey. In those cases, we assume that the tenant's rent is 31.2% of the tenant's income. This is the ratio of mean tenant rent to mean tenant income in HUD's 2013 Picture of Subsidized Households.

4.4 Implausible Incomes

Recent research has revealed substantial underreporting of resources by the poorest families in major household surveys (Corinth et al., 2021; Meyer et al., 2019, 2015; Meyer and Mittag, 2019). Although this problem has not been studied for the data set used in this study, there is no reason to believe that it is less severe in it. This leads to implausible reported cash incomes for many households. In the 2013 AHS, negative incomes (always small in absolute value) are reported for about 4% of renters.[8] Their mean reported housing expenditure is about $700 a month. Among renters with a positive reported income, about 12% report a rent exceeding their income, with mean reported rent of about $1,020 a month and reported income of less than $500 a month. Most of these households report rents more than twice as great as their incomes. Based on the work of Meyer and his coauthors, these implausible cash incomes almost surely result from the underreporting of the magnitude of labor earnings and the receipt of cash assistance such as Supplemental Security Income (SSI). Furthermore, the AHS does not ask about receipt of income from the earned income tax credit (EITC) or child tax credits, important sources of cash income for low-income households.

The AHS also does not provide any information on receipt of in-kind assistance except for low-income housing assistance and SNAP, and SNAP participation is massively underreported. According to self-reported receipt of SNAP assistance in the 2013 AHS, the program served less than 9 million households in that year. Administrative records indicate that it served 23 million.

The first-best solution to the underreporting of labor earnings and cash and in-kind assistance in the AHS would be to append to the information for each person in the public use data set information on these magnitudes from administrative records as the Comprehensive

[8] Since less than 1% of renters with negative reported income report income from sources that could be negative, this is the result of low reported values of income components combined with AHS bottom coding rules.

Income Dataset Project has done and continues to do for other public use datasets.[9] This is a major undertaking beyond the scope of this paper. A common quick fix to this problem is to exclude from the analysis all households that report an income less than their housing expenditure. This paper presents results based on this approach but goes well beyond a quick fix. It predicts which households that did not report SNAP or SSI receipt were served by these programs and the magnitude of their assistance, and it estimates the net taxes paid by each household, possibly negative due to refundable tax credits such as the EITC.

Appendix C describes the data and methods used to make these predictions. Like many other studies, we treat SNAP as cash assistance. Pure cash-out random assignment experiments suggest that this is close to the truth (Fraker et al., 1995, Table 2). Hoynes and Schanzenbach (2009) reach a similar conclusion. We do not attempt to account for other in-kind assistance and compensation. Both expand the budget spaces of eligible households in the presence and absence of housing assistance.

4.5 Price Indices

Our analysis requires interarea price indices. Carrillo, Early, and Olsen (2014) produced price indices for housing services, other goods, and all goods and services for each metropolitan area in the United States and the nonmetro part of each state from 1982 through 2012 and recently updated them through 2016.[10] We used their 2013 indices to create price indices at the lowest levels of geography identified in the AHS. Specifically, we used their price indices for households living in one of the 144 metro areas identified by the AHS variable SMSA. For other households in the 2013 AHS, we constructed population-weighted means based on the household's general area (DIVISION), whether it lived in an unidentified metro, and if so, the type of metro area (METRO3). All three price indices were rescaled to have a national mean of 1. As a result, our quantity indices can be interpreted as market values at national average prices. The housing price index is used to convert market rents into indices of the quantity of housing services and similarly for other goods. These price indices are also used in estimating a regression model explaining the housing expenditure of renters without housing assistance.

[9] Even that would understate the income of the poorest people because they have labor earnings from sources such as housekeeping, babysitting, and yard work that are not reported to any agencies (Edin and Lein, 1997, Table 2-6).
[10] These price indices can be found at https://eoolsen.weebly.com/price-indices.html

5. Methods

5.1 Consumption Pattern of Subsidized Households with Housing Assistance

The first step in predicting the quantity of housing services consumed by a household under a housing program and the taxpayer cost of the program is to estimate the market rent of each subsidized unit in the sample. Dividing the predicted market rent by the housing price index yields an index of the quantity of housing services provided by the subsidized unit. Multiplying the predicted market rent by the ratio of total cost to market rent for the program involved and subtracting the tenant's rent yields the taxpayer cost.

Appendix Table I reports the results of the estimation of a hedonic regression model that explains the logarithm of the rent of unsubsidized rental units as a function of their general location and the characteristics of the unit and its neighborhood.[11] Unsubsidized units are defined as units with positive rents that were occupied by households that did not receive HUD housing assistance according to HUD's administrative records, and reported that they did not receive housing assistance, did not live in a rent-controlled unit, and did not have their rent adjusted because someone in the household worked for or was related to the owner.

The 2013 AHS contains an unusually large number of variables capturing the condition of the unit, characteristics of the neighborhood, and contract conditions. The hedonic regression used to predict market rents contains 278 regressors representing 113 underlying variables that capture housing and neighborhood characteristics and contract conditions. Appendix Table I lists all of the regressors and their summary statistics.

Roughly half of the variables capture conditions of the housing unit, such as the number of bedrooms, bathrooms, whether a detached or multifamily structure, existence of various appliances, and the household's satisfaction with the landlord's response to repair requests. To capture aspects of the condition of the unit not covered by these characteristics such as worn carpets and old appliances, we included the number of years that the current resident has lived in the unit. Landlords usually wait until tenants move to refresh their units.

[11] We also estimate a regression model explaining the market rent rather than its logarithm. The results of the linear specification differ from results based on the log-linear specification so trivially that we do not report results from the linear specification.

The hedonic also includes 43 neighborhood variables, including 28 from two modules new to the AHS in 2013. One captures the respondent's opinion of his or her neighbors and the other the availability of public transportation and the walkability/bikeability of the neighborhood.[12] The neighbor module asked, among other things, whether the people in the neighborhood are close knit and get along. The transportation module focused on options available to households in the neighborhood such as the distance to the closest public transportation stop, what locations are accessible by public transportation, whether the neighborhood has bike lanes, and whether is it safe to walk in the neighborhood.

To capture omitted neighborhood variables, we also included dummy variables for Black and Hispanic head of the household. In our hedonic results, both are estimated to pay about 4% less for housing that is the same with respect to the included housing and neighborhood characteristics. We believe that these results reflect omitted neighborhood characteristics that are correlated with race and ethnicity.

The hedonic equation also includes 163 dummy variables (whose coefficients and summary statistics are not reported in Appendix Table I) to capture the general location of the unit. These include dummies that identify the specific metro area for households living in the 144 large areas identified in the AHS and combinations of census divisions and whether the unit is in a central city, suburban area, or rural area for other households.

Coefficients of important characteristics of the housing unit and location generally have expected signs and are statistically significant. For example, units with more bedrooms and bathrooms, with a working fireplace and with central air conditioning are estimated to have higher rents. Predicted rents fall with years in the unit and increase with additional persons per room. Units in the metropolitan areas of San Francisco, San Jose, New York City, and Honolulu were found to have the highest rents and the lowest were in small metropolitan areas of the south and southwest.

Despite its many regressors, the estimated hedonic equation had a relatively low R^2 – 0.44. This suggests the omission of important explanatory variables. We believe that the main culprit is the failure to fully account for the differences in the desirability of the neighborhood

[12] To reduce respondent burden, half of the AHS sample were asked the questions in the neighbor module and half the questions in the public transportation and walkability module. Our specification accounts for this feature by including dummy variables identifying observations that were not asked each set of questions.

and its proximity to places where people want to travel regularly. The AHS neighborhood questions ask the respondent's opinion of the desirability of the neighborhood in a variety of respects, for example, their overall rating of the neighborhood as a place to live. A person's rating of his or her neighborhood may convey its desirability relative to the neighborhoods where they grew up and might not give an objective measure of quality. The coefficients on opinions of neighborhoods are generally small and rarely significant. Beyond an indicator of whether the unit is part of the central city, or in an urban or rural area, no variables capture the unit's proximity to jobs or other locations of interest.

For our purposes, the key question is how well the hedonic regression based on unsubsidized units can predict the market rent of subsidized units. Key to this is how these units differ with respect to the unobserved characteristics of the housing unit and the neighborhood. The panel nature of the AHS allows us to explore this question for units occupied by voucher recipients. The AHS uses administrative data to identify these recipients in the 2011 and 2013 surveys and 142 units occupied by voucher recipients in 2013 were occupied by unsubsidized households in 2011. The household might have been the same or different, but the unit is essentially the same. The reported 2011 gross rent (updated by the change in the BLS shelter price index) is a good estimate of its 2013 market rent. The mean of the updated 2011 gross market rents for the 142 units involved was $960 per month. The mean of the predicted 2013 gross market rents of the same units based on the hedonic equation is $946 per month. This suggests that our hedonic does an excellent job of predicting the market rent of units occupied by voucher recipients using the observed factors listed in Appendix Table I.

We cannot use the same approach to assess the performance of the hedonic in predicting the market rent of units in subsidized housing projects (public or private). Units that were in a subsidized project in 2013 were in the same subsidized project in 2011. Other evidence suggests that these units are likely to be worse than unsubsidized rental units with respect to unobserved neighborhood characteristics. Newman and Schnare (1997, Table 3) report that 12.5% of all rental units are in census tracts with poverty rates exceeding 30% and that 14.8% of all voucher recipients, 21.9% of occupants of privately owned subsidized projects, and 53.6% of public housing tenants live in census tracts with poverty rates this high. Since poverty rates are highest in the worst neighborhoods, these results suggest that our estimates of market rent will be reasonably accurate for voucher units, somewhat overstated for units in privately owned

subsidized projects, and even more overstated for public housing units. If so, our results somewhat overstate the improvement in housing conditions and tenant benefits resulting from programs that have subsidized the construction and operation of privately owned subsidized projects, and more substantially overstate the improvement in housing conditions and tenant benefits resulting from public housing. Our results also overstate the taxpayer cost of these projects.

With these caveats in mind, our prediction of the market rent of each subsidized unit is the estimated mean market rent based on the hedonic equation and the unit's observed characteristics.[13] The predicted market rent is used to predict housing consumption and taxpayer cost for each subsidized household.

Our index of consumption of other goods under the program is the household's income minus its housing expenditure divided by our price index for other goods.

5.2 Consumption Pattern of Subsidized Households without Housing Assistance

The next step is to predict how much each subsidized household would spend on housing in the absence of housing assistance. For this purpose, we estimate a regression model explaining the housing expenditure of unsubsidized renters as a function of their income, market prices, and demographic characteristics. We exclude from this estimation the households in the top quintile of real per-capita income on the argument that the equation specified is at best a good approximation of reality for subsidized households and it will be a better approximation if its estimation is limited to similar households.

The equation specified assumes that each household decision maker has a displaced Cobb-Douglas utility function, where utility is derived from its consumption of two composite goods – housing services and other goods. Specifically,

$$U = (Q_H - \beta_H)^{\alpha_H}(Q_X - \beta_X)^{1-\alpha_H}$$

The displacement parameters β_H and β_X are assumed to be linear functions of household size and unobserved error terms and the marginal propensity to spend on housing α_H is assumed to

[13] We produce consistent estimates of conditional mean rents using Goldberger's (1968) adjustment of the semilog hedonic regression.

depend on demographic characteristics and an unobserved error term. For a given household, the error terms can be viewed as constants reflecting differences in taste among households with the same observed characteristics. However, since households are selected at random into the sample, they are random variables for our purposes. They could also reflect failure to maximize and measurement error in housing expenditure, but that would not affect our analysis. The maximization of this utility function subject to a linear budget frontier for a household with income Y and facing market prices P_H and P_X yields the housing expenditure function:

$$P_H Q_H = \alpha_H Y + (1 - \alpha_H)\beta_H P_H - \alpha_H \beta_X P_X$$

Substituting the expressions for α_H, β_H, and β_X into the preceding yields a housing expenditure function that is not linear in its parameters and has an error term that is heteroskedastic. We estimate it with Stata's nonlinear regression command with the robust standard error option to account for heteroscedasticity.

Table 3 lists the variables used in the estimation of the housing expenditure function, their summary statistics, and the results of the nonlinear regression. The estimated housing expenditure equation is used to predict the housing expenditure of participants in a housing program in the absence of assistance. Housing expenditure is divided by a housing price index to get an index of housing consumption. Our results depend importantly on the marginal propensity to spend on housing. The mean predicted marginal propensity across all subsidized households based on this estimated equation is 0.073, and there is little difference in the marginal propensity across households with different characteristics. This mean is roughly consistent with Reeder's mean of .092 based on the expenditure decisions of voucher recipients prior to voucher receipt (Reeder, 1985).

Our index of the quantity of other goods that an assisted household would consume in the absence of its program is the household's income minus its predicted housing expenditure without the program divided by our price index for other goods.

5.3 Recipient Benefit

The net benefit of the housing program to a recipient with the specified utility function is:

$$B = \left(\frac{P_H Q_H^G - P_H \beta_H}{\alpha_H}\right)^{\alpha_H} \left(\frac{P_X Q_X^G - P_X \beta_X}{1 - \alpha_H}\right)^{1-\alpha_H} + P_H \beta_H + P_X \beta_X - Y$$

The net benefit to the recipient depends on the household's consumption bundle under the program (Q_H^G, Q_X^G), the parameters of its budget constraint in the absence of the program (Y, P_H, P_X), and the parameters of its utility function $(\alpha_H, \beta_H, \beta_X)$. The consumption choices of the household's decision maker and this person's net benefit accounts for how the person feels about the consumption patterns of other members of the household as well as his or her own consumption.

5.4 Selection Bias

A standard objection to the preceding approach is that subsidized households might have different tastes on average than unsubsidized households with the same observed characteristics and hence spend more or less on housing when facing the same budget constraint. Due to the way that housing programs change the budget spaces of families that are offered assistance, the direction of self-selection bias in our method for estimating conditional mean preference parameters is theoretically ambiguous. Administrative selection further complicates the matter. Low-income housing programs are not entitlement programs. Only one in four eligible renters receive low-income housing assistance in the United States (Collinson et al., 2016), and waiting lists are long and closed to new applicants for extended periods. The system that determines which households are offered assistance varies enormously across thousands of public housing authorities and tens of thousands of privately owned subsidized projects. However, since subsidized households are not a random sample of eligible families, the existence of selection bias is undeniable. Only its importance and direction are in doubt.

Crews (1994) provides the best evidence on this matter. She accounts for both self and administrative selection in the estimation of the preferences of households with housing assistance and finds that ignoring selection bias leads to underestimating the mean tenant benefit of low-income housing programs by only 2% (Crews 1994, Tables 6.4 and 6.9). Given the small magnitude of the bias and the great complexity of dealing with it, our calculations ignore it.

6. Results

6.1 Characteristics of Assisted Households

Table 4 reports key characteristics of the subsidized households in our analysis for all programs combined and programs of each type. The first rows reveal that our income adjustments increase the mean incomes of households in HUD's largest programs and decrease the mean income of other subsidized households. Based on our income measure adjusted for differences in household size, price levels, taxes, tax credits, and receipt of SNAP and SSI, the households served by HUD's largest programs are substantially poorer than those in the residual category that mainly lived in housing projects built with a mix of low-income housing tax credits and subsidies from other sources. Households served by other programs have a mean income about two thirds greater than households served by HUD's largest programs. Public housing tenants and housing voucher recipients are much more likely than other programs to have a Black head or single female head with children. The fraction of Black households served by these two HUD programs is about 60% greater than in the programs that serve other subsidized households and the fraction of female-headed households with children served by the HUD programs is more than twice as great. HUD-subsidized privately owned projects cater heavily to the elderly. About 42% of their households have an elderly member – twice the percentage for the other types of housing assistance. The mean values of the price indices indicate that recipients of low-income housing assistance tend to live in places with somewhat higher than average prices, especially housing prices. The price indices were scaled to have a mean value of 1 across all households in the country.

6.2 Consumption Bundles

Table 5 reports indices of mean consumption of housing services and other goods with and without housing assistance. The most striking result is that low-income housing programs resulted in a much smaller percentage increase in aggregate consumption of housing services (12%) than in aggregate consumption of non-housing goods (25%). This true for all types of assistance except the residual category dominated by tax credit projects. We estimate that the programs serving these households increased their aggregate housing consumption by 8% and aggregate consumption of other goods by 6%.

The results for HUD's public housing program and its largest programs that subsidized privately owned projects differ markedly from the results of earlier studies which are based mainly on data from the 1970s (Olsen, 2003, Table 6.8). The earlier studies found that these programs led to large improvements in housing on average. The median was about 50%. The studies that reported percentage increases in consumption of both housing services and other goods found much larger increases for housing consumption. The median estimated aggregate increase was 59% for housing services and 16% for other goods as opposed to our 14% for housing consumption and 55% for other goods. This surely reflects a difference in both the true effects of these programs at very different times and differences in data and methods. Whatever the reasons for the difference, the old studies clearly provide an inaccurate picture of the effects of HUD's project-based assistance on consumption patterns in recent times.

Our results for housing vouchers are similar to the results of the only previous study that estimated percentage changes in overall consumption of both goods for a national sample. Based on data from 1976, Reeder (1985) reported a 16% increase in aggregate housing consumption and 50% increase in consumption of other goods compared with our 18% and 35%. Because these results are based in part on data on the consumption patterns of voucher recipients immediately prior to entering the program, they are highly credible for the households served by the voucher program that existed at that time.

The qualitative difference between his results and ours is consistent with the main changes in the program's structure since the time of his data.[14] Since then, the minimum tenant contribution to rent has been increased from 25 to 30 percent of adjusted income for almost all participants. This would be expected to reduce recipient consumption of other goods. Furthermore, voucher recipients are now allowed to occupy units with rents exceeding the local payment standard if they pay the extra rent. This has induced about 36% of recipients to occupy better housing at the expense of less spending on other goods.[15] The other main parameters of the budget space of a household offered a voucher – the housing quality standards and real default payment standard – have remained about the same over time.[16]

[14] Olsen (2003, pp. 401-405) describes the major changes in HUD's housing voucher program over its history.
[15] Rob Collinson provided this number based on the data underlying Figure B.5 in the online appendix to Collinson and Ganong (2018).
[16] The default payment standard is a program parameter called the Fair Market Rent. HUD adjusts it for inflation each year. Between October 1979 and April 2013, the national average two-bedroom FMR and the BLS's CPI shelter component increased by 262%.

In an offshoot of their study of the effects of the housing voucher program on labor supply, Jacob and Ludwig (2012, Appendix D) produced much larger estimates of the effects of the program on recipient consumption of housing services and other goods for households headed by able-bodied working-age adults in Chicago circa 2000 based in part on the assumption that the market rent of the unit occupied by each voucher recipient is equal to the applicable Fair Market Rent (FMR).[17] They estimate that the voucher program increased the housing consumption of these households 47% and their consumption of other goods 71%.

Under the assumption that market rents are equivalent to the applicable FMR, the estimates by Jacob and Ludwig (2012) have excellent internal validity, and reasonable adjustments of their assumption about market rents does not change their qualitative conclusions. On average, our predicted market rent of voucher units is only 7% less in real terms than the relevant FMR. Applying this result to their data leads to the conclusion that the voucher program increased the housing consumption of the households involved in their analysis 37% (rather than 47%) and their consumption of other goods 71%. Both percentages are substantially greater than ours, but the pattern is similar – much smaller percentage increase for housing services than other goods. Using data in the study that they cite in support of their assumption to adjust their results yields an even smaller increase in housing consumption (Leger and Kennedy, 1990, Table D.22C).

Table 5 contains other interesting results about consumption. First, the housing voucher program and the conglomerate of other programs provide housing of similar quality on average and somewhat better than public housing and privately owned HUD-subsidized projects. Second, the average subsidized unit is somewhat less desirable than the average unsubsidized rental unit – Q_H equal to 897 as opposed to 1026 (not reported in Table 5). These numbers can be interpreted as monthly market rents at national average prices in 2013. They capture the desirability of the neighborhood as well as the dwelling unit. Third, most households served by HUD's largest programs occupy better housing and consume more other goods, ranging from 58% for public housing to 70% for HUD-subsidized privately owned projects. This is much less true for households served by the conglomerate of other programs.

[17] The FMR is a program parameter. It is not the administering agency's view about the market rent of the unit.

6.3 Mean Recipient Benefit and Taxpayer Cost

Table 6 reports the mean recipient benefit, increase in the market value of goods consumed, and taxpayer cost. It reveals that the largest HUD programs make a big difference in the lives of the fortunate minority who are served. Overall, these programs increase the market value of goods consumed by recipients, ranging from 28% for the voucher program to 34% for HUD-subsidized privately owned projects. These increases in the market value of goods consumed generate substantial mean benefits to the decisionmakers in these households. The mean tenant benefit of the largest HUD programs is about 31% of mean household income. On average, other housing programs have a much smaller effect -- about a 7% increase in the market value of goods consumed and a 4% increase in real income. As mentioned earlier, most households in this category live in LIHTC projects that do not receive rental assistance from HUD's largest programs, and the existing evidence indicates that tax credit projects without deep subsidies from other programs provide small subsidies to their tenants. Ceiling tenant rents in these projects are only about 10% less than market rents (Burge, 2011, Table 3).

Although HUD's largest programs provide mean tenant benefits of about the same magnitude, they differ greatly in their taxpayer cost per household. As a result, tenant benefit per dollar of taxpayer cost differs enormously across these programs. For the voucher program, mean tenant benefit is 77% of the lower bound on taxpayer cost. For the two other major types of HUD housing assistance, it is 37% and 51%. The conglomerate of other housing assistance programs has even lower tenant benefits relative to taxpayer cost. Except for the voucher program, these percentages are much lower at the upper bounds on taxpayer cost.

What accounts for the large difference between the taxpayer cost of housing programs and recipient benefit? This difference can be usefully decomposed into the sum of (1) the excess of the subsidy (that is, the increase in the market value of goods consumed) over the recipient benefit and (2) the excess of the taxpayer cost over the subsidy. The former reflects a distortion in consumption patterns from the viewpoint of recipients and the nonpaternalistic altruists who want to help them; the latter reflects the program's administrative cost and cost-ineffectiveness in producing housing services.

The results in Table 6 suggest that the consumption distortion is modest in HUD's largest programs. The ratio of mean tenant benefit to mean subsidy is often used as an index of a program's overall consumption distortion from the perspective of its recipients and

nonpaternalistic altruists. The tenant benefit in a low-income housing program is equal to the subsidy if and only if the program induces the recipient to consume the same bundle of goods as he or she would choose if offered a cash grant equal to the subsidy. The further the consumption bundle under the housing program is from the bundle with the cash grant, the lower the ratio of tenant benefit to subsidy. The ratio of mean benefit to mean subsidy is 86% for HUD's voucher program and 91% for its programs that subsidize housing projects.[18] Except for housing vouchers, these are noticeably higher than previous estimates based on data from the 1960s and 1970s (Olsen, 2003, Table 6.17). The midpoint of the range for HUD's subsidized projects in these older studies was 76%. The estimated consumption distortion is much greater for other subsidized households – benefit is less than two thirds of the subsidy. There are no previous estimates for any of the programs that serve these household.

Except for the voucher program, our results indicate that the difference between taxpayer cost and recipient benefit is due primarily to administrative cost and cost-ineffectiveness in producing housing services. For the HUD's largest programs of project-based assistance, the excess of the taxpayer cost over the subsidy accounts for more than 90% of the large differences between taxpayer cost of a program and recipient benefit. This is consistent with previous research that indicates substantial cost-ineffectiveness in HUD's largest programs of project-based assistance (Olsen 2003, Table 6.7). Our estimates of taxpayer cost are based on this evidence.

6.4 Distribution of Recipient Benefits

People who favor low-income housing programs care how their benefits are distributed across households. Table 7 provides evidence about this matter for the entire system of low-income rental assistance. The first regression describes how recipient benefit varies with household characteristics among recipients. The second describes how it varies with these characteristics among all eligible renters, setting benefit equal to zero for nonrecipients. The third is a linear

[18] Our analysis ignores the consumption distortion that results from the inability of recipients to occupy any unit with the same market rent as their current unit. Recipients of project-based assistance are offered an all-or-nothing choice of a particular dwelling unit. The housing voucher program offers greater choice but has minimum housing standards. Our benefit estimates are biased upward on this account. This bias has not been studied for low-income housing programs. Glaeser and Luttmer (2003) study this consumption distortion for rent control.

probability model that describes how program participation depends on the characteristics among all eligible renters.[19]

In most low-income housing programs, tenants typically pay a fixed fraction of their adjusted income in rent independent of the desirability of their unit, and larger families are assigned to larger apartments or receive larger subsidies to enable them to occupy larger units without sacrificing housing quality or neighborhood desirability. This leads to the expectation that households with higher incomes receive smaller benefits on average, and larger households receive larger benefits. Our results are consistent with these expectations. A $1000 increase in monthly income (about one standard deviation) reduces mean benefit by $120, and an additional person increases mean benefit by about $34 a month.[20] Previous studies based on data from the 1960s and 1970s have produced similar results (Olsen 2003, Table 6-18).

We also find expected differences in mean benefits based on family structure. We distinguish between households with a single woman and her children, a married couple with or without children, and all other structures. Households containing a single female with children receive about $49 a month greater benefit than other households that do not contain a married couple, and married couples receive about $38 a month lower benefit than these other households. We attribute these differences to program rules concerning the number of bedrooms to which households are entitled. Single females living with their children are entitled to their own bedroom, married couples are expected to share a bedroom, and the residual group contains some people entitled to their own bedroom and other people expected to share.

It is safe to say that some people have strong priors about the existence and magnitudes of differences in mean benefits among recipients based on race or ethnicity. Our results are mixed. For households with a Black, Native American, and mixed-race head, our estimated differences are small compared with the overall mean or statistically insignificant at the standard levels. Households with Asian and Hispanic heads are estimated to have greater benefits than otherwise similar households. The result for households with Asian heads is particularly striking. They are estimated to have a mean benefit $92 a month greater than white households with the

[19] The results are also estimated using the sample of eligible owners as well as renters. The only meaningful differences in results were for elderly households, probably due to the high rate of homeownership for that group.
[20] For ease of interpretation, we do not report regressions with income and persons squared as explanatory variables. The inclusion of these variables does not change our qualitative conclusions over the range of values observed in the sample.

same other characteristics in the regression. This is surely not due to any intentional discrimination in favor of Asians but rather to correlation of Asian identity with other determinants of the calculated benefit that are not included in the regression, namely, the consumption bundle under the program or the parameters of the budget constraint in its absence, Y, P_H and P_X. For example, Asians tend to live in localities with high housing prices. The mean housing price for Asian recipients is 1.33 compared with 1.07 for all recipients. Adding the housing price index to the regression cuts the coefficient on the Asian dummy in half.

Finally, we find small differences in mean benefit between households with and without elderly or disabled members.

The ratio of the estimated standard deviation of the error term in the regression ($300) to the overall mean benefit ($315) indicates substantial variance in benefits among households that are the same with respect to the characteristics included in the regression. This is to be expected with project-based housing assistance because the rent paid by the tenant does not depend on the desirability of the dwelling unit or its neighborhood and the difference between the most and least desirable is large.

The second regression in table 7 takes a broader view of the distribution of recipient benefits. It describes how recipient benefit varies with household characteristics among all eligible renters, setting benefit equal to zero for nonrecipients. Presumably, taxpayers care about all people made eligible for a program not just those lucky enough to be offered assistance.

This analysis requires a definition of eligibility that can be implemented with AHS data. Most low-income housing programs have different eligibility criteria for admission into the program and for continued receipt of assistance. When different, income limits are higher for continued receipt. Our analysis is based on the most common criteria for admission at the time of our data, namely, income limits based on 50% of the local median income.[21]

The second regression indicates substantial, statistically significant differences in mean benefit across households of different types. As before, households with higher income and married couples had lower mean benefit, and larger households and single females with children had larger benefits. However, when consideration is expanded to all eligible renters, households

[21] For four-person households, the income limit is 50 percent of the local median income. Nationally uniform multiples are used to get limits for households of other sizes. The AHS variable L50 provides these limits.

headed by racial minorities of all types have larger mean benefits than households with white heads as do households with an elderly or disabled member.

The estimates of the linear probability model describing how program participation varies with household characteristics explain these results.[22] Households headed by racial minorities and households with an elderly or disabled member participate in low-income housing programs at rates much higher than average. This reflects in part the location and nature of subsidized projects. Subsidized housing projects have been built disproportionately in minority neighborhoods (Newman and Schnare, 1997), and many projects are limited to elderly and disabled people.

Households with a Hispanic head are a noteworthy exception to the pattern of minority participation in low-income housing programs, presumably because some members are noncitizens who lack permanent status. Households with no citizens or members with certain types of permanent status are not eligible for the largest HUD programs. Households with a mix of eligible and ineligible members are entitled to partial subsidies, but many households with noncitizens who are not legal residents surely do not apply for federal assistance to avoid detection.[23] These households typically contain adults who are not legal residents and children born in the United States who are citizens.

Appendix Table II reports how mean benefit varies with household characteristics for recipients of different types of assistance. For each type of assistance, recipient benefit varies inversely with income and directly with persons, though somewhat less so for the other subsidized category than for the largest HUD programs. Household characteristics beyond income and number of persons did not suggest a common pattern across programs, and few of those coefficients were statistically significant.

6.5 Effect of Misreported Income, Taxes, and Tax Credits on Estimated Program Effects

In light of the recent evidence on the underreporting of cash income and other assistance received by the poorest households in surveys, we made a concerted effort to predict which households that denied receiving SNAP and SSI benefits got them and the magnitude of the

[22] We report the estimates of a linear probability model because the results are easier to interpret. A logit regression had estimated coefficients with the same sign and general level of significance for each variable.
[23] McCarty and Kolker (2020) discuss the eligibility of housing assistance across immigrant categories.

assistance. In determining the resources available for consumption of private goods, we also accounted for the federal income and payroll taxes paid by each household and the refundable tax credits received. Finally, we deleted households that had adjusted after-tax incomes less than their reported rent on the grounds that adjustments were insufficient to correct the understatement their resources.

Table 8 reports how our income adjustments and deletions of problematic cases affected the results of the analysis. The first column reports the results of an analysis that takes reported income at face value and does not adjust reported income for taxes or refundable tax credits. The fourth column contains the results based on our income adjustments and sample selection. These are the same as the results reported in table 5. The sample selection deleted about 8% of the 7,767 households that received housing assistance.

Our income adjustments and sample selection did noticeably affect our quantitative conclusions about some metrics. Without them, we would have concluded that low-income housing programs increased the aggregate housing consumption of recipients by about 5% and increased their aggregate consumption of other goods by about 37%. With them, we concluded that the percentage increases for housing services and other goods were 12% and 25%. However, our qualitative conclusion would have been unaffected. These programs lead to a much smaller percentage increase in housing consumption than in consumption of other goods. Despite the significant difference in the estimated quantitative effect of the programs on recipient consumption patterns, the two approaches led to results that were remarkably similar with respect to the other metrics in the table – mean recipient benefit, increased market value of goods consumed, and taxpayer cost.

Table 8 also reports the results of two quick fixes to the shortcomings of the data. As mentioned earlier, the 2013 AHS reports negative incomes (always small in absolute value) for about 4% of all renters, almost none of whom report income from sources that could be negative. These result from AHS bottom-coding conventions. The second column reports the results of an analysis based on the subset of the sample that excludes these cases. This quick fix has little effect on the results. Another quick fix is to delete all observations that report cash income less than tenant rent (about 20% of the sample of subsidized households). This quick fix produces results remarkably similar to the results of our analysis that involved income adjustments for

almost all observations. This suggests that reported income less than reported tenant rent is a good filter for misreported income.

7. Conclusion

In the U.S., governments deliver housing assistance to low-income households in a wide variety of ways ranging from direct public provision (public housing) to subsidizing the occupancy of units in the private market chosen by tenants (housing vouchers). The largest part of the system is between these two extremes. These programs subsidize selected for-profit firms and not-for-profit organizations to build and operate housing projects for low-income households. Each year, Congress decides how much to spend on each program. Evidence on their comparative performance is important for making well-informed decisions.

This paper provides the first evidence on the effects of low-income housing programs on comprehensive indices of overall consumption of housing and neighborhood services and other goods and services, the relationship between recipient benefit and taxpayer cost, and the distribution of tenant benefits for each type of U.S. low-income housing assistance. Almost all existing estimates of this set of program effects are for individual programs based on data prior to 1980.

Our evidence indicates that the largest HUD programs make a big difference in the lives of the fortunate minority who are served. The mean tenant benefit of these programs is about 31% of mean household income. Other programs, mainly LIHTC projects, provide much smaller tenant benefits.

As expected, we find that households with lower incomes and more members received larger benefits than otherwise similar households. Among recipients with the same real income, household size, and other demographic characteristics, we find little difference in mean benefit between households with white, black, and mixed-race heads and households with and without elderly and disabled members. However, when we expand consideration to all eligible households, we find that households with minority heads and elderly or disabled members receive substantially larger mean benefits than otherwise identical households because they participate in low-income housing programs to a much greater extent than otherwise similar families. This reflects in part the location and nature of subsidized projects. Subsidized housing

projects have been built disproportionately in minority neighborhoods, and many projects are limited to elderly and disabled people.

This paper also explores the effect of accounting for underreported resources and the tax system on estimates of program effects. Doing so significantly alters estimates of the increase in housing consumption of recipients of housing assistance. Without accounting for underreporting of resources, taxes, and tax credits, our estimates suggest a modest 5 percent increase in housing consumption. With those adjustments, the estimate more than doubles to just over 12 percent. These adjustments have minimal effects on most other estimates and do not impact our qualitative conclusions.

Two results are particularly relevant for housing policy. One is the striking result that low-income housing programs resulted in a much smaller percentage increase in aggregate consumption of housing services than in the consumption of non-housing goods. For HUD's project-based assistance, the improvement in housing conditions is negligible, as low as 5% for public housing projects. For the conglomerate of other programs, the percentage increase is greater for housing consumption than for other goods, but both percentages are small. Voucher programs lead to the greatest increase in housing consumption, but they too induce a much larger increase in the consumption of non-housing goods and services than in housing consumption.

A second important finding is the enormous difference in tenant benefit per dollar of taxpayer cost across these programs. For the HUD voucher program, mean tenant benefit is 77% of the lower bound on taxpayer cost. For the two other major types of HUD housing assistance, it is 37% and 51%. The conglomerate of other housing assistance programs, dominated by LIHTC projects, has even lower tenant benefits relative to taxpayer cost at less than 30%.

In sum, on important metrics, tenant-based assistance, namely HUD's housing voucher program, dominates all other forms of housing assistance currently being delivered in the US. Vouchers offer the largest increase in recipient's housing consumption and the greatest benefit to recipients relative to taxpayer costs.

Previous research has found that we do not need to subsidize the construction of housing projects to provide affordable housing to low-income households. The primary vehicle for doing that for many years, namely, LIHTC in combination with subsidies from other sources, has not led to any significant increase in the number of dwelling units (Eriksen and Rosenthal 2010), and

the filtering of existing units provides adequate housing affordable to low-income households with housing vouchers at a much lower taxpayer cost (Rosenthal 2014).

These results raise questions about the desirability of HUD programs that subsidize the construction and operation of housing projects and the use of low-income housing tax credits combined with subsidies from other sources to fund the construction of such projects. Taxpayers and recipients would be better served if low-income housing programs relied exclusively on tenant-based assistance in the form of HUD's housing voucher program.

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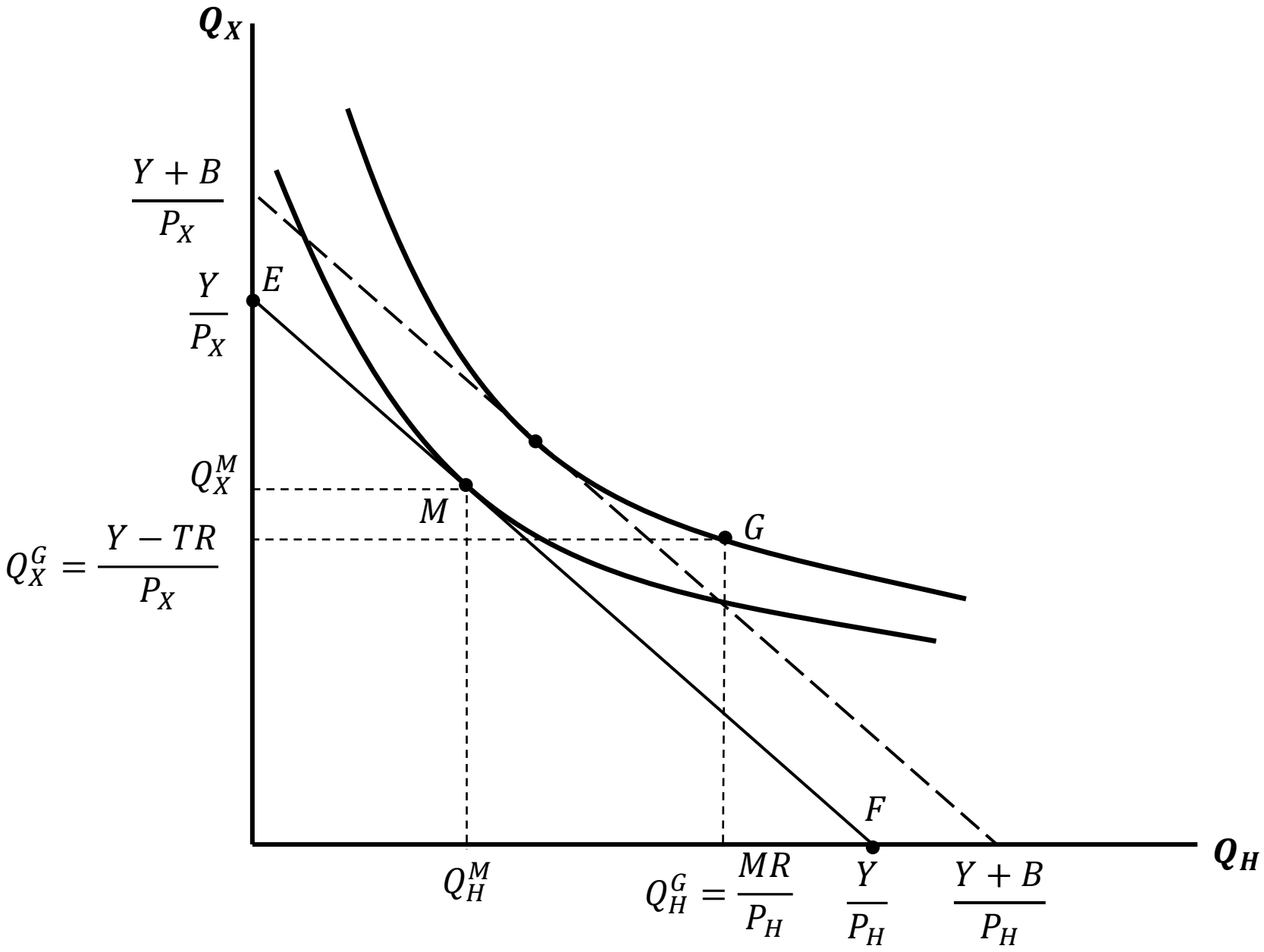

Figure 1. Effect of Housing Program on Recipient Consumption and Wellbeing

Table 1. Number of households and people who received rental assistance from each type of housing program

	All subsidized households	HUD housing voucher	HUD public housing	HUD subsidized privately owned projects	Other subsidized households
Number of assisted households	7,359,566	2,527,738	1,062,683	1,357,782	2,411,362
Number of assisted persons	16,700,130	6,208,522	2,440,810	2,564,609	5,486,190

Notes: Estimates based on 2013 AHS data using HUDADMIN and the self-reported variables that cover receipt of rental housing assistance. Some other subsidized households are assisted at least in part by HUD programs not captured by HUDADMIN.

Table 2. Estimated bounds on ratio of total cost to market rent for units in different programs

	All subsidized households	HUD housing voucher	HUD public housing	HUD subsidized privately owned projects	Other subsidized households
Lower bound on ratio of total cost to market rent	1.30	1.06	1.79	1.44	1.25
Upper bound on ratio of total cost to market rent	1.45	1.06	2.20	1.61	1.43

Notes: See text for sources and derivations. Numbers exceed 1 due to administrative cost and cost-ineffectiveness in producing housing services.

Table 3. Housing expenditure regression and descriptive statistics

	Marginal propensity to spend on housing (α_H)	
	mean/(SD)	b/(se)
Housing expenditure	958.921	-----
	(462.106)	-----
Constant	-----	0.112***
	-----	(0.005)
Age of head	41.435	0.000
	(15.880)	(0.000)
Head is female	0.507	0.005*
	(0.500)	(0.002)
Number of kids	0.765	-0.005***
	(1.143)	(0.001)
Number of adults	1.887	-0.008***
	(0.876)	(0.002)
Householder is Black	0.191	-0.011***
	(0.393)	(0.002)
Householder is Asian	0.050	-0.003
	(0.217)	(0.004)
Householder is Native American	0.016	-0.005
	(0.124)	(0.007)
Householder is mixed race	0.019	-0.007
	(0.136)	(0.005)
Householder is Hispanic	0.217	-0.012***
	(0.412)	(0.002)
Householder is married	0.351	0.004*
	(0.477)	(0.002)
	Displacement parameter on housing consumption (β_H)	
	mean/(SD)	b/(se)
Constant	-----	443.196***
	-----	(30.757)
Number of persons	2.652	22.808*
	(1.546)	(10.315)
	Displacement parameter on nonhousing consumption (β_X)	
	mean/(SD)	b/(se)
Constant	-----	-587.583*
	-----	(250.754)
Number of persons	2.652	-558.097***
	(1.546)	(102.788)
	R^2	0.881
	Adj R^2	0.881
	RMSE	375.849
	N	11,173

Notes: Based on unsubsidized renter households in the bottom 4 quintiles of real per capita household income. Observations reporting housing cost in excess of income are omitted from the analysis.

* significant at the 10% level, ** significant at the 5% level, *** significant at the 1% level

Table 4. Characteristics of assisted households

	All subsidized households	HUD housing voucher	HUD public housing	HUD subsidized privately owned projects	Other subsidized households
Monthly reported household income	1865.74	1572.02	1311.08	1240.41	2814.40
	(2337.98)	(1958.49)	(1499.58)	(1398.00)	(3075.91)
Monthly adjusted household income	1980.04	1791.33	1562.38	1408.01	2719.67
	(1925.59)	(1664.41)	(1241.50)	(1167.53)	(2504.55)
Real reported per capita household income	979.37	767.32	688.82	806.56	1446.85
	(1220.89)	(998.39)	(752.10)	(894.75)	(1595.14)
Real adjusted per capita household income	996.23	831.87	773.40	871.27	1352.09
	(975.39)	(830.93)	(585.49)	(720.56)	(1259.97)
Number of persons	2.32	2.50	2.35	1.92	2.36
	(1.53)	(1.64)	(1.48)	(1.33)	(1.50)
Housing price index	1.07	1.08	1.04	1.05	1.08
	(0.33)	(0.31)	(0.36)	(0.32)	(0.33)
Consumer price index	1.02	1.03	1.02	1.02	1.03
	(0.12)	(0.12)	(0.13)	(0.12)	(0.12)
Black head	0.38	0.44	0.48	0.38	0.28
	(0.49)	(0.50)	(0.50)	(0.49)	(0.45)
Asian head	0.04	0.03	0.02	0.06	0.05
	(0.20)	(0.17)	(0.16)	(0.23)	(0.22)
Native American head	0.03	0.02	0.02	0.01	0.04
	(0.16)	(0.14)	(0.13)	(0.12)	(0.20)
Mixed race head	0.03	0.03	0.03	0.03	0.03
	(0.17)	(0.17)	(0.16)	(0.17)	(0.18)
Hispanic head	0.19	0.19	0.20	0.15	0.23
	(0.40)	(0.39)	(0.40)	(0.36)	(0.42)
Single female with children	0.26	0.34	0.32	0.23	0.15
	(0.44)	(0.47)	(0.47)	(0.42)	(0.36)
Married	0.16	0.12	0.13	0.12	0.26
	(0.37)	(0.32)	(0.34)	(0.32)	(0.44)
Elderly person in the household	0.23	0.19	0.21	0.42	0.18
	(0.42)	(0.39)	(0.40)	(0.49)	(0.39)
Disabled person in the household	0.33	0.34	0.35	0.41	0.24
	(0.47)	(0.47)	(0.48)	(0.49)	(0.43)
N	7,183	1,226	1,783	3,036	1,138

Notes: Means and standard deviations in parentheses. Income adjustments add SNAP benefits to reported cash income for households who report receiving them, account for the underreporting of SNAP and SSI receipt, and subtract net federal income and payroll taxes, possibly negative due to tax credits. Characteristics of the household are coded 1 if condition exists, 0 otherwise. These statistics refer to households included in the analysis, mainly subsidized households with adjusted incomes no less than tenant rent and defined estimates of benefits.

Table 5. Recipient consumption patterns with and without housing assistance

	All subsidized households	HUD housing voucher	HUD public housing	HUD subsidized privately owned projects	Other subsidized households
Quantity of housing services without program	800.62	789.40	778.20	735.30	862.20
	(207.81)	(200.72)	(180.09)	(154.38)	(237.14)
Quantity of housing services with program	896.78	933.36	817.42	830.46	933.46
	(234.77)	(249.56)	(180.64)	(173.75)	(253.81)
Percentage increase in aggregate housing consumption	12.01	18.24	5.04	12.94	8.26
Quantity of other goods without program	1139.50	961.40	773.95	647.94	1795.43
	(1690.80)	(1469.64)	(1086.96)	(983.85)	(2203.82)
Quantity of other goods with program	1420.50	1301.99	1170.70	1017.85	1905.19
	(1674.44)	(1470.86)	(1120.05)	(952.84)	(2230.94)
Percentage increase in aggregate consumption other goods	24.66	35.43	51.26	57.09	6.11
Fraction of assisted households consuming more housing and more other goods	0.57	0.68	0.58	0.70	0.38
N	7,183	1,226	1,783	3,036	1,138

Notes: Means and standard deviations in parentheses. Quantities can be interpreted as monthly market values at national average prices in 2013. These statistics refer to households included in the analysis, mainly subsidized households with adjusted incomes no less than tenant rent and defined estimates of benefits.

Table 6. Tenant benefit and taxpayer cost per month

	All subsidized households	HUD housing voucher	HUD public housing	HUD subsidized privately owned projects	Other subsidized households
Adjusted income per month (AINC)	1980.04	1791.33	1562.38	1408.01	2719.67
	(1925.59)	(1664.41)	(1241.50)	(1167.53)	(2504.55)
Monthly increase market value of goods consumed (SUB)	391.18	500.59	453.23	483.22	188.86
	(403.20)	(366.24)	(339.37)	(352.67)	(421.48)
Ratio of mean SUB to mean AINC	0.20	0.28	0.29	0.34	0.07
Monthly tenant benefit (BEN)	328.50	432.86	406.91	438.40	113.42
	(418.25)	(364.47)	(347.79)	(345.75)	(459.12)
Ratio of mean BEN to mean AINC	0.17	0.24	0.26	0.31	0.04
Ratio of mean BEN to mean SUB	0.84	0.86	0.90	0.91	0.60
Monthly taxpayer cost lower bound (TCLB)	652.95	559.39	1112.68	862.28	416.74
	(494.19)	(375.67)	(505.07)	(433.83)	(442.28)
Ratio of mean BEN to mean TCLB	0.50	0.77	0.37	0.51	0.27
Monthly taxpayer cost upper bound (TCUB)	786.21	559.39	1454.92	1008.74	590.00
	(561.52)	(375.67)	(607.78)	(471.33)	(452.36)
Ratio of mean BEN to mean TCUB	0.42	0.77	0.28	0.43	0.19
N	7,183	1,226	1,783	3,036	1,138

Notes: Means and standard deviations in parentheses. These statistics refer to households included in the analysis, mainly

Table 7. Regressions describing how real tenant benefit and program participation vary with household characteristics among recipients and eligible renters

	Real Tenant Benefit among Recipients		Real Tenant Benefit among Eligible Renters		Participation among Eligible Renters
	mean/(sd)	b/(se)	mean/(sd)	b/(se)	b/(se)
Real monthly benefits	315.19	------	127.01	------	------
	(386.56)	------	(290.02)	------	------
Program participation	1.00	------	0.40	------	------
	(0.00)	------	(0.49)	------	------
Real monthly income in 1000s	1.93	-120.463***	1.83	-101.768***	0.029***
	(1.82)	(2.572)	(1.29)	(2.340)	(0.004)
Number of persons	2.32	34.355***	2.48	15.953***	-0.043***
	(1.53)	(3.361)	(1.62)	(2.274)	(0.004)
Black head	0.38	-6.922	0.28	64.401***	0.197***
	(0.49)	(8.354)	(0.45)	(6.248)	(0.010)
Asian head	0.04	91.988***	0.05	84.875***	0.100***
	(0.20)	(17.120)	(0.21)	(12.237)	(0.019)
Native American head	0.03	31.600	0.02	46.279*	0.093**
	(0.16)	(28.019)	(0.14)	(20.615)	(0.033)
Mixed race head	0.03	6.603	0.02	56.060**	0.144***
	(0.17)	(23.818)	(0.15)	(18.568)	(0.029)
Hispanic head	0.19	45.523***	0.24	35.480***	0.022*
	(0.40)	(9.928)	(0.42)	(6.969)	(0.011)
Single female with children	0.26	49.362***	0.18	130.525***	0.245***
	(0.44)	(10.629)	(0.39)	(7.839)	(0.012)
Married	0.16	-38.235**	0.24	-39.403***	-0.082***
	(0.37)	(12.012)	(0.43)	(7.835)	(0.012)
Elderly person in household	0.23	18.355*	0.19	82.765***	0.187***
	(0.42)	(8.782)	(0.40)	(6.644)	(0.010)
Disabled person in household	0.33	12.188	0.26	64.927***	0.157***
	(0.47)	(7.922)	(0.44)	(6.052)	(0.010)
Constant	------	470.237***	------	259.951***	0.431***
	------	(10.409)	------	(7.089)	(0.011)
R^2	------	0.264	------	0.220	0.148
Adj. R^2		0.263		0.219	0.147
RMSE		299.663		288.173	0.454
N	7,183	7,183	12,183	12,183	12,183

Notes: Assisted households with undefined estimates of benefits are omited.

* significant at the 10% level, ** significant at the 5% level, *** significant at the 1% level

Table 8: Recipient consumption patterns with and without housing assistance, tenant benefits, and taxpayer costs for all assisted households for different ways of dealing with misreported income

	No accounting for low reported income mean/(sd)	Nonnegative incomes mean/(sd)	Unadjusted income > rent mean/(sd)	Income accounting for benefits and taxes > rent mean/(sd)
Quantity of housing services without program	851.30	848.27	810.28	800.62
	(168.53)	(174.89)	(204.43)	(207.81)
Quantity of housing services with program	893.95	895.85	900.25	896.78
	(232.45)	(234.39)	(238.38)	(234.77)
Percentage increase in aggregate housing consumption	5.01	5.61	11.10	12.01
Quantity of other goods without program	843.57	948.10	1237.46	1139.50
	(2111.33)	(2127.45)	(2164.66)	(1690.80)
Quantity of other goods with program	1151.51	1247.87	1513.15	1420.50
	(2073.82)	(2092.29)	(2136.43)	(1674.44)
Percentage increase in aggregate consumption other goods	36.50	31.62	22.28	24.66
Fraction of assisted households consuming more housing and more other goods	0.56	0.56	0.56	0.57
Increase in market value of goods consumed (SUB)	365.69	362.74	378.51	391.18
	(423.94)	(421.22)	(403.02)	(403.20)
Benefit of the program to tenants (BEN)	306.48	304.83	316.71	328.50
	(442.56)	(438.64)	(417.77)	(418.25)
Taxpayer cost lower bound (TCLB)	627.33	624.44	639.99	652.95
	(511.18)	(510.92)	(495.48)	(494.19)
Ratio of mean BEN to mean TCLB	0.49	0.49	0.49	0.50
Taxpayer cost upper bound (TCUB)	761.32	758.84	774.44	786.21
	(575.89)	(576.31)	(562.74)	(561.52)
Ratio of mean BEN to mean TCUB	0.40	0.40	0.41	0.42
N	7,735	7,300	6,166	7,183

Notes: Means and standard deviations in parentheses. Quantities can be interpreted as monthly market values at national average prices in 2013.